

EXAMINING COLLECTIVE-EFFICACY AS A FRAMEWORK FOR WATERSHED SCALE  
RESOURCE MANAGEMENT

A Dissertation

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This dissertation represents years of work and evolving perspective. More than an end, it is a beginning towards a more strategic and sophisticated thinking on the role of communities in addressing some of our most challenging environmental issues. I am eager to apply what I have learned, and to continue learning in the years to come.

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## **Abstract**

This dissertation explores a collective-efficacy theoretical framework as it relates to climate change and extreme weather response and water and stormwater management in a northern Minnesota coastal community. A multi method research approach was implemented in two sub-watersheds of the Lower St. Louis River Basin near Duluth, Minnesota that included 27 interviews, two focus groups, a workshop, and bio-physical modeling of potential climate impacts. Perceived collective-efficacy to make decisions and take action to manage natural resources and potential future resource impacts from climate and extreme weather impacts emerged as a prominent theme in analysis. This dissertation explores collective-efficacy in the study community through three approaches, 1) perceived collective-efficacy for resource management and climate and extreme weather response as it relates to relationship to place, 2) the use of a collective-efficacy framework throughout a sequential community-based, multi methods, natural resource management study, and 3) the application of collective-efficacy principals in an applied tool for use in local decision making. An exploration of collective-efficacy in local communities can help identify barriers to effective decision making and opportunities for progress in climate and extreme weather preparedness. This work both builds the body of literature on climate response related collective-efficacy research and offers an applied path for stakeholders working collectively to address challenging natural resource management issues.

Keywords: Collective-efficacy • Place • Climate change • Preparedness • Extreme weather •

Water

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*Photo 1. Participants at the workshop work together to place action items on the matrix.*  
*Photo credit: Mae Davenport* \_\_\_\_\_ 125

## Chapter 1: Introduction

Increasingly, natural resource decision makers are including community members in finding solutions and identifying barriers for addressing wicked natural resource challenges (Fleeger & Becker, 2008; Lubell, 2004; Mandarano, 2008; Margerum, 2007; Matta & Alavalapati, 2006). Wicked problems are those that cut across scale and require complex, cooperative solutions. Lubell (2004) asserts that "collaborative management is a potential remedy to many of the pathologies of existing regulations, which have led to costly conflict and left many environmental problems unresolved" (p. 341). A collaborative community process, one that leans on individuals working together, better positions the community to consider their relationship and reliance on natural resources, in particular common-pool resources (Armitage, 2005; Donoghue & Sturtevant, 2007; Matta & Alavalapati, 2006). Community involvement is generally thought to increase the effectiveness of a decision-making process and to lead to more sustainable outcomes, as it leverages existing capacities and builds new capacities when addressing natural resource challenges.

Who is the "community" in community involvement or community-based decision making? Community is an important consideration when deciding who is involved in community decision making. Community may mean many different things and can be defined broadly as "a collection of human beings who have something in common" (Fabricius, Folke, Cundill, & Schultz, 2007, p. 27). Others have defined community more

narrowly as a group with shared goals and values (Agrawal & Gibson, 1999; Armitage, 2005). Some researchers reference geographical aspects of community (Agrawal & Gibson, 1999; MacQueen et al., 2001; Wellman, 2005). Frequently, collective natural resource management is place based, and as people can identify strongly with places, this can be an effective strategy for motivating involvement (Cheng & Daniels, 2005). However, some will also note the importance of social structures for defining community (Agrawal & Gibson, 1999; Long & Perkins, 2007; MacQueen et al., 2001), including increasingly important online communities (Wellman, 2005).

While community involvement in management and decision making brings the opportunity for balanced approaches and holistic consideration of community needs, not every community is equally positioned to participate in addressing these wicked natural resource challenges. Community capacity is the ability of a group to cope with disturbance or change (Armitage, 2005; Fabricius et al., 2007; Ivey, Smithers, De Loe, & Kreutwiser, 2004). One component of community capacity is efficacy. Perceived efficacy, the belief in ability to act in a way that will influence an outcome, may have a strong impact on capacity (Gibson, 1999) as a determinant of success in collaborative action. Collective-efficacy is the predominate beliefs and perceptions of a group as to what capacities exist, how strong they are, and the potential of a successful action. For example, the belief “we can do it” has the potential to support successes in otherwise low-capacity communities. Alternatively, if the belief in ability is absent, truncate action and motivation in communities may be disrupted, even if they would otherwise be

expected to succeed based on their capacities. Assessing efficacy by elucidating strengths and weaknesses could help better reach target audiences, better use resources, increase local ability and commitment to action, and increase community ability to react to change.

### **Research questions and propositions**

This dissertation will explore the factors influencing collective-efficacy to manage water, stormwater resources and climate and extreme weather impacts. The research is based on sequential multi-method research and includes the development of an applied tool to facilitate community discussion and decision making. Overall the work will explore:

- What is the role of collective-efficacy in water, stormwater, climate, and extreme weather resource management?
- What drives and constrains collective-efficacy for water, stormwater, climate, and extreme weather resource management at the watershed scale?

This dissertation will explore efficacy through research completed in the Lower St. Louis River Basin of Minnesota. The development of the work rests on the following propositions:

- Collective-efficacy is a fundamental determinant of the success of water resource management efforts.
- An assessment of collective-efficacy will allow communities to start building from current strengths and address current weaknesses.
- The watershed scale is the appropriate level of assessment for collective water resource management efforts.

The data collected were part of a larger study that explored coastal resilience to extreme weather and climate, and addressed the following questions:

- How do key community stakeholders view water management and future risk after extreme weather events?
- What existing capacities in the study watersheds can be leveraged to build collective-efficacy to meet future extreme weather and climate risks?
- How might applied tools be integrated into community decision-making processes?

### **Overview of dissertation**

This dissertation explores the role of collective-efficacy both through a theoretical and applied lens. There are six chapters, and while each chapter is complementary, they are also intended to be stand-alone documents. As such, there is some repetition in content between the chapters. This chapter, **Chapter 1**, the introduction chapter, is intended to give an overview of the dissertation and the theoretical frameworks underpinning the work. **Chapter 2** serves as a stand-alone manuscript intended for publication in a peer-reviewed journal that explores the relationship between place and collective-efficacy for water resource management and extreme weather response. The findings derive from interviews conducted in two sub-watersheds of the Lower St. Louis River Basin in northeastern Minnesota. **Chapter 3**, also a stand-alone manuscript intended for publication in a peer reviewed journal, explores the use of a collective-efficacy through a sequential multi-method research project. The chapter describes the development of potential community action items and their use in decision-making to address preparedness for future climate change impacts. Data were gathered from interviews,

focus groups, bio-physical modeling, and a community workshop in the Lower St. Louis River study areas. **Chapters 4 and 5** are complementary applied works, an activity guide and case study respectively. These items are intended for distribution to community leaders working to facilitate structured community decision-making processes through an action matrix tool. The content rests on a foundation of collective-efficacy theory, but the chapters are written primarily for use by non-academic audiences. Finally, **Chapter 6** provides a discussion and overview of the dissertation, potential contribution of the work, and future research ideas related to collective-efficacy and resource management.

The data for this dissertation were collected using a variety of research instruments. The following appendices reference items that apply across chapters: Appendix A: Interview Contact Script; Appendix B: Interview Guide; Appendix C: Study Participant Consent Form; Appendix D: Study Participant Demographics Form; Appendix E: Focus Group Recruitment Flyer; Appendix F: Focus Group Agenda; Appendix G: Focus Group Evaluation; Appendix H: Workshop Contact Script; Appendix I: Workshop Fact Sheet; Appendix P: Study 1-page Flyer. Other appendices are specific to a certain chapter and are referenced in those texts.

## **Theoretical overview**

### **Collective-efficacy**

#### ***Introducing efficacy***

Efficacy is an important determinant in the success of actions as levels of motivation and performance are a product of expected competence and efficacy (Zaccaro, Blair,

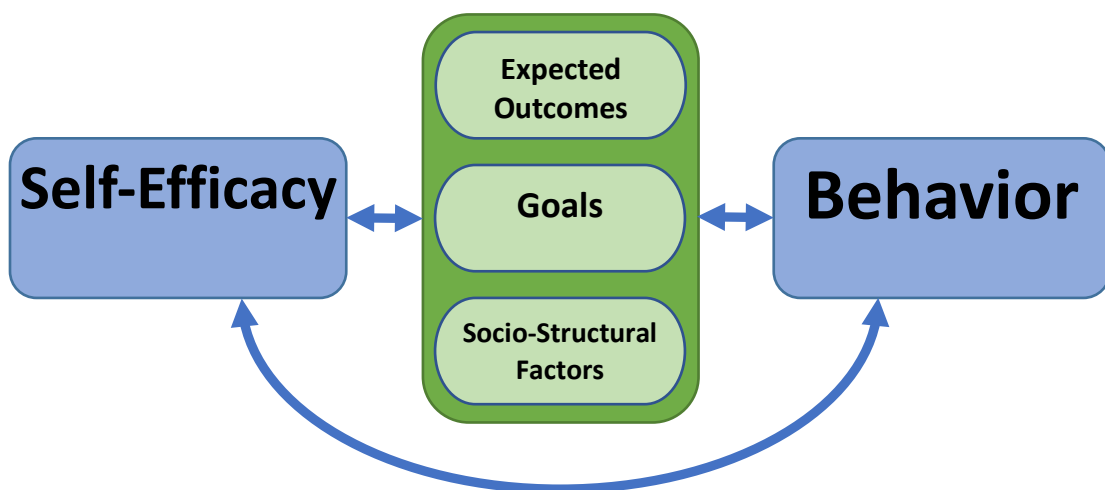


Peterson, & Zazanis, 1995). Collective-efficacy generally is described as having aspects similar to self-efficacy but at the collective scale. Further, collective-efficacy also includes and influences the self-efficacy of individuals in the group. It can be seen both as an extension of self-efficacy (Zaccaro et al., 1995) and as a representation of shared community values (Bandura, 2000b). Merriam-Webster Online Dictionary defines efficacy as “the power to produce a desired result or effect” (“Efficacy,” 2016). The efficacy of a group will affect its ability to participate in collective management and decision making.

Action and behavior can be significantly moderated by a perceived lack of control over events and conditions that affect one’s life (i.e., low levels of self-efficacy)(Bandura, 1990; Paulhus, 1983). Bandura (1990) asserts, “Among the mechanisms of agency, none is more central or pervasive than people’s beliefs about their capabilities to exercise control over events that affect their lives. Self-beliefs of efficacy influence how people feel, think, and act” (p. 128). Generally, the higher the level of efficacy, the more successful the performance, action, or behavior (Gibson, 1999), the more resilient the community (McNamara, Stevenson, & Muldoon, 2013), and the less distress members of the community will experience after a disaster or significant community impact (Benight, 2004). Higher efficacy may also correlate with higher physical and psychological well-being (Cohen, Inagami, & Finch, 2008; McNamara et al., 2013). Additionally, efficacy can bypass other factors (i.e., training or resources) as a determinant of success (Gibson, 1999).

### ***Self-efficacy as a foundation of collective-efficacy***

The vast majority of efficacy research has focused on the individual (Bandura, 2000b; Watson, Chemers, & Preiser, 2001; Zaccaro et al., 1995). Self-efficacy is the perceived beliefs of an individual in his or her ability to control or influence external demands and personal functioning (Luszczynska & Schwarzer, 2005). Bandura (2000a) described the relationship between self-efficacy and behavior as a function of cognitive processes in the Social Cognitive Theory (figure 1).



*Figure 1. Modified Social Cognitive Theory model from Bandura (2000a)*

In the model, self-efficacy affects cognitive processing and the formation of individual expected outcomes, goals, and socio-structural factors. Expected outcomes are related to the belief the person has that an action will result in certain changes or have certain influence. The reach and ambition of goals and the understanding and effect of socio-structural (i.e., environment, resources, other individuals, institutions) aspects are also

influenced by the strength of an individual's efficacy. Similar to other descriptions of efficacy, the formative aspects can be bypassed, with efficacy able to have a direct impact on behavior.

Efficacy can be built or moderated through a number of mechanisms. Bandura (2012) notes four primary mechanisms to develop self-efficacy: mastery, physical and emotional states, social persuasion, and modeling (Figure 2).

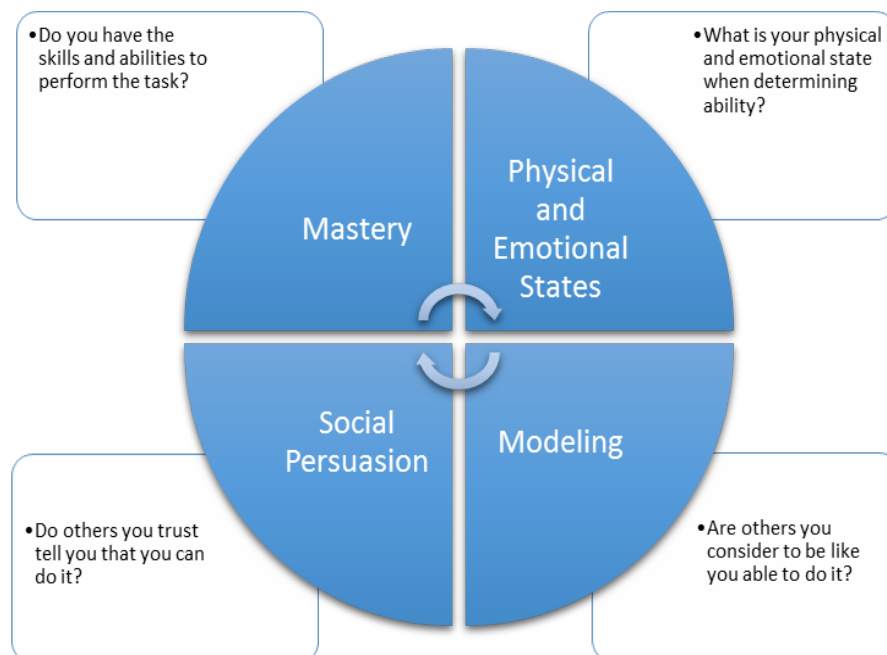


Figure 2. Illustrated sources of self-efficacy, modified from Bandura (2012)

Mastery are the cognitive, behavioral, and self-regulating tools developed via success and failure in action. Successes build positive mastery belief, while failures undermine mastery (Bandura, 1995). Individuals will have higher efficacy if others that they trust encourage them to try an action via social persuasion. Alternatively, they will likely have less efficacy if discouraged. It is easier to undermine efficacy via discouragement than to

build efficacy via persuasion or encouragement (Bandura, 1995). Modeling is the process of observing others you consider to be like yourself succeeding or failing at a task and in turn developing a personal sense of efficacy from that observation. Physical and emotional states are the effect of your interpretation of your mental and physiological well-being on efficacy and ability (Bandura, 2000b; Huh, Reigeluth, & Lee, 2014).

### ***A Collective-efficacy model***

A consideration of collective-efficacy will help to clarify aspects of individuals working together, how those relationships could be strengthened, and where there are opportunities to develop more impactful change. Collective-efficacy can be defined as "a group's belief in its ability to perform effectively" (Lindsley, Brass, & Thomas, 1995). Alternatively, collective-efficacy may be thought of with more specificity as the "perception of mutual trust and willingness to help each other" (Cohen et al., 2008, p. 198).

Collective-efficacy has been a focus of research in a limited number of research fields, namely criminology, sports psychology, and education. As might be expected, the definition and important aspects of collective-efficacy vary by field or focus area. Criminology researchers sometimes consider efficacy as trust and legitimacy between the police and the community (Nix, Wolfe, Rojek, & Kaminski, 2015), as the ability to access basic protection services from authority figures (Kochel, 2012), or as the ability to purchase and maintain a home in certain neighborhoods (Lindblad, Manturuk, & Quercia, 2013). Education researchers note better leadership, better student outcomes, better

teacher collaboration (Goddard, Goddard, Sook Kim, & Miller, 2015; Moolenaar, Sleegers, & Daly, 2012), and higher student commitment (Wang & Hwang, 2012) as outcomes of higher collective-efficacy in schools. Some authors relate lower crime rates (Hipp, 2016; Kirk, 2010; Lindblad et al., 2013) and higher sense of health and well-being (Halbert et al., 2014; Rice et al., 2015) with higher collective-efficacy. Sports teams with high efficacy perform better than teams with low efficacy but higher skilled individual players (Hampson & Jowett, 2014). Zaccaro et al. (1995) asserts that high collective-efficacy will result in higher group cohesion, groups setting and attaining more difficult goals, and a motivation for the group to work through challenges.

Poteete & Ostrom (2008) note over 30 factors influencing collective action. Some determinants of group efficacy include cultural characteristics, the perceived need for collective behavior versus independent behavior, the effectiveness of feedback between group members (Gibson, 1999), prior group performance, leadership structure and capabilities, group cohesion and effectiveness of interpersonal relationships, and availability of group resources (Zaccaro et al., 1995). Group members who perceived shared values with others or feel connected to the group through geography or shared interests are more likely to perceive high efficacy (Gibson, 1999; Zaccaro et al., 1995). Shared beliefs are developed when individuals interpret events in ways similar to other individuals (Watson et al., 2001). Cohen et al. (2008) and McNamara et al. (2013) found place, place identity, and the built environment as important components of efficacy.

For this dissertation, a model that represents collective-efficacy with components similar to self-efficacy, including the sources of efficacy (but at the collective scale, and including collective self-efficacy) will be used (Figure 3). While individual action and efficacy influences the success of collective action, collective success or failure in-turn contributes to efficacy of the individual (Zaccaro et al., 1995). Bandura (2000b) suggests that collective-efficacy can either be measured as an aggregate of individual efficacy or by directly assessing group members' perceptions of the capabilities of the group. There is iterative feedback between the self and the group and both must be considered in collective actions.

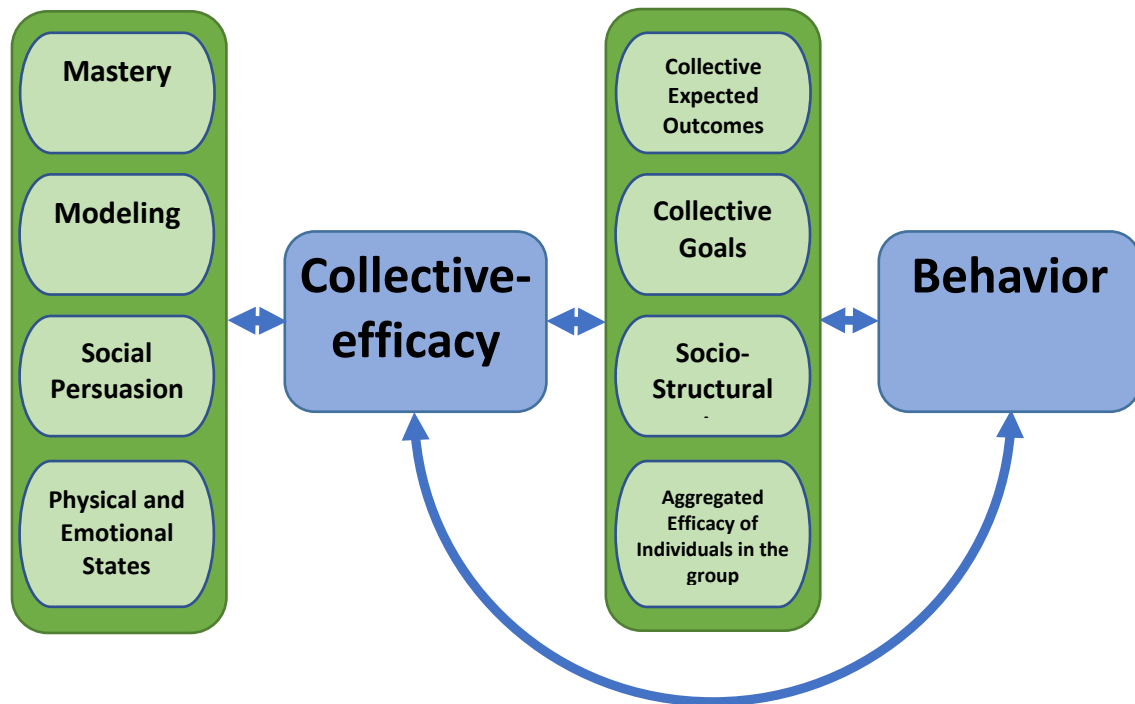


Figure 3. Collective-efficacy working model, adapted from Bandura's (2012) sources of efficacy and self-efficacy models

Important aspects of this model are the items it contains and the relationships between the items. Most notably is that the relationships between the items are iterative, the components feed and influence each other (Hipp, 2016).

Further, for this dissertation, a cohesive framework for analysis was developed that placed aspects of efficacy identified in the literature within the working collective-efficacy model (Table 1). This structure served as a starting place for analysis, not a definitive or conclusive answer to what the predominate aspects of collective-efficacy are in natural resource decision-making and management.

*Table 1 Collective-efficacy analysis framework*

<b>Model Component</b>	<b>Aspect of Component</b>	<b>Sub-aspect of Component</b>
<b>Choice processes - state of being</b>	belief of potential influence	
	image and identity	
	knowledge	
	perceived ability for collective action	
	relationship to natural resources	
	scale of decision making	
	sense of community	
	sense of place	
<b>Collective expected outcomes</b>	costs of participating	
	history of success (or not)	
	measurement of outcomes	
	outcomes of participation	
	response to challenges or problems	
	success stories	
	understanding of relationship between action and outcome	
<b>Collective goals</b>	priority action	
	shared values and beliefs	
	urgency perceived	
	value of action perceived collective	
<b>Collective socio-structural factors</b>	availability of resources	
	co-management	
	free riders	
	group cohesion	

	leadership	
	management issues	
	networks	
	partnerships	
	special interest influence	
	variety of group abilities and resources	
	well being	
<b>Mastery</b>	actual collective outcomes	
	success stories	
<b>Modeling</b>	Learning from others	
	Looking to examples of similar communities	
<b>Self-efficacy</b>	individual choice process - state of being	belief of potential influence
		image and identity
		knowledge
		perceived ability for collective action
		relationship to natural resources
		scale of decision making
		sense of community
		sense of place
	individual expected outcomes	costs of participating
		history of success (or not)
		measurement of outcomes
		outcomes of participation
		response to challenges or problems
		understanding of relationship between action and outcome
	individual goals	values and beliefs
		priority action
		urgency perceived
		value of action perceived
	individual socio-structural factors	availability of resources
		leadership
value of action perceived personal		
well being		
	mastery	
	modeling	
	Social persuasion	



In theory, efficacy builds community and community builds efficacy (Nix et al., 2015). The development process between self-efficacy and collective-efficacy is iterative. For example, if there was an interest in increasing community recycling rates, there may be many leverage opportunities within the collective-efficacy model to shift behavior. Efficacy could be developed by using other similar communities with higher recycling rates as a model, by encouraging the practices, by associating positive feelings with recycling by making it fun and easy, and by highlighting other green behaviors the community already practices as a source of mastery. Efficacy could be maintained by helping to set a common understanding of what the result of the community recycling could be and what the goals of the behavior are, by setting up social systems that make the practice more accessible (curbside pick-up or single sort collection), and by also increasing the self-efficacy of individual community members.

### ***Defining the collective***

The definition and conceptualization of a collaborative group, especially a “community,” is an important aspect of collective-efficacy work. What is the collective being researched? The definition of community related to collective-efficacy seems to largely be a function of the field of research. Sports psychologists who consider efficacy note the community as a sports team and related support (Bruton, Mellalieu, & Shearer, 2016; Hampson & Jowett, 2014); education literature consider the collective a classroom or a group of teachers and administrators as relevant to the study (Goddard et al., 2015;

Moolenaar et al., 2012; Smith, Osgood, Caldwell, Hynes, & Perkins, 2013). Criminology literature accessed for this review most frequently cited neighborhoods as the collective of interest (Hipp, 2016; Kirk, 2010; Lindblad et al., 2013; Nix et al., 2015). Public health researchers focused on non-geographical demographic characteristics such as race, age, gender, or weight (Halbert et al., 2014; Rice et al., 2015). Agrawal & Gibson (1999) assert that communities are diverse, not unified regardless of definition by geography, shared values, social ties, or other approaches. To that end, the authors suggest that for research on community involvement in natural resource management, institutions be the primary level of focus, with key stakeholders identified by their relationship to the institution.

For the collection of qualitative data for this dissertation, research was conducted on a watershed scale; however, researchers recognize there are other self-defined communities within the watershed geography. Research participants were asked to define what community means to them. For analysis purposes, “community” will be treated as an emergent concept, the definition as reported by participants in the studies being an important finding.

### ***Community action and decision making***

Participation in decision making is viewed by many as both a right of communities and a path to better outcomes. Lasker & Weiss (2013) assert that communities cannot fix their problems until they fix their problem-solving process. Not only do community members have the right to be involved in decision making and action, but community level

problems are too complex to be solved without cooperation (Lasker & Weiss, 2013). Proponents of community involvement tout the benefits of decentralized decision making and the strengthening of community connections that result from the development of informal and formal networks (Armitage, 2005). A wider range of involved stakeholders in lieu of a centralized decision making process with few participants can lead to the development of new relationships, trust, and understanding (Mandarano, 2008).

### ***Critiques of community decision making***

Critics of community based decision making offer that idealized bottom-up involvement does not also translate to actual productive experiences for participants (Conley & Moote, 2003). While collaborative efforts are increasingly common, requiring a more inclusive process assumes that agencies and communities have the capabilities and the interest in participating in such a process (Fleeger & Becker, 2008; Lurie & Hibbard, 2008). There may be a gap between either (or both) the technical expertise of the public or the public expertise of the technicians (Korfmacher, 2001). For example, rural communities, with fewer technical and financial resources, may be burdened by more complex and inclusive processes (Ivey et al., 2004). Conflicts may be a result of stakeholders not having a cohesive understanding of issues or facts related to an issue rather than malicious or initially obstructing progress (W. M. Adams, Brockington, Dyson, & Vira, 2003). Managers may have technical expertise but lack facilitation and conflict-resolution skills or the ability to productively navigate stakeholders' values (McGinnis, Woolley, & Gamman, 1999).

Additionally, public or community engagement may be outside the range of skills for those managing processes or difficult given the history of decision making in the community. People enter a process with different values and different outcomes in mind. Natural resource managers typically have expertise in managing natural resources, not in managing people (Decker, Raik, Carpenter, Organ, & Schusler, 2005). Participants who don't find the process sufficiently inclusive (Cheng & Daniels, 2005) or lacking transparency (Gray, Fisher, & Jungwirth, 2001) or don't get the outcome they want may question the investment of time and effort and may be less likely to participate in the future (Conley & Moote, 2003).

More community involvement does not necessarily result in better community outcomes—often the same individuals or organizations are able to attain positions of power and influence despite the planning process (Diamond, 2004; Foster-Fishman, Cantillon, Pierce, & Van Egeren, 2007; Lasker & Weiss, 2013). Further, entrenched politics and interest positions add complexity to processes with consensus-based goals (Armitage, 2005; Gruber, 2010; Irvin & Stansbury, 2004), and while a process might be democratic in nature the substance of the outcome may not (J. Adams et al., 2005). Processes that function differently but do not result in community-oriented outcomes may cost managers trust and legitimacy (Irvin & Stansbury, 2004).

### ***Keys to success in community decision making***

Successful management efforts share some characteristics. A meta-analysis of watershed management literature, which considered 28 themes and 210 variables, found that 95%

of variation in success could be explained by just four aspects of collective process: adequate funding, effective leadership, interpersonal trust, and committed participants (Leach & Pelkey, 2001). Other authors recommended transparency, clear roles for participants (Kellert, Mehta, Ebbin, & Lichtenfeld, 2000; Korfmacher, 2001), appropriate representation (Korfmacher, 2001; McGinnis et al., 1999), and equal access to data for all participants (McGinnis et al., 1999) as aspects important for successful processes. The 2013 Delft Statement on Water Integrity contends that among the steps needed to develop sustainable water management, investing in multi-stakeholder processes, building consensus among stakeholders, and developing community capacities are key (First International Water Integrity Forum, 2013). Habron (2003) notes that even under circumstances when participants hold conflicting views, they are at least sharing and talking to each other through a collective process, and this is an improvement over other processes. To achieve successful collaborative action, communities must understand the factors that influence change and be able to enable structures and processes of implementation (Patterson, Smith, & Bellamy, 2013).

Geographic and community scale are important considerations for collective processes and action (Decker et al., 2005). Participants in smaller scale efforts are more likely to identify with others and experience a sense of belonging and are therefore more likely to identify solutions for the place they belong (Cheng & Daniels, 2005). That said, smaller scale efforts may be more easily co-opted by special interest and in-group participants (J. Adams et al., 2005; Conley & Moote, 2003) and may be more likely to draw participants

with specific desired outcomes in mind (J. Adams et al., 2005). Further, effective collective action on natural resource issues are dependent on a community understanding that natural and human systems are linked (Gray et al., 2001), which may or may not be present in every community faced with natural resource management challenges.

Landscape context also matters when considering collaborative action. Hardy & Koontz (2010) note that differences important for consideration between urban and rural landscapes include population amount and density, land use types, pollutions sources, institutional capacity, transaction costs, and available capital. Collective action offers increased control over decision making to some, but may also threaten a sense of independence common among many rural property owners (Habron, 2003). Local property rights may be a major conflict point that could be resolved through processes functioning at a high level or scale rather than at a localized level (Margerum, 2007).

Frequently the scale of the resource in question, does not align well with community scale and perseverance, either temporally and geographically (Armitage, 2005; Chaskin, 2001; Foster-Fishman et al., 2007). Rarely do ecological boundaries match political boundaries. The time frame to see impacts of many conservation projects may be decades past the attention span, or life span, of even the most dedicated citizens. The blending of biophysical and social system assessments can be difficult (Donoghue & Sturtevant, 2007), and the assessment process itself may be politicizing and divisive (Diamond, 2004). Human and natural systems each on their own are complex, and

considering those systems as interlinked and dynamic increases that complexity (Patterson et al., 2013). The occurrence of those systems shifting in tandem or in relation to each other adds additional layers of complexity (Ivey et al., 2004).

