Collaborating for Climate Change Adaptation Planning at the Watershed Scale: A Case Study of the Resilient Mystic Collaborative

A thesis submitted by

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Abstract

This study explores watershed-based collaboratives for climate change adaptation planning and uses the Resilient Mystic Collaborative (RMC) as a critical case. Conducting research as a participant observer, the author compiled the case study using observation notes, interviews, GIS mapping and a survey of collaborative members. This study compares the progression of the RMC with current frameworks on watershed-based collaborative development from both outcome- and process-oriented approaches. Analysis reveals collaborative advantage in early RMC action. It further identifies challenges and opportunities offered by the RMC's approach to adaptation, including sustainable funding for the collaborative; stakeholder resources required to participate; watershed-wide stormwater data collection and analysis; the role of the public; and building relationships. A possible capacity paradox is identified: the collaborative may expand available resources, but staffing and other demands of collaborative participation may prove difficult for under-resourced communities in the watershed. Recommendations for further study are offered.

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Glossary

CCC: Cape Cod Commission

DCR: Massachusetts Department of Conservation & Recreation (state agency)

EPA: United States Environmental Protection Agency (federal agency)

MAPC: Metropolitan Area Planning Council (regional planning agency)

MVP: Municipal Vulnerability Preparedness Program (state grant program)

MyRWA: Mystic River Watershed Association

RMC: Resilient Mystic Collaborative

RTWN: Resilient Taunton Watershed Network

SFRCCC: Southeast Florida Regional Climate Change Compact

SRPEDD: Southeastern Regional Planning & Economic Development District (regional planning agency)

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A Case Study of the Resilient Mystic Collaborative

Introduction

Although a global phenomenon, climate change presents different concerns for different communities; in New England, an increase in the intensity and frequency in precipitation is a significant problem (Hamilton, Wake, Hartter, Safford, & Puchlopek, 2016, p. 919). With aging stormwater infrastructure, this additional influx of stormwater is already presenting a challenge for many communities in the Boston area, particularly urbanized communities that have large amounts of asphalt and other impervious cover that intensify stormwater flows.

Like many climate change impacts, increased precipitation presents challenges for municipalities because the nature of the problem is truly cross-jurisdictional: land use decisions in an upstream community can severely impact stormwater flooding in a downstream community. This growing understanding of the interconnected nature of climate change impacts is leading to more regional, collaborative approaches to climate change adaptation planning. However, defining the most effective scale for doing this work remains challenging. Watersheds serve as natural boundaries for stormwater flows, but are rarely governed by one administrative body. Even when efforts at the watershed level are made in the United States, they usually exist in the form of watershed associations, which are typically non-profit organizations with limited authority.

The Mystic River Watershed Association (MyRWA) in Massachusetts, however, has taken on the task of climate change adaptation planning at the watershed scale. As the most densely populated watershed in Massachusetts, the Mystic is heavily developed; more than half of its land is impervious cover. To respond to the growing need for watershed-level climate adaptation planning—particularly in light of severe flooding in metro Boston in early 2018—it has brought

municipal stakeholders together to tackle climate change adaptation planning collaboratively. After some initial stakeholder interviews, the resulting Resilient Mystic Collaborative (RMC) began to meet in September 2018.

This thesis explores the early work of the RMC. The following research question frames this study: *To what extent does collaboration at the watershed-level allow for the creation of regional climate change adaptation strategies that overcome barriers to the multi-jurisdictional stormwater problems intensified by climate change?*

After explaining my methods in chapter one, I establish the context in which the RMC has developed by explaining the need for watershed-level climate change adaptation planning in New England, as well as the collaborative approaches that have been practiced and studied for approaching environmental management problems. I also provide three examples of collaboratives that address climate change planning or stormwater management to demonstrate the unique nature of the RMC.

Following Robert Yin's methodology for compiling a single, exploratory case study, I then present a case study on the RMC, including a description of the Mystic River Watershed and its watershed association. This is followed by a description of the first four meetings of the RMC based on personal observations, interviews with the collaborative facilitators and founders, survey responses, and the working documents created and utilized by the collaborative. After analyzing the development of the RMC in light of the contextual literature reviewed in chapter two, I draw conclusions about the unique nature of climate change adaptation planning at the watershed scale and describe some challenges and opportunities of using this approach.

Overall, I hope that this document will further the conversation on the ways in which communities are responding to the challenges posed by climate change, and that it will serve as a useful record of the early work of the Resilient Mystic Collaborative for others who hope to use a similarly collaborative, watershed-based approach.

I. Case study methodology: A critical case

My central research question for this study is: *To what extent does collaboration at the watershed-level allow for the creation of regional climate change adaptation strategies that overcome barriers to the multi-jurisdictional stormwater problems intensified by climate change?* In table 1, I outline the sub-research questions that I pursued in order to explore my central research question, as well as the corresponding methods that I used for each sub-question. The methods are explained throughout this chapter.

Table 1. Research matrix for this study, including sub-research questions and corresponding methods.

PURPOSE	QUESTION	METHOD
Establishing context: Understanding current trends in climate change adaptation planning, watershed planning, and collaboratives	• At what scale is climate change adaptation planning currently done? • What is the typical role of the watershed association in regional climate change adaptation planning and/or stormwater management? What other roles do they serve? • How are collaboratives defined in the literature? What frameworks are used for evaluating the evolution, progress and success (or failure) of collaborative planning? • What are some examples of collaborative planning for climate change adaptation and/or watershed management? *After choosing a few that seem the most relevant:* What obstacles have these collaboratives faced and what strategies have they used to overcome those barriers, if any?	⇒ Literature review
Why the collaborative was formed:	• What are MyRWA's motivations for forming the collaborative? • What problem(s) are they hoping to address?	⇒ Interviews: Collaborative facilitators/founders

Understanding the benefits of the collaborative model, the intentions of the founders/facilitators, and who was invited to participate	• Why did they choose to form a collaborative to tackle the problems they've identified? How are these problems beyond the capacity of any one organization? • Is the collaborative based on any precedents? If so, which ones, and why did these groups/models appeal to the facilitators? • What stakeholders were invited to participate? What factors influenced MyRWA's decisions on whom to include or not include? • What steps did they take to contact stakeholders? What benefits of the collaborative did they present to stakeholders to attract participants? Were any stakeholders resistant or hesitant to participating and if so, what was their response?	⇒ Secondary analysis of collaborative documents
Why the collaborative was formed: Understanding motivations for participating or for not participating	• Which groups accepted the invitation, and which did not? Did the groups that refused the invitation provide rationale for their decision? • What social and/or environmental factors may have influenced the decision to participate or not? • For those who decided to participate, what are they benefits of participating that they foresee? Do they have past experiences with climate change adaptation planning, or with watershed-scale projects, and if so, how did these experiences influence their decision to participate?	⇒ Interviews: Collaborative facilitators/founders ⇒ Survey ⇒ Focus area: Mapping the Mystic River Watershed
How a collaborative works: Understanding benefits and challenges of collaboration	• Why do participants feel the collaborative is an appropriate model for addressing climate change adaptation at the watershed scale? • Do they have any past experiences working in a collaborative? How did these experiences influence their decision to participate? • How many current or past relationships exist between stakeholders? What form do these relationships take—collaborating on other projects, advising each other on other initiatives, etc.? Have interactions between groups outside of the collaborative increased, remained the same, or decreased since the start of the collaborative? These interactions may include contacting each other for support on other projects, working collaboratively on joint projects, connecting them with relevant stakeholders, etc.	⇒ Survey
How a collaborative works: Understanding benefits and challenges of	• What were/are the goals of your group? • Do you feel that these goals were met/are being met? Through what indicators can you determine that they have been met?	⇒ Interviews: Leaders of model groups identified as precedents

collaborative model experienced by similar groups (precedents)	• What steps did you and the group at large take to meet these goals? • What barriers did these groups face in their early days, and what steps did they take to overcome them?	
How a collaborative works: Understanding leadership challenges in a collaborative and facilitation strategies	• How much of your work time do you devote to planning the collaborative? • What factors do you consider when planning the agenda for each meeting? • What are your strategies for encouraging/promoting/inciting collaboration and productivity at each meeting? • What resources did you use to develop these strategies—past experiences, current literature, etc.?	⇒ Interviews: Collaborative facilitators/founders
How a collaborative works: Defining success for the RMC and its watershed-scale	• What problems has the group identified? What goals have they set to address these problems? • Have they identified action steps necessary to meet these goals? If so, what are they? • Through what mechanisms will they determine these goals have been met, if any? • Are any of their goals specific to the watershed-based nature of the collaborative? What are the benefits and challenges of having members of the same watershed address the identified problems?	⇒ Interviews: Collaborative facilitators/founders ⇒ Observations of collaborative meetings ⇒ Secondary analysis of collaborative documents
How a collaborative works: Understanding benefits and challenges of collaboration	• To what resources does the collaborative have access? Who is providing these resources? • Are these resources unique to the collaborative, or would the individual actors be able to access these resources without participating in the collaborative? • Do these resources benefit some stakeholders more than others? • How long are these resources expected to last?	⇒ Interviews: Collaborative facilitators/founders ⇒ Observations of collaborative meetings ⇒ Secondary analysis of collaborative documents ⇒ Survey
Comparing adaptation approaches: Benefits and challenges of current climate change adaptation models to compare with watershed-scale adaptation models	• Which municipalities have completed the Municipal Vulnerability Preparedness (MVP) Program?[1] • Does participating in the RMC address any problems that arose during the MVP process that they could not address as an individual municipality? If so, what are these problems, and how is the RMC addressing them?	⇒ Survey ⇒ Observations of collaborative meetings ⇒ Secondary analysis of collaborative documents ⇒ Focus area: Mapping the Mystic River Watershed

[1] A grant program run through the Massachusetts Executive Office of Energy & Environmental Affairs to assist municipalities in assessing their vulnerability to climate change impacts and in climate change adaptation planning. This will be further explained in chapter two.

A. Case study model

Main research method: Single case study

To answer my research question, I use a single case study. According to Robert Yin (1994), a single case study is appropriate (1) when the case study "represents the *critical case* [emphasis added] in testing a well-formulated theory", (2) when it is an "*extreme or unique case*" [emphasis added], or (3) when the opportunity to perform a case study has never before been available to science—what Yin calls a "*revelatory case"* [emphasis added] (Yin, 1994, pp. 38–40). Studying the Resilient Mystic Collaborative (RMC) to better understand how climate change adaptation can be done collaboratively at the watershed scale is an example of Yin's first reason: a critical case. While there are few examples of collaboratives working towards climate change adaptation at the watershed scale in the same manner as the RMC, there are no case studies documenting their work. In chapter three, however, I will compare the early formation of three other collaborative projects to the progress of the RMC to enrich my analysis and provide context.

Exploratory nature of case study

Because the RMC is a critical case that is still in its early stages, I cannot make any propositions or hypotheses about the efficacy of the collaborative (Yin, 1994; Streb, 2010). Therefore, instead of explaining or identifying causal relationships, this study is necessarily an exploration of the functioning of the collaborative and its watershed-based approach to climate change adaptation planning. Since exploratory cases often tackle topics that have not been previously studied extensively, it makes sense that these studies often lay the groundwork for future study, at which point causal statements can be tested (Streb, 2010).