When ecological systems change, local communities are often best positioned to detect impacts and are critical, although often neglected, management and planning participants (Frabricius et al., 2007). Collective "planning and design efforts openly recognize the interdependence of community well-being and ecosystem health" (Gray, Fisher, & Jungwirth, 2001, p. 30). Gray et al. (2001) suggest that the land be treated as part of the community and the community as part of the land. Habron (2003) suggests that collective adaptive management is particularly well situated to accommodate a science-citizen approach to ecological system management.

## **Conclusion**

A collaborative process can better position a community to consider their relationship and reliance on natural resources and provides the opportunity for balanced approaches and holistic consideration of community needs. While community involvement is generally thought to increase the effectiveness of a process and to lead to more sustainable outcomes, there is limited certainty of the success of those efforts. A better understanding of drivers and constraints to successful collaborative processes may lead to better outcomes. In particular, the influence of collective-efficacy can illuminate the factors influencing collective behaviors and outcomes.

Collective-efficacy, a group's belief of "can we do it?," has the potential to alter the outcome of efforts to conserve or protect natural resources, or perhaps even determine if an effort is made at all. In a time of increasing community involvement in decision making and resource management, the ability to assess efficacy and build capacity could help better reach target audiences, better use resources, increase local ability and commitment to change, and increase community ability to react to change.

This dissertation will explore collective-efficacy for collaborative management and decision making at the watershed scale. The components of efficacy as identified through literature will be used as a starting framework to filter the experiences of stakeholders and decision makers engaged in water resource management decisions and climate and extreme weather response. Through this research, findings and recommendations for ways to build and develop efficacy for pro-environmental management of resources will be identified and disseminated to managers and community organizers. Further, a better understanding of the role of efficacy in natural resource management will be developed, adding to the body of literature and research on the topic.



## **Chapter 2: “The Only Place We Have to Live:” Leveraging Place Connections to Develop Collective-Efficacy for Climate Preparedness and Response**

### **Summary**

While climate change is often discussed at a global scale, communities are acutely experiencing the impacts and are being challenged to respond to an uncertain future at a local level. Community decision makers can be unsure of the need and ability of their communities to prepare, and hesitant to lead on an evolving issue. An important aspect, however, in preparation is how a group thinks about their needs and abilities. Collective-efficacy is how a group perceives their ability to respond to change or challenge. This perceived ability can significantly influence how, or if, a community uses resources and capacities to prepare and respond to climate change. While there are many interconnected aspects of perceived collective-efficacy, in communities with strong ties to natural resources, place considerations may provide a path to furthering development of collective-efficacy. This qualitative paired watershed study was conducted in the Lower St. Louis River Basin near Duluth, Minnesota. The aim was to assess community response and perception of climate change impacts and extreme weather. Analysis of 27 semi-structured interviews with key community decision makers suggest both that perceived collective-efficacy is a critical element of decision making for climate and extreme weather response and preparedness, and that perceptions of place may be a unifying factor in increasing collective-efficacy for climate preparedness.

**Keywords**

Climate change; collective-efficacy; place; water management; qualitative research

**Introduction**

In an era of more frequent and intense extreme weather events, a community's long-term viability depends on its ability to live, learn, and act effectively together under changing conditions, even under uncertainty. Regardless of physical infrastructure, fiscal resources, or leadership abilities, low levels of perceived collective-efficacy among community members can impair a community's capability to effectively manage both common natural resource challenges and extreme crisis. Perception becomes reality, and perceptions of collective ability to respond to climate and extreme weather impacts will influence the likelihood and effectiveness of community response. As such, understanding a community's perceived ability to meet natural resource management challenges is critical for planning and policy development at both ecosystem and social scales.

Duluth, Minnesota and surrounding communities are uniquely positioned as places to explore perceptions of climate and extreme weather, local impacts, and community preparedness. There is evidence that changes to the climate are having, and will continue to have, impacts in the Great Lakes Region. Lake water levels are likely to drop while temperatures rise, altering aquatic and localized terrestrial habitat integrity (Dietz & Bidwell, 2012; Gronewold et al., 2013). There are forecasted to be more extreme and flashy precipitation events, with higher winter snowfall totals, lower summer rainfall totals, and increased spring melt flow (Bartolai et al., 2015; d'Orgeville, Peltier, Erler, &

Gula, 2014). In June 2012, Duluth and the surrounding area was impacted by a catastrophic flood. Climate change conditions set the stage for more frequent extreme events in coming decades.

Of particular interest for this research, is perceptions of a community's efficacy to address challenging natural resource management issues, in particular climate change response and preparedness. Bandura (1990) asserts, "Among the mechanisms of agency, none is more central or pervasive than people's beliefs about their capabilities to exercise control over events that affect their lives. Self-beliefs of efficacy influence how people feel, think, and act." (p.128). Action and behavior can be significantly moderated by a perceived lack of control over events and conditions that affect one's life (i.e., low levels of self-efficacy)(Bandura, 1990; Paulhus, 1983). Analysis of collective-efficacy, as a moderator of community ability, may provide insight into opportunities and challenges to community level action for addressing climate change and extreme weather impacts. Generally, the higher the level of efficacy- greater success in performance, action, or behavior (Gibson, 1999)- the more resilient the community (McNamara et al., 2013) and the less distress members of the community will experience after a disaster or rapid and significant community change (Benight, 2004). The efficacy of a group will affect its ability to participate in collective management and decision making and, analysis of community response and perceptions of risk may highlight aspects of collective-efficacy that can assist in preparedness and resilience efforts.

Research on collective-efficacy frequently references aspects of place and place attachment – generally claiming a positive association between the two (Brown, Perkins,

& Brown, 2003; Comstock et al., 2010; Devine-Wright, 2009; McNamara et al., 2013).

Communities with social norms that support engagement in the outdoor environment and protection and restoration of resources often have higher place attachment, place identity, and place dependence than communities that lack those characteristics or stigmatize resource protection (McNamara et al., 2013; Scannell & Gifford, 2010a).

Researchers have also show the importance of linking climate response behavior to a local place in order to better motivate community response (Groulx, Lewis, Lemieux, & Dawson, 2014). It is believed that a local framing will both signify the importance of action and provide a scale at which communities feel able to act. In a community like the one in this study, a coastal community with strong ties to the natural environment, place attachment has potential to illuminate aspects of collective-efficacy.

This paper uses data collected from 27 interviews conducted during a sequential multi-method research project in two sub-watersheds of the Lower St. Louis River Basin of Minnesota. The overall study was interested in coastal community response to climate and extreme weather impacts. This paper specifically investigates the following questions:

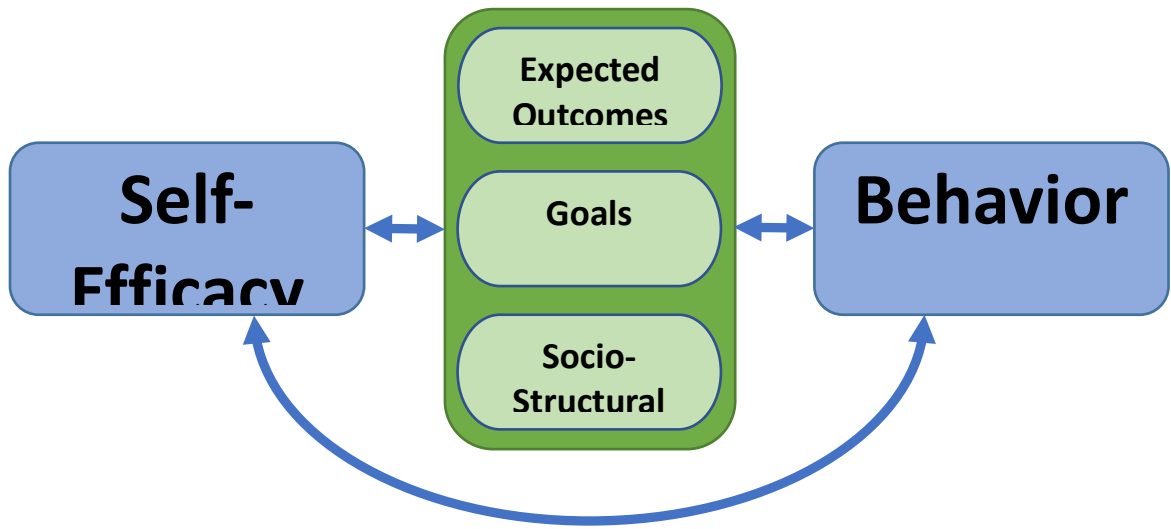
- How do key community stakeholders view water management and future risk?
- What elements of perceived collective-efficacy could be leveraged to advance local resource management?
- How might place-attachment influence collective-efficacy in climate preparedness decision making?

The literature review for this study provides a foundation for use of a collective-efficacy theoretical framework in place-based watershed scale research. The findings highlight the role of place as a significant aspect of collective-efficacy among participants in this qualitative study. The discussion highlights potential managerial approaches to leveraging place attachment as a way to build community efficacy. An increase in efficacy could support community preparedness for climate and extreme weather impacts as well as increasing the effective community management of natural resources.

## **Related literature**

### **Efficacy**

Bandura describes three modes of agency: direct personal agency (individual ability to influence the self), proxy agency (ability of others to influence the individual), and collective agency (ability of a group to have an influence together) (Bandura, 2000b). Most research on agency, or more specifically efficacy, has focused, however, on direct personal agency or self-efficacy (Bandura, 2000b; Watson et al., 2001; Zaccaro et al., 1995). Self-efficacy is the perceived beliefs of an individual in their ability to control or influence external demands and their personal functioning (Luszczynska & Schwarzer, 2005). Bandura (2000a) described the relationship between self-efficacy and behavior as a function of external and internal processes in the Social Cognitive Theory (Figure 4).



*Figure 4 Modified Social Cognitive Theory Model from Bandura 2000a*

In the model, self-efficacy affects cognitive processing and the formation of individual expected outcomes, goals, and socio structural factors. Expected outcomes are related to the belief the person has that an action will result in certain changes or have certain influence. The reach and ambition of goals and the understanding and effect of socio structural aspects (i.e. environment, resources, other individuals, institutions that are perceived impediments or opportunities for action) are also influenced by the strength of an individual's efficacy. Similar to other descriptions of efficacy, the formative aspects can be by-passed, with efficacy able to have a direct impact on behavior. In other words, despite expected outcomes, goals, and socio structural factors, low efficacy may disrupt behavior performance while high efficacy may support behavior performance.

Efficacy can be built or moderated through a number of mechanisms. Bandura (2012) notes four primary mechanisms to develop self-efficacy: mastery, physical and emotional states, social persuasion, and modeling (Figure 5).

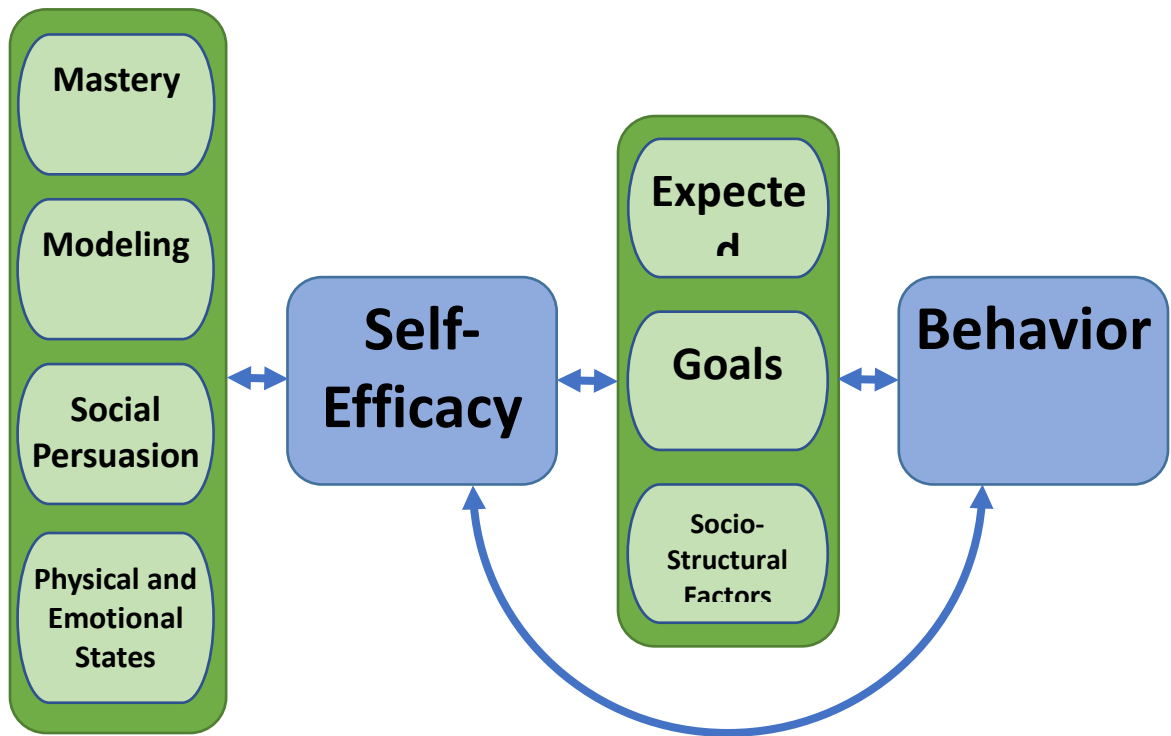


Figure 5. Self-Efficacy Model with Sources of Efficacy

Mastery includes the the cognitive, behavioral and self-regulating tools developed via successes and failures in action. Do you have the skills to perform the task? Successes build positive mastery belief, while failures undermine mastery (Bandura, 1995). Further, social persuasion can play a role in building or diminishing efficacy. Do others you trust tell you that you can do it? Individuals will have higher efficacy if trusted others encourage action via social persuasion. Alternatively, there will likely be less efficacy if discouraged. It is easier to undermine efficacy via discouragement than to build efficacy via persuasion or encouragement (Bandura, 1995). Modeling is the process of observing

others. Are others you consider to be like yourself succeeding or failing at a task? A sense of efficacy can be developed via those observations. Physical and emotional states are the effect of your interpretation of your mental and physiological wellbeing on efficacy and ability (Bandura, 2000b; Huh et al., 2014). How do you feel and what is going on in the environment around you? For example, a person might feel more able to go for a run on a sunny day or when they are well rested than on a rainy day or when they have an injury.

To consider how self-efficacy may relate to behaviors that impact water/stormwater management or climate/extreme weather impacts, we could consider a hypothetical landowner in an urbanized residential area. Perhaps this landowner cares about water quality and wants to take steps to manage their property (a behavior) to limit their personal impact on water resources (goals). Currently stormwater from their property runs from gutters and impervious surfaces to the street and storm sewers, which drain to the local river (socio structural factors). They expect that if they do certain behaviors, like building a rain garden or installing a rain barrel, that there will be a positive improvement in water quality of the river (expected outcome). They have a good friend in the town over who has had success establishing a rain garden (modeling), and the homeowner recently participated in a raingarden workshop hosted by a local non-profit (mastery). Unfortunately, the landowner is nervous that an upcoming knee replacement will limit their ability to maintain the garden (physical/emotional states), in particular because they have a neighbor that told them that they “hate the look of weedy front yard rain gardens” (social persuasion). Although the aspects and sources of efficacy are generally



aligning to positively influence their perceived personal efficacy, there are still barriers.

They will need to work to mitigate their potential physical limitations and not upset their neighbor in order to meet their goals and reach an outcome within the existing socio structural system.

### **Collective-efficacy**

While most efficacy research has been focused on self-efficacy, not collective-efficacy, environmental problems will be addressed by groups, not individuals. As such, a consideration of collective-efficacy could help to clarify how individuals work together, how those relationships could be strengthened, and where there are opportunities to develop more impactful change through group impact. Collective-efficacy is the belief of a group to perform in an effective manner (Lindsley et al., 1995) and ability to extend mutual trust in order to help each other (Cohen et al., 2008). Perceived collective-efficacy, *do we think we can*, will impact a groups' motivation, resilience, and accomplishments (Bandura, 2000b).

Efficacy beliefs influence whether people think erratically or strategically, optimistically or pessimistically; what courses of action they choose to pursue; the goals they set for themselves and their commitment to them; how much effort they put forth in given endeavors; the outcomes they expect their efforts to produce; how long they persevere in the face of obstacles; their resilience to adversity; how much stress and depression they experience in coping with taxing environmental demands; and the accomplishments they realize. (Bandura, 2000b, pg. 75)

Collective-efficacy has been a focus of research in a limited number of research fields, namely criminology, sports psychology, and education. As might be expected, the definition and important aspects of collective-efficacy vary by field or focus area.

Criminology researchers sometimes consider efficacy as trust and legitimacy between the police and the community (Nix et al., 2015), as the ability to access basic protection services from authority figures (Kochel, 2012), or as the ability to purchase and maintain a home in certain neighborhoods (Lindblad et al., 2013). Education researchers noted better leadership, better student outcomes, better teacher collaboration (Goddard et al., 2015; Moolenaar et al., 2012) and higher student commitment (Wang & Hwang, 2012) as outcomes of higher collective-efficacy in schools. Some authors related lower crime rates (Hipp, 2016; Kirk, 2010; Lindblad et al., 2013) and higher sense of health and wellbeing (Halbert et al., 2014; Rice et al., 2015) with higher collective-efficacy. Sports teams with high collective-efficacy perform better than teams with low efficacy but higher skilled individual players (Hampson & Jowett, 2014). Zaccaro et al., (1995) asserts that high collective-efficacy will result in higher group cohesion, groups setting and attaining more difficult goals, and a motivation for the group to work through challenges.

Various studies have found a wide range of potential factors influencing collective-efficacy. Frequently, these specific factors are context and situationally specific, and may fall within a larger conceptual framework. Depending on circumstances, some aspects that may be at play in group efficacy include: shared cultural characteristics, a perceived need for collective behavior versus independent behavior, the effectiveness of feedback between group members (Gibson, 1999), prior group performance, leadership structure and capabilities, group cohesion and effectiveness of interpersonal relationships, and availability of group resources (Zaccaro et al., 1995). Fernández-Ballesteros, Díez-Nicolás, Caprara, Barbaranelli, & Bandura (2002) suggest that collective-efficacy is a function of

perceived personal efficacy (ability to manage daily life) and perceived individual social efficacy (ability to contribute to society), and that these are both a function of socio-economic status. Shared beliefs are developed when individuals interpret events in ways similar to other individuals (Watson et al., 2001). Group members who perceived shared values with others or feel connected to the group through shared interests are more likely to perceive high efficacy (Gibson, 1999; Zaccaro et al., 1995). Cohen et al. (2008) and McNamara et al. (2013) found place, place identity, and the built environment as important components of efficacy. Stable systems and environments allow individuals to bond with a place which may increase a sense of wellbeing and resilience to disruptions (McNamara et al., 2013).

In lieu of a well-established and accepted model that represents collective-efficacy, this study applies a representative working model for analytical purposes. This model rests upon the assertion that collective-efficacy is similar to self-efficacy but at the collective scale, *and* also includes and influences aggregated self-efficacy (Fernández-Ballesteros et al., 2002; Zaccaro et al., 1995) (Figure 6).

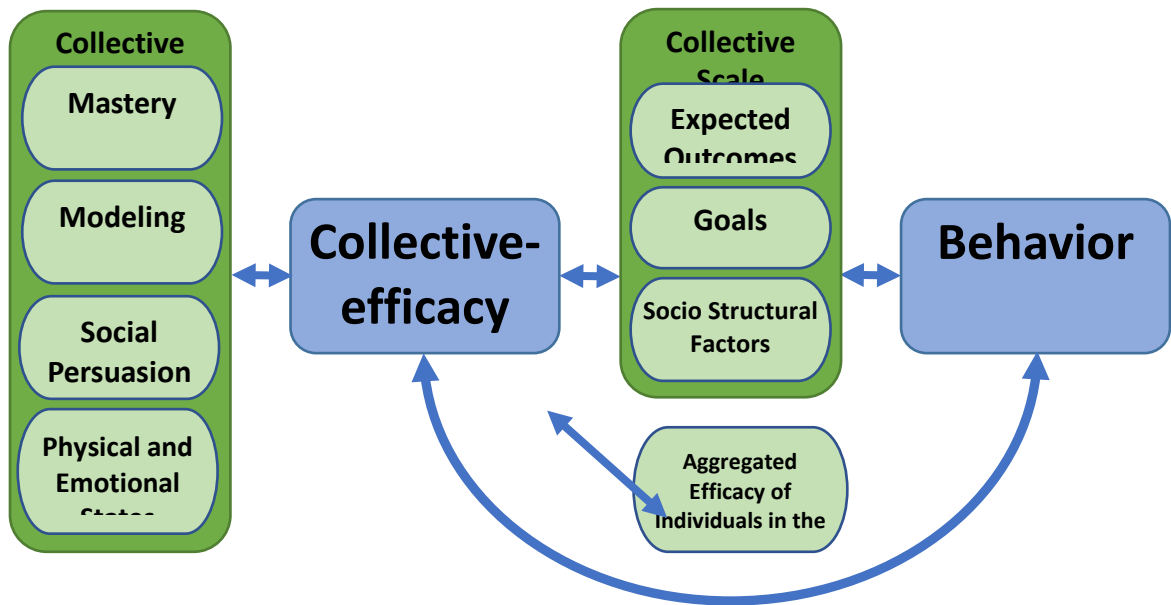


Figure 6. Collective-efficacy working model, adapted from Bandura (2012) sources of efficacy and self-efficacy model

This model will serve as a starting place from which to analysis and consider the effectiveness of the study community to making decisions and acting regarding water/stormwater management and climate change/extreme weather impacts. Important aspects of this model are both the items it contains and the relationships between the items. The aspects of efficacy and sources of efficacy will both be considered at the collective, rather than individual scale. Further there is a relationship between individual efficacy and collective-efficacy represented in this model. While individual action and efficacy influences the success of collective action, collective success or failure in-turn contributes to efficacy of the individual (Zaccaro et al., 1995). There is iterative feedback between the self and the group and both must be considered

in community actions. Most notably, the components support and influence each other (Hipp, 2016).

To consider how collective-efficacy may related to behaviors that could impact water/stormwater management or climate/extreme weather impacts, we can return to the hypothetical landowner from the self-efficacy example. They are still a landowner in an urbanized residential area, yet they recently joined a neighborhood council campaign to protect the river (goal). This campaign is a coalition of neighborhood residents, local non-profits, and city department representatives. The city will be replacing roads in the neighborhood soon and the neighborhood council wants street improvements that will limit stormwater inputs to the storm sewer system to positively impact the river (expected outcome). The city recently passed a bond to help support water improvement projects (socio structural factors) and has indicated a willingness to install curb cuts for boulevard rain gardens on properties of land owners that are willing to help with maintenance (aggregated individual efficacy) if they can get minimum 20% participation. The council is proud of the work they have accomplished so far and excited to keep momentum going (physical/emotional states), but are watching a similar process in another local community where low tax advocates sued the city for public investments on private land and disrupted progress (modeling). Representatives from the other community suggested that the coalition get as much support from neighbors as possible, well over the minimum 20%, prior to the project starting (social persuasion). The neighborhood previously organized curb-side recycling, and the coalition will use similar engagement tactics to get support for the street improvement project (mastery).

## **Place and collective-efficacy**

Places are distinguishable from spaces and environments in that they are geographies but also carry meaning and emotions for people (Devine-Wright, 2009). These places may or may not align with biological landscapes (Farnum, Hall, & Kruger, 2005), and are frequently associated with residential areas and neighborhoods (Brown et al., 2003; Burchfield, 2009; Comstock et al., 2010). Aspects of place related to efficacy include place attachment, place identity, and place dependence. Some authors consider concepts as nested dimensions (Vaske & Kobrin, 2001; White, Virden, & Riper, 2008) while others suggest they be considered independently of each other (Hernández, Martín, Ruiz, & Hidalgo, 2010; Scannell & Gifford, 2010a). Place attachment refers to the bond between a person and a place, as well as the process of bonding or attaching to a place (Devine-Wright, 2009; Farnum et al., 2005). In some research place attachment and sense of place are used interchangeably, both referring to emotional or spiritual bonds (Jepson & Sharpley, 2015). These bonds, typically thought of as positive associations, relate to both physical and social ties in a place, and reflect group and individual identity (Brown et al., 2003; Comstock et al., 2010; Groulx et al., 2014; Scannell & Gifford, 2010a). At an individual scale, history and length of time in a place are widely viewed as among the most important considerations when measuring place attachment. Place attachment is generally higher among individuals with longer residency in a place (Brown et al., 2003; Comstock et al., 2010; Devine-Wright, 2009; Hernández et al., 2010; Manzo & Perkins, 2006). Neighborhoods with greater levels of trust and social cohesion, key elements of collective-efficacy, were also found to have higher levels place attachment, even when

controlling for other factors like rates of violence and poverty (Burchfield, 2009; Comstock et al., 2010).

(Scannell & Gifford, 2010a) offer a tripartite framework to consider elements of place attachment (Figure 7). In this framework, place attachment is determined by aspects of the person, the physical or social, and the process. The person aspect could be associated with either the individual's or the communal relationship to a place. Examples of the person aspect include religious experience, historical community, personal experiences, and individual milestones or accomplishments. The physical aspect could be related to the physical natural or built location itself or the social associations and symbols linked with the location. The process aspect is a combination of affect (feelings like happiness, pride, or love), behavior (actions like proximity-maintaining or reconstruction of place), and cognition (thinking processes like learning, memory development, of construction of meaning) (Scannell & Gifford, 2010a).

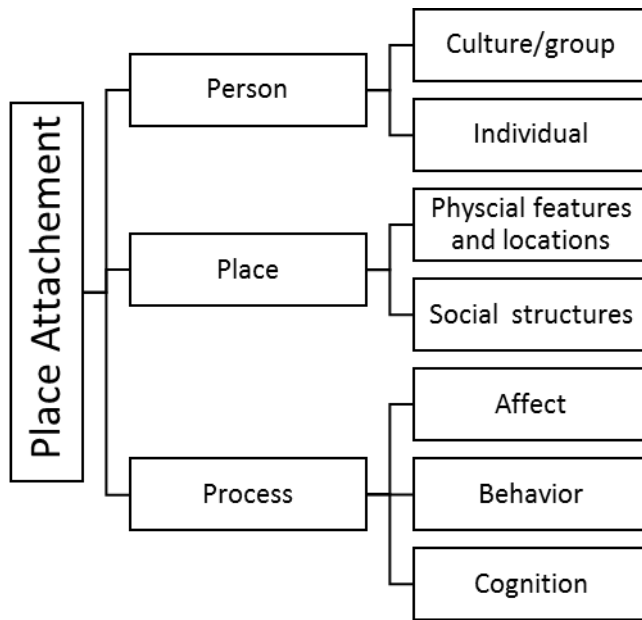


Figure 7. Tripartite place attachment organizing framework (Scannell & Gifford, 2010)

Place attachment may help build place identity and community identity (Brown et al., 2003). Like place attachment, a longer history and more experience in a place will increase place identity and sensitivity to changes to the place (White et al., 2008). Further, places that have changed rapidly, either via natural disaster or human development, may have populations with lower place identity and attachment (Brown et al., 2003; Devine-Wright, 2009).

Place dependence might be developed in relation to wellbeing (aesthetics, cultural ties, or access to natural areas) and economic purposes (resource extraction or geographical location). Communities that are dependent on a place for will generally have a stronger attachment (Groulx et al., 2014), to a greater extent the more import they consider the place (Jorgensen & Stedman, 2006). Place bonding (or attachment) may be strongly



connected to place dependence, as increased use of a place is likely to increase opportunities to bond (Hammit, Backlund, & Bixler, 2004).

In communities considering natural resource management, place appears to be an important aspect of perceived collective-efficacy. A stronger sense of place is associated with an increased sense of community (Manzo & Perkins, 2006), increased wellbeing (McNamara et al., 2013), and more pro-environmental behavior (Scannell & Gifford, 2010a; Vaske & Kobrin, 2001). There is an iterative relationship between the concepts – communities with higher place attachment and place identity feel higher efficacy regarding the place, and communities with higher efficacy have stronger connections and commitments to place (Brown et al., 2003; Comstock et al., 2010; Devine-Wright, 2009; McNamara et al., 2013). Communities that engage in protection and restoration efforts in a place develop strong bonds, identity, and dependence (Brown et al., 2003; Manzo & Perkins, 2006).

Increased direct interactions with the place, over time, increase place attachment (Farnum et al., 2005). Participation in outdoor activities, such as gardening and outdoor recreation, are also associated with increased commitment to places (Comstock et al., 2010; Hernández et al., 2010; Jepson & Sharpley, 2015). Conversely, a disconnect from nature and the outdoors, particularly in areas with low environmental quality, may lead to a disruption of place attachment (Scannell & Gifford, 2010a). Place attachment helps support stability and in turn motivates investment in place (Brown et al., 2003; Comstock et al., 2010; McNamara et al., 2013; Scannell & Gifford, 2010a). Burchfield (2009) reports that “residents of structurally disadvantaged neighborhoods are unlikely to develop

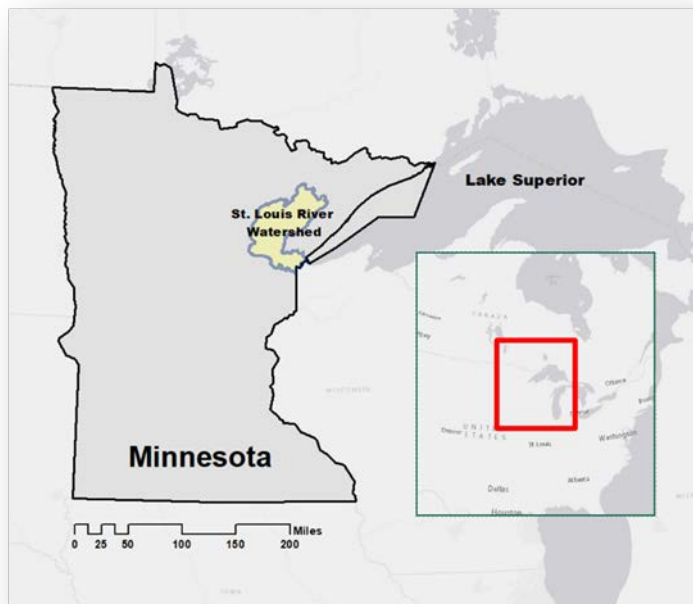
positive forms of neighborhood attachment, and as a result, are unlikely to feel invested in their neighborhood or be willing to prevent or intervene in local problems" (p. 52). It should be noted, however, that connection to a community may not be equivalent to connection with natural environments (Scannell & Gifford, 2010a). In instances when there is a conflict between place identity and group identity, individuals may default to their social connections (Hernández et al., 2010). Communities that stigmatize participation in outdoor or place based activities or where social norms conflict with place protection may foster low place attachment (Hernández et al., 2010; McNamara et al., 2013).

Collective-efficacy is an important determinant of a community's ability to act in an effective manner. Place, in particular in instances where the community is addressing a place based issue, can be a key element of collective-efficacy. Consider the relationship of a community to place and the impact on their perceived ability to make decisions could provide insight into their management and make natural resource decision making. This study explores collective-efficacy in a northern Minnesota coastal community related to climate and extreme weather impact response, and is informed both by the literature on collective-efficacy and place, place attachment, place dependence, and place identity.

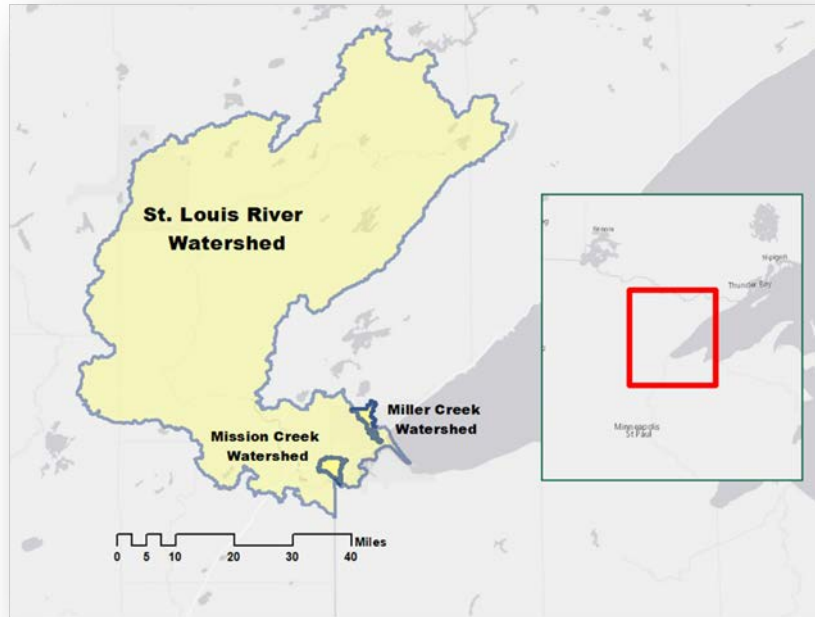
### **Study area**

This study was conducted in the Mission and Miller Creek watersheds of the St. Louis River in the Duluth, MN area. The St. Louis River Watershed is the largest U.S. Lake Superior tributary, covering 3,634 square miles in northern Minnesota (Figure 8 & 9). The

lower portion of the watershed is a federally designated Area of Concern (AOC) largely due to impacts of industrial development in the region. Mission and Miller Creek watersheds, sub-watersheds in the lower St. Louis River Basin, both include designated trout streams near and in the city of Duluth (Figure 10). In 2014, Outside Magazine named Duluth the “Best Town in America” namely for its food scene, walkability, and access to trails, rivers, and lakes (Pearson, 2014). In the article, the then mayor is quoted as saying “Duluthians are super passionate about this city.”

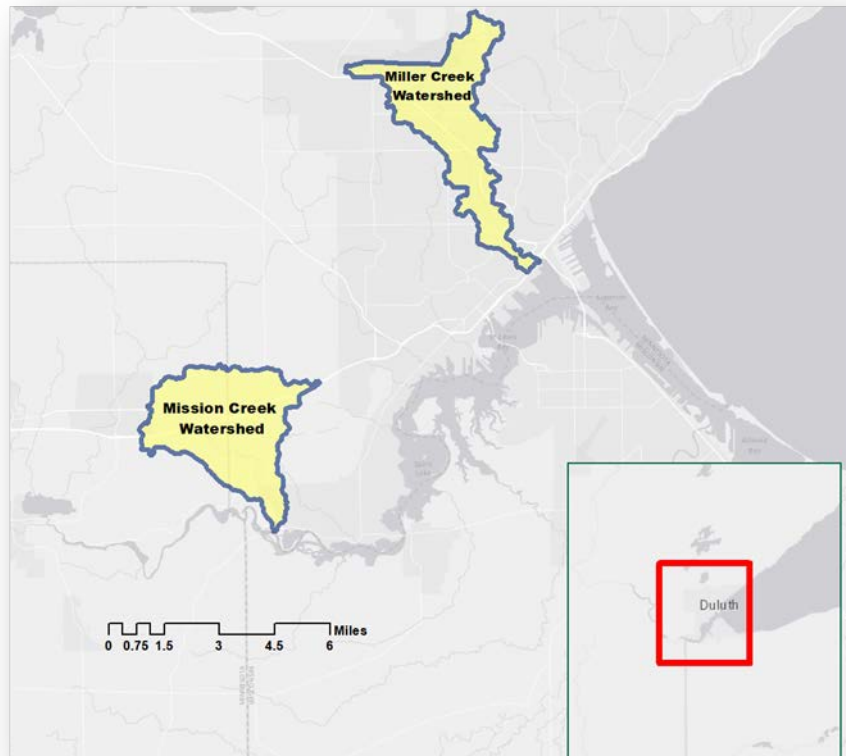


*Figure 8 Mission and Miller Creek Watersheds - Regional Context*



*Figure 9 St. Louis River Watershed with Mission and Miller Creek sub-watersheds*

Miller Creek is in a highly urbanized and impacted landscape, flowing from the Duluth airport south to Lake Superior (Figure 10). Due to the development of surrounding areas, rising water temperatures and the resulting impacts on trout habitat area particular concerning in the creek. Additionally, headwater wetlands have been significantly impacted by development. The steep, narrow, bed-rock based geology of the creek makes it particularly susceptible to flooding (Axler et al., 2009). Mission Creek drains lands west of Duluth including the ceded lands of the Fond du Lac Band. The watershed is less than 3% developed, primarily in forest land, grassland, and wetland. Primary concerns in the watershed include potential future development, sedimentation impacts in the estuary, and slumping hillsides near the outlet of the creek (Axler et al., 2009).



*Figure 10 Miller and Mission Creeks Watershed Detail*

## **Methods**

This paper is the result of data gathered in a sequential mixed-methods research project.

The overall goal of the project was to assess the interactions between environmental risk and community response in coastal ecosystems under changing precipitation regimes and extreme weather events. The project applied a participatory research approach using qualitative data gathered through key informant interviews and focus groups, and biophysical scenario planning developed by the Natural Resource Research Institute (NRRI) of Duluth. University personnel and NRRI staff partners collaborated on project planning, local coordination, and a stakeholder inventory for participant recruitment.

A stakeholder inventory identified a range of potential study participants. NRRI

developed a list of governmental bodies with jurisdiction in each of the watersheds. Researchers identified appropriate contacts in these organizations and agencies. Interviewees included local community organization representatives, natural resource managers, philanthropic organizations which had been active in the flood recovery, governmental representatives, housing advocates, and emergency response personnel. Researchers employed a snowball sampling technique to further build the stakeholder list. Snowball sampling, or chain referral sampling, invites participants to identify other members of their community who they believe have important knowledge about their community or community action (Weiss, 1995).

UMN personnel developed a project description flier, contact script, and interview guides to facilitate community member participation. The interview guide was piloted by project personnel and refined based on input from pilot participants. Interview questions included topics on community, community decision making, water, stormwater, climate and extreme weather response, and opportunities and challenges. The project was reviewed by the Institutional Review Board (IRB) as designated by University policy. The IRB process is designed to protect human subjects involved in research from harm and ensure the ethical practice of research by University personnel. IRB review determined the study was not at risk of causing harm and therefore was exempt from further review.

Initially, researchers intended to interview 15 individuals from each of the two study watersheds using a paired watershed approach. This approach was based on the presumption that watershed scale is appropriate for water resource studies. Geographic

and community scale are important considerations for assessment of collective processes and behaviors (Decker et al., 2005). Participants in smaller scale efforts are more likely to identify with others as belonging, and therefore more likely to identify solutions for the place they belong (Cheng & Daniels, 2005). Frequently, however, the scale of the resource in question, does not align well with community scale and perseverance, either temporally and geographically (Armitage, 2005; Chaskin, 2001; Foster-Fishman et al., 2007). Rarely, do ecological boundaries match political boundaries. The time frame to see impacts of many conservation projects may be decades past the attention span, or life span, of even the most dedicated citizens. That said, when ecological systems change, local communities are often best positioned to detect impacts (Frabricius et al., 2007). There is evidence that managing water at the watershed scale may be most effective for sustaining ecosystem health (Roy et al., 2008). Similarly, for community assessments related to water resources or specific places, the watershed scale may be the most effective scale (Alessa et al., 2008; Cestero, 1999).

While the paired watershed assessment did move forward, it was quickly discovered that there were few people who only had knowledge of, or management responsibility in, just one of the watersheds. Often interviewees were aware of issues, had worked on projects, and experienced resources in both study watersheds. Individuals were able to draw distinctions between management and needs in the two areas, but often combined and aggregated answers as they had responsibilities and experiences in both watersheds. Most interviews occurred in the individual's place of business, although some opted to meet at public establishments (e.g., community center, local coffee shop, etc.). Each

individual signed a consent form prior to the start of the interview and the interviewer emphasized that participation was voluntary and that every reasonable effort would be made to ensure confidentiality. The interviewer also answered any questions the interviewee had prior to beginning the interview. Following the interview, participants were asked to complete a participant background information form (Table 2). This information was used to help understand the sample profile and is only reported at the aggregate level. No personally identifying information is linked to the interview data.

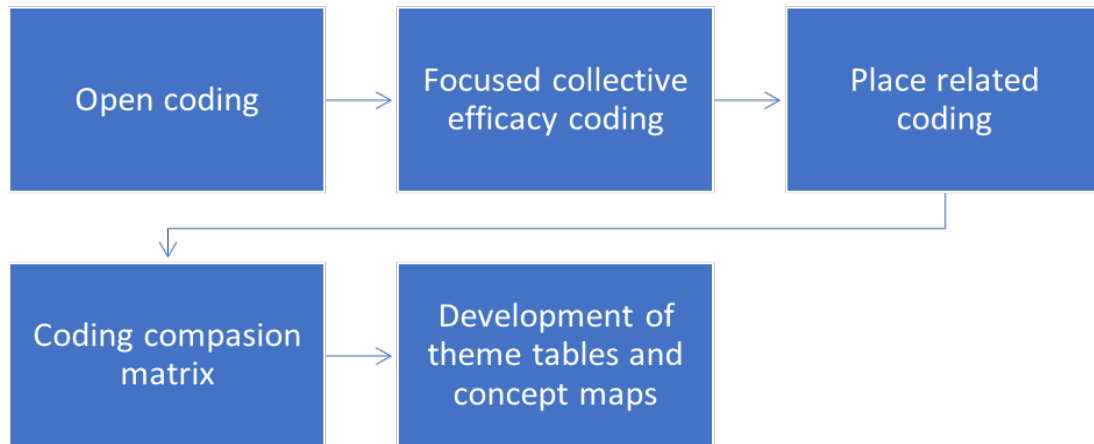
*Table 2. Interviewee Demographics*

	<b>TOTAL</b>
<b>No. of interviewees</b>	27
<b>Age (min/max)</b>	28-66
<b>Age (median)</b>	48
<b>Years in community (min/max)</b>	2.5-40
<b>Years in community (median)</b>	17
<b>Gender</b>	15 female 11 male 1 not provided
<b>Self-identified race/ethnicity</b>	1 Anglo 24 White/Caucasian 2 not provided
<b>Self-identified occupation</b>	11 Natural Resource Professional 5 Community activist/advocate 5 Local government staff 2 Elected local government official 2 Educator 2 Private foundation staff



## **Analysis**

The interviews were initially coded via a grounded theory approach (Charmaz, 2006). Aspects of collective-efficacy emerged as particularly relevant and the interviews then were re-coded using a collective-efficacy working model, adapted from Bandura's (2012) sources of efficacy and self-efficacy models. Through application of the collective-efficacy based analysis, aspects of place, sense of place, and sense of community emerged as particularly prevalent and relevant. A review of the literature on place attachment revealed the Scannell 2010 Tripartite Place Attachment Organizing Framework as a potential framework for analysis. The interviews were re-coded a third time using this place attachment framework as a foundation. The analysis revealed that place attachment, as well as other considerations of place (place identity, place dependence, sense of place), were important in the efficacy of the respondents. The study findings did not, however, contain sufficient detail to parse the place related aspects into finer or more specific detail. Researchers ran a coding comparison matrix query in NVivo 11 between the efficacy coding and place considerations coding. This allowed for rapid assessment of which aspects of the efficacy framework aligned with the aspects of place. Theme tables and concept maps that highlight the areas of alignment were developed based on the matrix results, theme tables, and concept maps (Figure 11).



*Figure 11 Summary of analysis process*

## **Findings**

This section highlights findings related to collective-efficacy, place-based aspects, and the relationship of place to collective-efficacy in the interview data. Perceived collective-efficacy emerged as a key theme in the findings. Interviewees expressed feelings of both ability and inability to address climate change and extreme weather impacts across the spectrum of collective-efficacy attributes. Elements of place and relationship to place also were a prominent theme in the findings. Of the various aspects of place explored in the literature review, place attachment, place identity, and place dependence, were particularly relevant to the data in this study. These are referred to in the findings as place-based influences/aspects/considerations. Finally, it appears that for the participants in this research, place is a key determinate in the perceived ability of stakeholders to make decisions and act to better prepare for climate and extreme

weather impacts. Place was present in conversations and influenced the importance of action for many, while also supporting a comfort in in-action for others.

### **Collective-efficacy**

In interview data, perceived collective-efficacy emerged as a significant theme related to climate and extreme weather response in the study communities. In particular, the aspects of expected outcomes, goals, and mastery as they related to the community's ability to manage water resources for climate and extreme weather impacts were seen as limits to perceived efficacy.

### **Expected outcomes**

One aspect of collective-efficacy are the expected outcomes. Expected outcomes are the extent to which members of the group feel similarly about what will happen if they perform a certain action. Divergence in expected outcomes on actions to better prepare for climate and extreme weather impacts was viewed as a limiting to the community's ability to make decisions about natural resources. Participants were asked if the community was doing what it needed to prepare for potential future climate change impacts. Responses ranged from "yes" to "no" to "climate change is too big to prepare for". For example, one participant said:

Oh, no. No, [the community] is not! You know, we all know it's happening, but it's like...it hasn't hit here yet, I'm pointing to my heart, it hasn't hit home yet. We live in a northern community - things are changing and there's shifts happening. But it's like well what can we even do at this point? It is a global issue, and the answer is much, much bigger now.

In this quote, the participant is speaking to a perceived disconnect in the community between the climate impacts occurring and others' ability to connect with those impacts. There is divergence in expected outcomes because individuals aren't connecting impacts to their community. Other study participants were concerned about the potential for conflicting expected outcomes between various management agencies. An individual said,

Working with resource agencies is a challenge, because they have good intentions, but a different angle on things. For example, on a stream restoration project in a park, the City is looking at park users, trail access, public safety, parking, all the different components. The state agency looks at the project as just the stream channels. They are seeing just the channel, the bed, the banks, the trees, riparian zone, they are not thinking about the trail crossings or the dog walkers or the other stuff. That's their job, they do it well, but it's a different focus.

Another interviewee specifically discussed the shift to collaborative management of water resources as a chance to align expected outcomes for better results:

I think the move towards watershed-based management is a huge opportunity. If that can be fully rolled out and implemented on a community level - where everyone fully understands what it means, what their potential role is, and plans for watershed management based projects that will have a gigantic impact. It has to be collectively addressed across wider areas - collaborating with everyone in the watershed and realizing that our actions are impacting what else is going on.

Some interviewees expressed concern that the variety of desired uses of the resources might lead to unsustainable and unsatisfying management outcomes. One individual who is responsible for local park management saw this issue with recreationists, saying,

There is always the concern of balancing the user groups. The park has a lot of opportunity for a lot of different resource uses, we have everything

going on there from skiing to kayaking to biking, hiking, to horseback riding. Each user group wants to do that in as many places as they can. We want to, of course, allow that and allow for the connection to the natural resources. That is important in developing a sense of stewardship, but needs to be done in a sensitive manner that doesn't put that resource at risk.

Without unified and aligned expectations, there was a concern about losing the resource about which the community cares.

### **Mastery**

Mastery, as it relates to collective-efficacy, is when a sense of proficiency is gained or lost because of experience in which the group was able (or not able) to accomplish a task and gain skills. Mastery appeared as a theme as interviewees explained their concerns regarding the ability to work with the public to protect water resources, saying, “[The public doesn't] understand the connections between lakes and rivers and groundwater tables, and aquifers; I just don't think people understand. I think that our biggest challenge [for natural resource management] is always public perception and what the public just doesn't understand.” In this instance, the study participant did not perceive that the community had sufficient understanding to be effective at managing water resources.

Interviewees also saw the recovery from previous natural resource impacts, like the 2012 flood, as increasing collective skills to manage future natural resource impacts. One interviewee said,

I think there is a lot of damage to in stream habitat, as a result of the flood. But also, there is a lot of improvements to habitat based on some of the work that was done as a result, so it was kind of a double edge sword. There was damage, and we were able to go in and use some pretty high tech methods to put a stream back to the way it is supposed to be, to

mimic natural conditions, that I think are going to be more long-term a big improvement.

### **Goals**

Collective goals in the context of collective-efficacy are the shared vision and direction the community thinks they need to move. In this study shared goals for resource management emerged as a theme in findings. In particular, settling on shared priorities was perceived as a barrier to making progress on pressing natural resource management issues. An ongoing debate in the community is if all water bodies should be “saved” regardless of impairments, or if resources should be concentrated towards waters that can be protected or restored most easily. One participant said, “My concern is how do we look at the land use in each of these watersheds, and prioritize where we do development, and which streams we’re either willing to sacrifice or make sure they don’t reach a tipping point.” Another individual talked about the challenges of getting the community committed to dedicated resources towards a singular effort. They described the restoration efforts in the St. Louis River estuary thusly, “It is hard to start things, it is hard to start big projects and programs. After 20 years of work, it is just in the last 3 or 4 years that the natural resources community has organized itself well enough and has taken the lead into actually taking action.”

### **Significance of Place to Collective-efficacy**

Among the interviewees in this study, relationship to place emerged as important in management of natural resources and response to climate and extreme weather impacts. Findings indicated that components of perceived collective-efficacy and place

are intertwined and related to each other for decision makers in this community.

Feelings associated with the concepts of place attachment, place identity, sense of place, and place dependence emerged in analysis, yet none prominently and independently of the other factors. The collective-efficacy aspects of socio structural factors, physical and emotional states, and expected outcomes had the most prominent relationship to place considerations. The following sections highlights elements related to place from the interview data, and describes in more detail the incidents of alignment between collective-efficacy and place.

Study participants almost universally saw the local environmental conditions and features as an asset that they felt strongly and positively connected. One interviewee captured the sentiment, saying, “This is a cool place. The number one outdoor town from *Outdoor Magazine*. *National Geographic* has done articles on it. People really recognize it as, ‘oh, wow we do have something special here.’” Another interviewee more specifically noted the value the community places on water resources and the emotional relationship people have with the resources, saying, “Water is life. Creeks and streams have a different mood every season. People want to be by the water, they want to live by the water, they want to hear it running, they want to see it in its different moods.” Many interviewees were particularly connected to the local creek or stream that ran through their neighborhood. For example, of study participant said, “Miller Creek, of course goes all the way down through Lincoln Park. It’s so beautiful down there. I mean that park is a treasure. Miller Creek there is gorgeous and it kind of winds through and there are rocks and it’s beautiful.”

The management of natural resource was often perceived as a challenge for the community, however, even while they continued to connect with the resources emotionally and see it as an asset. For example, an interviewee had concerns regarding conflicts between resource extraction and development, especially under uncertain future climatic conditions. They said,

We live next one of the largest resources of freshwater in the world. A combination of the changing climate and how we decide to develop and use our resources has always been a big issue. Up here mining is a big issue, and we need to be able to prevent [pollution from mines] versus wait [for contamination] and clean up. I mean, it's the only place we have to live.

The place itself and the prominent geography also presented challenges for the community. When describing the process they took to get to know the neighborhood communities in town, one individual said, "Duluth is kind of funny because of the ledge rock on the hillside. There's lots of streams coming down, and there's likely a dead end at a stream and you got to go around. It makes for very interesting neighborhoods. Very interesting neighborhoods."

### **Collective socio structural factors and place**

The environments, resources, and institutions (the socio structural factors) that impede or build perceived collective-efficacy aligned closely with process considerations of place. In particular, socio structural factors emerging were closely related to restoration or preservation of places. For example, interviewees noted the potential for conflicts between economic interests and environmental interests in the management and development of the study watersheds. The upper reaches of Miller Creek were



developed for a shopping mall and experienced significant flooding during the June 2012 storm event. One participant said,

Miller Creek is probably the area that has been most in the community dialogue. There was a conflict between people with environmental backgrounds and people with economic backgrounds. [Environmental] people saw that as an area where storm water should be retained. But we created a lot of impervious surfaces [with the mall development]. The stream goes through some very dense residential areas and they also have very steep elevation drops from the upper reaches of their watershed down to the lake.

Other study participants saw relationship to natural resources as an opportunity to motivate institutions to act to protect the place. An interviewee stated,

I think as people spend more time in the streams, and enjoy them, and see the fish, and the flows, and the trees, and have good experience on the streams, they will value them more, and protect them more, or want to pay more to maintain them. So I think getting folks out, whether it is on a mountain bike, or skis, or whatever, on those streams and realizing that we have such good water quality right here in the city, that will spur them to protect it.

In these instances, participants noted the importance of place in the social systems and structure that would impact the places. The iterative connection between the two was both a concern and an opportunity.

### **Collective Expected Outcomes and Place**

The collective-efficacy component of collective expected outcomes as they relate to place and resource management appeared across all interviews. Place can be a uniting or dividing construct for expected outcomes around climate preparedness. What the community expected to happen if they took a natural resource management action aligned closely with behaviors and perspectives related to restoration or preservation of places. Many individuals saw use of the resources as an opportunity to build a common

direction for management of the resource. One participants said, “I think, that’s a great opportunity to educate people. It’s a great opportunity to get people using the river and the bay. There’s a lot of people who live up there, they already [use the bay]. They know that. There would be opportunities to educate people about water.”

### **Physical and emotional states and place**

The components of perceived collective-efficacy related to physical and emotional states, how you feel about a behavior and what environmental factors might be influencing perceived efficacy, appeared to be particularly impacted by relationship to place.

Relationships with place affect emotional states around climate preparedness. It also affects the physical scale or context of climate preparedness actions. Many of the aligning factors can be seen in the data simultaneously. For example, some interviewees could place themselves in many different communities of scale simultaneously, while also recognizing where they might have influence on resource management. This feeling of understanding the broader physical context while perceiving limits to their authority was both an opportunity and impediment for decision making. One individual said,

I work in is the City, which is our municipal boundaries, the corporate boundaries of the city, and that’s where our authority is for managing stormwater and managing runoff. On a broader scale, our community are the watersheds - our trout streams, the Saint Louis River, Lake Superior. We try to manage and think about our stormwater impact in terms of being more than just our city, we look at the watershed scale and how we can impact the entire watershed or make decisions across the watershed.

Social values of place emerged as a component of the emotional and physical considerations of collective-efficacy. Some study participants did not feel that the

community as a whole had sufficient knowledge of place to connect decision making to preserve the places they valued. A study participant characterized limits to decision making saying, “We all value the trout streams, but I’m not sure that most citizens realize how many streams there are in town, they drive over one about every mile. I think folks don’t realize it all the time, but they do value them. The kids play in them, they fish, the fat tire mountain bikers bike up these things in the winter. We use them.”

## **Discussion**

As communities grapple with how to manage wicked natural resource issues, their collective perceived ability will be a key determinate of success. Traditional management challenges like flooding, resource extraction, development pressure, and water quality are bumping up against growing populations, climate change impacts, and increasing incidents of extreme weather. Bandura and others have demonstrated that efficacy is at the core of an individual and community ability to activate behavior. Finding key elements to leverage development of collective-efficacy at the local community level will be instrumental in facilitating action to respond to challenging natural resource management issues.

In this study, place emerged as an important component of perceived collective-efficacy. The research participants identified strong connections to place and saw their relationship to place as both a barrier and opportunity to elicit preparedness for future natural resource impacts via protection and restoration.

The research investigated the influence of place on collective-efficacy in natural resource management decision making. For this community, with strong ties to their natural resources, place attachment appears to be a significant component of perceived collective-efficacy, and appearing to align across many elements of efficacy. The process of restoration and protection of place seemed to be particularly salient across collective-efficacy.

A conceptual model of the relationship between collective-efficacy and place-based influences on collective-efficacy is illustrated in figure 12. Research findings suggest that there is a reinforcing feedback relationship between collective-efficacy, place-based influences, and place-based behavior. As efficacy increases so might place-based behavior, and then an increase in place-based influences, and finally an even greater increase in collective-efficacy. Alternatively, less strong connections to place may lead to lower commitment to place-based action and in turn a loss of efficacy.

Physical/emotional states and socio structural factors may be more contextual or situational factors that affect place attachment and collective-efficacy, rather than sources of efficacy and place attachment in this study community.

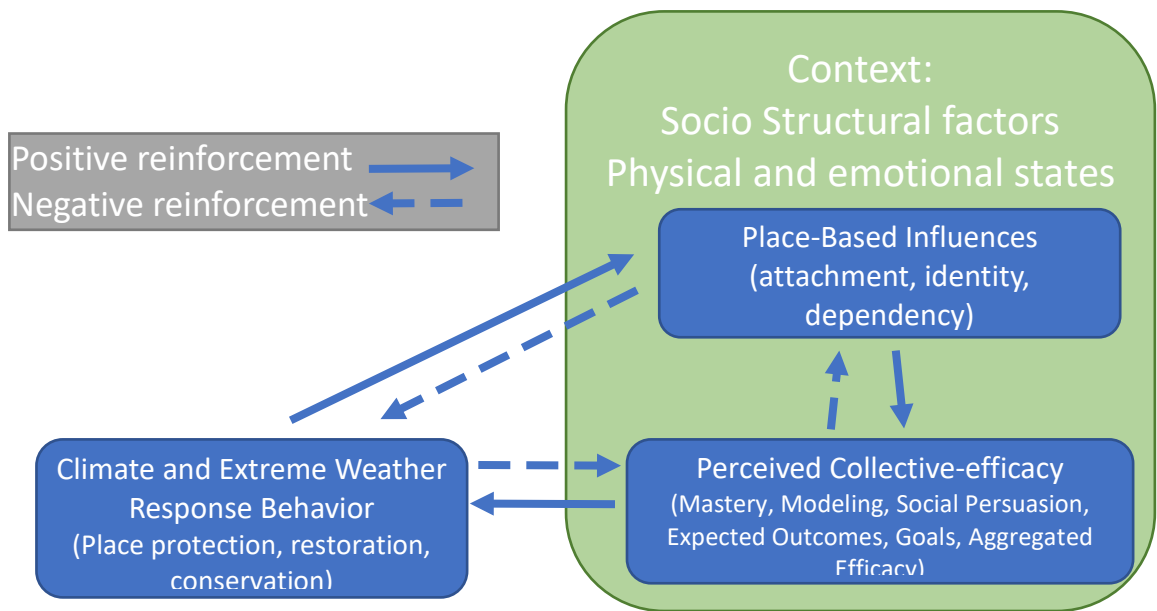


Figure 12 Model of climate and extreme weather response behavior related to Collective-efficacy and Place-Based influences

Researchers explored how community stakeholders view water management and future risk post extreme weather events. Overall, this is a community for whom the impacts of a 2012 flood are still present and relevant for the most part. This is also a community that has a strong relationship to the local natural resources, in particular water resources. From neighborhood creeks and streams to Lake Superior, study participants viewed water and watersheds as key community priority and a strong aspect of local identity. Study participants saw linking community experiences and attachment as an opportunity to move conversations on preparedness forward in order to mitigate potential risk from climate and extreme weather. With that in mind, resource managers may find benefits from building from existing natural resource connections when hosting community

discussions on water and resource management. For example, increasing the visibility of restoration and protection successes, as well as increasing community participation in restoration and protection efforts may support development of collective-efficacy across elements of the framework.

Finally, the study also investigated elements of collective-efficacy could be leveraged to advance local resource management. Interviewees were able to identify many incidents of low and high efficacy. Research suggests that communities with higher collective-efficacy will be better positioned to make decisions and act of those decisions. Exploring elements of collective-efficacy as they relate to natural resource management, especially collective expected outcomes, socio structural components, and physical and emotional states, may help managers identify opportunities to increase efficacy and in turn increase effective management.

The research was based on the presumptions that:

- Collective-efficacy is a fundamental determinant of the success of community based water resource management efforts.
- An assessment of collective-efficacy will allow communities to build from strengths and address weaknesses in natural resource management.
- A place-based, watershed scale assessment is appropriate for collective water resource management efforts.

This study did not expose any findings that would substantially challenge these presumptions, although it was not in the scope of the work to prove these assertions.

Aspects of collective-efficacy as a determinant of resource management success emerged organically through data collection without explicit prompting. Study participants were able to frame answers within the watershed scale, although they were not always able to distinguish between the two study geographies. The field may be served with future research that explores the effectiveness of collective-efficacy based interventions, and the merit of alternative non-political boundary research study areas.