A note on completeness

According to Yin (1994), an exemplary case study should be as complete as possible. In other words, a case study cannot be declared "done" simply because the academic semester is over (p. 148). While the completion of this thesis is bound by the limits of an academic year, the development of the RMC was timed well for this study. The RMC's first meeting took place on September 26, 2018, and while they will continue to meet indefinitely, they established their governance strategy and the division of working groups on January 16, 2019. Because these initial meetings mark the first three stages of the collaborative process as described by Bentrup (2001), this study will present a complete analysis of the RMC's early development.[2]

B. Focus Area: Mystic River Watershed

To establish the geographical context for my case study, I used the ESRI geographical information systems (GIS) software, ArcMap, to map the Mystic River Watershed and some of its key characteristics. Data layers and their sources are outlined in table 2.

Table 2. Data layers and corresponding sources for maps created for this study.

DATA LAYER	SOURCE
Municipal polygons (TOWNS_POLY)	Massachusetts Bureau of Geographic Information (MassGIS)
Major watersheds (WATERSHEDS_POLY)	MassGIS
Water bodies (HYDRO25K_POLY)	MassGIS
Census tracts (CENSUS2010TRACKS_POLY)	MassGIS
Regional planning agencies (RPAS_POLY)	MassGIS
Social vulnerability index	United States Center for Disease Control
Median household income	American Factfinder, United States Census Bureau
Municipal data, including FY18 budget and number of staff	Municipal Databank from the Division of Local Services, Commonwealth of Massachusetts
Municipalities that have participated in the MVP Program and the Resilient Mystic Collaborative	Executive Office of Energy & Environmental Affairs, Commonwealth of Massachusetts

[2] See chapter five for this analysis.

C. Observing the Resilient Mystic Collaborative as a participant

As an intern for the City of Medford's Office of Energy & Environment, I initially began attending RMC meetings as a participant, accompanying Alicia Hunt, Medford's Director of Energy & Environment. Once I decided that I would be studying the RMC, my role shifted and I became a participant-observer.

According to Jorgensen (1989), there are several determining factors that make participant observation the most appropriate method for a particular case study. These include: (1) the research question is centered around human interactions viewed "from the insiders' perspective", (2) the subject of the case study is something observable, accessible by the researcher, and limited in scope so that it is appropriate for a case study; and (3) the research questions can be adequately addressed by a case study using "qualitative data gathered by direct observation and other means pertinent to the field setting" (p. 13). Jorgensen (1989) further notes that "participant observation is especially appropriate for exploratory studies" (p. 13).

Each of these factors applies to this study. First, I hope to better understand the collaborative planning process (based on "human interaction") as it pertains to the RMC. Second, RMC meetings are limited in time and space, and were accessible to me first as a municipal intern, and then as a researcher. Finally, because my case study is exploratory, the kind of qualitative data that I gathered from observations provided the appropriate kind of information needed to answer my research questions.

Jorgensen (1989) emphasizes the importance of taking detailed notes as a participant observer (p. 96). Once I had decided to use the RMC as a single case

study, I ensured my notes were detailed and comprehensive, capturing direct quotes when possible (Jorgensen, 1989, pp. 96–100).

My role as a participant observer was overt: I informally announced my decision to study the RMC in January 2019, and sent out a more formal email announcement in February 2019.[3] While it is difficult to tell if this announcement changed any individual's behavior during meetings, it did not appear to have any significant impacts as meetings after February were not markedly different from the earlier meetings.

Both before and after announcing my role as a participant observer, I participated in the meetings in a variety of ways. I participated in "ice-breaker" group activities, and, during the first meeting in September, I communicated Medford's priorities for the collaborative in my role as proxy for my supervisor. During the November meeting, when reviewing the draft "vision and initial priorities" document, I contributed my opinion on ensuring that the watershed-nature of the group was emphasized in this document. I also contributed my opinion on the group name during this meeting.[4] During the January and February meetings, my participation was limited; I introduced my survey during the February meeting and encouraged participants to take it. In April, I presented my findings to the RMC.

In addition to using my own notes, I also reviewed other documents relevant to the RMC, another important part of participant-observation research (Jorgensen, 1989, p. 22). I was given access to the Google Drive folder of collaborative documents that was made available to all participants. This folder includes the

[3] This process, and all other research methodologies employed in this study, have been approved by the Tufts University Social, Behavioral & Educational Research Institutional Review Board.
[4] This was prior to my decision that I would be using the RMC as my case study.

meeting minutes,[5] the draft "vision and initial priorities" documents, photos from meetings, a list of meeting participants, and climate change vulnerability data.

D. Interviewing collaborative facilitators and model group representatives

To better understand the motivations for and the process involved in the formation of the collaborative, I interviewed Ms. Julie Wormser, the Deputy Director of MyRWA, and Ms Carri Hulet, Senior Mediator at the Consensus Building Institute. Ms. Wormser, along with Dr. Patrick Herron, the Director of MyRWA, developed the concept for the RMC after speaking with individuals whom she had identified to be municipal and nonmunicipal "thought leaders" in the watershed. Ms. Wormser leads every RMC meeting in collaboration with Ms. Hulet, whom MyRWA hired as a facilitation consultant for the RMC.

I met with Ms. Wormser and Ms. Hulet during one of their regular meetings at which they prepare for upcoming RMC meetings. I asked Ms. Wormser and Ms. Hulet the questions outlined in table 2. I took typewritten notes during this series of interviews, capturing direct quotes where possible. Any direct quotes that I have referenced in this document have been approved for use by Ms. Wormser and Ms. Hulet.

I also interviewed two individuals about the Cape Cod Commission and the Resilient Taunton Watershed Network, groups identified as being similar to the RMC. To learn more about the Cape Cod Commission, I spoke with Mr. Scott Horsley, part-time lecturer in the Urban & Environmental Policy & Planning and co-owner of Horsley Witten Group, an engineering and environmental consulting firm based on Cape Cod. I also spoke with Mr. Bill Napolitano, an environmental planner at the

[5] Meeting minutes were taken by MyRWA staff member Ms. Amber Christoffersen and collaborative facilitator Ms. Carri Hulet.

Southeastern Regional Planning & Economic Development District. Mr. Napolitano was one of the original coordinators for the Resilient Taunton Watershed Network. I asked Mr. Horsley and Mr. Napolitano the questions outlined in table 2, and any direct quotes that I have referenced in this document have been approved by Mr. Horsley and Mr. Napolitano.

E. Survey

I created and distributed a survey to RMC members in order to gather data on their motivations for participating in the RMC, their previous experiences working in a collaborative setting, and their experience of the RMC thus far. This survey was created using Qualtrics. I asked Ms. Wormser to distribute the survey via email to the collaborative in the days leading up to the February 27th meeting. I also provided the collaborative members with an information sheet that explained the purpose of the survey and the elements of consent as dictated by the Tufts University Institutional Review Board. After the February 27th meeting, I sent an email reminding collaborative members to take the survey, followed up by a final email one week later. By March 15, 2019, 18 out of 23 collaborative members responded (a 78% response rate).

II. The adaptation challenge: Coping with the effects of climate change on stormwater in New England

A. Climate change challenges for stormwater management in New England

Climate change is no longer discussed in the future tense alone—its impacts are being felt *now*. One of the primary impacts of climate change in New England is an increase in precipitation intensity. Between 1958 and 2010 in the Northeastern United States, "there was a 70 percent increase in the amount of precipitation that

fell on the days with the heaviest precipitation,"—the highest precipitation increase in this timeframe throughout the country (City of Boston, 2016).

Such a change in precipitation rates challenges the essential assumption of stationarity (Mailhot & Duchesne, 2010), "the idea that natural systems fluctuate within an unchanging envelope of variability" (Milly et al., 2008, p. 573), which has severely negative ramifications for New England's stormwater management. Most development within the last fifty years throughout the eastern United States has been designed and built based on precipitation averages that the US Weather Bureau published in a 1961 report (Todd, Harbor, & Tyner, 2006; Durrans & Brown, 2001). While more recent studies have provided updated data (Durrans & Brown, 2001), such as the study by the Northeast Regional Climate Center at Cornell University, current state regulations in Massachusetts only require that the 1961 data be considered for current design and construction (Massachusetts Department of Environmental Protection, 2015). If developers are using outdated data when considering how stormwater will be managed on their property, then public stormwater infrastructure will certainly be overwhelmed during intense storms—stormwater infrastructure that, in this region, can date as far back as the nineteenth century (Mikovits, Rauch, & Kleidorfer, 2018; Water Infrastructure Finance Commission, 2012).

With aging infrastructure and a reliance on pre-climate change precipitation data, severe stormwater flooding is inevitable in this region (Mailhot & Duchesne, 2010; Wernstedt & Fanny, 2014; Berggren, Mats, Viklander, & Svensson, 2012). Severe precipitation flooding can have detrimental physical, environmental, social and economic consequences that will be compounded in areas that will also experience sea-level rise and riverine flooding. Some of these impacts are illustrated in figure 1.

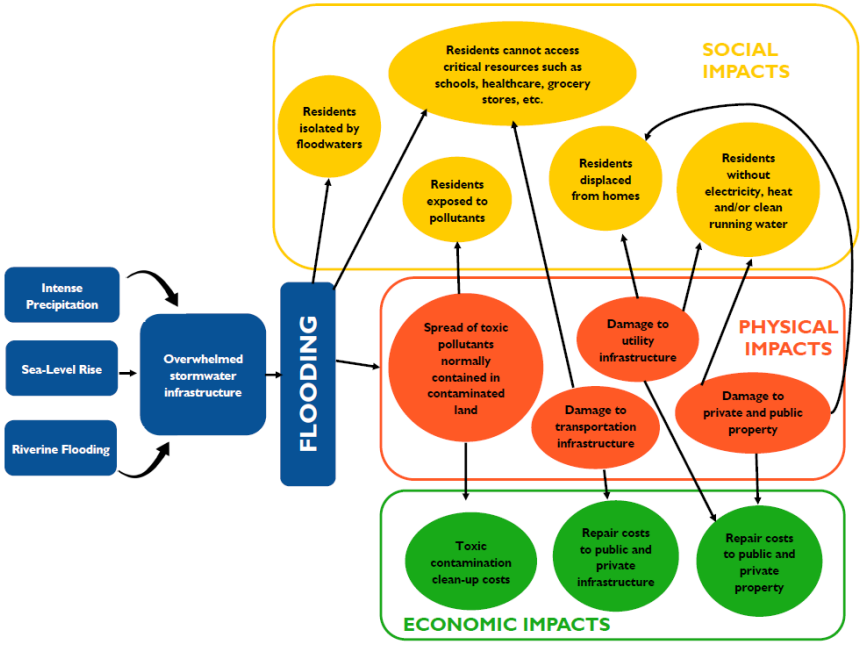


Figure 1. Diagram of the physical, social and economic impacts of flooding. Please note that this is not comprehensive. Graphic format adapted from *Kick the Habit: A UN Guide to Climate Neutrality*, 2009.

While a full analysis of the impacts of flooding are beyond the scope of this study, it is important to understand the breadth and severity of these impacts in order to understand the importance of climate change adaptation. The recognition that adaptation is now imperative is growing amongst policymakers and planners at all levels of government, from international to local (Preston, Mustelin, & Maloney, 2015). The question of *how* adaptation is achieved, however, is hotly debated.