# Chapter 3: Sequential Design for Participatory Climate Preparedness Research and Outreach

## Summary

Human communities globally are faced with the grand challenge of responding to climate change and related impacts of extreme weather. While climate change is a global issue, adaptation and preparedness decisions are made locally—by municipalities, counties, and regional planning and management bodies. Collective-efficacy beliefs (“is my community able to prepare and adapt?”) have the potential to support or disrupt community-level decisions and action implementation critical to climate change adaptation including emergency response, water and stormwater management, infrastructure replacement and upgrades, resident education and engagement, and other measures. Communities with high levels of collective-efficacy beliefs in their collective ability are better positioned than communities with low collective-efficacy to prioritize actions, make decisions, and act to prepare for climate change. However, climate change beliefs, adaptation goals, and outcome expectations vary dramatically between and within communities, even among core decision makers, straining adaptation efforts. This paper addresses the value of a participatory sequential design in climate change research and outreach. A sequential multi-methods research design allows for expansion and triangulation of findings – with study segments available for separate or combined analysis. Qualitative and quantitative data were gathered and



scrutinized through key informant interviews, reflective focus groups, and an interactive action-planning workshop. The concept of collective-efficacy served as an analytical tool for organizing and prioritizing climate preparedness actions. The research and outreach project was conducted in two sub-watersheds of the Lower St. Louis River Basin in northeastern Minnesota, U.S.A. All study participants were key stakeholders involved in decision making and response to climate and extreme weather impacts. Study participants identified and evaluated climate preparedness actions for community planning and natural resource management. The project revealed that a sequential participatory design validates and elucidates diverse and sometimes competing perspectives on climate change preparedness. Barriers to and opportunities for building collective-efficacy emerged.

### **Key words**

Sequential design; Collective-efficacy; community decision making; climate; extreme weather

### **Introduction**

Climate change impacts will require significant response from local communities to maintain viable social, ecology, and economic systems. To date, efforts to shift behavior in ways that will mitigate climate impacts have centered on regulatory and social marketing approaches (Rees & Bamberg, 2014). Local regulatory approaches, however, are not an appropriate fit with the global scale of climate change contributors (Wiener, 2007) and many governments in the United States have been reluctant to expend political capital forcing pro-environmental behaviors (Ockwell, Whitmarsh, & O'Neill,

2009). Approaches to shift behavior through attitudinal change and social marketing have been largely focused on individual action, rather than collective action (Ockwell et al., 2009; Rees & Bamberg, 2014), yet in-lieu of systems to enforce social accountability, the “free-rider” effect may reduce participation and effectiveness of efforts (Ostrom, 2000). Consideration beyond regulation and individual action will be required for meaningful community response to climate and extreme weather impacts (Bamberg, Rees, & Seebauer, 2015).

The extent to which a group believes it is able to effectively implement an action has a strong influence on its approach toward collective actions. The subjective assessment of a group’s resources is more impactful on outcomes than objective resources like access to technical or financial support (Bamberg et al., 2015). The group belief in ability to achieve a desired change is perceived collective-efficacy (Bamberg et al., 2015; Bandura, 2000b). For example, a community that has a history of working together to successfully manage challenges may be able to tap into their collective knowledge of what worked well, have systems established to access resources, and to prioritize actions through a common understanding of the type of outcomes they might expect from working together. These factors could contribute to a high collective-efficacy and a high likelihood of successful outcomes with sufficient resources. Alternatively, in a community with divisive goals, a lack of structures for effective decision making and distribution of resources, or a history of failed initiatives may have low collective-efficacy, even with an influx of resources. A

greater understanding of collective-efficacy, as well as collective-efficacy interventions, help illuminate a path forward for effective local climate and extreme weather action.

This paper reviews the use of a sequential design to engage community decision makers in identifying, evaluating and prioritizing actions for climate change preparedness in a northern Minnesota coastal community. Literature on collective-efficacy and the influence on community decision making and action implementation are described, as is the use of an innovative participatory sequential design. Findings describe outputs of each of study segment, or method, as it relates to collective-efficacy and climate preparedness. A discussion on future application of participatory sequential design and use of a collective-efficacy framework are presented.

## **Related Literature**

### **Sequential Design**

In sequential research designs, researchers execute multi-method study segments one after the next (Padgett, 2012). This contrasts with *concurrent* multi-method designs which will have different research methodologies occurring at the same time.

Participatory sequential research builds learning as the study progresses, and incorporates community perspectives from former segments into the implementation of later segments (Padgett, 2012).

Efforts to address complex problems, like climate change, benefit from collective approaches by bringing in a variety of sources of knowledge, creating broader

commitment to outcomes, and advancing community learning (Koontz, 2014). Sequential design may be a particularly good fit for community climate change preparedness research. The use of sequential research design is effective for the development and refinement scenarios modeling possible futures in a community. Study participants are able to contribute to the development of a scenario in one segment of the research and respond the scenario is a later portion of the research. Moss et al. (2010) found that incorporating feedback from end users of climate change impact forecasts allowed for the development of information that was more applicable in the local community. Further, reflecting the input of stakeholders increased the effectiveness of collaboration and communication between researchers and decision makers (Moss et al., 2010). Moser & Ekstrom, (2010) suggest that given the complexity of climate change, decision making should take into account decision makers and the context they are working in, and also recognize that processes will be “iterative and messy” while needing to be “linear for convenience” (p. 22,027). Multi-method sequentially designed research is well suited to address these considerations.

### **Efficacy**

Most research on efficacy has focused on direct personal agency or self-efficacy (Bandura, 2000b; Watson et al., 2001; Zaccaro et al., 1995). Self-efficacy is the beliefs of an individual in their ability to control or influence external demands and their personal functioning (Luszczynska & Schwarzer, 2005). Bandura (2000a) described the relationship between self-efficacy and behavior as a function of external and internal processes. In the approach, self-efficacy affects cognitive processing and the formation of

individual expected outcomes, goals, and socio-structural factors. Bandura (2012) notes four primary mechanisms to develop self-efficacy: mastery, physical and emotional states, social persuasion, and modeling. Similar to other descriptions of efficacy, the formative aspects can be by-passed, with efficacy able to have a direct impact on behavior. In other words, despite expected outcomes, goals, and socio-structural factors, low efficacy may disrupt behavior performance while high efficacy may support behavior performance.

Collective-efficacy extends self-efficacy concepts to group behavior, action, decision making, and response (Figure 13).

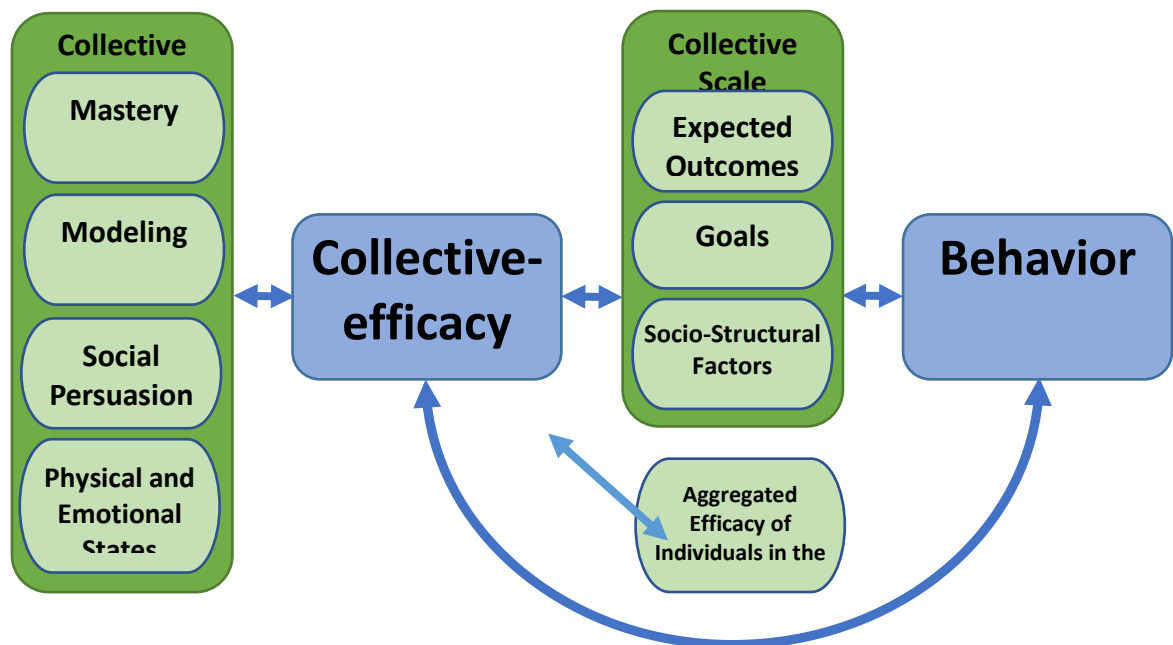


Figure 13 Collective-efficacy Working Model, Adapted from Bandura (2012) Sources of Efficacy And Self-Efficacy Model

Collective-efficacy is the perception of a group’s ability to perform in an effective manner (Lindsley et al., 1995) and ability to extend mutual trust in order to help each other

(Cohen et al., 2008). Perceived collective-efficacy, *do we think we can*, will impact a groups' motivation, resilience, and accomplishments (Bandura, 2000b).

Efficacy beliefs influence whether people think erratically or strategically, optimistically or pessimistically; what courses of action they choose to pursue; the goals they set for themselves and their commitment to them; how much effort they put forth in given endeavors; the outcomes they expect their efforts to produce; how long they persevere in the face of obstacles; their resilience to adversity; how much stress and depression they experience in coping with taxing environmental demands; and the accomplishments they realize. (Bandura, 2000b, pg. 75)

Zaccaro et al., (1995) asserts that high collective-efficacy will result in higher group cohesion, groups setting and attaining more difficult goals, and a motivation for the group to work through challenges.

Geographic and community scale are important considerations for collective-efficacy (Decker et al., 2005), yet frequently the scale of natural resources beginning collective considered, do not align well with community scale (Armitage, 2005; Chaskin, 2001; Foster-Fishman et al., 2007). Participants in smaller scale efforts are more likely to identify with others as belonging, and therefore more likely to identify solutions for the place they belong (Cheng & Daniels, 2005). Often local decisions are made within the framework of political boundaries, yet rarely, do ecological boundaries match political boundaries. The blending of biophysical and social system assessments can be difficult (Donoghue & Sturtevant, 2007), and the assessment process itself may be politicizing and divisive (Diamond, 2004). Human and natural systems each on their own are complex, and increasingly complex when considered as interlinked and dynamic (Patterson et al.,

2013), and are frequently shifting in tandem adding even further complexity (Ivey et al., 2004).

It may be that climate and extreme weather will have both direct impacts to natural environments and indirect impacts to collective response to the changes. Zelenski, Dopko, & Capaldi (2015) found that connecting with nature tends to correlate with both a willingness to engage in pro-environmental behaviors and likelihood of working together cooperatively. Researchers suggest that nature exposure taps into evolutionary needs, as well as situates individuals into a larger social and ecological context that is greater than themselves (Comstock et al., 2010; Farnum et al., 2005; Zelenski et al., 2015). In collectivist cultures, collective rather than self-efficacy is a stronger predictor of pro-environmental behavior (Chen, 2015). Rapid changes to natural areas may serve to disrupt connection to place and in-turn collective-efficacy to protect and restore places (Brown et al., 2003; Scannell & Gifford, 2010b).

One study found, though, that the more threat individuals feel from climate change, the higher the perceived efficacy (Hornsey et al., 2015). The cause of the relationship is uncertain, although it may be that a greater perceived ability of how to respond to threats from climate and extreme weather allow individuals to cognitively process the potential threats (Hornsey et al., 2015).

## **Study Sites**

This multi-method study was conducted through a paired watershed approach in two sub-watersheds of the St. Louis River Watershed in northeastern Minnesota. The St. Louis River Watershed is the largest U.S. Lake Superior tributary, covering 3,634 square miles in northern Minnesota. The lower portion of the watershed is a designated Area of Concern (AOC) largely due to impacts of industrial development in the region. Mission and Miller Creek

watersheds, sub-watersheds in the St. Louis River Basin, are both designated trout streams near and in the Duluth area (Figure 15).

Miller Creek is in a highly urbanized and impacted landscape,

flowing from the Duluth airport south to Lake Superior (Figure 15). Due to the development of surrounding areas, rising water temperatures and the resulting impacts of trout habitat are of particular concern in the creek. Additionally, headwater wetlands have been significantly impacted by development. The steep, narrow, bedrock based nature of the creek makes it particularly susceptible to flooding. While there have been

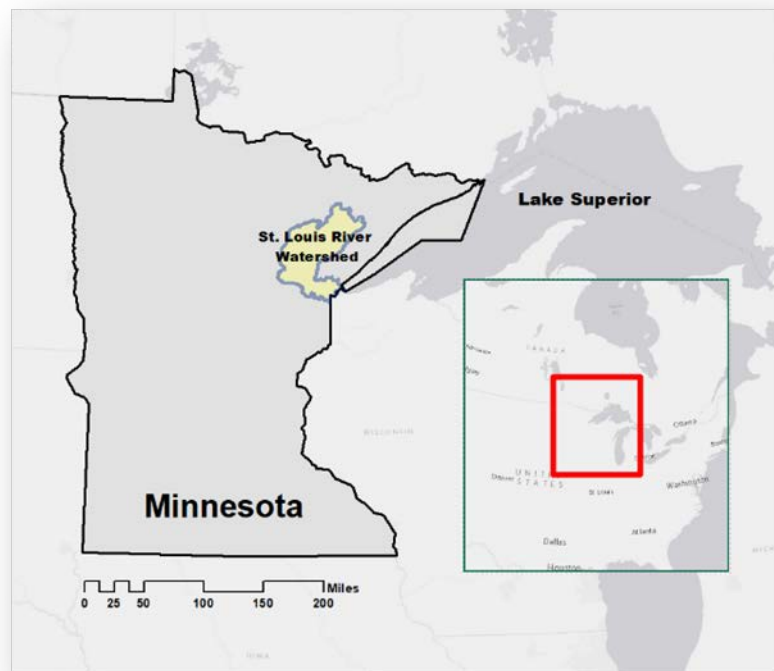


Figure 14. St. Louis River Watershed Context



some efforts to restore Miller Creek, investment is controversial as some decision makers think the creek is too impacted to be worth restoration efforts. Mission Creek drains lands west of Duluth including the area near Esko, the Fond du Lac community and the ceded territories of the Fond du Lac Band of Lake Superior Chippewa reservation, portions of Jay

Cook State Park, and ceded lands of the Fond du Lac Band. The watershed is less than 3% developed, primarily in forestland, grassland, and wetland. Primary

concerns in the watershed include

potential future development, sedimentation impacts in the estuary, and slumping hillsides near to the outlet of the creek.

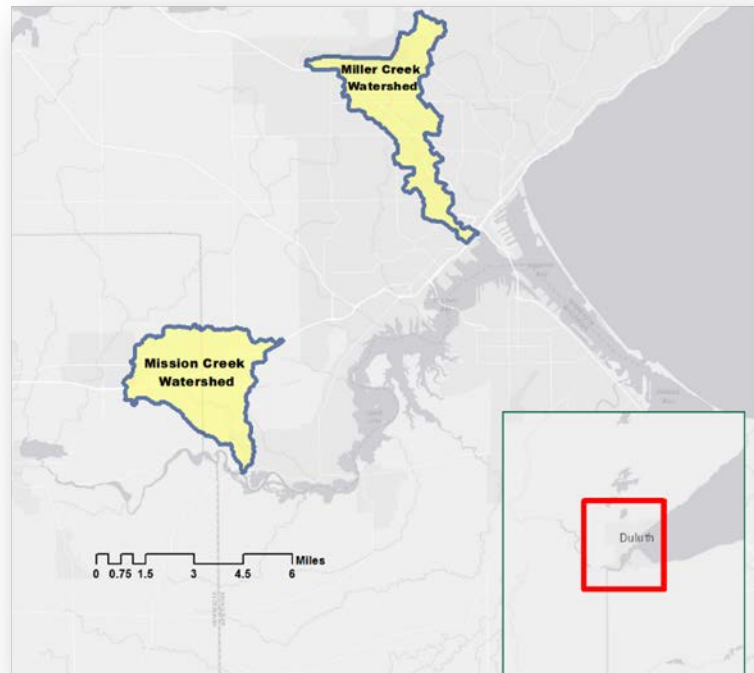


Figure 15. Mission and Miller Creek sub-watersheds

Information on the St. Louis River Basin and the Mission and Miller Creek watersheds was sourced from information gathered via [www.lakesuperiorstreams.org](http://www.lakesuperiorstreams.org), a source managed by the University of Minnesota-Duluth (Axler et al., 2009).

## **Methods**

The project applied a participatory sequential design for gathering and analyzing qualitative and quantitative data. Researchers conducted key informant interviews, focus groups, and workshops with a range of community and natural resource decision makers.

The aim of this study was to better understand community responses to water resources impacts and to build climate readiness in coastal communities. The research study had two primary focus areas:

1. Assessment of local perspectives on community assets, community needs, environmental planning, and water conservation programming
2. Exploration of the adaptive capacity of communities, community leaders, and land use/water resource professionals and their ability to anticipate and respond to climate and extreme weather impacts.

The research was conducted using a four-stage multi-methods approach: interviews, biophysical modeling, focus groups, and workshop (Figure 16) with the bulk of the work conducted between the spring of 2015 and fall of 2016. The project was reviewed by the Institutional Review Board (IRB) as designated by University policy. The IRB process is designed to protect human subjects involved in research from harm and ensure the

ethical practice of research by University personnel. IRB review determined the study was not at risk of causing harm and therefore was exempt from further review.

Each research method used was equally important; findings from each were used to support subsequent methods. For example, findings from the interviews would inform the biophysical model scenarios to reflect potential actions identified by interviewees; findings from the interviews and the results of the biophysical models could then be used to inform conversations in the focus groups around specific actions in which the community might engage; finally, the actions identified in the focus groups could be vetted and further developed in an interactive participatory workshop focused on tangible and actionable items.

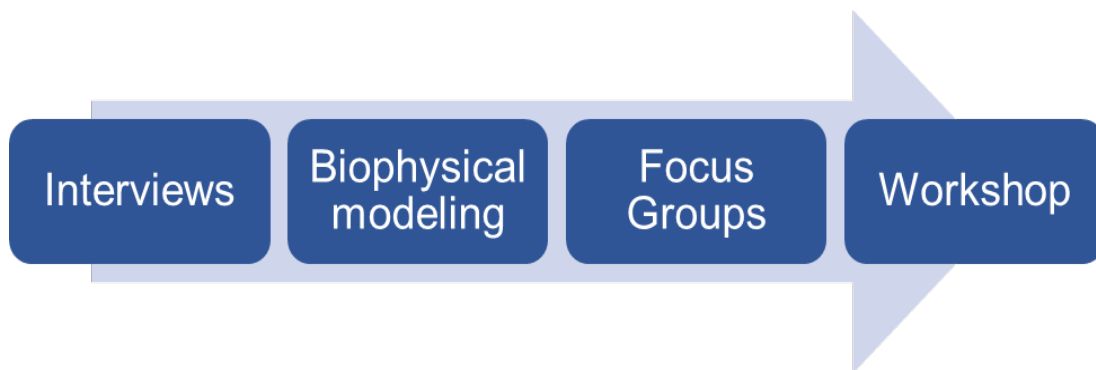


Figure 16 Four phase multi-methods approach

### **Key informant interviews**

Interviews allow for in-depth data collection with key informant individuals. For this study, interviews were conducted with key stakeholder that had decision-making influence related to natural resource management and climate response in the Mission and Miller Creek watersheds of the St. Louis River in the Duluth, MN area. Interviewees

ranged from local community organization representatives, resource managers, philanthropic organizations, governmental representatives, housing advocates, and emergency response personnel. Interview questions included topics on community priorities, community decision making, water, stormwater, climate and extreme weather response, and opportunities and challenges. Participants were asked both about their individual assessment of natural resource barriers and opportunities and their impressions of community ability to prepare and respond. Through this mix of approach researchers could glean information related to both self and collective-efficacy.

Twenty-seven semi-structured interviews were conducted. UMN personnel developed a project description flier, contact script, and interview guides to facilitate community member participation. The interview guide was piloted by project personnel and refined based on input from pilot participants. Often interviewees were aware of issues, had worked on projects, or experienced resources in both study watersheds. Participants included local community organization representatives, resource managers, philanthropic organizations, governmental representatives, housing advocates, and emergency response personnel. Most of the interviews occurred in the individual's place of business, although some opted to meet at public establishments (e.g., community center, local coffee shop, etc.). Each individual signed a consent form prior to the start of the interview and the interviewer emphasized that participation was voluntary and that every reasonable effort would be made to ensure confidentiality. The interviewer also answered any questions the interviewee had prior to beginning the interview. Following

the interview, participants were asked to complete a participant background information form. This information was used to help understand the sample profile and is only reported at the aggregate level. No personally identifying information is linked to the interview data.

All interviews were recorded, transcribed, and analyzed using best practices for qualitative analysis (Charmaz, 2006; Corbin & Strauss, 2008; Weiss, 1995). Using the transcribed text from the recorded discussions, event organizers used the software NVivo 11 (QSR International Pty Ltd., 2012) to assign codes or labels to the text and in turn analysis the codes for themes and findings. As the first step in the research process, the interviews were initially coded via a grounded theory approach (Charmaz, 2006). Grounded theory allows the data to “speak for itself”, or to let themes emerge without preconceived notions of what may be most important or compelling.

Analysis explored emergent themes related to the framework, areas of strong convergence and divergence, possible additional theoretical approaches, and actions with the potential for implementation.

### **Biophysical modeling**

Biophysical modeling can create information and scenarios for community members to consider and respond. The reaction to the models and illuminate potential barriers and opportunities, as well as highlight areas of high and low perceived collective-efficacy. The models serve as a tool and resource for other methods, as well as stand-alone informative findings of potential futures. The Natural Resources Research Institute (NRRI)

of the University of Minnesota, Duluth employs researchers with expertise in GIS modeling and mapping. NRRI took the lead on development of GIS modeling scenarios to represent potential future climatic conditions and development in the Mission and Miller Creek watersheds. Specifically, the intent of the modeling was to understand better how the impact of precipitation events would change with different implementation of best management practice (BMP) like rain gardens and green roofs. NRRI researchers used the EPA's Storm Water Management Model (SWMM) version 5 (Huber, 1985) to predict the flooding that would occur under 2, 3, and 4 inch rain events in sub-watersheds that had no BMPs, currently installed BMPs, and a high level of BMPs. Modeling scenarios were selected based on current BMPs used in the community so that study participants reviewing the models might better connect to the findings, related their previous experience with the techniques, and could imagine potential futures in greater detail.

The biophysical models were created using best practices for GIS analysis and modeling including use of most up to date data sets and calibration of the models with actual observed precipitation events.

### **Reflective focus groups**

Focus groups are facilitated collective interviews in which participants are able to work together and respond to each other (Wholey, Hatry, & Newcomer, 2010). While group dynamics can influence responses, unlike interviews, participants are faced with alternative approaches and perspectives in real time (Krueger & Casey, 2000). The method can result in a rich data that includes elements of self-efficacy and collective-efficacy. The

focus group included a presentation of findings from the interviews and the biophysical modeling. The objectives of the focus group sessions were to 1) present and receive feedback on study findings to date and potential future weather scenarios, 2) identify constraints and opportunities for developing climate readiness and water resource management strategies, and 3) increase knowledge of local perspectives on community assets, community needs, environmental planning, and water programming.

Participants were recruited from a similar pool and with similar methods as were used for interviewee recruitment.

There were two sessions with a total of 19 participants between the two events. Each event started with full group discussion on community assets related to water or natural resource management, and potential priority actions to better

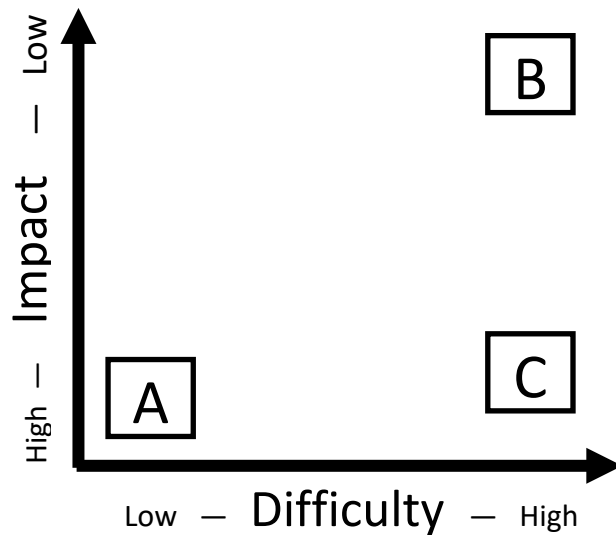


Figure 17 Example Matrix

prepare the community for future climate and natural resource impacts. Initial findings from the interviews and biophysical modeling phases were presented and then the group revisited the discussion of priority actions. Changes to actions and additional actions were recorded to distinguish them from the first round of action item discussion.

The focus group phase used an action matrix activity approach to focus the discussions of action items. A matrix is a rectangular arrangement of quantitative or qualitative elements in rows and columns used to display the resultant products of various combinations of those elements (“Matrix | Matrix Definition by Merriam-Webster,” n.d.). In community-based decision-making processes, an action matrix offers a simple way for participants to display, evaluate, and prioritize potential strategies and actions based on multiple parameters. The axes of the grid can be a variety of parameters that community members may want to assess – i.e. difficulty, impact, support, financial feasibility, environmental benefit, equity benefit. By contemplating two parameters simultaneously, use of the action matrix allows for deeper discussions and a grounded assessment of priorities.

For the focus groups the action matrix had difficulty and impacts axes. Event facilitator collected action items from participation of sticky-notes and placed them on a large matrix through a group discussion process. Final discussion centered on ways to shift items to be less difficult or more impactful and as well as strategies to move the community forward on highest priority actions.

Focus group conversations were recorded and analyzed similarly to the interviews using a combination of grounded, open, coding and focused theoretically based coding. Further, results of the group matrix activity at the focus group was recoded and digitized.



### **Action-planning workshop**

The objective of the workshop was to develop a set of recommended actions for decision makers of the lower St. Louis River watersheds to better prepare the community for climate change and extreme weather. Facilitators designed the workshop event to be a mix of individual reflection, small group activities, and full group discussion. The variety of activities allowed participants to reflect solo and with others, accommodating various learning styles and preferences. The event was planned for two hours. Agenda items were scheduled to take 90-100 minutes with extra time to allow for shifts between individual, small, and full group discussions.

Invitations were sent to approximately 40 local stakeholder representatives. Participants for the workshop were invited from a stakeholder inventory like the one developed for previous phases of the research. Reminders and confirmations followed the initial email. Around 12 individuals formally or informally indicated prior to the workshop that they would be attending and 15 individuals ended up attending the event.

The workshop centered around the use of a similar matrix tool to the one used in the focus group phase. In this instance, though, participants were given 16 action items to work with, rather than asked to generate action items during the event. The action items for the workshop were identified through analysis of the interviews and focus groups. The items were selected to represent the range of actions that were provided by interview and focus group participants when asked “what actions would you prioritize to better prepare the community for climate change and extreme weather impacts”. The

actions were arranged thematically into four groups, with 4 specific actions in each theme (Table 3).

*Table 3. Workshop Action Items*

<b>Planning</b>	Encourage multijurisdictional planning
	Facilitate watershed scale planning
	Incorporate best climate science into planning and development processes
	Provide planning and training for emergency response
<b>Community Engagement</b>	Involve non-traditional groups in decision making (i.e. low income individuals, non-recreationist community, school district representatives)
	Educate public on risk and responsibility via increased communication
	Increase accountability for implementation of planning
	Facilitate homeowner action and preparedness
<b>Natural Resource Management</b>	Increase protection and restoration of natural water systems
	Further climate and extreme weather research on local impacts
	Reduce resource dependence & use (i.e. energy, water, minerals)
	Provide up-to-date information for resource management (FEMA maps, invasive species info)
<b>Infrastructure Improvement</b>	Replace aging infrastructure and right-size new infrastructure
	Develop sustainable alternative energy sources
	Develop viable public transportation options
	Prioritize green over gray infrastructure when applicable

As individuals, participants assigned a high, medium, or low ranking for both the difficulty and impact of each of the actions. They then ranking the action in priority from 1-16. In small groups, participants discussed their individual assessments and came to consensus of the difficulty, impact, and ranking for each item using a matrix to facilitate discussions. All individual scorings were collected and all small group conversations were recorded.

Both qualitative and quantitative data were collected for the workshop event. The ranking, difficulty, and impact scores from all participants and groups were entered into a Microsoft Excel spreadsheet. The results were analyzed using basic descriptive statistics (Cannon, 2013) for all three data points collected on the cards including mean and median individual score for each action item, mean and median group score for each action item, average change in score for each action item between individual and group scoring, and standard deviation between individuals, groups, and changed rank.

Like the other qualitative phases of the research, all small and full group discussion were recorded, transcribe, and analyzed for emergent themes.

### **Participant Profile**

UMN personnel and NRRI staff partners collaborated on project planning, local coordination, and a stakeholder inventory for participant recruitment for all qualitative phases of the project. NRRI developed a list of governmental bodies with jurisdiction in each of the watersheds. UMN researchers identified appropriate contacts in these organizations and agencies (e.g., planning, park, water-management department staff). Additional participants included environmentally focused non-profit staff, emergency relief organizations, and philanthropic foundations. Researchers employed a snowball sampling technique to further build the stakeholder list. Snowball sampling, or chain referral sampling, invites participants to identify other members of their community who they believe have important knowledge about their community or community action (Weiss, 1995). The interview group consisted of 27 individuals. There were 19

participants in the focus groups, 26% (5 individuals) of the focus group had also participated in the interviews. The workshop had 15 participants. Three individuals (20%) had also participated in the focus group. Of the 3, 1 individual had contributed as an interviewee.

### **Validity and Reliability**

The coding was conducted by a team of researchers trained in qualitative analysis methods employing peer debriefing techniques to refine findings and increase validity. Analysts had expertise in collective-efficacy and other theoretical frameworks. Findings of each qualitative phase were summarized in theme tables and concept maps and reviewed at research team meetings. Findings were from interviews and focus groups were presented at subsequent research phases to participants to establish validity and confirm that interpretation resonated with the stakeholders.

## **Findings**

The research project generated a wealth of rich data. For purposes of this manuscript, reported findings will be limited to demonstrating outputs and outcomes of each method with respect to collective-efficacy.