B. Current paradigms: Adapting to climate change at what scale?

There is an exhaustive body of literature that explores at what scale climate change adaptation happens, should happen, and should not happen. Preston et al. (2015) explore the use of the popular phrase "adaptation is local" in such literature, and found that more literature argues in favor of local adaptation than against it. In the United States, municipalities are granted primary powers by state legislatures to engage in planning efforts, to tax residents, to regulate land use, and more, so actions that address adaptation will necessarily happen at the local level (Bennett & Grannis, 2017; Betsill & Bulkeley, 2006). In 2018, Massachusetts began the Municipal Vulnerability Preparedness (MVP) Program to provide grant funding and some resources (including baseline climate change projections) for municipalities to begin assessing their climate vulnerability and to engage in adaptation projects (Massachusetts Executive Office of Energy and Environmental Affairs, 2018).

While local governments have a wide range of powers that allow them to respond to the need for climate change adaptation planning, they do not operate in a vacuum. Urwin and Jordan (2008) explore the interactions between and influences of national policy on local governance. Many argue that, indeed, local adaptation necessitates support from different levels of government (Amundsen, Berglund, & Westskog, 2010; Measham et al., 2011), as there are many barriers that local governments face when it comes to climate change adaptation, including "lack of information, staff capacity, political leadership, and funding" (Shi, 2019, p. 262).

Because climate change adaptation pervades all sectors and levels of government—posing many strategic challenges—Shi (2019) explains there is a growing predominance of climate change adaptation planning at the metropolitan regional scale. A regional approach provides municipalities with access to more

financial and technical resources for adaptation planning, and allows municipalities to converse with each other about cross-boundary climate change impacts (Bennett & Grannis, 2017). Results from a 2013 survey of 350 municipalities around the globe suggest that the most successful adaptation planning efforts were achieved through "building [regional] collaborative networks" (Aylett, 2015, p. 14).

Of course, while regional adaptation planning is growing in popularity, it maintains its share of challenges. Primarily, unlike municipalities, regions are not a consistently well-defined, governing body. Through most of the United States, a region could be defined by a county which typically has a seat of government, but this is not consistent throughout the country: New England has notoriously weak county government. A region may also be defined by the jurisdiction of a metropolitan planning organization or a council of government, a water management district, a public health authority, a transit agency, the coverage area of a utility, and more (Bennett & Grannis, 2017; Shi, 2019), further complicating the question of where to draw the line.

C. Current paradigms: Watershed associations

One way to define a region for climate change adaptation planning is within a watershed. A watershed is commonly defined as the land area from which water drains into a receiving body of water and is delineated according to points of high elevation. Within a watershed, precipitation creates stormwater that either permeates into the ground to recharge the water table, or flows over land until it enters the principal waterbody within the watershed, such as a river (Arnold, 2010).

Historically, it has been recognized that watersheds are a helpful spatial unit for managing water quality and the natural environment in general. An early and prominent example surrounds the Danube River. In 1921, most of the countries that

border the Danube River signed a treaty to establish "a commission to review all of the proposed hydraulic works in the river and allow implementation of only those not interfering with free navigation" (Gregersen, Ffolliott, & Brooks, 2007, p. 50), which later grew into other treaties and resolutions to protect the Danube's water quality. Recognizing the watershed as an economically and environmentally beneficial unit for coordinating planning efforts has only gained momentum since the latter half of the twentieth century with the inception of integrated watershed management, or IWM, in the early 1990s (Wescoat & White, 2003; Gregersen et al., 2007).[6]

Despite the development of IWM, planning at the watershed scale has some significant challenges. Most obvious, perhaps, are political; watersheds can be made up of many municipalities, counties, states, or even countries, like in the Danube watershed. Therefore, there is typically no regulatory power at the watershed level. There are minimal exceptions; New Hampshire, Minnesota, and Kansas have bestowed regulatory power on "watershed districts" to varying degrees. Kansas watershed districts have some taxing authority, while New Hampshire watershed districts can influence land use and zoning decisions that may impact water quality (State of New Hampshire, 2011; Kansas Division of Conservation, 2018; Office of the Revisor of Statutes, 2018). Watershed associations are common throughout the country as non-profit organizations that work to support this natural region. While they can support the planning efforts of other governing bodies and advocate for the watershed's well-being, they have no regulatory or planning authority by right (Kruel, Herst, & Cash, 2018).

[6] Other terms seen in the literature to describe this approach include integrated catchment management and integrated river basin management (Gregersen, Ffolliott, & Brooks, 2007).

In some cases, IWN strategies have been used to address climate change adaptation. In Oregon, the Resource Innovation Group published their report, "Towards a Resilient Watershed: Addressing Climate Change Planning in Watershed Assessments" in 2012 as a guide for watershed associations (Vynne, Adams, & Gregg, 2012). There is also a climate change adaptation plan for the Taunton River watershed in southeastern Massachusetts (Plocinski, 2012), in addition to continuous resilience efforts for this watershed coordinated through the Southeastern Regional Planning and Economic Development District (which are more fully discussed in chapter three). As a part of their cooperative efforts around the Danube River, the European Union has engaged in watershed-based climate change adaptation planning that is more strongly rooted in policy, unlike in the United States: the EU mandated that the International Commission for the Protection of the Danube River create a "Strategy on Adaptation to Climate Change" in 2012 for the watershed (International Commission for the Protection of the Danube River, 2018).

While practitioners and some policy makers (at least in Europe) are thinking about climate change adaptation planning at the watershed scale, it is not widespread. Because municipalities have the political ability to implement climate change adaptation planning measures but have limited capacity, collaborative networks of municipalities within the same watershed offer a solution, which I will discuss in the following section.

D. Current paradigms: Collaborative approaches to planning

Collaboration as a solution

In the 1990s, collaboration for environmental management in the United States emerged as those in the field grew frustrated with top-down policies that stemmed from the environmental laws passed in the 1960s and 1970s, and the resulting policy "gridlock" (Kenney, McAllister, Caile, & Peckham, 2000). As Kenney et al. (2000) note,

> Watershed initiatives are among the most obvious expressions of the community-based environmental protection (CBEP) movement…based on a 'community/collaborative model' of action that is fundamentally different than many of the 'traditional' modes of decision-making, particularly regulatory and litigation-oriented approaches to policy design and implementation. (p. 11)

Thus, the interdisciplinary nature of problems faced by watersheds and the necessarily holistic nature of solutions lends itself to a collaborative framework. Climate change is equally interdisciplinary and in need of holistic solutions, necessitating collaboration (Emerson & Murchie, 2010). In this section, I will further explore why collaborative networks may be an effective solution for addressing climate change adaptation at a watershed scale, as well as how collaboration is defined and described in the literature.

Defining collaboration

Collaboration happens across various sectors, fields, and in a wide variety of capacities. There are many different terms that are used throughout academic literature—"collaborative," "network," "partnership," etc.—that all refer to a similar concept: when multiple actors representing themselves as individuals, groups or organizations engage with each other to address a common goal or goals (Popp, Brinton, MacKean, Lindstrom, & Casebeer, 2014). While these terms can stand alone

to describe relationships between actors, they are often used to describe a decision-making process, a management style, and/or a kind of governance (Popp et al., 2014, p. 18). This kind of process within the realm of public policy and planning is often penned as "collaborative public management", the term that I use in this chapter (Emerson, Nabatchi, & Balogh, 2012; McGuire, 2006).

The *collaborative advantage*

The goals of collaborative public management are often to address complex problems that a single actor cannot address alone (McGuire, 2006, p. 33) and that typically defy traditional management mechanisms such as government bureaucracies (Weber & Khademian, 2008, p. 336; McGuire, 2006, p. 34). Literature often refers to this concept as *the collaborative advantage* (Vangen & Huxham, 2003). It therefore makes sense that collaboratives are a growing method of environmental management, including climate change adaptation and watershed management.

How collaboratives work: Formation and leadership

The leadership of a given collaborative and the kind of relationships fostered amongst its members depend on the impetus of the collaborative. It may have been mandated by a government agency or it may have emerged organically. Similarly, it may be formal or informal (Popp et al., 2014; Connelly, Zhang, et al., 2008).

Whether a collaborative is legally binding or not, scholars frequently cite "trust" as a key component for collaboration (Popp et al., 2014; Klijn, Edelenbos, & Steijn, 2010; Provan & Kenis, 2008). Keast et al. (2004) explain that "informal power based on interpersonal relations can be more important than formal power" (p. 365). It is particularly advantageous if collaborative members already have established relationships before beginning their collaborative work, but regardless

of preexisting connections, the manager or leader of the collaborative can facilitate trust between all members through the actual work of collaboration (Keast, Mandell, Brown, & Woolcock, 2004).

How collaboratives work: Evolution

From their inception to their conclusion, collaboratives tend to follow a similar evolutionary process. Selin & Chavez (1995) outline five steps typically experienced by collaboratives focused on environmental management: *antecedents*, *problem-setting*, *direction-setting*, *structuring* and *outcomes*. This process may occur in iterative cycles, as the outcomes may result in a rethinking of the collaborative or the forming of another collaborative altogether.

In his 2001 article, Bentrup revised Selin & Chavez's model for application to watershed planning, which is shown in figure 2. He adds an important element to Selin & Chavez's original diagram that is critical for a collaborative's sustainability: the "acquiring or redirecting of resources" (Bentrup, 2001, p. 746). Without consistent funding, the collaborative process could fall apart at any stage.

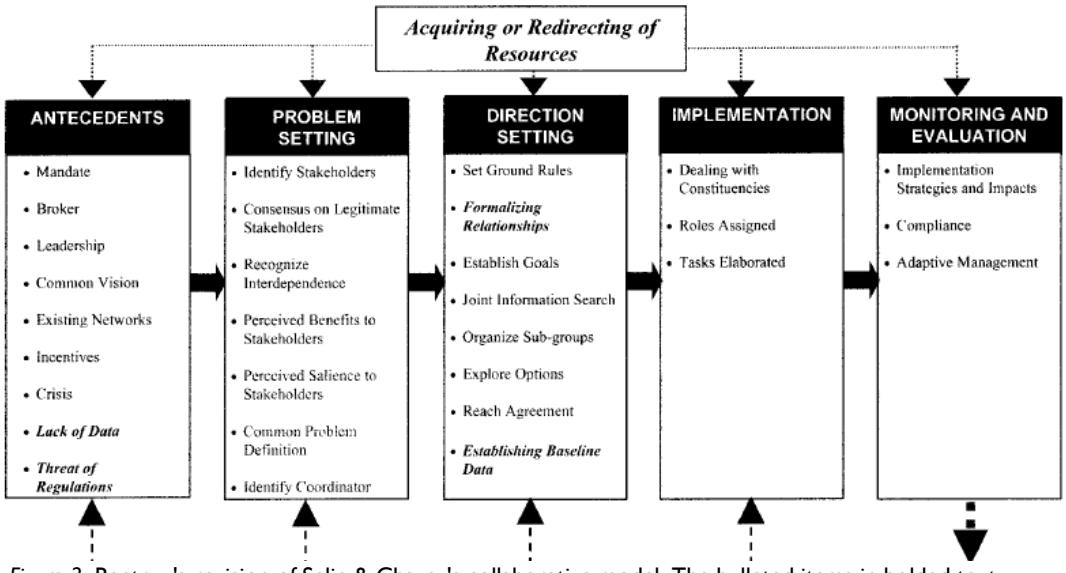


Figure 2. Bentrup's revision of Selin & Chavez's collaborative model. The bulleted items in bolded text represent Bentrup's additions to the model. Source: Bentrup, 2001.