### **Interviews**

In interview data, collective-efficacy emerged as a significant theme related to climate and extreme weather response in the study communities. In particular, the aspects of expected outcomes, goals, and mastery as they related to the community's ability to

manage water resources for climate and extreme weather impacts where particularly seen as limits to perceived efficacy (Table 4).

Table 4. Collective-efficacy interview highlights

Prominent interview findings related to collective-efficacy		
Theme	Descriptors	Example interviewee quote
Collective Expected Outcomes	Divergent expectations limits community ability to prepare for climate impacts	<i>Oh, no. No, the community is not [prepared for future climate impacts]! It hasn't hit home yet. We live in a northern community - things are changing and there's shifts happening. But is it's like well what can we even do at this point? It is a global issue, and the answer is much, much bigger now.</i>
	Aligned expectations for management of natural resources is an opportunity to increase effective management	<i>I think the move towards watershed-based management is a huge opportunity - where everyone fully understands what it means, what their potential role is, and plans for watershed management based projects that will have a gigantic impact. It has to be collectively addressed across wider areas - collaborating with everyone in the watershed and realizing that our actions are impacting what else is going on.</i>
Collective Mastery	Lack of public mastery of management needs limits ability to prepare	<i>[The public doesn't] understand the connections between lakes and rivers and groundwater tables, and aquifers; I just don't think people understand. I think that our biggest challenge [for natural resource management] is always public perception and what the public just doesn't understand.</i>
	Previous emergency response experience increases mastery for response	<i>I think there is a lot of damage to in stream habitat, as a result of the flood. But also, there is a lot of improvements to habitat based on some of the work that was done as a result, so it was kind of a</i>

		<i>double edge sword. I think are going to be more long-term a big improvement.</i>
Collective Goals	A lack of shared goals for restoration strategies limits effectiveness and extends timelines	<i>My concern is how do we look at the land use in each of these watersheds, and prioritize where we do development, and which streams we're either willing to sacrifice or make sure they don't reach a tipping point.</i>
		<i>After 20 years of work, it is just in the last 3 or 4 years that the natural resources community has organized itself well enough and has taken the lead into actually taking action [on restoration of estuary].</i>

Divergence in expected outcomes was viewed as a limiting to the community's ability to make decisions about natural resource. Some interviewees expressed concern that the variety of desired uses of the resources might lead to unsustainable and unsatisfying management outcomes. Similarly, settling on shared goals was perceived as a barrier to making progress on pressing natural resource management issues. Respondents mentioned an ongoing debate in the community is if all water bodies should be "saved" regardless of impairments, and the time it takes to gather momentum towards a same goal. Mastery appeared as a theme as interviewees explained their concerns regarding the ability to work with the public to protect water resources. However, interviewees also saw the recovery from previous natural resource impacts, like the 2012 flood, as increasing collective-efficacy to manage future natural resource impacts.

### **Biophysical modeling**

The biophysical modeling did not have results directly related to the collective-efficacy framework, but they were used in later research phases so basic results are reported here. Originally the modeling was slated to reflect findings from the interviews.

Interviewees were asked what actions they would prioritize to best prepare the community for future climate and extreme weather impacts. There was not sufficient consensus among interviewee responses to support a certain BMP focus for the GIS models. Instead, rain gardens and green roofs, best practices already employed to some extent in the watersheds, were used at higher, same, and lower than current levels for the precipitation modeling.

Generally, the greater amount of BMP use the less impact a storm event had. That said, per the modeling, BMPs were most effective at managing run-off from less intense, rather than more intense, precipitation storm events (figure 18).

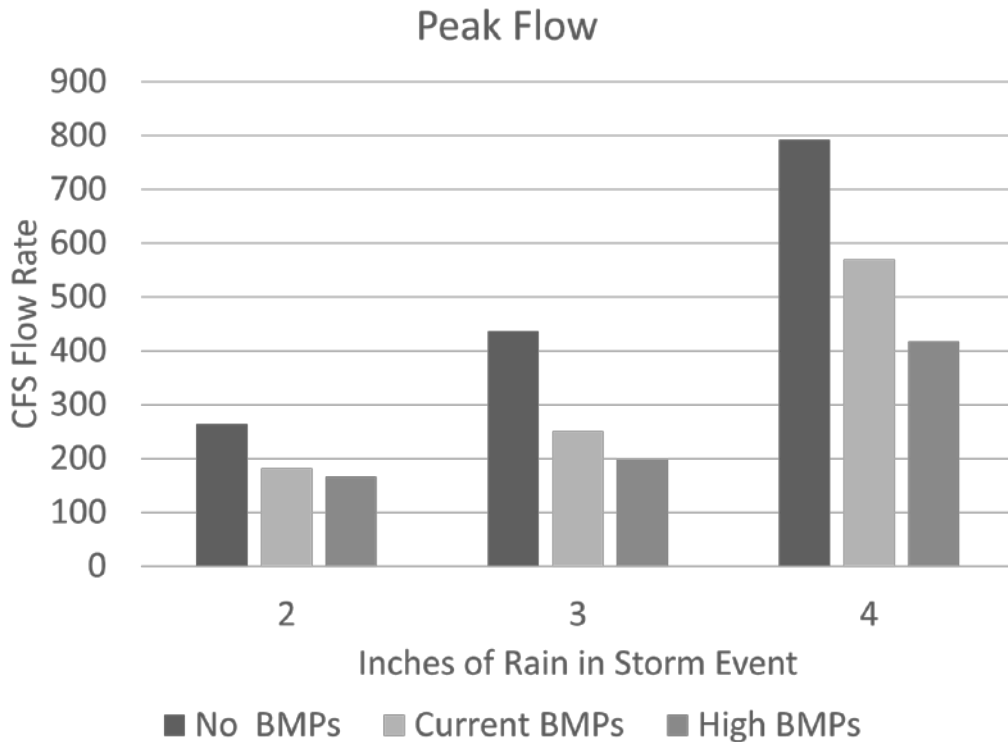


Figure 18 Overview of biophysical modeling results

### Focus groups

Analysis of the focus group sessions was particularly focused on the generation of the action items, response to the presented findings from previous research phases, and aspects of collective-efficacy. Aspects of collective-efficacy that emerged centered around collective goals and collective expected outcomes. Action-items to address climate and extreme weather preparedness tended to cluster as both high impact and high difficulty (Figures 19 and 20).



Related to collective goals, some participants expressed personal experience and general agreement with the lack of connection and coordination between agencies, organizations, areas of government. They saw little success in cohesive approaches to community decision-making and implementation of planning. This was a theme in the action-item generation and many actions related to multi-jurisdictional planning were identified as being very impactful, but also very difficult, or even impossible until other steps had been taken. One participant summed up the group discussion, saying “The city doesn’t talk to the county, the county doesn’t talk to the city, don’t even ask them to, they couldn’t even sit in a room together. This agency won’t talk to this agency, don’t even ask because it’s not going to happen.”

Participants also discussed a lack of unified expected outcomes. In particular, participants struggled to connect water resource management to climate change impacts and preparedness. One participant said, “If your goal is to simply preserve the streams, it doesn’t necessarily help the climate change discussion because preserving all the streams doesn’t necessarily help your community with climate change resiliency, like that is a bigger picture thing.” Another individual had a similar perspective, saying, “How can we connect people with climate change, the big climate change with something local, that still has an impact. If people identify with something local that doesn’t have that high impact, then you’re not really having much luck in changing the landscape.”

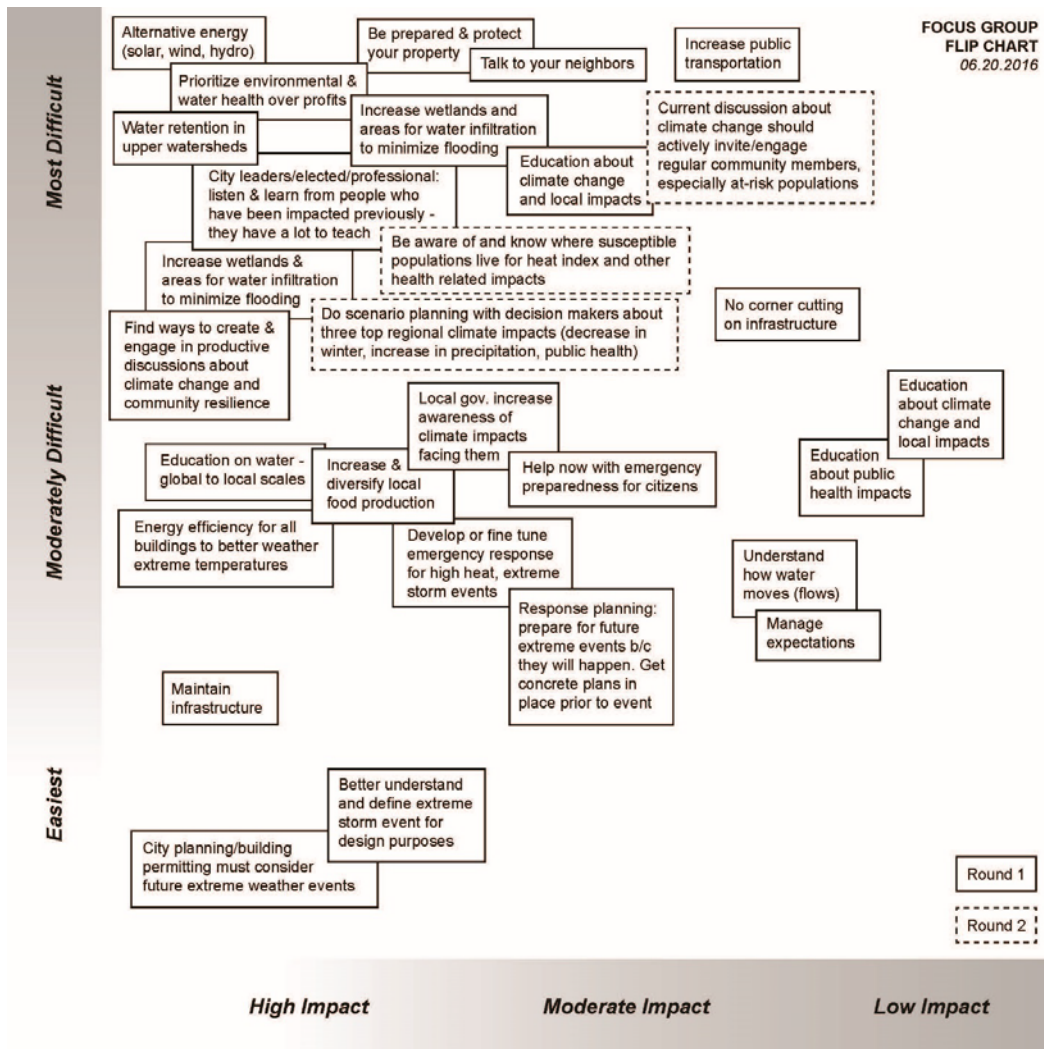


Figure 19. Action Item matrix results, focus group event 1

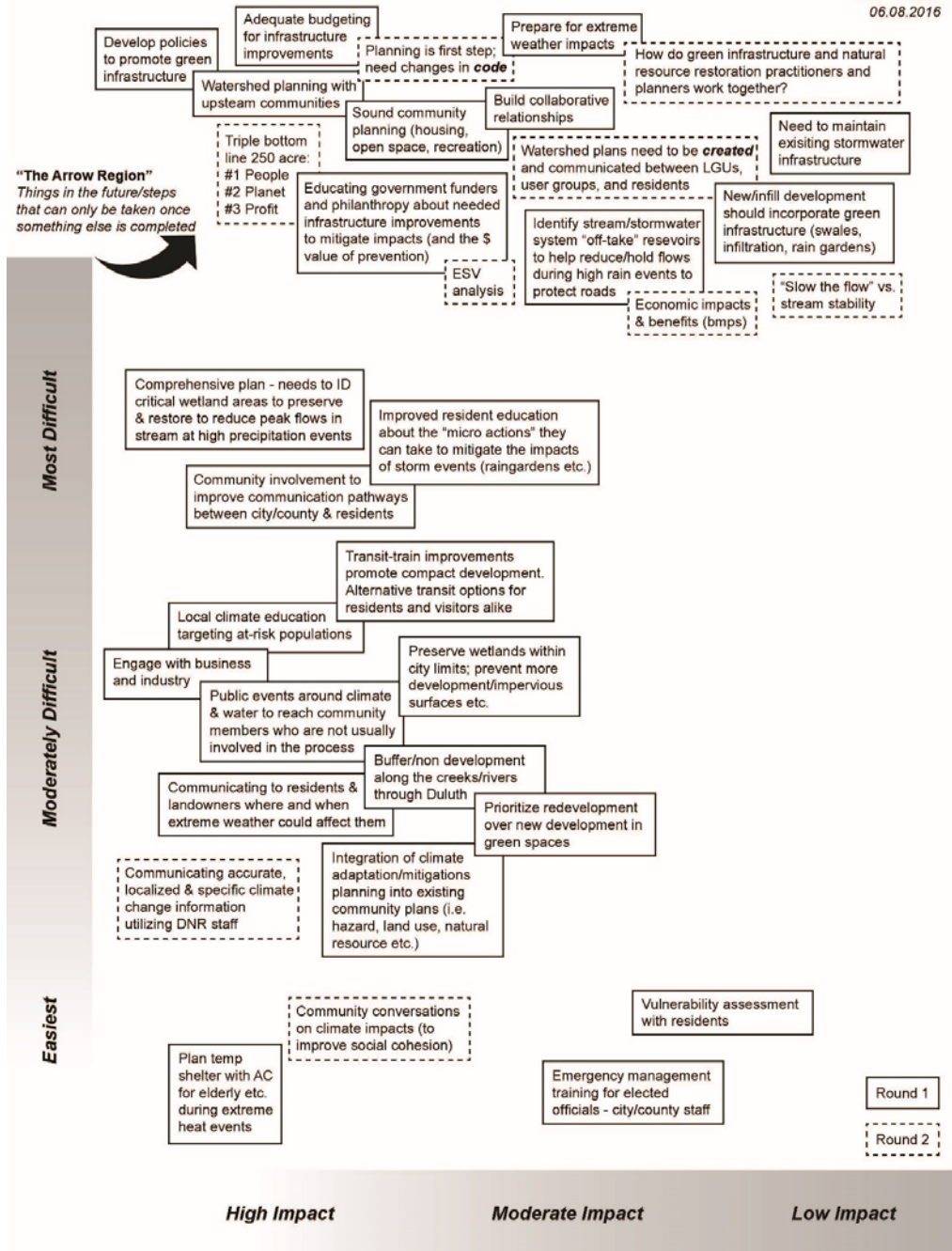


Figure 20. Action item matrix results focus group event 2

The findings from previous research segments resonated with focus group participants and served as a foundation for discussions during this portion of the research.

Discussions built from the interview and biophysical findings started with some development already went further with more detail than earlier research phases.

### **Workshop**

The workshop included presentations of findings from the earlier research segments. Further, findings from the interviews and focus groups were used to develop the 16 action items which served as the core of the activities in the workshop. Participants worked both from findings from previous segments and worked together. Respondents frequently expressed that the discussion process, in particular the discussions about how others were viewing the issues, was valuable. One participant said, "I think we found that a lot of us were kind of thinking differently. So, we had to get the sense of what the question was really asking. That was interesting too, we all have kind of a different perspective on the questions." Another individual characterized the workshop format as it being "Super-fruitful discussion to have the science and planning community together."

Efficacy continued to emerge as a predominate theme in the workshop analysis. Using efficacy frameworks to underpin analysis, elements surfaced that might support preparedness efforts or serve as a barrier to preparedness efforts (Table 5). Self-efficacy and collective-efficacy are related and support each other. That said, elements primarily related to self-efficacy might suggest that there are opportunities to work at the individual level to leverage existing efficacy or build additional perceived efficacy. Similarly, elements primarily related to collective-efficacy might suggest that there are opportunities to work at the community level to leverage existing efficacy or build additional perceived efficacy.

Table 5. Workshop results related to efficacy

	Element	Sub-elements	Emerged as an element of self/individual efficacy	Emerged as an element of collective/group efficacy
Elements that may support actions to better prepare the community for climate change and extreme weather impacts	Increasing individual and community knowledge and understanding of climate and extreme weather issues and impacts	Improved professional emergency response training		X
		Improved information resources for professionals and non-expert public		X
		Education for public rather regulation to change behavior		X
		Individuals and community need to know more about local natural resource systems		X
		Passive education (modeling and signage) rather than active education (pamphlets or classes) could be more effective	X	
		Use homeowners looking to other homeowners as examples	X	
		Looking to international examples of climate and extreme weather preparedness		X
	Use integrated systems decision making	Use collaborative learning techniques		X
		Decision makers must be empathetic to others' needs and abilities	X	
		Leverage feelings of confidence from previous experiences	X	

		Leverage systems initiated from flood response		X
		Leverage systems initiated from AOC response		X
		Increase accountability for expert and non-expert public		X
	Tap into existing motivations to inspire preparedness actions	Leverage interest in water quality improvements	X	X
		Leverage desire to travel easily around town (via public transit systems)	X	
		Use existing momentum related to better preparing for future impacts		X
		Increase link to local impacts to make issues relevant		X
		Start with small steps effective as a hook to get people engaged	X	X
		Leverage concern of protection of personal property	X	
		Link health improvements and environmental improvements	X	X
Elements that may be <b>barriers to actions</b> to better prepare the community for climate change and	Feeling stuck, like actions won't matter	There are too few resources to address issues	X	X
		Climate impacts will happen despite future action		X
		Everything feels hard to some extent		X
		It is very difficult to get results		X
	Difficult to get community engaged	Non-expert public is not connecting with experts		X
		Public may not see that there is anything they need to prepare for -	X	

extreme weather impacts		think they are already sufficiently prepared			
		Individuals don't see their part in the collective impact		X	
		It is hard to have meaningful group conversations		X	
		There is limited accountability for decision makers		X	
	Government and public systems don't support adaptation efforts		Initiatives need to be backed by funding and regulations		X
			Many don't trust government effectiveness	X	X
			Area development not dense enough for viable public transportation systems	X	
			Resources are prioritized for larger communities leave lower capacity communities behind	X	X
			Planning and decision making processes don't motivate participation or integrate voices of those trying to participate	X	
			It is hard to mobilize resources for preparedness response actions		X
	Lack of understanding of impacts and efforts		There is an inconsistent understanding of on-going efforts		X
			People not learning from past when impacts and recovery efforts	X	X

	Experts and non-expert public need better and more accessible information to gain mastery	X	X
	Need more and better decision making resources (FEMA maps, GIS technology)	X	
	There is some lack of comfort with technical concepts and vocabulary		X

## Discussion

This project revealed that a sequential participatory design validates and elucidates diverse and sometimes competing perspectives on climate change preparedness. Moving through a sequential multi-method study, researchers were able to progressively build and refine an approach to result in a discreet set of priority actions for climate preparedness, with accompanying rich data on barriers and opportunities, that that community could act upon in the near term. The process of completing this study will have made an impact in the community. The sequential design included multiple interactions within the same type of participant, and even some of the same participants between segments. The research methods included findings generated from the participants, and asked them to work together to interpret and advance the concepts. The study community has an attachment to local natural resources and a history of effective management in some instances, yet has struggled to gain traction on climate and extreme weather impact actions. The sequential nature of this study has refined thinking on climate and extreme weather preparedness.



From a researcher perspective, application of the collective-efficacy based theory throughout the project brought some advantages and seems to have been a strong fit with the data. Although the research was geographical constrained, climate change and extreme weather are a large topic and it could have been easy to get “lost” in the process. By using collective-efficacy as a lens throughout, there was a focus and connection across to the work. At each qualitative phase, aspects related to collective-efficacy emerged organically through analysis, and the application of the focused analysis using the framework was a strong fit.

While researchers for this study perceived that it was useful to work from a theoretical framework, it is not clear that the research participants from the community benefited from knowledge of the framework. The focus group and workshop both included portion of presentations of findings from past research phases. As a portion of the presentation, the collective-efficacy framework was introduced, as was the relationship of findings to the framework. Researchers were sensitive to the various levels of interest and comfort that research participants might have for theory, and to that end kept the presentation at a high level – avoiding “wonky” jargon language and overly-detailed descriptions. Although the collective-efficacy framework was a part of the presentations it is not evident that the theoretical framework resonated or helped ground the findings for stakeholders.

### **Future research**

The field may be served through future research that applies in greater detail both self-efficacy and collective-efficacy frameworks as a foundation to community research on natural resource management. The relationship between the two concepts and how they related and change in tandem with each other would be particularly interesting. How do individuals resolve conflicts between their personal efficacy and that of the group? Is the community better served by working to strength collective-efficacy or self-efficacy of the aggregated members? How much variance is there between the efficacy of members of a community and the whole? How does the process of moving from individual to collective decision making shift efficacy? Sequential research would be well suited to address these questions as the research segments would build on each other and could be considered individually or in aggregate.

## **Chapter 4: Better Together: An Action Matrix Approach to Community-Based Environmental Decision Making**

### **What Is an Action Matrix Approach to Community-Based Environmental Decision Making?**

An **action matrix**, as described in this guide, is a simple grid that allows activity participants to assess and prioritize potential action items related to an environmental community decision through a combination of facilitated individual and group discussions. The guide includes an overview of the action matrix approach, the activities and tasks included in the approach, and considerations of a stakeholder engagement event using the action matrix.

#### **The Goal**

An action matrix provides a structure for community members to discuss and prioritize local actions to support community-based implementation.

The action matrix activities build on community values and allow for both individual contemplation and group deliberation. The action matrix approach was informed by theoretical frameworks for building individual and collective-efficacy (Appendix L).

#### **The Deliverables**

Outputs of the action matrix approach include both the tangible and the intangible. Tangible takeaways are primarily a set of action items—evaluated and prioritized by

stakeholders. Further, each action item will be fully analyzed by stakeholders regarding strategies to increase potential impact of an action and/or decrease difficulty of an action. These strategies may include necessary steps to initiate implementation of the action, the likely stakeholders that would need to be involved in the action implementation, and alternative action steps that may not have been previously considered. From these activities, recommendations for next steps can be developed that address opportunities and barriers as well as reflect community values and priorities.

There are intangible benefits to communities as well. When individuals come together to learn from each other and make decisions collectively there are opportunities for mutual learning and relationship building. Further, individuals are able to come to a better understanding of the barriers and challenges that other might face and in turn come to a more cohesive understanding of shared goals and outcomes. Collective-efficacy theory research suggests that communities with stronger alignment of goals and expected outcomes and higher levels of mastery will be better positioned to feel able to address critical community decisions.

### **Who Is It For?**

This decision-making matrix activity is intended to be used by communities that perceive a need to gain clarity and direction around a natural resource management issue. This activity will work best for communities where trusted organizers have the capacity to

engage key stakeholders around a management topic and where there is a refined question of interest to invite stakeholders to engage with.

### **What Do We Mean By “Community”?**

In brief, community can mean many different things.

Broadly, community can be defined as “a collection of human beings who have something in common” (Frabricius, Folke, Cundill, & Schultz, 2007, p. 27). Some researchers reference geographical aspects of community (Agrawal & Gibson, 1999; MacQueen et al., 2001; Wellman, 2005), like a city or township, or within certain geographical boundaries, like a watershed or habitat zone. Community could also mean a group tied by social connections (Agrawal & Gibson, 1999; Long & Perkins, 2007; MacQueen et al., 2001), including increasingly important online communities (Wellman, 2005). Project or program managers may choose to define communities based on pre-existing political boundaries, or communities may define themselves organically in response to challenges (i.e., natural disasters, resource depletion) or opportunities (i.e., funding availability, infrastructure investments) (Brosius, Tsing, & Zerner, 2005).

Organizers of a matrix decision-making process should carefully consider who the community is that should be engaged and contributing. It may be easiest to lean on traditional community leaders and decision makers. A creative and full inventory of potential communities that may be affected by an issue, however, could reveal a wider variety of potential participants and fuller insight into the question of interest. Many

high-quality resources on community engagement and stakeholder analysis exist. Process organizers should explore these resources as appropriate for their purposes.

### **When Might a Community Use the Matrix Approach?**

Broadly, the matrix activity would be appropriate for communities to use when facing a decision.

Specific examples might include

- Comprehensive planning processes
- Organizational strategic planning
- Public informational “open-house” events
- New development or redevelopment processes
- Natural resource extraction proposals
- Restoration proposals
- Interdisciplinary cooperative events

### **Why Use An Action Matrix Approach?**

Community involvement in decision making is generally thought to increase the effectiveness of a process and to lead to more sustainable outcomes as it leverages existing capacities and builds new capacities. Lubell (2004) asserts that "collaborative management is a potential remedy to many of the pathologies of existing regulations, which have led to costly conflict and left many environmental problems unresolved" (p. 341). A collaborative process better positions the community to consider their relationship and reliance on natural resources, in particular common-pool resources, as

management plans are made (Armitage, 2005; Donoghue & Sturtevant, 2007; Matta & Alavalapati, 2006).

Community involvement in management and decision making brings the opportunity for balanced approaches and holistic consideration of community needs. Participants in smaller scale efforts are more likely to identify with others as belonging and, therefore, more likely to identify solutions for the place they belong (Cheng & Daniels, 2005).

Brosius et al. (2005) notes that

Community-based natural resource management (CBNRM) is based on several premises: that local populations have a greater interest in the sustainable use of resources ..., that local communities are more cognizant of the intricacies of local ecology ..., and that communities are more able to effectively manage those resources... (p.1)

The matrix activity allows for efficient collection of both individual and group thinking on a particular question of interest. It is flexible both in scope and scale: appropriate for small groups, narrow topics, and short time periods, or large groups, broad topics, and full-day complex events. Further, the activity complements other research and evaluation methods or stands alone as a data collection strategy.

### **Preparation: What Do You Need Before the Action Matrix Activity Event?**

There are several considerations prior to running a action matrix event with stakeholders. Make sure to consider the specific community context, history, and goals of your question of interest and any additional preparation that may be necessary.

Sufficient preparation is a core aspect of a successful event and as such includes many considerations, such as:

- Topic selection
- Organizer roles and responsibilities
- Organizational requirements
- Stakeholder selection
- Material organization
- Action item selection
- Matrix aspect selection

## **Topic**

The first thing, of course, is to have something to talk about. The matrix approach can help communities prioritize actions to address a pressing natural resource issue, but the issue must be discreet and refined enough so that potential action items can be developed and prioritized that are meaningful and may lead to implementation.

This guide is specifically directed towards decision related to natural resource or environmental topics. Community-based resource management decision making has unique challenges, though. Frequently the scale of the resource in question does not align well with community scale, either temporally or geographically, and perseverance (Armitage, 2005; Chaskin, 2001; Foster-Fishman et al., 2007). Rarely, do ecological boundaries match political boundaries. The time frame to see impacts of many conservation projects may be decades past the attention span, or life span, of even the most dedicated citizens. The blending of biophysical and social system assessments can be difficult (Donoghue & Sturtevant, 2007), and the assessment process itself may be politicizing and divisive (Diamond, 2004). Human and natural systems each on their own are complex, and increasingly complex when considered as interlinked and dynamic



(Patterson et al., 2013), and are frequently shifting in tandem, adding even further complexity (Ivey et al., 2004).

Organizers of a matrix event will be well served to take time to scale the question of interest to a level that is actionable by their community. This may mean reducing the geographic reach of the question (i.e., from state to neighborhood), the social research of the question (i.e., all potential stakeholders to hunters and fishers), or the natural resource scope of the question (i.e., water resources to vernal ponds). This doesn't discount the holistic and interconnected nature of human and natural systems, but setting some framing will help focus discussions and action prioritization efforts.

### **Organizers**

Every effort must start with someone. The matrix approach is intended to help communities consider how they might address pressing natural resource management questions. As such, the organizers of a matrix event are likely to have a particular interest or expertise in the question at hand.

The **role of the event organizer** is to refine the topic or question(s), identify stakeholders and event participants, recruit participants, develop the action items, host the event, complete or coordinate analysis, and deliver reporting and results in a timely manner. This can be a lot of work! Community engagement is a key element of local decision making and natural resource management, but a poorly run process can do more harm than good. Successful management efforts share some characteristics. A meta-analysis of

watershed management literature found that the success or failure of a process could be largely explained by just four aspects of collective process: adequate funding, effective leadership, interpersonal trust, and committed participants (Leach & Pelkey, 2001). Other authors recommended transparency, clear roles for participants (Kellert et al., 2000; Korfmacher, 2001), appropriate representation (Korfmacher, 2001; McGinnis et al., 1999), and equal access to data for all participants (McGinnis et al., 1999) as aspects important for successful processes.

A **benefit of the matrix approach** is that a wealth of information can be collected relatively quickly, easily, and inexpensively; still, organizers should ensure they have the time, capacity, and financial resources to invest prior to engagement with stakeholders. Community members' time is finite, and organizers must provide value and meaning to event participants to mitigate process exhaustion and burnout.

### **Institutional/Organizational Requirements**

Depending on the type of event you are planning, how the analysis will be done, and the purpose of the data collection, your organization may have requirements for approval of research design, protection of participants, and consent for recording. Non-profit organizations may have expectations regarding inclusion and representation of stakeholders. Academic institutions may have requirements regarding research. Check with your organization to determine if the event is considered "research" and if there are special permissions and approvals. Depending on the institution, these approvals may take several weeks. Plan accordingly.

Regardless of formal requirements, participants should be informed prior to the start of the event if they will be recorded or photographed, and they should be given the opportunity to consent or decline.

### **Stakeholder Participants**

**Identification of stakeholders and participants** for the matrix engagement activity largely depends on the aims and goals of the effort. In this case, we are using stakeholder and participant interchangeably to indicate people who may have an interest in the outcome of the question being considered *and* would potentially participate in the matrix approach activity. For most issues, not all stakeholders will be able to participate, but all participants should be stakeholders. Organizers should consider who the community is that the issue in question may affect, and who has influence and potential to implement action steps that may be prioritized. Some efforts may be focused on the broad community or just a narrow set of experts on a specific topic. Other efforts may be intended as an opportunity for people in power to engage with people affected directly by an issue, or alternatively as a way to reenergize long-existing groups or coalitions. Regardless, a thoughtful and deliberate analysis of potential stakeholders and event participants will serve organizers well in meeting their goals for the effort.

When **recruiting and advertising** for the event communication should be clear, early, and in a way that will reach the stakeholder. Materials should include the most pertinent information of where, what, and why, and invitations are also an appropriate time to let participants know if the effort is part of broader research, the other types of people that

will be invited, and if any **incentives to participate will be provided**. Incentives could be monetary and would of course need to be considered as part of an overall engagement budget. Stakeholders participating as part of their professional employment often cannot receive financial incentives. Providing food, childcare, transportation reimbursements, and/or convenient timing for the audience can also help ease the burden of participating.

### **Activity Materials**

The following materials are suggested for the matrix activity event:

- Agendas, with event objectives
- Flip chart paper (1–2 pages per small group)
- Name tags
- Markers
- Sticky notes
- Printed action item cards (a set for each participant and a set for each small group)
- Pens and pencils for participants
- Computer and projector to present background information
- Recording devices, if applicable
- Research participation and recording consent forms, if applicable
- Sign-in sheet for participants

### **Action Items**

Before event participants can prioritize and place action items on the matrix, there must be a set of action items to place and prioritize. The action items are a set of brief statements that summarize potential steps that the community could take to address the question or problem of interest. The number of action items is somewhat dependent on the complexity of the question of interest, the time available for the engagement activity, and the familiarity of participants with topic.

- Less complex questions may generate fewer potential action items or, alternatively, may allow for discussion of more items that are also more detailed and specific.
- More time for an engagement activity may allow for consideration of more action items, but organizers should be careful to keep participants interested and engaged throughout—not filling time just to fill time.
- Participants with deeper backgrounds related to the topic may be able to consider a wider variety of potential action items with less support than participants with less familiarity. On the other hand, experts may have trouble moving on from topics on their particular specialty—getting “stuck in the weeds.”

<b>Benefits and Drawbacks of Timing of Action Item Development</b>			
<b>Prior to Matrix Activity Event</b>		<b>As Part of the Matrix Activity Event</b>	
<b>Benefits</b>	<b>Drawbacks</b>	<b>Benefits</b>	<b>Drawbacks</b>
Saves time at event	Requires upfront investment of time and resources	Event stakeholders will more easily understand and buy into the items	Takes additional time at event for action item development and material creation (cards or other tools)
Allows for preparation of materials (cards, presentations) before event	Event participants will need additional explanation and justification of items	Fewer “touches” with key stakeholders may reduce participant process-exhaustion	Development of the steps may distract from the detailed consideration and prioritization
Can use data drawn from a wider range of stakeholders than those at the event	Items may not resonate with event participants	Less coordination and analysis work for organizers	Action items and matrix results will only reflect the perspective of

			participants at the engagement event
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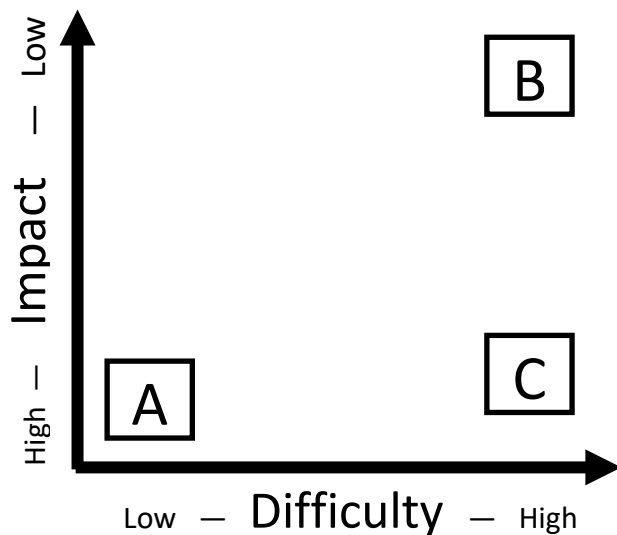
**Table 6. Timing of Action Item Development**

The actions could be established prior to the engagement with stakeholders or as part of an engagement event. There are benefits and drawbacks to each approach (Table 6).

Regardless of how action items are selected, organizers of an event that uses the matrix approach would be well served to provide some background on the issue in question. If action items have been selected prior to the matrix event, an explanation of the methods used to collect data and select the items will help mitigate some of the potential drawbacks.

### The Matrix

The basic matrix is a two-axis grid (Appendix J). The axes of the grid can have a variety of parameters that a community may want to assess—i.e., difficulty, impact, support, financial feasibility, environmental benefit, equity benefit. By considering two parameters simultaneously, it



*Figure 21 Example Matrix*

allows for deeper discussions and more realistic assessment of priority.

For example, in Figure 21, participants placed potential action items on a matrix that had Difficulty on the x-axis and Impact on the y-axis. Action A was placed as high impact and low difficulty. This might be a “low-hanging fruit” item, easy to do with a high impact, and in turn, could be considered a high priority. Alternatively, action B was placed as low impact and high difficulty. This is both hard to do and won’t make much difference. This might be a low priority. Finally, action C was placed as difficult, but with high impact. This may be an item that community participants could consider further for strategies to reduce difficulty.

### **Detailed Activity Instructions**

The community engagement event for decision making with the matrix can be tailored for large or small groups and for a variety of lengths of time. At minimum, this activity should be done with 5 people in 45–60 minutes. Larger groups and complicated topics will take additional time, perhaps a full day depending on the level of detail participants are asked to develop at each step of the process.

#### **A Basic Structure for the Matrix Activity Process**

##### **1. Select a set of potential action items.**

Prior to running the matrix activity, organizers should select a limited number (12–20) of action items for consideration. These action items could be selected with matrix activity participants or through another data collection process. Please see section above “What Do You Need for the matrix approach – The Action Items” for more information.

- 2. Have individuals consider and prioritize the items on their own. If time allows also have them assign rankings based on the axis.**

This should be a fairly rapid activity. The intent is to familiarize the participants with the actions and have them consider independently how they would rank the items prior to involvement in a group. There is a gray box on each card in which participants should write the numerical ranking of items 1–X, e.g., numbers 1–16 for 16 action items, once they have settled on an arrangement. These rankings are also data that will be collected and used by researchers.

- 3. Have individuals work in small groups of 3–7 to place the items on the matrix and develop a consensus prioritization as a group.**

Participants should briefly share their individual prioritization and justification before moving into placing items on the matrix and prioritizing as a group. This is intended to start the process of group discussion, familiarize participants with others, and begin to bring diverse perspectives in to the conversation.

- 4. Debrief and share results in the full group.**

Small groups report back to the full group briefly with top 3 actions, justification, and highlights from the discussion.

- 5. Optional step: Return to small groups to identify implementation details of one or two top priority actions.**



Back in small groups, participants have the opportunity to dig in on a particular action item to think about what it might take to implement.

They should consider how to make the item higher impact and less difficult, who would need to be involved, and what barriers and opportunities exist for implementation.

**6. Optional step: Once more return to full group for summary of implementation brainstorming and discussion of actionable next steps.**

Small groups come together again for a final report back to the full group.

Small groups give a brief overview of steps for implementation that were discussed in the last small group time. Common barriers and opportunities should be a focus of facilitated wrap-up discussion.

**Example Agenda**

As an example of a matrix activity process, details from the “Better Together Case Study, A matrix approach to Climate Change and Extreme Weather Response in the Lower St. Louis River Basin of Minnesota” are provided below. The event was 2 hours in total. There were 20 participants and 3 groups of 6–7 each. The session was run by a primary facilitator, with assistance from 2 other researchers. Small and full group discussions were recorded for later analysis.

**1. Selection of Action Items**

(Completed prior to matrix activity engagement event) The action items for this case study were garnered from the results of 27 interviews and 2 focus groups with local

community decision makers in two watersheds of the Lower St. Louis River Basin of Northern Minnesota. The items were selected to represent the range of actions that were provided by interview and focus group participants when asked, “What actions would you prioritize to better prepare the community for climate change and extreme weather impacts?” The actions were arranged thematically into four groups, with four specific actions in each theme.

## **2. As individuals**

(10–15 minutes) Participants are given the 16 action cards (Appendix K) and asked to prioritize the items from 1 (highest priority) to 16 (lowest priority). Some participants mentioned the difficulty of the activity and claimed the action items were too vague. They were encouraged to do their best to make the hard decisions and interpret the cards with the meaning most relevant to them. The areas of difficulty and uncertainty lead to rich discussion in the group activity.

## **3. In small groups**

(~10 minutes) After quickly sharing individual prioritizations and rankings, the group began the process of developing consensus. A note taker in each group wrote down any substantive items of discussion on flip chart paper.

(~20 minutes) Groups were given a fresh set of the same 16 items and asked as a group to place them on a difficulty/impact matrix (on flip chart paper). The facilitator

encouraged conversation about justification for placement. Conversations were recorded and note takers captured particular barriers and opportunities that emerge in the discussions.

(~15+ minutes) Groups are then asked to prioritize the actions informed by their initial individual prioritization and the group discussions, again, ranked 1 (highest priority) to 16 (lowest priority).

#### **4. Full group**

(~10+ minutes) Small groups reported back to the full group one at a time in front of the room. A representative from each small group briefly described top 3 actions, justification, and highlights from the discussion. Other participants and facilitators had an opportunity to ask questions.

#### **5. (Optional) Back to Small Group**

(~20+ minutes) Each group is asked to focus on 1 priority action from their top 3 (different actions from group to group ideally). Due to time constraints, this activity was done as a full group discussion rather than moving back to small groups.

#### **6. (Optional) Full group report back**

(~10+ minutes) This step was combined with the previous two steps due to time restrictions. Facilitators will develop recommendations for distribution to participants.

### **After the Matrix Activity—What Happens Next?**

While the matrix activity has potential to be an effective technique to identify and prioritize best implementation steps to address a community issue, the real work comes after the activity and analysis are complete. Reporting findings and following up with participants, implementation of priority actions, and evaluation of the effort are all important next steps after the community engagement event has completed.

#### **Analysis**

Event organizers should consider capacity, interest, and resources for analysis methods prior to implementing the matrix event. Analysis may be as simple as an average of action-item rankings and a summarized list of implementation steps. More complex analysis might include statistical examination of deviation between individuals and changes between individual and group processing. Detailed analysis may also include a focused or grounded theory thematic qualitative analysis of participant discussions.

Considerations for deciding on analysis methods include skills of the organizers, time before reporting is needed, expectations of participants and report recipients, and needs for next steps and implementations. In all cases, organizers should ensure that the information collected during the activity is tailored to meet the requirements for the analysis.

Further, organizers should consider if analysis will include a check in with participants after the engagement experience to ensure results were interpreted appropriately. In instances where participants and stakeholders may have different backgrounds this analytical confirmation can be particularly important to ensure nothing was lost in translation.

### **Reporting and Follow-Up with Participants**

Following up with participants and reporting findings is a respectful and responsible aspect of the public engagement process. Stakeholders who have taken time to offer their expertise and perspectives deserve to know what the results of the effort are and how the information will be used. That said, reporting and follow-up could take a variety of forms and should fit the community to which it will be delivered. Reporting should include a summary of the purpose of the activity, the types of stakeholders who participated, and a summary of the event, method of data analysis, findings, and proposed next steps/recommendations.

Methods of reporting that may be appropriate could include:

- Technical report
- Blog post
- Social media reporting
- Multi-media presentation
- Poster session at community event
- Fact sheet
- Local news article

## Evaluation

Evaluation is systematic program assessment to address questions about operations and results (Wholey et al., 2010). Evaluation can offer insight into motivations and constraints of program participants and non-participants, suggest opportunities to increase effectiveness of program delivery, and provide recommendations for adjustments to help meet overall program goals (Wholey et al., 2010). Lasker & Weiss (2013) assert that there is no widely adopted standard to assess the success of collaborative initiatives, and there has been difficulty translating theoretical research to implementable practices. For natural resource management issues, the geographical and temporal scale of a natural resource issue may not align with the scale of the community or engagement effort. Tools designed for large geographic scales—global, national, state level—may not be effective at more local, regional scales (Graymore, Sipe, & Rickson, 2010). For example, a local community building resilience for climate impacts will not be measured in a global decrease in CO<sub>2</sub> but may be measured in a greater sense of preparedness among key decision makers.

Organizers should consider, prior to starting a community engagement effort, what success will look like for them and how they will measure it. Evaluation criteria that may be appropriate for a community scale matrix approach might include:

- Participant confidence in ability to manage an issue
- Perceived cohesion among decision makers
- Implementation of identified and prioritized action steps

- Leveraging the matrix activity to gain funding or additional exploration of action items
- Expansion of networks and relationships for stakeholders

# Chapter 5: A Matrix Approach to Climate Change and Extreme Weather Decision Making, A Case Study, Lower St. Louis River Basin, Minnesota

## What is an Action Matrix Approach to Community-Based Decision Making?

A matrix is a rectangular arrangement of quantitative or qualitative elements in rows and columns used to display the

resultant products of various combinations of those elements

("Matrix | Matrix Definition by Merriam-Webster," n.d.). In

community-based decision-making processes, an action

matrix offers a simple way for

participants to display, evaluate, and prioritize potential strategies and actions based on

multiple parameters. The axes of the grid the can be a variety of parameters that

community members may want to assess – i.e. difficulty, impact, support, financial

feasibility, environmental benefit, equity benefit. By contemplating two parameters

simultaneously, use of the action matrix allows for deeper discussions and a grounded

assessment of priorities.

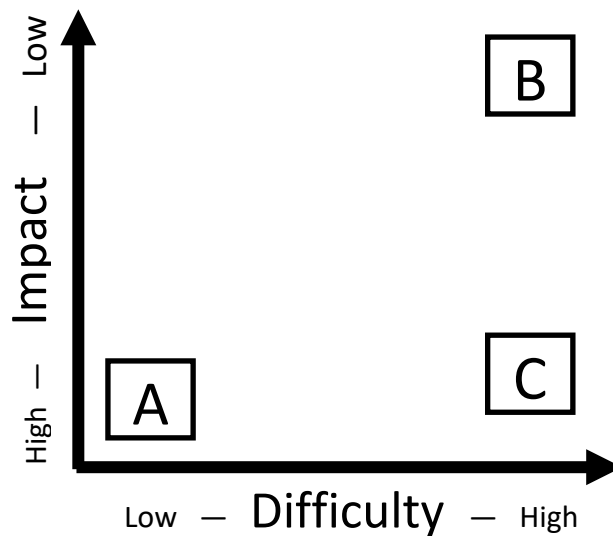


Figure 22 Example Matrix



In community-based decision making, understanding impact and difficulty is important. Without a clear way to assess and prioritize next steps, decision makers may feel stuck choosing between an array of options. For example, in Figure 22, a sample action matrix is displayed. In this matrix participants placed potential action items on a matrix that has *Difficulty* on the x-axis and *Impact* on the y-axis. As a hypothetical example, perhaps a community is trying to make decisions regarding efforts to increase pollinator habitat. Action A appears as high impact and low difficulty. Action A in the hypothetical example could be including an insert in the city newsletter that free pollinator friendly plants seeds are available to residents. This might be a “low hanging fruit” item, easy to do with a high impact, and in turn, could be considered a high priority. Alternatively, action B appears as low impact and high difficulty. An example action related to the hypothetical example could be an initiative to replace all flowering plants in the community with native flowering plants only. This is both hard to do and will not make much difference relative to other actions for pollinator wellbeing. Action B might be a low priority. Finally, action C appears as difficult, but with high impact. For the hypothetical, action C could be replacing all non-pollinator friendly landscapes (i.e. turf-grass lawns) with pollinator friendly native-plant landscapes. This may be an item that participants could discuss further for strategies to reduce difficulty (transition over time, or prioritize city owned landscapes above others), or the impact might be significant enough to warrant implementation despite the difficulty.

## **Lower St. Louis River Basin, Minnesota: Case Study Background**

Changes to the climate will have, and are having, impacts in the Great Lakes Region. Lake water levels are likely to drop as temperatures rise, altering aquatic and localized terrestrial habitat integrity (Dietz & Bidwell, 2012). Understanding perceived risk and community preparedness for climate change in coastal communities is critical for decision makers concerned with impacts to ecosystems and human systems. In an era of more frequent and intense extreme weather events, a community's sustainability will depend on its ability to live, learn, and act under uncertainty.

Data supporting the development of the workshop focus was gathered as part of a broader multi-method social science investigation to assess the interactions between environmental risk and community response. The research explored community capacity, conservation behaviors and decision making of key stakeholders related to extreme weather, climate change, water management, and stormwater impacts in the Mission and Miller Creek watersheds of the St. Louis River Basin in and near Duluth, Minnesota. The residents living in and near this area have a particularly strong connection and affinity to the natural resources of the area, especially the local creeks and streams and Lake Superior.

The St. Louis River Basin is the largest U.S. Lake Superior tributary, covering 3,634 square miles in northern Minnesota. The lower portion of the watershed is a designated Area of Concern (AOC) largely because of impacts of industrial development in the region. Since AOC designation in 1987 there has been extensive investment in restoration and

protection. In June 2012, the Lower St. Louis River Basin was impacted by a catastrophic flood. In a roughly 24-hour period up to 10 inches of rain fell on already saturated spring soils causing significant damage to homes, roads, and other public infrastructure. Mission and Miller Creek watersheds, predominately un-developed and predominately developed respectively, are both sub-watersheds in the St. Louis River Basin. Both watersheds were significantly impacted by the 2012 flood.

This work was funded by Minnesota Sea Grant and completed in partnership the Natural Resource Institute (NRRI) of University of Minnesota, Duluth and social scientist researchers from the University of Minnesota, Twin Cities (UMN).

Researchers gathered qualitative data through 27 key informant interviews and 2 focus groups and bio-physical scenario planning developed by the NRRI. UMN personnel and NRRI staff partners collaborated on project planning, local coordination, and a stakeholder inventory for participant recruitment. Interviews and focus groups were conducted in the Mission and Miller Creek watersheds of the St. Louis River in the Duluth, MN area. Research questions included topics on community strengths and challenges, local decision making, water, stormwater, climate and extreme weather response, and opportunities and barriers for future action. Interviewees ranged from local community organization representatives, natural resource managers, philanthropic organizational staff, governmental representatives, housing advocates, and emergency response personnel.

## Case Study Action Matrix Activity

This exercise provided a structure for stakeholders involved in decisions related to climate and extreme weather preparedness to discuss and prioritize resilience actions. The final product was intended to be a set of

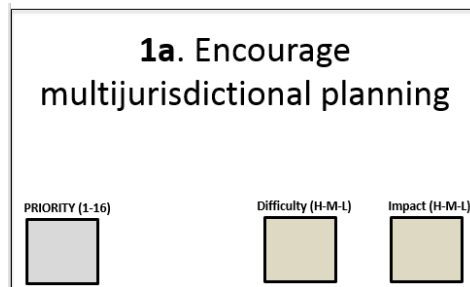


Figure 23: Example Action Item Card

action items that have been considered in relation to their potential impact and likely difficulty and then prioritized for future action. In this case, we defined difficulty as the amount of effort it might take the community to accomplish a successful outcome and defined impact as the extent to which an action would positively shift the outcome of climate and extreme weather resilience efforts.

### Participant Recruitment

Invitations (Appendix M) were sent to approximately 40 local stakeholder representatives. Participants for the workshop were invited from a stakeholder inventory developed by event organizers. NRRRI developed a list of governmental bodies with jurisdiction in each of the watersheds. UMN researchers identified appropriate contacts in these organizations and agencies (e.g., planning, park, water-management department staff). Additional stakeholders included environmentally focused non-profit staff, emergency relief organizations, and philanthropic foundations.

Reminders and confirmations followed the initial email. Around 12 individuals formally or informally indicated prior to the workshop that they would be attending and 15 individuals ended up attending the event.

### **Action Item Development**

The action items for this case study were identified through analysis of 27 interviews and 2 focus groups with local community decision makers in two watersheds of the lower St. Louis River Basin of Northern, Minnesota. The items were selected to represent the range of actions that were provided by interview and focus group participants when asked “what actions would you prioritize to better prepare the community for climate change and extreme weather impacts”. The actions were arranged thematically into four groups, with 4 specific actions in each theme (Table 7).

*Table 7. Workshop Action Items*

<b>Planning</b>	Encourage multijurisdictional planning
	Facilitate watershed scale planning
	Incorporate best climate science into planning and development processes
	Provide planning and training for emergency response
<b>Community Engagement</b>	Involve non-traditional groups in decision making (i.e. low income individuals, non-recreationist community, school district representatives)
	Educate public on risk and responsibility via increased communication
	Increase accountability for implementation of planning
	Facilitate homeowner action and preparedness
<b>Natural Resource Management</b>	Increase protection and restoration of natural water systems
	Further climate and extreme weather research on local impacts
	Reduce resource dependence & use (i.e. energy, water, minerals)
	Provide up-to-date information for resource management (FEMA maps, invasive species info)

<b>Infrastructure Improvement</b>	Replace aging infrastructure and right-size new infrastructure
	Develop sustainable alternative energy sources
	Develop viable public transportation options
	Prioritize green over gray infrastructure when applicable

## Event Process

Facilitators designed the event to be a mix of individual reflection, small group activities, and full group discussion. The variety of activities allowed participants to reflect solo and with others, accommodating various learning styles and preferences. The event was planned for two hours. Agenda items were scheduled to take 90-100 minutes with extra time to allow for shifts between individual, small, and full group discussions. Table 8 includes the agenda items, the individual or group arrangement, the scheduled and actual timing, and a description of each item. All small and full group conversations were recorded. Individual reflection products (ranking and notes) were collected.

**Table 8. Agenda with timing and descriptions**

<b>Work Arrangement</b>	<b>Process Task</b>	<b>Timing</b>	<b>Description</b>
Individual	Personal consideration and assessment	Scheduled for 10-15 minutes (Took 20+ minutes)	participants were given 16 action cards and asked to consider the difficulty and impact and then prioritize the items from 1 (highest priority) to 16 (lowest priority). There were spaces on each card in which participants could write the difficulty, impact, and 1-16 ranking.
Small Groups	Group introduction and initial discussion	Scheduled for 10 minutes (Took 15+ minutes)	Participants were asked to briefly share their individual prioritization and justification. This was intended to start the process of group discussion, familiarize participants with others, and

			begin to bring diverse perspectives in to the conversation.
	Group difficulty/impact assessment	Scheduled for 20 minutes (Took around 20)	Groups were given a fresh set of 16 items and asked as a group to place them on a difficulty/impact matrix (on large flip chart paper).
	Group prioritization	Scheduled for 15 minutes (Took 20+ minutes)	Groups were then asked to prioritize the actions informed by their initial individual prioritization and the group discussions.
Full group	Report back	Scheduled for 10 minutes (Took 20 minutes)	Groups report back briefly top 3 actions, justification, and highlights from the discussion.
Agenda items above took over 90 minutes to complete. Facilitators decided to let the discussions continue, despite time limitations, because they seemed to be fruitful and rich. Thus, the final two scheduled discussion rounds were cut from the agenda.			
Small Group	Detailed implementation strategizing	Scheduled for 20 minutes	Each group was asked to focus on 1 priority action from their top 3 (different actions for each group ideally). They should consider how to make the item higher impact and less difficult. Who would need to be involved? What barriers and opportunities exist for implementation?
Full group	Final wrap up discussion	Scheduled for 10 minutes	final group report back. Brief overview of steps for implementation. Common barriers and opportunities should be focus of facilitated wrap up discussion.

### Activity Analysis

Both qualitative and quantitative data were collected for this workshop event. Per the activity description, all participants received 16 cards populated with action items

derived from interviews and focus groups conducted during the larger research project. They first ranked these as individuals, and then worked in small groups to place the items on the matrix and in turn prioritize the items. The small group and full group discussions were audio recorded and transcribed for analysis. The action cards from individuals and groups were collected and the ranking, difficulty, and impact scores were recorded.

### **Quantitative Analysis**

The ranking, difficulty, and impact scores from everyone and group were entered into a Microsoft Excel spreadsheet. The results were analyzed using basic descriptive statistics (Cannon,



2013) for all three data points collected on the cards including mean and median individual score for each action item, mean and median group score for each action item, average change in score for each action item between

*Photo 1. Participants at the workshop work together to place action items on the matrix. Photo credit: Mae Davenport*

individual and group scoring, and standard deviation between individuals, groups, and changed rank (Appendix O).

### **Qualitative Analysis**

All discussions were recorded, transcribed, and analyzed using best practices for qualitative analysis (Charmaz, 2006; Corbin & Strauss, 2008; Weiss, 1995). Using the



transcribed text from the recorded discussions, event organizers used the software NVivo 11 (QSR International Pty Ltd., 2012) to assign codes or labels to the text and in turn analysis the codes for themes and findings. Each transcription was first coded to identify the discussions related to each action item. These discussions were further coded to identify areas of agreement and disagreement. Earlier data analysis for this research project had revealed that self-efficacy and collective-efficacy were particularly important to effective climate and extreme weather response in the study community. Self-efficacy is the perceived beliefs of an individual in his or her ability to control or influence external demands and personal functioning (Luszczynska & Schwarzer, 2005). Collective-efficacy is the perceived ability of a group to community to achieve an action and accomplish a goal (Bandura, 2000b). The workshop recordings were also analyzed for this theoretical framework (Appendix N).

## **Case Study Findings**

### **Quantitative Findings**

Participants were given 16 climate preparedness action cards. They were asked to consider the action and perform 3 tasks: 1) assign a difficulty (high, medium, or low) to each, 2) assign an impact (high, medium, or low) to each, and 3) to rank the 16 items with number 1 being the highest priority and number 16 being the lowest. Some highlighted quantitative findings are below (Table 9).

**Table 9. Highlighted Case Study Results**

<b>Action Item</b>	<b>Mean Priority Ranking</b> (1 is highest priority, 16 is lowest priority)	<b>Average Difficulty Rating</b> (1 is lowest difficulty, 3 is highest difficulty)	<b>Average Impact Rating</b> (1 is lowest impact, 3 is highest impact)
<b>As individuals, on average, ranked the following items the highest:</b>			
Encouraging multijurisdictional planning	4.53	1.85	2.66
Facilitate watershed scale planning	4.80	2.05	2.70
Increase protection and restoration of natural water systems	5.46	2.33	2.73
Replacing aging infrastructure and right-size new infrastructure	5.86	2.63	2.63
<b>As groups, on average, the activity participants ranked the following items the highest:</b>			
Increase protection and restoration of natural water systems	2.66	2.00	3.00
Replace aging infrastructure and right-size new infrastructure	3.33	2.66	3.00
Encourage multijurisdictional planning	4.33	1.83	2.66
Facilitate watershed scale planning	4.33	2.00	2.66
<b>Individuals, on average, ranked the following items the lowest:</b>			
Provide planning and training for emergency response	10.06	1.73	2.06
Reduce resource dependence and use	10.06	2.73	2.13
Develop sustainable	12.20	2.65	2.01

alternative energy sources			
Develop viable public transportation options	12.46	2.20	1.90
<b>The groups, on average, ranked the following items the lowest:</b>			
Develop sustainable alternative energy sources	9.33	2.83	2.33
Develop viable public transportation options	10.00	2.66	2.00
Facilitate homeowner action and preparedness	10.00	2.33	2.10
Reduce resource dependence and use	10.66	3.00	2.73

The greatest difference between individual and group rankings occurred with the items “provide planning and training for emergency response” and “reduce resource dependence and use” with a shift of nearly 5 and just over 5 places on average respectively.

On average, there was only a 0.54 difference between individuals and groups on assessment of difficulty, and only a 0.59 difference between individuals and groups on assessment of impact. That said, some the smallest discrepancies occurred with the highest ranked items and some of the largest discrepancies occurred on the lowest ranked items. For example, all the highest ranked items came in below average on difference between individual and group assessment of impact. On the other hand, “reduce resource dependence” and “develop viable public transportation options” both had an average difference between individuals and groups of 0.8. “Provide planning and

training for emergency response had an average difference in impact assessment between individuals and groups of 0.9.

Quantitative analysis included calculation of standard deviation between individual and group ranking. This analysis helped identify the action items that had the most variation in ranking of between individual assessment and group assessment of priorities. Data used in this calculation came from the individual ranking cards and final group prioritizations. These differences may provide a better understanding of the action items that had the most divergent understanding among group members. The maximum standard deviation was 5.16 ranking places (e.g. on average individuals ranked the item more than 5 places, plus or minus, from the resulting group score). All the follow items had standard deviations above 4:

- Involve non-traditional groups in decision making
- Educate public on risk and responsibility via increased communication
- Reduce resource dependence and use
- Develop viable public transportation options
- Prioritize green over gray infrastructure when applicable

All remaining items had standard deviations between 3.00 and 3.79.

### **Qualitative Findings**

Previous research in this community, with similar research participants, had indicated that self and collective-efficacy was an important aspect of natural resource management, climate change response, and extreme weather preparedness. Efficacy

remained a prominent theme in workshop group discussions both related to the workshop process and the action item discussions.

### ***Process Related Findings***

From a process perspective, aspects of efficacy related to collective expected outcomes seemed relevant in all group discussions as individuals came to a common understanding of the meaning of action items. Frequently, participants reported that they entered group discussions with different understandings or interpretations of the action cards from each other and the group needed to come to a common understanding prior to settling on an assessment of impact or difficulty, or ranking the item. This divergence is illustrated in participant quotes like, “It is a short item with lots of ways to interpret it.” and “A lot of people all have had different interpretations [of the meaning of the action item].” Another individual described the situations as, “Every time we bring up one, we all have kind of different things that we’re thinking about.”

Participants frequently expressed that the discussion process, in particular the discussions about how others were viewing the issues, was valuable. One participant said, “I think we found that a lot of us were kind of thinking differently. So, we had to get the sense of what the question was really asking. That was interesting too, we all have kind of a different perspective on the questions.” Another individual talked about their group dynamic as, “We compromised pretty well [as a group], I feel. We were talking between scientists and planners, so thinking differently about how city planners work and how they think, and what they need to know about the natural resources”. In reference to the FEMA map

item, a participant said, “[I didn’t understand] what a kind of difference it would make, but then I talked to someone who works with that on a day-to-day basis and I see how that could be really important and useful. It was kind of eye-opening, and so we bumped that priority way up.” And finally, an individual characterized the workshop format as it being “Super-fruitful discussion to have the science and planning community together.”