Analyzing collaborative effectiveness: Outcome and process

Understanding the effectiveness of a collaborative can be simplified if using an outcome-oriented approach: has the collaborative achieved the goals that it was formed to achieve? What it means to accomplish a goal depends on the nature of the goal(s) itself and whether the collaborative has chosen indicators that will demarcate an accomplishment. In this sense, the group itself must decide what outcomes would demonstrate long-term success for them and what short-term outcomes they can achieve to reach this overall vision (Popp et al., 2014).

The functioning of the collaborative process itself can also provide insights on its overall effectiveness. Popp et al. (2014) provide a helpful chart in their literature review on interorganizational networks (figure 3) to guide a multi-level analysis of any collaborative network, providing process-oriented factors to

Level of analysis	Description	Sample outcomes
Individual	Assessment of the impact that the network has on the individuals who interact in the network on behalf of their respective organizations and on individual clients.	• Increased job satisfaction • Increased capacity • Increased client satisfaction with services • Improved client outcomes
Organization	Assessment of the impact that the network has on member organizations, as the success of network members is critical to overall network effectiveness.	• Agency/organization survival • Enhanced legitimacy • Resource acquisition • Improvement in referrals
Network	Assessment of the network itself can have a variety of foci, many of which depend on the relative maturity of the network. The strength of relationships across the whole network is always an important focus.	• Network membership growth • Relationship strength • Member commitment to network goals
Community	Assessment of the contributions that the network makes to the community it was established to serve.	• Better integration of services • Less duplication of and fewer gaps in services • Services provided at lower cost to the community • Positive policy change • Improved population-level outcomes

Adapted from: Provan & Milward, 1995; Provan & Milward, 2001; Hill, 2002

Figure 3. Levels of analysis in interorganizational network evaluation. Source: Popp et al. 2014

consider about the collaborative's progress outside of its actual outcomes. This is particularly helpful for evaluating a collaborative at any stage, which they frame as critical: "…evaluation should commence as soon as the network is up and running…given the importance of using early process evaluation results to inform ongoing network development" (p. 74).

III. The search for examples of collaborative planning for climate change adaptation at the watershed scale

In the previous chapter, I reviewed literature on climate change adaptation planning, watershed management, and collaborative networks in order to frame the analysis of the case study on the Resilient Mystic Collaborative (RMC). While there are studies of collaboratives for watershed management (Sullivan, White, & Hanemann, 2019; Compagnucci & Spigarelli, 2018; Serra-Llobet, Conrad, & Schaefer, 2016; Koebele, 2015), of collaboratives for regional climate change adaptation planning (Shi, 2019; Betsill & Bulkeley, 2006; Amundsen et al., 2010; Green, Leonard, & Malkin, 2018), and on integrating climate change adaptation into watershed management (Pahl-wostl, 2007; Binder, 2006), it is rare for a collaborative to combine watershed planning and climate change adaptation planning in the way that Mystic River Watershed Association (MyRWA) is doing.

Based on recommendations from the RMC facilitators and my own research, I have selected three interorganizational networks—the Southeast Florida Regional Climate Change Compact, the Cape Cod Commission, and the Resilient Taunton Watershed Network—to serve as examples of groups that share some, but not all, traits of the RMC in order to provide further context for the development of this unique collaborative.

A. The Southeast Florida Regional Climate Change Compact

In an interview, Ms. Wormser highlighted the SFRCCC as a model for the RMC (personal communication, February 7, 2019), as this is a well-established climate change group that also focuses on the environmental impacts of land use planning and urban development. However, it is not specifically focused at the watershed scale.

Southeast Florida is particularly vulnerable to sea-level rise and the increase in storm severity and frequency due to its extensive coastline, flat landscape, abundant wetlands and high population density (Shi, 2017, p. 54). This region responded earlier than many others in the United States to these climate change impacts, as Miami-Dade County helped to found ICLEI Local Governments for Sustainability, a prominent network-based organization in the field. Miami-Dade County even had a carbon reduction plan by 1993 (Shi, 2017, p. 62). Despite these early efforts in Miami-Dade, climate change did not become a state-wide priority for another fifteen years when Florida adopted a statewide climate action plan that led to the rise of sustainability-related offices in many local governments (Shi, 2017, p. 62).

In this supportive political atmosphere, the SFRCCC began in 2009 after representatives from Miami-Dade County, Palm Beach County and Broward County traveled to Washington D.C. to speak with legislators about the impacts of climate change in southeast Florida and to advocate for the American Clean Energy and Security Bill. However, it became apparent that all three counties were using different climate data, so legislators recommended that the counties coordinate to develop stronger *regional* data. The three counties went on to establish SFRCCC that December, joined by neighboring Monroe County (Shi, 2017, pp. 62–63).

Besides establishing consistent and high-quality baseline data, the initial goals of the SFRCCC counties included: creating a Regional Climate Action Plan, promoting integration of climate change adaptation and carbon mitigation into regional plans and policies, organizing a large conference, and advocating for state and federal funding. The group was largely successful in accomplishing each of its goals. The 2011 election of Governor Rick Scott posed challenges for climate change adaptation planning in Florida since he focused predominantly on economic growth and has reversed many of his predecessor's climate change related policies (Shi, 2017, p. 23). However, the SFRCCC is continuing its collaborative work in regional climate change adaptation planning even though it "has neither legal power to enforce any of the planning recommendations it develops, nor fiscal power in its own name" (Shi, 2017, p. 63).

B. Cape Cod Commission

The Cape Cod Commission (CCC) was also highlighted by the RMC facilitators as a model agency for its regional approach to stormwater management, even though the CCC is not devoted specifically to climate change (J. Wormser, personal communication, February 7, 2019).

Cape Cod is a delicate coastal ecosystem on a Massachusetts peninsula that sustains a dense summer tourist population, and is highly vulnerable to climate change impacts. Geologically, the peninsula is mostly made of sand and is host to a single-source aquifer, meaning all drinking water on the Cape comes from the same source. The peninsula experiences significant water quality problems, particularly nitrogen loading, due to the prevalence of septic systems (US EPA, 2018).

In the 1980s, Cape Cod experienced a development boom which concerned residents and ultimately influenced the creation of the CCC. Unregulated growth had

already been leading to environmental degradation and decreased water quality. The regional agency at the time, the Cape Cod Planning and Economic Development Commission, began the initiative "Prospect: Cape Cod" to think about regulatory strategies to control this growth and restore environmental quality to the Cape's delicate natural resources ("About CCC: History," 2019). In 1988, a moratorium was placed on development while regulations were being considered. That same year, Barnstable County was granted "home-rule authority" by the Massachusetts legislature, meaning it could create regulations as a county so long as they did not conflict with any existing state or federal regulations.[7] Both of these legislative actions laid the groundwork for the 1990 Cape Cod Commission Act, establishing the CCC as the regional regulatory and planning agency for Barnstable County (Lipman & Geist, 2011).

The CCC has several planning initiatives for managing water quality on Cape Cod: the Cape Cod Water Protection Collaborative and the Section 208 plan, Project STORM (Stormwater Outreach for Regional Municipalities), the Cape Cod Ocean Management Plan, and the Regional Wastewater Management Plan. The Cape Cod Water Protection Collaborative is a group of municipal representatives specifically dedicated to managing water on Cape Cod with hopes of "protect[ing] Cape Cod's shared water resources and to provide access to cost effective and environmentally sound wastewater infrastructure" ("Cape Cod Water Protection Collaborative," 2019). They support the development and implementation of the Section 208 plan, a regional water quality management plan mandated by the Environmental Protection Agency (EPA) in upholding the Clean Water Act (S. Horsley, personal

[7] Massachusetts is a "home-rule state" with traditionally weak county government, meaning municipalities have regulatory power. However, counties have very little power, leaving few structures for regional regulation, with the exception of Barnstable County and Dukes County (Martha's Vineyard).

communication, March 8, 2019). Through Project STORM, the CCC assists municipalities in adhering to EPA stormwater regulations and permitting (Cape Cod Commission Technical Services, 2019).

The CCC is a professionally-staffed entity whose reach clearly extends well-beyond stormwater management and climate change adaptation. The alignment of the geography, hydrology and regulatory structure of Cape Cod has given rise to a watershed-based approach to planning that is unique in Massachusetts; the CCC acts like a "watershed association" that *does* have regulatory power, if only because the county achieved home-rule status and its planning agency aligns with watershed boundaries (as seen in figure 4).

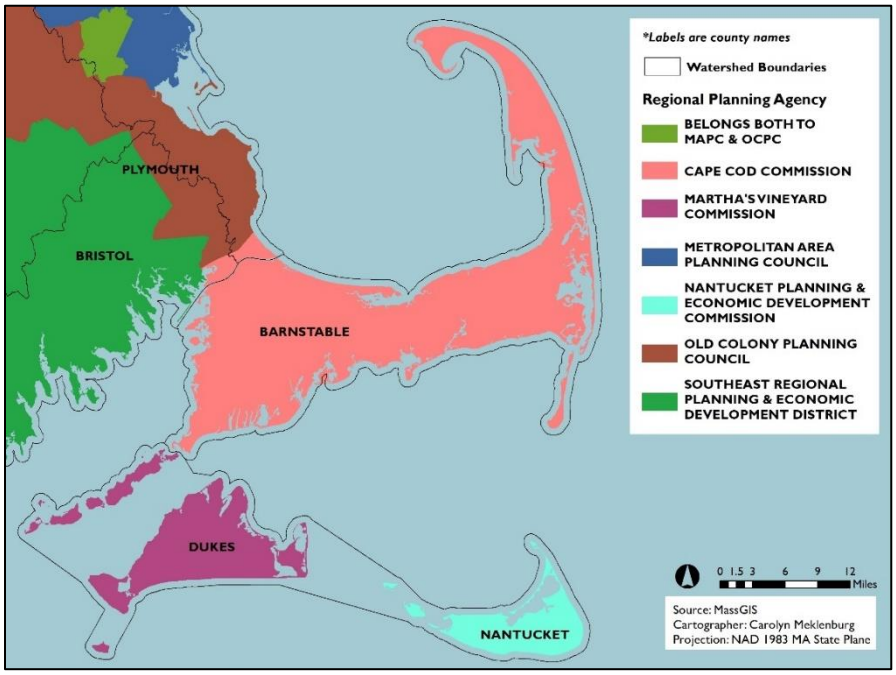


Figure 4. Map showing the alignment of Cape Cod's watershed, county, and regulatory land use commission.

In this sense, the development and achievements of the CCC can offer insights for other groups in Massachusetts who want to take a watershed-based approach to climate change adaptation and stormwater management such as the RMC. According to Mr. Scott Horsley, a previous employee of the CCC's predecessor

(the Cape Cod Planning and Economic Development Commission), public support for controlling growth on the Cape had a significant impact on the ultimate creation of the CCC, despite opposition from development and real estate lobbies. Overall, he notes that the CCC has been largely successful in carrying out its mission of controlling growth (personal communication, March 8, 2019). While it is too early to gauge any improvements in water quality—as this can take decades (S. Horsley, personal communication, March 8, 2019)—it will be important for other regions and watersheds throughout Massachusetts to understand the ultimate impacts of their watershed-based approach as more groups like the RMC develop.