**Action Item Related Findings**

There were both over-arching themes and specific action item highlights that emerged in the qualitative findings on action items. Taken together, the results can help support next steps and implementation in the community. Table 10 provides highlights from the findings on the action item specific analysis.

**Table 10. Qualitative Action Item Finding Highlights**

Item Group	Action Item	Finding Highlights
<b>Planning</b>	Encourage multijurisdictional planning	<ul style="list-style-type: none"> <li>• Mixed perceptions on meaning and current ability to do this in the community</li> <li>• Concern over un-funded incentives</li> <li>• Uncertainty as to how to might differ from watershed scale planning</li> </ul>
	Facilitate watershed scale planning	<ul style="list-style-type: none"> <li>• Mixed perceptions on whether this was already happening in the community</li> <li>• Concern about available funding because local waters are considered clean at state level</li> </ul>
	Incorporate best climate science into planning and development processes	<ul style="list-style-type: none"> <li>• Participants saw it as important to use best available data, but were concerned that the information might not fit into existing planning processes</li> </ul>
	Provide planning and	<ul style="list-style-type: none"> <li>• Some saw this as a high priority because</li> </ul>

	training for emergency response	<p>there was substantial funding available</p> <ul style="list-style-type: none"> <li>• Others saw it as a low priority because the community had received much training already</li> <li>• Emergency response during the 2012 flood informed some participant’s responses</li> </ul>
<b>Community Engagement</b>	Involve non-traditional groups in decision making (i.e. low income individuals, non-recreationist community, school district representatives)	<ul style="list-style-type: none"> <li>• Overall, respondents saw this as a difficult task with mixed impact</li> <li>• Some perceived that non-traditional groups were not intersected in being involved</li> <li>• Some saw this as a moral obligation through a lens of environmental justice</li> </ul>
	Educate public on risk and responsibility via increased communication	<ul style="list-style-type: none"> <li>• Many saw the responsibility to seek education as falling on the non-expert individuals rather than local experts, with experts doing plenty already</li> <li>• Some saw this action as a obligation and component of environmental justice</li> <li>• Often there was limited trust that the public would use information provided to them</li> </ul>
	Increase accountability for implementation of planning	<ul style="list-style-type: none"> <li>• There was a wide variety of interpretations of this action, from government to individual homeowner accountability</li> <li>• Many saw it as important that plans were implemented and didn’t just “sit on a shelf”</li> </ul>
	Facilitate homeowner action and preparedness	<ul style="list-style-type: none"> <li>• Generally, participants saw this as important, but had low confidence in motivating homeowners who weren’t already motivated</li> </ul>
<b>Natural Resource Management</b>	Increase protection and restoration of natural water systems	<ul style="list-style-type: none"> <li>• Participants thought protection was important but needed enforcement and regulation to support</li> <li>• Some were unsure of what restoration would be in the local community</li> </ul>
	Further climate and	<ul style="list-style-type: none"> <li>• There were mixed perceptions of how</li> </ul>

	extreme weather research on local impacts	<p>important this would be, as well of mixed perceptions of researchers' ability to provide actionable results</p> <ul style="list-style-type: none"> <li>Some saw this as a first step before other actions could be taken, others thought there was sufficient information for decision making</li> </ul>
	Reduce resource dependence & use (i.e. energy, water, minerals)	<ul style="list-style-type: none"> <li>Impact assessment was more certain than paths to implement action</li> <li>Some looking to international examples as models of change</li> </ul>
	Provide up-to-date information for resource management (FEMA maps, invasive species info)	<ul style="list-style-type: none"> <li>Perception of this issue largely depended on if someone worked regularly with the information source</li> <li>This was seen as necessary for public education purposes</li> </ul>
<b>Infrastructure Improvement</b>	Replace aging infrastructure and right-size new infrastructure	<ul style="list-style-type: none"> <li>Participants discussed not being able to afford the right sized infrastructure and the infrastructure they can afford not making enough of a difference</li> <li>Some saw the action as two discreet items (replacing aging and right-sizing new) while others saw them as multiple steps in the same action</li> </ul>
	Develop sustainable alternative energy sources	<ul style="list-style-type: none"> <li>This was perceived as difficult but beneficial from the extraction (mining) and resilience (self-sufficient) aspects</li> </ul>
	Develop viable public transportation options	<ul style="list-style-type: none"> <li>This was discussed as highly desirable, but not viable for the local community density and habits</li> <li>Seen as limited impact from energy use standpoint, but high impact on ability to reduce parking and road infrastructure with</li> </ul>
	Prioritize green over gray infrastructure when applicable	<ul style="list-style-type: none"> <li>Concern that individual efforts (i.e. homeowner rain barrels) won't scale up to make a significant difference</li> <li>Perception that homeowners will model other homeowners and will learn from each other</li> </ul>



		<ul style="list-style-type: none"> <li>• Perception that local, state, and federal dollars won't be available to support the level of infrastructure change needed</li> </ul>
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As in previous research in this community on this topic, self and collective-efficacy also continued to emerge as a predominate themes. Using efficacy frameworks to underpin analysis, elements surfaced that might support preparedness efforts or serve as a barrier to preparedness efforts (Table 10). Self and collective-efficacy are related and support each other. That said, elements primarily related to self-efficacy might suggest that there are opportunities to work at the individual level to leverage existing efficacy or build additional perceived efficacy. Similarly, elements primarily related to collective-efficacy might suggest that there are opportunities to work at the community level to leverage existing efficacy or build additional perceived efficacy.

**Elements that may support actions to better prepare the community for climate change and extreme weather impacts**

Participants identified that efforts to prepare the community for climate and extreme weather impacts could be supported by increasing individual and community knowledge and understanding of issues and impacts. Formal training for professional experts and modeling and passive training for non-expert community members was preferred to regulation. Respondents thought individual homeowners would be particularly motivated by other homeowner's actions.

Analysis findings suggests that participants believe there would be significant gains in community preparedness using integrated decision making. They saw benefits from individuals with different backgrounds learning together, holding each other accountable, and thinking of others' needs and abilities. Further, workshop attendees suggested that the community take more advantage of existing integrated groups established to respond to the 2012 flood and the 1987 AOC designation.

Participants described the benefits of tapping into issues that the community already cares about to illicit behavior change. Respondents identified water quality improvements, health and wellness improvements, preparedness for future impacts, and using personal impacts as motivations that may be effective. Further the group stressed the importance of starting with easy or small actions to get people engage before making bigger asks.

### **Elements that may be barriers to actions to better prepare the community for climate change and extreme weather impacts**

A feeling of being stuck or that actions wouldn't matter emerged during analysis of workshop transcriptions. There was a general feeling of it being very difficult to get results and that all the available actions were difficult. There were also specific feelings that climate change being too big to make an impact on from local action and there being too few resources to address issues.

Many participants' discussions the challenges of working with the broader community.

They noted a feeling of individuals not seeing their impact, not perceiving they need to be doing anything differently, and not actively working to connect with experts.

Participants also noted that it is hard to host meaningful community engagement efforts.

Finally, workshop attendees noted that decision makers (formal and informal) are rarely held accountable.

The structure of government and public systems arose as a barrier for many workshop participants. There was a general lack of trust that government initiatives would make a difference. More specifically, respondents saw limited funding, resources, and regulation to properly support preparedness efforts. Further, participants mentioned not feeling like decision making and planning could support integration of community input. Finally, there was a general sense that the community hadn't been designed to accommodate significant and viable non-automotive transportation options.

Finally, respondents at the workshop saw a lack of understanding climate and extreme weather impacts and efforts as a barrier to improved preparedness. They reported a need for better and more resources and technology. Additionally, they observed an inconsistent understanding for efforts that had been accomplished to date and some participants self-reported a discomfort with technical concepts and vocabulary.

**Table 11. Qualitative Self and Collective-efficacy Findings Table**

Element	Sub-elements	Emerged as an element of self/individual efficacy	Emerged as an element of collective/group efficacy
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Elements that may <b>support actions</b> to better prepare the community for climate change and extreme weather impacts	Increasing individual and community knowledge and understanding of climate and extreme weather issues and impacts	Improved professional emergency response training		X
		Improved information resources for professionals and non-expert public		X
		Education for public rather regulation to change behavior		X
		Individuals and community need to know more about local natural resource systems		X
		Passive education (modeling and signage) rather than active education (pamphlets or classes) could be more effective	X	
		Use homeowners looking to other homeowners as examples	X	
		Looking to international examples of climate and extreme weather preparedness		X
	Use integrated systems decision making	Use collaborative learning techniques		X
		Decision makers must be empathetic to others' needs and abilities	X	
		Leverage feelings of confidence from previous experiences	X	
		Leverage systems initiated from flood		X

		response		
		Leverage systems initiated from AOC response		X
		Increase accountability for expert and non-expert public		X
	Tap into existing motivations to inspire preparedness actions	Leverage interest in water quality improvements	X	X
		Leverage desire to travel easily around town (via public transit systems)	X	
		Use existing momentum related to better preparing for future impacts		X
		Increase link to local impacts to make issues relevant		X
		Start with small steps effective as a hook to get people engaged	X	X
		Leverage concern of protection of personal property	X	
		Link health improvements and environmental improvements	X	X
Elements that may be <b>barriers to actions</b> to better prepare the community for climate change and extreme weather impacts	Feeling stuck, like actions won't matter	There are too few resources to address issues	X	X
		Climate impacts will happen despite future action		X
		Everything feels hard to some extent		X
		It is very difficult to get results		X
	Difficult to get community	Non-expert public is not connecting with		X

engaged	experts		
	Public may not see that there is anything they need to prepare for - think they are already sufficiently prepared	X	
	Individuals don't see their part in the collective impact		X
	It is hard to have meaningful group conversations		X
	There is limited accountability for decision makers		X
	Government and public systems don't support adaptation efforts	Initiatives need to be backed by funding and regulations	
Many don't trust government effectiveness		X	X
Area development not dense enough for viable public transportation systems		X	
Resources are prioritized for larger communities leave lower capacity communities behind		X	X
Planning and decision making processes don't motivate participation or integrate voices of those trying to participate		X	
It is hard to mobilize resources for preparedness			X

		response actions		
Lack of understanding of impacts and efforts		There is an inconsistent understanding of on-going efforts		X
		People not learning from past when impacts and recovery efforts	X	X
		Experts and non-expert public need better and more accessible information to gain mastery	X	X
		Need more and better decision making resources (FEMA maps, GIS technology)	X	
		There is some lack of comfort with technical concepts and vocabulary		X

### Case Study Discussion and Potential Next Steps

The intent of the matrix activity is to provide a simple mechanism to allow community members to assess and prioritize potential actions, and in turn move towards addressing a community need. This case study illustrates the possible utility of the exercise and opportunities to modify for other circumstances.

Perhaps the most notable take away is the value participants placed on a gathering where they could hear from other professionals and key community decision makers. They mentioned how they came to different understandings of issues and potential barriers. A group's efficacy should increase as a common understanding of goals and outcomes is

developed. Additionally, within the community of decision makers, it seems they developed a more sophisticated understanding of who is doing what and who can do what. This may help break down the narrative of an “other” being responsible for action and increase likelihood of responsibility within the community.

The process of ranking and prioritizing actions may prove valuable for unsticking this community on climate and extreme weather action items. While the workshop was important for building relationships and developing a greater understanding in the community, the ultimate goal is to facilitate actual action and behavior change. To that end, there are several next steps the community could take:

**1) Move forward on the priority items identified in the workshop.**

The workshop process and the outcomes could be used to justify forward movement on implementation of the action items that emerged as most prominent. The workshop participants, or some subset of the participants, could gather to identify the more specific steps and responsible parties that would be needed to accomplish the actions and work to hold each other accountable on forward progress.

For example, in this community increasing multi-jurisdictional planning, watershed scale planning, and increased protection of natural resources all may strong candidates for additional exploration. These items are strongly related and would complement each other – action on any would likely have impacts on the others. Building from existing networks and strengthening existing multi-jurisdictional groups may be a strategic



starting place. Developing methods to hold the group accountable for progress and increase inclusive transparency may address barriers identified in this process.

**2) Work to build more consensus around areas of greatest divergent understanding.**

The action items that had the largest shifts between individuals and the group may illustrate where the least common understanding is and where there is the most opportunity to build more understanding. This greater common understanding could increase efficacy and ability to act.

The greatest divergence emerged around the action items “involve non-traditional groups in decision making”, “educate public on risk and responsibility via increased communication”, “reduce resource dependence and use”, “develop viable public transportation options”, and “prioritize green over gray infrastructure when applicable”.

Working to build a more common understanding and identify areas of differing understanding may make these actions more accessible for implementation. For example, workshop participants identified barriers to engaging communities, but noted the benefits of leveraging areas of existing motivation. Working with non-traditional groups might elucidate existing values and interest of those groups that could align with the goal of increasing community preparedness for climate and extreme weather impacts.

**3) Look for areas of particularly low difficulty or particularly high impact try to shift the other aspect.**

If there is an action that may be easy, but has low impact, community members could work together to develop ways to increase the impact while maintain the ease. Similarly, an item of particularly high impact could be developed to make it easier to accomplish. These steps may shift the prioritization and highlight some clear “winners” for action to move forward with.

In this matrix activity “reducing resource dependence and use” was among the lowest ranked action items, despite having a relatively high potential impact. This item was ranked very high difficulty, and from the qualitative findings it emerged that while participants saw it was important, there was little clarity on how to move forward. This item may be a strong candidate to explore options to reduce difficulty. Some participants suggested looking to international examples of countries and cities that had taken innovative steps to reduce energy dependence.

**4) Do same exercise with other prominent stakeholder communities to find areas of alignment or areas of significant divergence.**

The participants in this exercise were selected because they have the most immediate and direct decision making authority on issue most closely aligned with climate change and extreme weather impacts. However, all people in the geographic area are going to be effected to some extent. Hosting a similar event and comparing results could serve as an opportunity for collaborative learning and as a time to clarify priority actions.

Ultimately, the goal for the workshop participants is to better prepare the community for climate change and extreme weather impacts. The next best steps need to be to do something! Turn the potential actions into actual action.

### **Considerations for Organizers**

Above all, a community decision making process should fit the needs of the community. This case study illustrated one process and the results and recommendations that could be generated from the process. Any component of the process could be modified to meet the goals and objectives of organizers. Three aspect that organizers may consider for their own event are time management, gathering of discussion content, and the appropriate scale of analysis.

#### **Gathering Discussion Content: Recording Versus Notetaking**

Two common ways of capturing data during group discussions are recording conversations and notetaking. For analysis purposes, all discussions during the workshop for this case study were recorded. There were digital recording devices at each group and for the full group discussion. Organizers were interested in both the outcome of the discussion and the discussion themselves, and capturing the content verbatim was important. Recording conversations may inhibit free conversation and requires all participants to sign a consent to be recorded. For other matrix workshops, recording may not be needed – an assigned or volunteer notetaker could be responsible to capture major points of discussion and final decisions. Notetakers may be challenged to both participate and take substantial notes, and they should be fully aware of the needs for

outcomes and analysis. Depending on the process, other strategies for collecting and presenting data may be appropriate. Artist interpretations, verbal reporting, or individual reflection activities may also deliver desired results. In the end, deciding whether data are collected via recording, notetaking, both methods, or some other method will depend on the goals of the decision-making process and the interests of the community and organizers.

### **Extent of Analysis**

The workshop highlighted in this case study was organized by biophysical researchers at NRRI and social scientist at UMN and was part of a larger multi-methods research study. The detailed analysis, the development of descriptive statistics and the quantitative coding analysis may not be appropriate for other communities and is not necessary for a successful use of the matrix tool. A community may be served equally well through a voting or consensus process to finalize prioritization after the matrix activity, with no additional post-event analysis. The extent of the analysis should be decided by organizers prior to an event so that the workshop can be organized to support the analysis. Techniques for analysis may be based on the desired outcomes, the expertise and experience of the organizers, and the time and resources available for analysis activities.

### **Distribution of Findings**

Event organizers should develop a plan for distribution of findings prior to holding a workshop or event. The event highlighted in this case study had been planned to include

an agenda item focused on narrowing action to a limited set of priorities and identifying path forward for those items. This portion of the agenda would have resulted in participants leaving with prioritized, specific, and actionable next steps. The timing, however, did not work out to accomplish the full agenda. Organizers did not have a backup strategy to distribute findings. Each was sent a link to this case study write up, but it is likely that momentum was lost in the interim between the workshop and the release of the case study. An alternative, and more rapid plan, for analysis and distribution of key findings would have increased the impact of this event.

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**For detailed information on designing and implementing a matrix engagement activity please see “Better Together: An Action Matrix Approach to Community-Based Environmental Decision Making” (Perry, 2017)**

## Chapter 6: Discussion

The threats and risks of climate change and extreme weather may often feel hyperbolic to individuals going about their everyday lives. Images of stranded polar bears and far away cities underwater may not feel close enough or real enough to inspire behavior change by individuals if they are not directly impacted. However, as communities are increasingly challenged to address natural resource management issues impacting their viability, quality of life, and sustainability, apocalyptic futures may appear less apocryphal. A community's perceived ability to address these issues, or their collective-efficacy, will be a key factor in successful management. Collective-efficacy is a group's trust and willingness to work together, and belief in their ability to perform effectively (Cohen, Inagami, & Finch, 2008; Lindsley, Brass, & Thomas, 1995). Practically, the greatest impacts to climate and extreme weather preparedness will come from collective efforts, however the bulk of efficacy research has been focused on individuals and in fields in-directly related to natural resource issues. A better understanding of collective-efficacy related to climate and extreme weather response behavior may elucidate opportunities to build preparedness and resilience in local communities.

The Lower St. Louis River Basin of Minnesota is a particularly fitting place to explore collective-efficacy for climate change preparedness. Specifically, investigating community perspectives on water, stormwater, and climate and extreme weather is relevant for this area which was significantly impacted by a massive flood event in 2012. This is emblematic of the type of impacts the Great Lakes region is likely to experience is greater

frequency as a result of warming climatic conditions (Bartolai et al., 2015; d'Orgeville, Peltier, Erler, & Gula, 2014). In 2015 researchers from the Department of Forest Resources at the University of Minnesota Twin Cities and the Natural Resources Research Institute at the University of Minnesota Duluth began a sequential multi-methods study funded by Minnesota Sea Grant to explore coastal community response to climate change and extreme weather.

Perceived collective-efficacy and relationship to place emerged as particularly important. This is similar to findings of other studies (Brown, Perkins, & Brown, 2003; Comstock et al., 2010; Devine-Wright, 2009; McNamara, Stevenson, & Muldoon, 2013) which generally find a positive association between the two concepts. In this community, the study participants are challenged to gain momentum to address climate change impacts because of a lack of cohesion related to goals, perceived outcomes, and risk assessment, yet study participants expressed a strong connection to water resources in particular, and were proud of past efforts to engage the community around water restoration and protection efforts. Many community members have a strong attachment emotionally and economically to water resources in the basin and were strongly impacted by the flood.

Generally, research findings indicate that communities with greater attachment to outdoor and natural places have higher collective-efficacy to effectively manage those places (McNamara et al., 2013; Scannell & Gifford, 2010). In this case, however, there are still divergent perspectives on the extent to which the community will be affected by

climate change and extreme weather in the future. Participants in this study generally expressed that the community was able to work together to make positive progress on natural resource management issues, but felt stuck on climate preparedness. Perceived collective-efficacy is low in this community regarding ability to prepare for future events like the 2012 flood. This is perhaps unsurprising given the complexity and uncertainty of climate change impacts, however, a holistic consideration of context and the strong connection to place and the natural environment could be leveraged to build cohesion (Moss et al., 2010). Decision makers would benefit from developing a climate preparedness strategy that helps the community connect potential future climate impacts with water resources and empowers mitigation and adaptation actions that will help maintain places and place identities.

This work is a deep examination of decision makers' perspectives in the Lower St. Louis River Basin of Minnesota. The study findings center on relationship to place as a source of efficacy as a path towards better outcomes for individuals and communities.

Considering efficacy and place-based theoretical perspectives, in particular the work of Bandura (2000) and Scannell & Gifford, (2010), there may be a path forward for this community at the intersection of place considerations and collective-efficacy considerations. For example, if the community wanted to pursue multi-jurisdictional planning for watershed restoration, there may be efficacious gains by leveraging commonly held place-based connections. Specifically, identifying the commonly held values related to water resources in the watershed among stakeholders that will be most



influenced by management decisions, could help illuminate a path building commonly held goals and expected outcomes – both key elements of collective-efficacy in this study community. Within the context of this process of identifying values, key decision makers could address barriers within socio structural factors, such as drafting joint power agreements or memorandum of understands between relevant local units of government. By leveraging existing place-based influences to increase collective efficacy, while addressing the local context, the community may be better positioned to engage in climate response behavior.

This research used a sequential multi-method approach to build upon a body of research on self-efficacy and collective-efficacy. Sequential design is effective in community-based research for building analysis from research segments in to each other and reflecting findings back to study participants (Padgett, 2012). This study merged social science and biophysical methods to identify barriers and opportunities to better prepare communities for potential futures they might be facing. This process allows for researchers to adapt as throughout, while still considering outcomes independently if desired. For example, findings from the workshop are interesting discreetly, yet carry more validity for a community that contributed directly to the content of the workshop in previous research segments (namely, interviews and focus groups). Designing the process to build on previous segments added opportunities for participants to build efficacy as the study unfolded and to legitimize and customize outcomes. Participants have a connection to the research and a greater trust in the meaning. A sequential

research approach may be particularly appropriate for complex issue like climate change response which benefit from the integration of a variety of knowledge source to advance community learning (Koontz, 2014).

There are many opportunities to build from this work to better understand how communities might more effectively tackle challenging natural resource issues. One pressing need will be to continue to work to merge biophysical and social science research. This multi-methods study had some successes, and researchers would benefit from a directed and intentional look into best practices to merge the human and natural science approaches. Within the social sciences, the relationship between individuals and community for natural resource decision making and action would benefit from more exploration. In particular, investigating the relationship between self- and collective- efficacy as it relates to natural resource perspectives would benefit managers and decision makers that are working across scales to influence behavior. Finally, further use and expansion of the action matrix activity in a wider variety of contexts would help develop the process into a more robust decision-making tool. A comparison of findings from implementation of the action matrix across different communities with decision making influence, might be a particularly interesting exploration (i.e. what are the outcomes on the same topic between elected officials and government staff).

Managers and decision makers in this community can use the information and findings to shape their actions as they manage water and stormwater and prepare for climate and extreme weather impacts. In some instances, participants expressed a feeling of

assurance that others perceived the community's abilities similarly to themselves. The study findings might help highlight areas of divergence to expedite the building of more cohesion and momentum. Study participants expressed the value of working together and learning from others. Human induced natural resource challenges are the result of collective impacts and in turn will require collective responses. A community's perceived ability to work together to achieve a common goal is a key element in their actual ability to work together. An exploration of efficacy can help illuminate opportunities and barriers, and facilitate better outcomes for natural resource management.

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## Appendices

## **Appendix A: Interview Contact Script**

Hello [name],

My name is [X]. I am a [position] conducting research on communities and water resources for Mae Davenport, Associate Professor in the Department of Forest Resources at the University of Minnesota. This study involves community residents, local leaders and natural resource professionals in the [Mission Creek; Miller Creek] watershed. One goal of this study is to identify different resources communities need and strategies they can use to enhance their ability to respond to water resource impacts. To do this, we'll be conducting interviews with local residents and professionals in the watershed. I am hoping you would be able to assist me by participating in the study and sharing your perspectives with me. The interview takes about one hour. Would you be willing to participate?

**If yes:** "Thank you. I am available on \_\_\_\_\_ (days of week, times, have alternates ready) is there a time that would work best for you? [Set date, time, location (get directions)]. I would like to send you a confirmation email with date, time and location information. The email will include all of my contact information, in case you have any questions or concerns. Do you have an email address I can send the confirmation to?"

- a. **If yes,** take it down or confirm we have the correct email address for them. "Thank you. I look forward to meeting with you on \_\_\_(agreed upon date)\_\_\_."
- b. **If no,** "Is \_\_\_(phone # you contact them with)\_\_\_ the best way for me to get a hold of you? In case you need to get a hold of me with questions or concerns, my phone number is \_\_\_\_\_. " I look forward to meeting with you on \_\_\_(agreed upon date)\_\_\_.

**If no:** "Ok, thank you for your time. Good bye."

**If they seem unsure:** "Just to be clear, participation is completely voluntary and if you decide to participate you can withdraw at any time. Your identity will remain confidential and we won't include any information that would make it possible to identify you in the final report. We're only talking to a limited number of key representatives, so capturing your perspective is important. Can I ask what your concerns about participating are?" [Try to address their concerns]

**If they want to know why they are being asked to participate:** "We're interviewing a variety of stakeholders in the watershed to try to get diverse perspectives and a range of experiences. We've been conducting a stakeholder inventory in your community and your name came up as someone who would be a good person to talk to. Since we are

only able to conduct a limited number of interviews, capturing your perspective is important.”

**If they want to know how the information will be used:** “We are trying to better understand people’s perspectives on community resources, conservation practices, and programs to determine the capacity of communities to respond to environmental risks. We’ll be putting together a final report that describes how participants view these issues to share with community leaders, educators and resource professionals. Your information will be kept confidential and there will not be any identifying information in the report.”

**If they want to know what the study is for:** “This project is aimed at better preparing communities to respond to water resource impacts and building community readiness.”

**If they want to know who is supervising the research:** “Mae Davenport is the supervisor for this study. She is an assistant professor in the Department of Forest Resources at the U of M. If you would like to contact her directly I can give you her phone number [612-624-2721] or email address [mdaven@umn.edu].”

**If they ask about IRB:** The research project has been reviewed by the IRB/Human Subjects Committee.

## **Appendix B: Interview Guide**

Community Climate Readiness: Duluth  
Interview Guide (updated 02/25/15)

\*Questions in bold are high priority questions

*First, I have some general questions about you and your community. Many people have different definitions of community ranging from a geographic area to a community that is based in social relationships. So, before I ask you questions about your community, I would like to know how you define it.*

- 1. When you think of “your community,” what comes to mind?**
- 2. What is your connection to the community?**
  - a. How would you describe your role in the community [as a professional/landowner/activist]?
3. What would you say are the best things about [working in/being a member of] the community?
- 4. Do you have any concerns about your community? Please explain.**
  - a. What challenges do you face in working/engaging in this community?**
5. Can you describe any situations in which the community came together to respond to a problem or opportunity? Please explain.
  - a. How did the community respond?
  - b. What things led to success (or failure) of community action?

*Next, I'd like to ask some specific questions about natural resources and the environment in the community. For clarity, I'll just generally refer to “natural resources” but that may include all aspects of the natural environment including water.*

- 6. What significant changes or impacts to natural resources have occurred in the community in the past 5 years? Please explain.**
7. What were the effects of these changes/impacts on the community?
8. How would you characterize the response of the community?
9. What things led to success (or failure) of community action?
- 10. When events like this happen, who typically gets involved?**
  - a. Community members?**
  - b. Businesses? Owners?**
  - c. Community groups?**
  - d. What about government officials at local, tribal, state, or federal levels?**
  - e. How about non-government (non-profit) organizations?**
- 11. What types of resources are typically used to address the impacts?**

**12. Are you concerned about changes or impacts to natural resource into the future? Please explain.**

a. *[If list multiple]* Which of these is your biggest concern?

**13. In your opinion, are there ways in which the community could better avoid, prepare for, or respond to these types of events? Please explain.**

***We are focusing our research project on water in this watershed [refer to the watershed map]. Next, I have some general questions about water.***

14. When you think of water in this area, what comes to mind?

a. How do you use water here?

b. What about water is important to you?

c. What about water is important to your community?

**15. Do you have any concerns about water in this area? Please explain.**

a. Are you concerned about your drinking water?

b. Are you concerned about flooding or drought?

c. Are you concerned about lakes, rivers, or wetlands?

16. Have you ever talked to anyone specifically about water in this area or protecting water before? Please explain.

a. If you had a question or concern about water in this area, who would you go to?

17. Do you think the community is concerned about water in this area? Please explain.

**18. Are there success stories of protecting water in this area? Please explain.**

***One issue local resource professionals are particularly concerned about is stormwater runoff.***

19. First of all, how familiar are you with stormwater runoff issues?

20. Many people have different things in mind when they think about stormwater runoff [flooding]. When you think about stormwater runoff, what comes to mind?

**21. Have you observed any problems with rainwater, snowmelt or stormwater runoff in the area? Please explain.**

**22. Who do you think should be responsible for addressing these types of water resource problems in this area?**

***Some people we have talked to in the area are concerned specifically about climate change, extreme weather events, and effects on the natural environment.***

- 23. First, what are your perspectives on climate change?**
- 24. Are you concerned about the impacts of [climate change or] extreme weather events on this area? Please explain.**
- 25. In your opinion, is the community doing what it needs to do to prepare or plan for [climate change or] extreme weather events? Please explain.**
- 26. If you were in charge of planning for climate related impacts in the community, what actions would you prioritize?**

***Now just a few final wrap-up questions:***

- 27. What do you see as the 3 biggest challenges to protecting water in this area?**
- 28. What do you see as the 3 most promising opportunities to protecting water in this area?**
- 29. Is there anything else you would like to share with me about your community, natural resources or water in the area?**



## **Appendix C: Study Participant Consent Form**

## **Community Climate Readiness: Duluth Study Consent Form**

You are invited to participate in a research study that explores community responses to water resource impacts. You were selected as a possible participant for an interview because you currently live, work, or engage in water resource management in either Miller Creek watershed or Mission Creek watershed. We ask that you read this form and ask any questions you may have before agreeing to be in the study. This study is being conducted by: Mae Davenport, Associate Professor at Department of Forest Resources, University of Minnesota.

### **Background Information**

The purpose of this study is to better understand community responses to water resource impacts and to build community capacity for engaging in water resource management.

### **Procedures:**

If you agree to be in this study, we would ask you to do the following things: Participate in an interview, lasting approximately 60 minutes. The interview will be audio recorded and transcribed.

### **Risks and Benefits of being in the Study**

Risks associated with this study are minimal, responses are confidential and names will not be linked to any information in any publications. Benefits of participation include increased awareness of watershed and community issues. Study results will be made available to the public and all participants will have access to them.