C. Resilient Taunton Watershed Network

The Resilient Taunton Watershed Network (RTWN) was unfamiliar to the RMC collaborative facilitators (J. Wormser, personal communication, April 5, 2019), so it was not cited as a model for the RMC. However, I chose to look at the RTWN because of its striking similarities: it is a collaborative group that addresses climate change adaptation at the watershed scale. The central difference surrounds its core decisionmakers, which are regional planning agencies and non-profit organizations as opposed to municipal employees, which I will discuss later in this section.

The Taunton River Watershed is the second largest watershed in Massachusetts, located south of Boston (B. Napolitano, personal communication, April 4, 2019). When the Southeastern Regional Planning and Economic Development District (SRPEDD) received a Healthy Communities grant from the EPA, Trish Garrigan, the EPA Region 1 Watershed Programs coordinator, brought stakeholders together at Bridgewater University to present on various grant-funded projects that were happening throughout the watershed. The group realized that there was much overlap among their work, and a tremendous opportunity to

collaborate on several projects; while many of these stakeholders had worked together on past projects, there were still a lot of "missed opportunities to collaborate" (B.Napolitano, personal communication, April 4, 2019). SRPEDD, who had joined together with three well-known environmental organizations with a strong local presence—Mass Audubon, the Nature Conservancy, and Manomet—on their own Healthy Communities grant, soon joined with other grantees and organizations in the room to begin what would become the Resilient Taunton Watershed Network.

The RTWN works to address climate resiliency throughout the area from an environmental, economic and social perspective. The larger network acts as a support for nineteen smaller project-based groups. Presently, the RTWN consists of: three regional planning agencies (SRPEDD, MAPC and Old Colony Planning Council), three state agencies (MA Department of Environmental Protection, MA Division of Ecological Restoration, and MA Executive Office of Energy and Environmental Affairs), two federal agencies (EPA and US National Park Service) and eight nongovernmental organizations including a private environmental engineering consulting firm.

The RTWN also interacts with municipalities throughout the watershed on a consistent basis, most notably through their Resilience Roundtables program and their Green Infrastructure/Climate Change workshop program. Through these programs, RTWN members will approach municipal leaders and staff to ask them what they need to better address climate resiliency in their community. After meeting and discussing these needs, the RTWN will create a plan that includes short-term, long-term and ongoing solutions to these resiliency problems. Mr. Bill Napolitano, the environmental planner for SRPEDD and a key RTWN leader, notes

that engaging municipalities was a critical early step in launching their work: "It took one municipal partner to take the first step, and that was Norton, who took part in the first Resiliency Roundtable and also hosted the first RTWN Green Infrastructure/Climate Change workshop sessions" (personal communication, April 4, 2019). Once municipalities saw the ways in which the RTWN helped Norton think about resiliency, others wanted to work with them too.

The RTWN also assists municipalities with the Municipal Vulnerability Preparedness (MVP) program. While this program is municipally focused, RTWN has helped coordinate MVP projects at a regional scale throughout the watershed. Mr. Napolitano notes that even when an MVP project is just for one municipality, the RTWN takes the time to sit with project coordinators to reflect on the regional importance of each project and identify opportunities for future collaboration (personal communication, April 4, 2019).

Mr. Napolitano explained that he felt that the high level of communication between collaborative members is a strong indicator of their success thus far. "It has become so seamless to work together," he said. In addition to monthly meetings that alternate between in-person and via conference call, collaborative members communicate regularly on joint projects or to share grant opportunities and other resources. He describes the group as mutually supportive and committed to the overall work with no regard for individual egos. They are beginning to share their approach and methods with other municipalities and watersheds beyond the Taunton watershed, such as Westport, MA and Narragansett Bay in Rhode Island (B. Napolitano, personal communication, April 4, 2019).

The Southeast Florida Regional Climate Change Compact, the Cape Cod Commission and the Resilient Taunton Watershed Network are all examples of

some combination of successful regional climate change planning and watershed planning. Their development and accomplishments can offer valuable insights for the RMC as it works towards its early goals, which I will examine more closely in the final chapter. In the following chapters, I will explore the RMC as a model for watershed-based climate change adaptation planning.

IV. A case study of the Resilient Mystic Collaborative

After describing the need for collaborative climate change adaptation at the watershed scale, I will now describe the geographical nature of the Mystic River Watershed, the problems it faces, and the ways in which the Mystic River Watershed Association (MyRWA) is working to address these problems through the formation of the Resilient Mystic Collaborative (RMC).

A. Focus Area: Mystic River Watershed, Massachusetts

This research focuses on the Mystic River Watershed, a 76-square mile watershed north of Boston, Massachusetts. As the most densely populated watershed in the Commonwealth, the Mystic River Watershed faces unique challenges regarding stormwater management and climate change adaptation. Proportionally, the watershed has the least amount of open space in the Commonwealth and is expecting even more development in the near future (Burkin, Meaney, Meklenburg, & Sherman, 2018). This implies that a significant portion of the watershed consists of impervious cover which exacerbates stormwater management problems; it does not allow stormwater to sink back into the ground but instead causes it to runoff into the storm drain system. As this infrastructure is quite old and needs to be maintained frequently to function properly, it often backs up, leading to flooding throughout the watershed. GIS analysis reveals that

impervious surfaces cover 56% of the watershed, a percentage which may increase with development.

Because of the tidal nature of the Mystic, flooding as a result of sea-level rise and storm surge is also a significant concern. The Amelia Earhart Dam, installed in the 1960s, currently separates the freshwater Mystic from the saltwater tides of Boston Harbor. However, as climate change brings rising sea levels and more aggressive storm surges, this dam is in danger of overtopping by 2050 (City of Cambridge, 2017). This would bring significant flooding to communities that directly border the Mystic.

The lower Mystic River Watershed contains a high density of critical infrastructure (as classified by the US Department of Homeland Security), including fuel storage for Logan International Airport, the New England Produce Center in Chelsea, and the Amelia Earhart Dam (J. Wormser, personal communication, April 5, 2019). Any flood damage to this infrastructure would seriously threaten transportation, health and safety of the region. The region is also home to many vulnerable populations that may need additional resources to recover from severe

flooding events, including high concentrations of immigrants, low-income households, and limited English-speaking populations (figure 5).

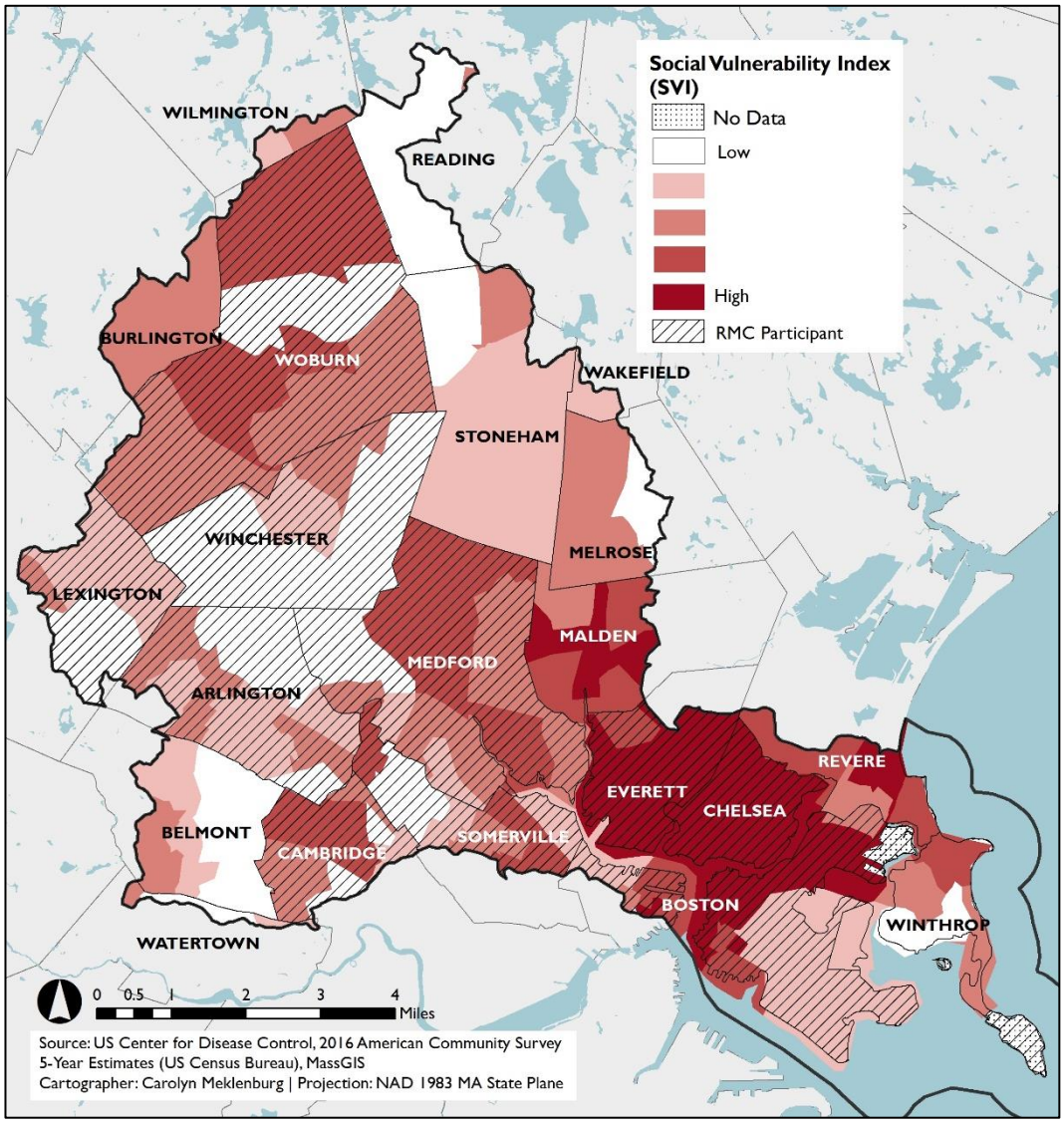


Figure 5. Map of social vulnerability per census tract in the Mystic River Watershed. The US Center for Disease Control has developed this social vulnerability index to assist their work in disaster response. It considers socioeconomic status, household composition, race/ethnicity/language, and housing/transportation.

Municipalities within the watershed vary widely in terms of population and resources available to cope with these challenges. Lower-income households are concentrated in the lower Mystic Watershed, while higher-income households are concentrated in the upper Mystic Watershed (figure 6). Total revenue available to the municipality (figure 7) as well as the ways in which the municipality spends this

revenue on municipal staff (figure 8) may impact its capacity for responding to the climate change impacts that are an increasingly added stress.

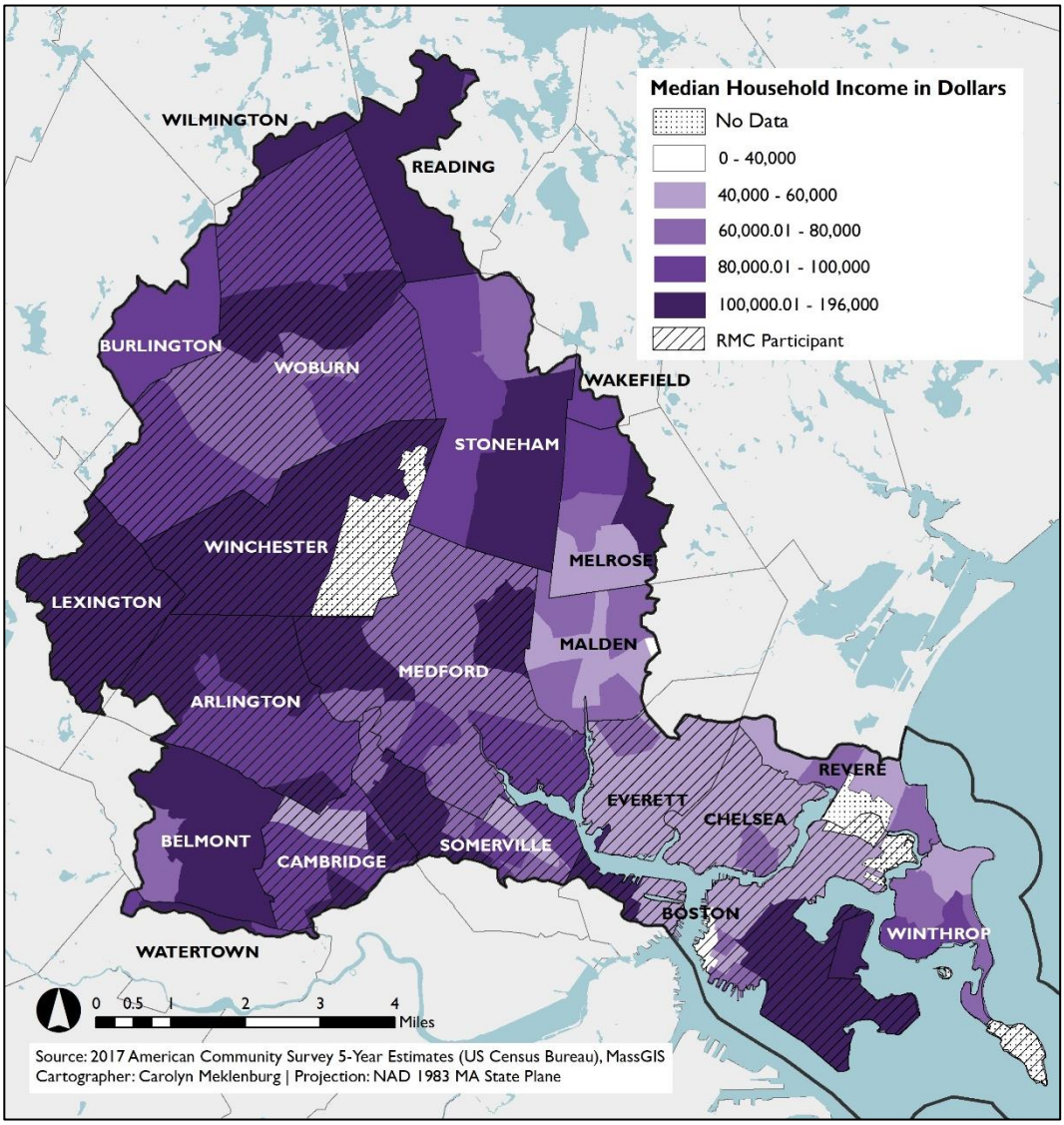


Figure 6. Map of median household income per census tract in the Mystic River Watershed. This offers further insight into the capacity of the residential tax-base in each municipality, as well as how well each municipality's population is equipped to respond to climate change impacts. Source: 2017 American Community Survey 5-Year Estimates, US Census Bureau.

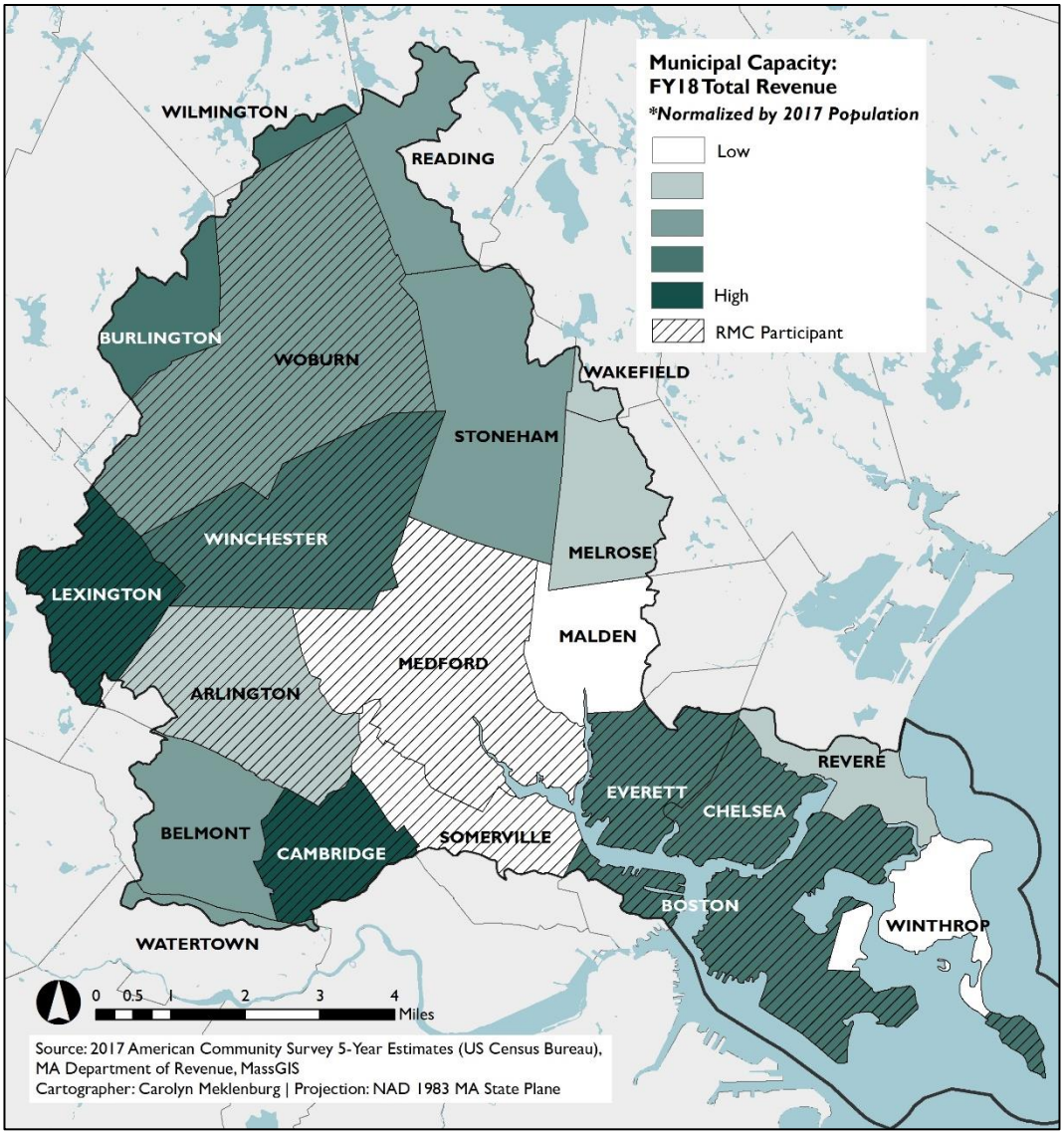


Figure 7. Map of total revenue per capita for fiscal year 2018 by municipality in the Mystic River Watershed. Source: Municipal Databank, Division of Local Services, Commonwealth of Massachusetts.

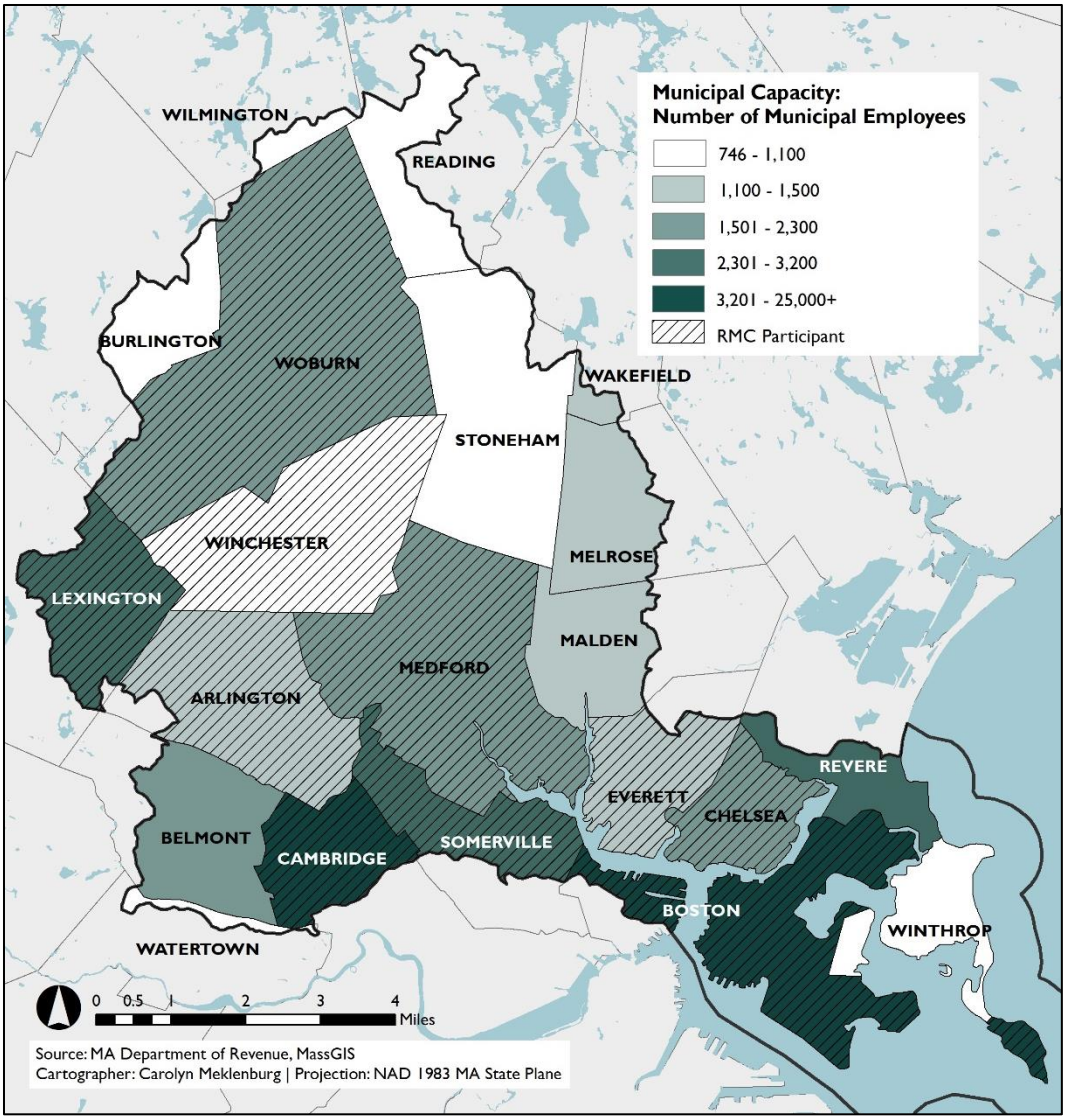


Figure 8. Map of the number of municipal staff members per municipality in the Mystic River Watershed for fiscal year 2018. Source: Municipal Databank, Division of Local Services, Commonwealth of Massachusetts.