### **Confidentiality:**

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records. Your responses to the interview questions will be audio recorded, transcribed and kept for three years in a locked office. Afterward, these tapes will be destroyed. Only those directly involved with the project will have access to the audio tape of the interview notes.

### **Voluntary Nature of the Study:**

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

### **Contacts and Questions:**

The researcher conducting this study is: Mae Davenport. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at address: 115 Green Hall 1530 Cleveland Ave. North, St. Paul, MN 55108-6112, phone: 612-624-2721, email: mdaven@umn.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

***You will be given a copy of this information to keep for your records.***

**Statement of Consent:**

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

"I agree\_\_\_\_\_ I disagree\_\_\_\_\_ to have my responses audio recorded"

"I agree\_\_\_\_\_ I disagree\_\_\_\_\_ that Mae Davenport may quote me anonymously in her papers"

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature of Investigator: \_\_\_\_\_ Date: \_\_\_\_\_

## **Appendix D: Study Participant Demographics Form**

Community Climate Readiness: Duluth

**Participant Demographic Information**

Age:

Highest level of formal education:

Years lived in community:

Occupation:

Gender:

Race/Ethnicity:

Community groups/organizations:

## **Appendix E: Focus Group Recruitment Flyer**



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## **We want to hear from you about your community and clean water!**

In partnership with the Mississippi Watershed Management Organization, researchers at the Department of Forest Resources, University of Minnesota, are gathering data about community, decision making, and perspectives on water. One goal of this study is to identify different resources communities need and strategies they can use to enhance their ability to respond to water resource problems. To do this, we'll be conducting focus groups with residents in your community.

**We hope you will consider joining a focus group  
session!**

**We are offering a \$50 reimbursement for your participation.  
Light refreshments will be served.**

There will be two focus groups in your area. Please RSVP for one of the sessions below:

**December 11, 2015, 9:30 – 11:00 am, Northeast Library, 2200 Central Ave NE  
OR**

**December 11, 2015, 1:30 – 3:00 pm, North Regional Library, 1315 Lowry Ave North**

Results and recommendations for enhancing community engagement in stormwater management will be shared with interested organizations and groups through a summary report and interactive presentations. Ultimately, this project will inform water resource communication, education, outreach and civic engagement programs in the Metro Area and other urban watersheds.

**If interested please respond to:**

**Vanessa Perry, Research Associate  
University Of Minnesota - Department of Forest Resources  
perry497@umn.edu**

## **Appendix F: Focus Group Agenda**



## **Coastal Climate Readiness, Mission and Miller Creeks, Focus Group Agenda**

**Focus Group Objectives:** (1) Present and receive feedback on study findings to date and potential future weather scenarios, (2) identify constraints and opportunities for developing climate readiness and water resource management strategies, and (3) increase knowledge of local perspectives on community assets, community needs, environmental planning, and water programming.

### **Agenda and Questions:**

1. Welcome and agenda (10 min-  
Intros, Agenda, and Roles by Vanessa
2. Introductions and ice-breaker (go-around) (10 min – consider based on number of participants)

**Q1: Let's go around the room and have each of you tell the group your name, what you do/where you work, and one thing that inspires you about water or resource management today, (as well as one thing that concerns you about water or resource management today.)**

1. Action discussion round 1, (20 min –

10 minutes -Short intro presentation to project – then pause for

Introduce the grid – go through one round

**Q2: What actions would you prioritize to better prepare the community for future extreme weather and climate impacts – please list 3-5 items.**

(collect and place on grid) – note taker takes detailed notes on disagreements – pick one color for this

2. Interview findings presentation, (25 min –  
15 min presentation by research team, 10 minutes of discussion

**Q3: What questions or comments do you have about the material presented?**

3. Scenario presentation and discussion, (20 min  
10 min presentation by research team, 10 minutes of discussion

**Q4: What questions or comments do you have about the material presented?**

**Q5: Now that you know what we have learned – do you think any of the actions need shifted on the grid?**

**Q6: What new actions would you add (take away)?**

4. Break (10min – reflect on next set of questions) vote on priorities

5. Action discussion!

**Q7: Are there ways to make easy items more impactful, or impactful items more easy.**

**Q6: What barriers and constraints exist for high impact items**

**Q7: How might the community move forward in accomplishing priority actions – as identified -**

6. Closing (10 min -

**Q9: What else would you like to know about climate and extreme weather preparedness in the Mission and Miller Creek Watershed areas? (capture on flip chart)**

**Q10: What is one action to advance preparedness that you can personally commit to that you will share with the group?**

Post session: Anything else we should know? What else would you like to know about our research or this project?

#### THE MATRIX

Most difficult			
Med easy			
Most easy			
	Low impact	Med impact	High impact

## **Appendix G: Focus Group Evaluation**

**Duluth Focus Group Evaluation, June, 2015**

- 1. What about today's focus group was most valuable?**
  
  
  
  
  
  
  
  
  
  
- 2. What would have improved the experience for you?**
  
  
  
  
  
  
  
  
  
  
- 3. What remaining questions do you have after today's focus group?**
  
  
  
  
  
  
  
  
  
  
- 5. Other comments or suggestions?**

**Duluth Focus Group Evaluation, June, 2015**

- 1. What about today's focus group was most valuable?**
  
  
  
  
  
  
  
  
  
  
- 2. What would have improved the experience for you?**
  
  
  
  
  
  
  
  
  
  
- 3. What remaining questions do you have after today's focus group?**
  
  
  
  
  
  
  
  
  
  
- 5. Other comments or suggestions?**



## **Appendix H: Workshop Contact Script**

Hello,

I am writing to invite you to participate in a two-hour interactive workshop in \*\*\*\*\*, MN to learn about and share input on research findings from the project on community response to extreme weather and management of water resources.

**We will be hosting the meeting on \*\*\*\*\* at the \*\*\*\*\*.**

**Please reply to this e-mail if you are able to join us** (we will send an agenda & event reminder one week in advance).

Additional information on the project and meeting is described at the end of this email.

If you are interested in learning more about the project but are unable to attend the meeting, or if you have specific questions, please contact me as well. We would also appreciate it if you would please forward this invitation email on to others you think might be interested in this project.

The goal of the meeting is to present and discuss findings from interviews with decision makers in your community, to discuss potential future extreme weather scenarios, and to identify appropriate next steps for outreach and future research.

Tentative meeting agenda:

- Introductions and project overview
- Presentation and discussion of preliminary findings
- Breakout discussions on applying study findings in water resource programming and developing climate readiness
- Reconvene for full group discussion and wrap-up

**Again, please reply to this email if you are able to attend the meeting on \*\*\*\*.** I look forward to the opportunity to meet you! Thank you for your time.

Sincerely,

Vanessa Perry

**\*\*\*\* Additional Project and Meeting Information \*\*\*\***

Researchers from the University of Minnesota's Department of Forest Resources are meeting with local stakeholders to better understand community responses to water resource impacts and to build climate readiness in coastal communities. This study is part of a broader research and outreach project funded by Minnesota Sea Grant that integrates water and social science to assess and enhance coastal community resilience under extreme weather events. The broader project is led by the Natural Resources Research Institute at University of Minnesota Duluth.

The community study area is the Duluth and Hermantown communities within the Mission and Miller Creek Watersheds. Interviews and focus groups are being conducted with local actors, community leaders, and land use/water resource professionals. Specifically, the study investigates

- 1. Local perspectives on community assets, community needs, environmental planning, and water conservation programming and*
- 2. The adaptive capacity of communities, community leaders, and land use/water resource professionals—their ability to anticipate and respond to climate-related impacts*

Interview and focus group data will be combined with water and land use impact models to help communities anticipate and respond to future climate-related impacts, including extreme weather events. Results and recommendations will be shared with community leaders, educators, and resource professionals in interactive workshops.



## **Appendix I: Workshop Fact Sheet**

# 2017 Perspectives on Climate Preparedness

A Study in the Lower St. Louis River Basin, Minnesota, USA\*

Holly Meier, Vanessa Perry, M.S., and Mae Davenport, Ph.D., Center for Changing Landscapes, University of Minnesota

In partnership with the Natural Resources Research Institute (NRRI), researchers from the Center for Changing Landscapes, University of Minnesota, interviewed 27 local government officials, natural resource professionals, and other community leaders active in the Miller Creek and Mission Creek watersheds of the Lower St. Louis River Basin in Minnesota to examine community climate preparedness. Leaders from the watershed communities, including Duluth, Hermantown, and Fond Du Lac Reservation, were invited to reflect on extreme weather events, impacts to water and other community assets, and climate preparedness. Interview data were analyzed for convergent and divergent themes.

## WHAT IS CLIMATE PREPAREDNESS AND WHY IS IT IMPORTANT?

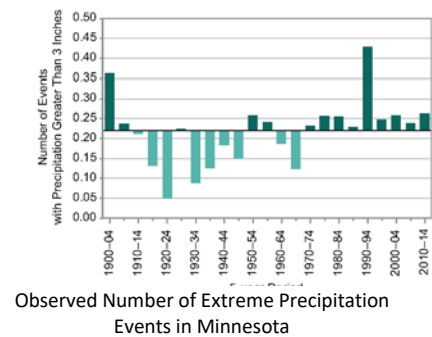
Climate preparedness enables communities to anticipate, plan for, and effectively respond to climate change impacts. Climate change in Minnesota has meant an increase in extreme precipitation events and higher seasonal temperatures (MN State Climatology Office, 2016). Extreme rain events already have had ecological, economic, and social impacts in the northeastern part of the state. For example, increased stormwater runoff in the Duluth area



contributes to sediment pollution in the St. Louis River estuary, and in June 2012, a catastrophic flood caused more than \$55

million in damages. To be prepared for climate change, communities must understand both their vulnerability to climate change and their capacity to anticipate and adapt to a changing environment.

*Credit: NOAA National Centers for Environmental Information*



## WHAT DID PARTICIPANTS SAY ABOUT CLIMATE CHANGE?

Study participants largely believed climate change was real and were concerned about

“I’ve been living here 25 years, and I do feel like the climate has changed since I’ve been here. I feel like the moisture patterns, the way we get snow, the way it comes our way, the temperatures—I feel like that’s a very natural assumption to make: that that’s partly impacted by climate change.”

impacts to the region. Participants expressed concern about ecosystem integrity, financial costs, infrastructure damage, and effects on vulnerable populations. Few participants expressed skepticism or apathy about climate change or its

impacts.

## WHAT DRIVES CLIMATE PREPAREDNESS IN THE WATERSHEDS?

**The 2012 flood** was considered a “wakeup call,” both in terms of how intense extreme rain events can be and how unprepared the community was for extreme weather. The flood triggered emergency response and hazard mitigation planning for future events. The flood also catalyzed collaboration and partnerships among organizations, agencies, and departments both within and across public and private sectors, leading to resource mobilization and knowledge sharing.

“I think that people were just so taken by surprise that that could even happen here. So it was really a big wakeup call. A ton of attention has come in and a ton of funding and trying to plan for future events like that. But before that, we just had no preparedness built in. I think that’s one thing that’s really been a lesson learned: that this type of thing can happen in this area.”

**A water ethic** emerged as integral to preparedness. Interviews revealed powerful physical and emotional connections to water and strong water values among participants. Participants characterized water as being “everything,” “our life force,” and “lifeblood” to their communities. Participants also described communities as highly motivated to protect water and engaged in water protection actions such as green infrastructure development, regional cross-sector stormwater planning, and St. Louis River corridor restoration projects.

**Awareness and leadership** in the communities is an asset. Participants were attentive to climate change, current and projected impacts to the region, and the need for increasing readiness in communities. Participants also acknowledged that several local decision makers have shown strong leadership in climate change preparation—agencies have adapted the tree species sold and planted, the City of Duluth applied for a national disaster resilience grant, and local communities are incorporating emergency response and sustainability into comprehensive planning.

## WHAT CONSTRAINS CLIMATE PREPAREDNESS?

**Climate impacts** are inherently challenging, including unpredictability, conflicting timescales of planning (shorter term) and climate impacts (longer term), perceived distance of climate change (i.e., it will happen far into the future and far from us), and invisibility of many climate impacts (i.e., impacts are often incremental, difficult to notice, and don’t affect daily life).

“If you don’t know what you are planning for, how do you plan for it?”

**Low levels of perceived efficacy** appear to constrain action.

Participants questioned their own ability to respond to climate change and were skeptical about the feasibility and efficacy of possible solutions.

**Lack of prioritization and coordination** were viewed as barriers to preparedness. Some participants

“People are starting to hear and see things about changes in plants, changes in biological community distributions, but they don’t necessarily have an idea of how to help or what to do.”

acknowledged that climate preparedness is a low priority among decision makers and the broader public. Participants noted examples in which climate change is not integrated into planning, climate response actions are inconsistent across jurisdictions, other environmental issues (e.g., illegal dumping, pollution) or community issues take precedence, and community leaders appear to overlook the toll of the 2012 flood. Additionally, participants acknowledged being uninformed of what

“Agency folks, I think they’re aware of [climate change], but at this point I haven’t seen where it’s a primary concern or a

other departments, agencies, or sectors were doing for climate preparedness.

**Limited discourse and understanding** has sweeping effects on climate actions and preparedness efforts. Participants observed that communication about climate change among decision makers, between decision makers and the public, and within the broader public was uncommon. Participants also perceived that the general public was not thinking about climate change on any regular basis.

**Insufficient resources and requirements** emerged as constraints to preparedness efforts. Participants identified inadequate funding, limited staffing, and a dearth of technical expertise as hindering climate preparedness.

Preparing for climate impacts is not required at the federal, state, or local level, and participants remarked that funding programs generally target disaster response (e.g., infrastructure repair) versus increasing community readiness and resilience.

“The biggest barriers [are] that communities see changes happening, they want to do something, but they lack a capacity, or a link to funding, technical support, tools, and resources . . . to really address the issues.”

## HOW CAN COMMUNITIES BUILD CLIMATE PREPAREDNESS?

**Leverage the strong water ethic in the region.** Climate preparedness activities framed as a way to protect water and its myriad benefits will resonate because water is integral to community identity and member values.

“[Water] is the foundation of us being here, right? We wouldn’t be here without water. So, it’s our life force. Like I said, if we didn’t have it, we wouldn’t be here. So it needs to be protected.”

### Create a climate preparedness task

**force.** A cross-sector, interagency, and cross-cultural climate preparedness task force can serve as a hub for synergy, resource mobilization, scientific and traditional knowledge sharing, and

action coordination.

**Disseminate actionable information and success stories.** Create a safe space for climate discourse that acknowledges cultural and ecological impacts and opportunities and stories of success.

**Make climate preparedness a part of all planning processes.** Encourage or require some form of climate-scenario planning in all levels of government through ordinances, resolutions, or joint powers agreements.



## Appendix J: Matrix Template

### Matrix Template

This template can be modified with different axes, printed on single sheets for individuals, or printed/written on large flip-chart sheets for groups. The matrix could also be used on a smart board or populated on an individual computer and projected for participants to see.

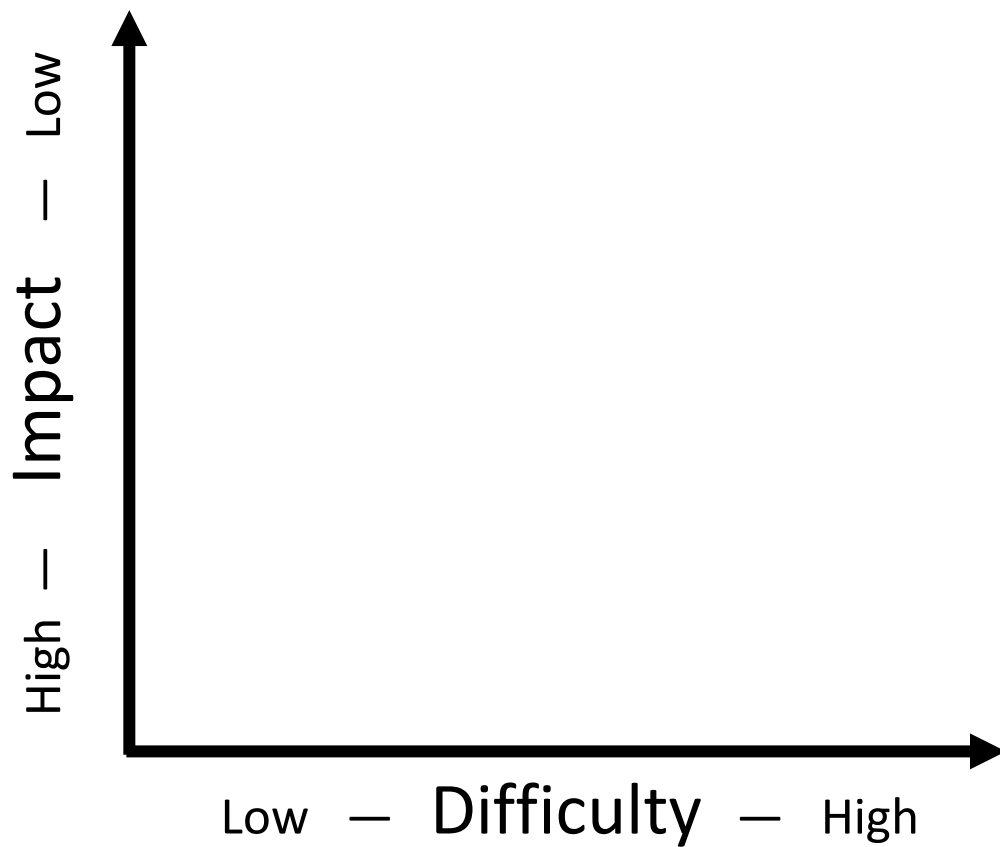


Figure 24. Matrix Template

## **Appendix K: Action Item Card Template**

### Action Item Card Template

The action item cards should be large enough to accommodate print that can be easily read in a small group setting. Spaces to capture participant assessment of the action items help clarify and standardize the process, ease analysis, and give a structure for participants to develop their perspective. This template has a gray box for the 1-X prioritization and spaces to capture axis ratings such as (H)igh, (M)edium, or (L)ow. Finally, if there are themes or clumps of similar action items, coloring coding can be helpful to ease organization and analysis.

Each of the numbered pages below were printed on a single 8.5x11 landscape sheet.

<b>1. Planning</b>			
<b>1a. Encourage multijurisdictional planning</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>1b. Facilitate watershed scale planning</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>1c. Incorporate best climate science into planning and development processes</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>1d. Provide planning and training for emergency response</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>2. Community Engagement</b>			
<b>2a. Involve non-traditional groups in decision making (i.e., low income individuals, non-recreationist community, school district representatives)</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>2b. Educate public on risk and responsibility via increased communication</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>2c. Increase accountability for implementation of planning</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>2d. Facilitate homeowner action and preparedness</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>3. Natural Resource Management</b>			
<b>3a. Increase protection and restoration of natural water systems</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>3b. Further climate and extreme weather research on local impacts</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>3c. Reduce resource dependence &amp; use (i.e., energy, water, minerals)</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>3d. Provide up-to-date information for resource management (FEMA maps, invasive species info)</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>4. Infrastructure Improvement</b>			
<b>4a. Replace aging infrastructure and right-size new infrastructure</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>4b. Develop sustainable alternative energy sources</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	
<b>4c. Develop viable public transportation options</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>		<b>4d. Prioritize green over gray infrastructure when applicable</b> PRIORITY (1-4E) <input type="checkbox"/> DIFFICULTY (2H-4L) <input type="checkbox"/> IMPACT (2H-4L) <input type="checkbox"/>	

Figure 25. Action Card Example



## **Appendix L: Theoretical-Framework Summary, Self- and Collective-Efficacy**

## **Theoretical-Framework Summary, Self- and Collective-Efficacy**

Efficacy is an important determinant in the success of efforts as levels of motivation and performance are a product of expected competence and efficacy (Zaccaro et al., 1995). Merriam-Webster Online Dictionary defines **efficacy** as “the power to produce a desired result or effect” (“Efficacy,” 2016). The efficacy of a group will affect its ability to participate in collective management and decision making. Bandura (1990) asserts, “Among the mechanisms of agency, none is more central or pervasive than people’s beliefs about their capabilities to exercise control over events that affect their lives. Self-beliefs of efficacy influence how people feel, think, and act” (p.128). Generally, the higher the level of efficacy, the more successful the performance, action, or behavior (Gibson, 1999), the more resilient the community (McNamara et al., 2013) and the less distress members of the community will experience after a disaster or significant impact (Benight, 2004). Efficacy can be built or moderated through a number of mechanisms. Bandura (2012) notes four primary mechanisms to develop self-efficacy: mastery, choice processes, verbal persuasion, modeling.

**Self-efficacy** is the perceived beliefs of an individual in their ability to control or influence external demands and their personal functioning (Luszczynska & Schwarzer, 2005). Self-efficacy affects cognitive processing and formation of individual expected outcomes, goals, and socio-structural factors. Expected outcomes are related to the belief the person has that an action will result in certain changes or have certain influence. The reach and ambition of goals are affected by efficacy. The understanding of and effect of

socio-structural (i.e., environment, resources, other individuals, institutions) aspects are also influenced by the strength of an individual's efficacy. Similar to other descriptions of efficacy, the formative aspects can be by-passed, with efficacy able to have a direct impact on behavior.

Change and problem solving for issues impacting groups of people is not completed on the individual level. Individuals are supported by resources around them, and the consideration of collective-efficacy helps to clarify aspects of individuals working together. **Collective-efficacy** generally is described as similar to self-efficacy but at the collective scale. It can be seen both as an extension of self-efficacy (Zaccaro et al., 1995) and as a representation of shared community values (Bandura, 2000b). There is iterative feedback between the self and the group and both must be considered in community actions.

Lasker & Weiss (2013) assert that communities cannot fix their problems until they fix their problem solving process. Not only do community members have the right to be involved in decision making and action, but community level problems are too complex to not be solved cooperatively (Lasker & Weiss, 2013). Proponents of collaborative action tout the benefits of decentralized decisions making and the strengthening of community that results from the development of informal and formal networks (Armitage, 2005). Collective action and decision making can lead to a wider range of involved stakeholders and the development of new relationships, trust, and understanding (Mandarano, 2008).

Consideration of the relationship between self- and collective-efficacy, as a moderator of both community capacity and collaborative action, may provide insight into opportunities and challenges to community level action for management of natural resources. The matrix approach described in this guide facilitates the iterative process between the self and collective and is structured to present opportunities for discussion that will highlight socio-structural factors, goals, expected outcomes, and potential behaviors.

## **Appendix M: Event Invitation Example**

## Event Invitation Example

Greetings,

We would like to invite you to a half day workshop on “Building Community Resilience to Extreme Weather Events”. The objective of this workshop is to develop a set of recommended actions for decision makers of the lower St. Louis River watersheds to better prepare the community for climate change and extreme weather. Results of the workshop will be shared with community leaders and decision makers. This builds on work that many of you previously have participated in.

Researchers from NRRI and UMN will present initial findings from a recent study that integrates hydrologic modeling of climate scenarios and green infrastructure in Duluth watersheds with a social assessment of decision-maker perceptions of community understanding and preparedness for a future climate. One of our key findings was that there is considerable uncertainty in prioritizing actions and applying data and research to the decision-making process. Workshop participants will engage in activities to prioritize management practices that balance impact with the effort of implementation. Your participation will help reduce uncertainty, and will result in meaningful actions that will enhance community resilience.

We welcome your participation in this effort! If you would like more information about the workshop or the study on extreme weather response and perceptions, please contact me. Also, feel free to share this invitation with any of your colleagues that may be interested; the number of participants will be capped at 40.

Thank you,

### Workshop Details

Location: 4<sup>th</sup> floor conference room

Date: February 23, 2017

Time: 8:30 – 12:00

Light breakfast refreshments will be provided

Please RSVP to email@email.edu by Friday February 10

*\*\* Thank you to Minnesota Sea Grant for supporting this work\*\**

## **Appendix N: Coding Framework**

Each group discussion and the full group discussion were reordered and coded for discussions on the action items and on collective-efficacy, self- efficacy, and place attachment.

Table 12. Action Item Coding

Action Item Coding
1a - Encourage multijurisdictional planning
1b. Facilitate watershed scale planning
1c - Incorporate best climate science into planning and development processes
1d - Provide planning and training for emergency response
2a - Involve non-traditional groups in decision making (i.e., low income individuals, non-recreationist community, school district representatives)
2b- Educate public on risk and responsibility via increased communication
2c - Increase accountability for implementation of planning
2d - Facilitate homeowner action and preparedness
3a - Increase protection and restoration of natural water systems
3b - Further climate and extreme weather research on local impacts
3c - Reduce resource dependence & use (i.e., energy, water, minerals)
3d -Provide up-to-date information for resource management (FEMA maps, invasive species info)
4a - Replace aging infrastructure and right-size new infrastructure
4b - Develop sustainable alternative energy sources
4c - Develop viable public transportation options
4d - Prioritize green over grey infrastructure when applicable



Table 13. Theoretical Framework Coding

Theoretical Framework Coding	Description
<b>Self-efficacy</b>	perceived beliefs of an individual in his or her ability to control or influence external demands and personal functioning (Luszczynska & Schwarzer, 2005)
Expected outcomes	the belief the person has that an action will result in certain changes or have certain influence
Goals	The result or achievement that an individual aims for
Socio structural	environment, resources, other individuals, institutions that might affect an individual and their ability to perform a behaviour
<b>Collective-efficacy</b>	A group's belief in its ability to perform effectively (Lindsley et al., 1995)
Collective expected outcomes	The belief a group has that an action will result in certain changes or have certain influence
Collective goals	The result of achievement that a group aims for
Collective socio structural factors	Environment, resources, other individuals, institutions that might affect a group and their ability to perform a behaviour
<b>Sources of Efficacy</b>	Mechanisms in which efficacy is built or diminished
Physical and emotional states	Effect of an interpretation of mental and physiological well-being on perceived efficacy and ability (Bandura, 2000b; Huh et al., 2014)
Mastery	Cognitive, behavioural, and self-regulating tools developed via success and failure in action (Bandura, 1995)
Modelling	Process of observing similar others as they succeed or fail and developing a sense of efficacy from that observation
Verbal persuasion	Encouragement or dissuasion by others related to ability to perform a behaviour

## **Appendix O: Results Spread Sheet Excerpt**

1a - Encourage multijurisdictional planning			1b. Facilitate watershed scale planning			1c - Incorporate best climate science into planning and development processes			1d - Provide planning and training for emergency response			action 1 priority	
priority	difficulty (3H, 2M,1L)	Impact (3H, 2M,1L)	priority	difficulty (3H, 2M,1L)	Impact (3H, 2M,1L)	priority	difficulty (3H, 2M,1L)	Impact (3H, 2M,1L)	priority	difficulty (3H, 2M,1L)	Impact (3H, 2M,1L)	average	median
2	2	2	3	2	2	8	3	2	5	3	2	4.5	
5	2	2	7	2	2	3	2	2	16	1	1	7.75	
7	2	2	2	2	3	1	2	3	12	1	3	5.5	
3			12			5	3	2	7	2	2	6.75	
4	1	3	10	1	3	1	2	3	5	1	3	5	
4.2	1.75	2.25	6.8	1.75	2.5	3.6	2.4	2.4	9	1.6	2.2	5.9	
4	2	2	7	2	2.5	3	2	2	7	1	2	5.25	
10	2	2	9	2	2	5	2.5	2.5	6	1	2	7.5	
2.92689			3.97073			2.71416			4.50555			1.35708	
6	2	2	2	2	3	8	2	2	9	1	1	6.25	
1	2	3	3	2	3	5	2	3	15	3	1	6	
6	2	2	5	3	3	12	1	2	2	2	3	6.25	
3	1	3	1	2	3	6	2	2	12	2	2	5.5	
9	1	3	14	2	3	5	1	3	15	1	3	10.75	
5	1.6	2.6	5	2.2	3	7.2	1.6	2.4	10.6	1.8	2	6.95	
6	2	3	3	2	3	6	2	2	12	2	2	6.75	
2	1.5	3	3	2	3	4	1.5	3	14	1	3	5.75	
3.01662			4.76095			2.94392			5.03653			1.98116	
3	2	2	3	2	2	11	1	1	2	2	2	4.75	
6	2	2	3	2	2	9	2	2	13	1	3	7.75	
1	2	3	3	2	3	6	3	2	11	3	1	5.25	
1	2	3	1	2	3	10	2	2	11	1	1	5.75	
11	3	3	3	3	3	2	3	3	16	2	3	8	
4.4	2.2	2.6	2.6	2.2	2.6	7.6	2.2	2	10.6	1.8	2	6.3	
3	2	3	3	2	3	9	2	2	11	2	2	6.5	
1	2	3	1	2	3	5	2	2	7	2	3	3.5	
4.02078			1.0328			3.43026			4.89898			1.75119	
4.53333	1.85	2.48333	4.8	2.05	2.7	6.13333	2.06667	2.26667	10.0667	1.73333	2.06667		
4	2	3	3	2	3	6	2	2	11	2	2		
4.33333			4.33333			4.66667			9				
3.32143			3.25482			3.02945			4.81369				
3.29441													

Figure 26. Results Spread Sheet Excerpt

## **Appendix P: Study 1-page Flyer**



## Community Climate Readiness Study: Duluth, Minnesota

Researchers from the University of Minnesota's Department of Forest Resources are meeting with local stakeholders to better understand community responses to water resource impacts and to build climate readiness in coastal communities. This study is part of a broader research and outreach project funded by Minnesota Sea Grant that integrates water and social science to assess and enhance coastal community resilience under extreme weather events. The broader project is led by the Natural Resources Research Institute at University of Minnesota Duluth.

The community study area is the Duluth and Hermantown communities within the Mission and Miller Creek Watersheds. Interviews and focus groups are being conducted with local actors, community leaders, and land use/water resource professionals. Specifically, the study investigates

1. *Local perspectives on community assets, community needs, environmental planning, and water conservation programming and*
2. *The adaptive capacity of communities, community leaders, and land use/water resource professionals—their ability to anticipate and respond to climate-related impacts*

Interview and focus group data will be combined with water and land use impact models to help communities anticipate and respond to future climate-related impacts, including extreme weather events. Results and recommendations will be shared with community leaders, educators, and resource professionals in interactive workshops.

*Project timeline Oct 2014-Oct 2016*

### **Comments, questions, or want to participate?**

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