The RMC is not the first attempt to address problems in the watershed. Since bacteria and contaminant levels in the Mystic River were high, the EPA spurred the creation of the Mystic River Watershed Steering Committee in 2009, which works "to improve water quality and public access to open spaces in the Mystic River watershed" and "is led by a coalition of representatives from government agencies, municipalities, non-profit organizations, community groups, and others who care about the Mystic River watershed" (US EPA, 2015). However, it is not focused on

climate change adaptation planning. Additionally, the Metropolitan Area Planning Council's Metro Mayors Climate Preparedness Task Force is a climate change collaborative, but the region at which it operates does not align with the Mystic River Watershed boundaries.

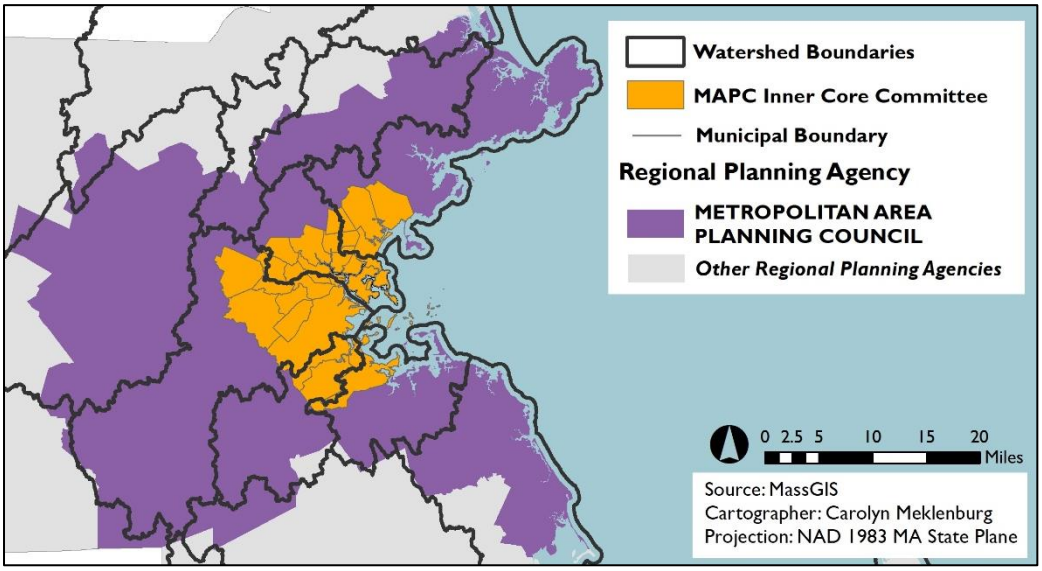


Figure 9. Map of MAPC "Inner Core Committee" subregion, overlaid with watershed boundaries. While the Mystic River Watershed is completely within the overall MAPC region, it is not within the "Inner Core" subregion, which currently hosts the Metro Mayors Climate Preparedness Task Force.

B. MyRWA and climate change

Since 1972, MyRWA has worked to "protect and restore natural resources" in the Mystic River watershed. In March 2019, MyRWA had nine full-time professionals on staff and one AmeriCorps volunteer. The organization monitors water quality, works to reduce the prevalence of invasive riverine plants, and monitors river herring migration up the Mystic River, all with the help of community volunteers. MyRWA also advocates for the completion of the Mystic River Greenway system—25 miles of connected trails along and around the river—and engages the community in educational and recreational programming ("About Us," 2019).

In early 2018 after the Boston area experienced record-setting flooding events, MyRWA approached Ms. Julie Wormser about addressing climate change

adaptation in the watershed due to her extensive experience in developing coastal resilience strategies. Initially, Ms. Wormser was hired as a consultant, and worked with MyRWA's director, Dr. Patrick Herron, to interview stakeholders in the watershed to inquire what kind of assistance they would like from MyRWA for addressing climate change adaptation. This group of stakeholders consisted of:

- Municipal planning, engineering, and/or environmental staff members from watershed municipalities,
- Local experts on climate change adaptation,
- Staff from state and regional government,
- Private sector representatives who work in the watershed, and
- Non-profits representing local environmental and social interests.

Ms. Wormser explained in an interview that stakeholders suggested multiple concrete actions that became the basis for the RMC's draft workplan. Several municipalities encouraged MyRWA to help communities work together on on-the-ground projects; each stakeholder felt that they were facing obstacles to climate change adaptation initiatives that could be better addressed in a collaborative setting. In a press release from June 2018, Dr. Herron explains that they "heard over and over from cities and towns that they can't manage flooding from just within their municipal boundaries" ("Mystic River Watershed Association Goes All In on Climate Resilience," 2018).

Ms. Wormser explained that coordinating collaboration between these stakeholders was a way for MyRWA to provide facilitative leadership. In an interview, Ms. Wormser reflected on the role of non-profit advocates: "We're not regulators. Our work is really about bootstrapping the collective vision and power of multiple communities to make change" (personal communication, February 7, 2019).

Establishing the RMC

Once Dr. Herron and Ms. Wormser agreed that forming a watershed-wide collaborative was the best approach for addressing climate change adaptation, they had several important steps to address: 1) procuring funding, 2) inviting stakeholders and 3) coordinating the facilitation and logistics of meeting as a collaborative.

Funding: The Barr Foundation. MyRWA applied for and received a grant from the Barr Foundation to hire Ms. Wormser to lead their climate change adaptation work, which is focused around this watershed collaborative. In a press release about Ms. Wormser's position, Mary Skelton Roberts from the Barr Foundation's Climate Program expressed their interest in supporting this kind of collaborative, multi-jurisdictional work:

> The Barr Foundation's climate resilience grantmaking has historically focused on Boston. Yet, we know climate change is no respecter of city boundaries. If some act in isolation, neighboring communities could actually become more vulnerable. It is our privilege to support MyRWA's efforts to advance solutions at a more expansive, watershed scale. ("Mystic River Watershed Association Goes All In on Climate Resilience," 2018)

While this initial grant only extends until June 2019, it was enough to jumpstart the Resilient Mystic Collaborative.

Inviting stakeholders. While there are 21 municipalities within the Mystic River Watershed, Ms. Wormser initially reached out to ten communities that she identified as early adopters when it comes to climate change planning, and as particularly vulnerable to flooding: Arlington, Boston/East Boston, Cambridge, Chelsea, Everett, Lexington, Medford, Somerville, Winchester and Woburn. As of March 2019, each of these municipalities have also participated in the Municipal

Vulnerability Preparedness (MVP) Program.[8] Ms. Wormser explained in an interview that it was important that these initial invitees already had a strong understanding of climate change vulnerabilities so they would be motivated to participate. She further explained that once these initial leaders created a structure and a momentum for the collaborative, it would be easier for the remaining municipalities in the watershed to join who are not as engaged in climate change planning, and/or may not have the staff or financial resources to participate initially. All of the municipalities that she invited responded positively, and agreed to participate (personal communication, February 7, 2019).

Figure 10. Map of municipalities that are participating in the MVP program and in the RMC. Please note that Winchester, while not a designated MVP community at this time, has done extensive climate action planning beginning in 2011 and so was asked to participate in the early formation of the RMC.

[8] Winchester is an exception; they are not yet a designated MVP community as of this writing, but they have been doing climate action planning since 2011.

Ms. Wormser also wanted to include local experts that could offer some helpful technical knowledge that would support and inform the collaborative work. These experts (to whom I shall refer as "nonmunicipal members") are knowledgeable in law, planning, environmental justice, socially vulnerable populations, engineering, climate science, and private sector interests. These invitees were drawn from Ms. Wormser's professional network and were predominantly white with advanced degrees (personal communication, February 7, 2019).

Coordinating to collaborate. MyRWA hired a consultant to assist with planning and facilitating the collaborative, Carri Hulet. Ms. Hulet is a Senior Mediator for Consensus Building Institute, a non-profit in Boston that focuses on promoting leadership for effective problem solving (Consensus Building Institute, 2019). Her mediation experience covers a range of contexts, from energy and transportation to climate change and local land use planning (C. Hulet, personal communication, April 25, 2019).

As of April 2019, Ms. Hulet and Ms. Wormser meet regularly to plan future collaborative meetings. Planning for these meetings and providing all necessary support for the RMC's work is the primary focus of Ms. Wormser's job. This is one of many facilitative projects under Ms. Hulet's charge. Ms. Hulet explained in an interview that she focuses on creating a productive environment for the group, making sure physical needs are met and integrating activities that engage participants intellectually, physically, and emotionally, where appropriate. She works to keep meetings focused, considering what absolutely must get done during a meeting and what kinds of work and research can be done outside of the meeting (J. Wormser and C. Hulet, personal communication, February 7, 2019)

C. Early collaborative meetings: September 2018 – January 2019

In late August 2018, Ms. Wormser sent out a group email with a Doodle poll to narrow down a date for the first meeting, a draft agenda for this meeting, and asked if anyone would be willing to host. She also asked members to begin brainstorming names for the group.

Inaugural meeting: September

Table 3. Key features of September meeting.

When	September 26, 2018, 9:00AM – 11:00AM
Where	Conference room at City Hall, Medford, MA

Meeting Objectives (taken directly from official agenda)	• Kick-off a regional collaborative you want to be a part of
	  o Make it fun and productive
	  o Set and understand process expectations (e.g. participation, our name(!), decision making)
	• Select initial priority projects and initiatives
	• Get to know one another

Distributed Meeting Documents	• Agenda • Mystic Climate Collaborative[9] Process Document: Discussion Draft September 26, 2018 • Possible Regional Climate Resilience Projects in the Mystic

Getting started. Ms. Hulet introduced the first activity, which was a networking "ice-breaker" in which collaborative members were asked to introduce themselves to and exchange business cards with three individuals they did not know well. Members were then asked to create name tags with their name and municipality or organization.

Climate change impacts and concerns. Next, Ms. Wormser gave a PowerPoint presentation on climate change. This included more general information on the causes and global impacts of climate change, as well as the specific vulnerabilities of

[9] Please note that in early collaborative documents, the group is referred to as the Mystic Climate Collaborative. The facilitators used this name as a stand-in until the group chose the name "Resilient Mystic Collaborative" during the November meeting.

the Mystic River Watershed. Ms. Wormser and Ms. Hulet then asked participants to sketch the climate change vulnerability that most concerns them about their specific community. Ms. Hulet collected the drawings and placed them on the wall at one end of the conference table (see figure 11). She asked the group to share what they drew and why; one member shared that they were concerned about the impact of flooding and extreme heat on socially vulnerable populations.

Figure 11. Drawings by collaborative members of the climate change vulnerability of their community that most concerns them. Copyright 2018 by Carri Hulet.

Identifying priorities. Ms. Wormser then directed the group to think about the priorities that came out of the initial conversations they had with her and Dr. Herron, which were summarized into a single document that was distributed to each member. One member emphasized the power of multiple municipalities coming together to talk to utility companies to advocate for more resilient infrastructure. Another member suggested implementing a watershed-wide stormwater utility fee, or compiling information for municipalities interested in creating their own stormwater utility fees. Finally, one member emphasized the importance of focusing on projects with regional impacts, suggesting that each community share their top priority projects to see which projects would be best addressed at a regional scale.

After this discussion, Ms. Wormser asked collaborative members to vote on their top priorities within each of three focus areas: planning efforts, projects, and policy advocacy.[10] First, all members affirmed that approaching this work as a collaborative made sense and was a priority for them and their respective municipalities/organizations; continuing meeting as a group was thus identified as a priority planning effort. The group identified the following as other top priorities in order of importance:[11]

1. Install a fourth pump on the Amelia Earhart Dam (Projects)
2. "Develop a scenario-driven regional stormwater management model" (Planning)
3. "Lobby for changes in state policy and funding" (Policy)
4. Coordinate regional infrastructure and advocate as a region for more resilient infrastructure (Planning/Policy), and
5. Create and implement a regional stormwater utility (Policy)

The group also voted that the completion of the Mystic River Greenway system should be a priority due to its co-benefits as green infrastructure, and that the flanking of the Amelia Earhart Dam is also a concern related to coastal flooding. However, these were not identified as "top" priorities.

Group identity. The next discussion focused on the overall role of the group itself. Group members emphasized the importance of differentiating the actions of this group from those of individual municipalities (who have all already completed vulnerability assessments of their own) and MAPC's Metro Mayors Climate Preparedness Task Force. Other discussion included the importance of a regional focus for the group, and only pursuing projects with widespread regional benefits. While Ms. Wormser asked if anyone had ideas for a group name, no one volunteered any.

[10] Ms. Wormser developed these focus areas from information collected during initial stakeholder interviews.
[11] Language adopted or quoted from summary document distributed at October meeting.

Wrap-up and logistics. Finally, the group discussed logistics. Ms. Wormser reminded the group of the shared folder on Google Drive (which she had previously emailed to the group) for members to share their own vulnerability assessments, any existing stormwater modeling done by municipalities, and other relevant documents. Ms. Wormser also suggested that the group meet two more times before Thanksgiving. Members suggested finding a location that was closer to public transportation. One of the members who works for Partners Healthcare offered to host future meetings since the office is adjacent to a subway stop.

Follow-up. Ms. Wormser distributed an email to the group the next day, containing the meeting minutes, the document that summarized potential priorities that was distributed during the meeting, and a link to a Google Drive folder. She asked members to complete three tasks:

> 1) to fill out an internet poll to narrow down dates and times for the next two meetings,
> 2) to comment on the shared document that lists priorities identified at the meeting to further narrow and prioritize, and
> 3) to confirm which individuals from the municipality/organization should receive her emails.

Members responded quickly, and meetings were scheduled four days.

October meeting

Table 4. Key features of October meeting.

When	October 25, 2018, 9:00AM – 11:00AM
Where	Partners Healthcare, 399 Revolution Drive, Somerville, MA

Meeting Objectives (taken directly from official agenda)	• Start to define the vision, purpose and potential of this collaborative:
	  o What key values help us choose worthy projects?
	  o What criteria do we use to prioritize worthy projects?
	  o What special sauce makes this collaborative worth the effort?
	• With these values and criteria in mind, determine which worthy projects to include in our imminent grant proposals.

	• Begin to build relationships and understanding of each others' local challenges and efforts.
Distributed Meeting Documents	• Agenda • Possible Regional Climate Resilience Projects in the Mystic

Getting started. As members entered the conference room, they took their appropriate nametag before finding a seat. Ms. Hulet led the group in another "ice-breaker" activity.

Identifying shared goals. Ms. Hulet and Ms. Wormser welcomed the group and introduced the first activity: to identify the group's shared values and criteria for prioritizing projects. Collaborative members were asked to write their responses to each question written on the pieces of chart paper placed around the room. The questions and responses were as follows:

1. What will this collaborative accomplish in 1-3 years if it is wildly successful?

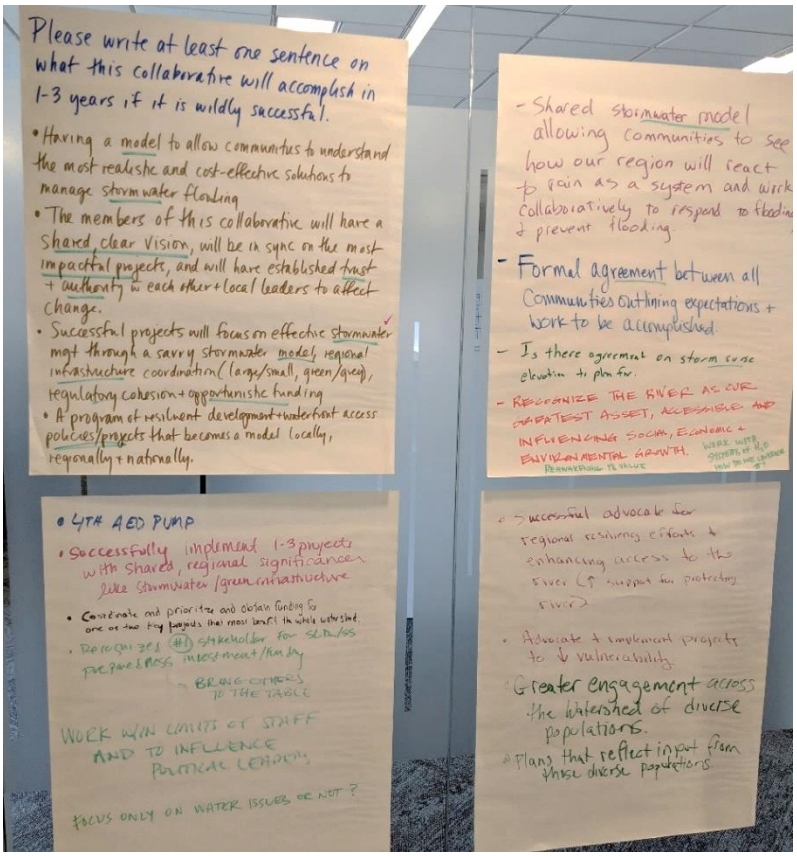


Figure 12. Responses of collaborative members to the prompt, "What will this collaborative accomplish in 1-3 years if it is wildly successful?" Copyright 2018 by Carri Hulet.

In response to question one (figure 12), some members indicated specific outcomes that they would like to see accomplished, such as completing a watershed-wide stormwater model, adding a fourth pump to the Amelia Earhart Dam, and agreeing on baseline climate data. Others emphasized that accomplishing one to three stormwater management projects with regional significance would indicate collaborative success, but did not name specific projects. Some mentioned obtaining funding, while others focused on more process-oriented goals such as creating group cohesion through shared goals and strong, trusting relationships. A few members expressed that a successful collaborative would promote engagement

with the diverse populations of the watershed, while another questioned if the collaborative should focus only on water-related issues. Finally, some wrote that a successful collaborative would promote the overall value of the Mystic River as a natural resource for the watershed as a whole.

2. Think selfishly. If there is just one thing this collaborative does that directly and significantly benefits your municipality in an amazing way, what will it be?

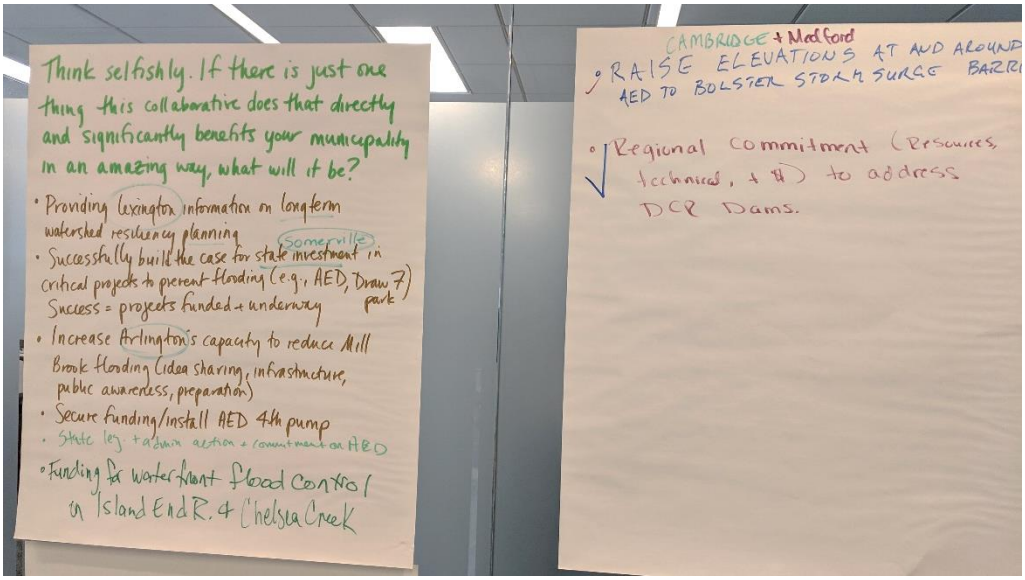


Figure 13. Responses of collaborative members to the prompt, "Think selfishly. If there is just one thing this collaborative does that directly and significantly benefits your municipality in an amazing way, what will it be?" Copyright 2018 by Carri Hulet.

All of the responses to question two (figure 13) were related to flood prevention, whether in relation to specific water bodies or dams, or to data consistency. Six municipalities were mentioned by name in these responses.

3. Now think generously of one other municipality in the collaborative. Which municipality is it, and what do you hope for them?

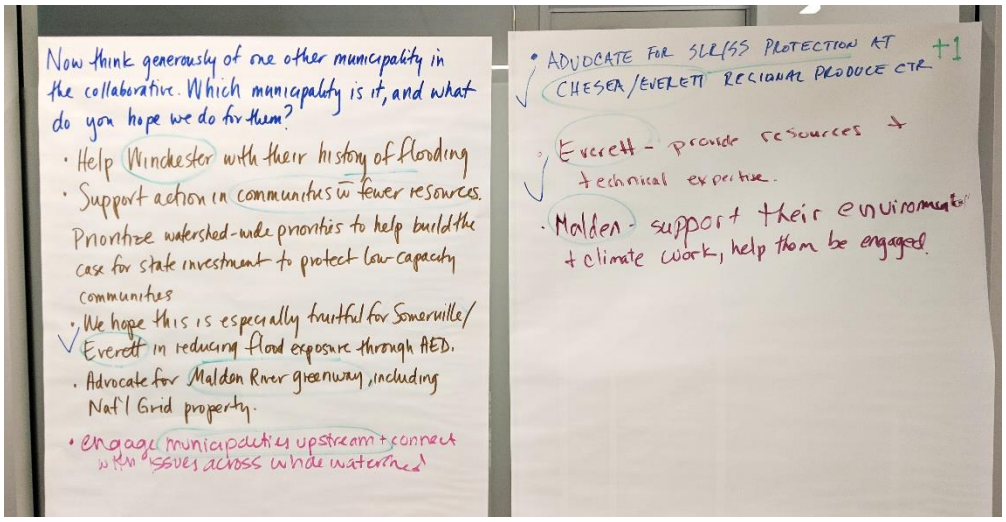


Figure 14. Responses of collaborative members to the prompt, "Now think generously of one other municipality in the collaborative. Which municipality is it, and what do you hope for them?" Copyright 2018 by Carri Hulet.

Of the nine responses to question three, three specifically mention flood prevention, and five mentioned providing support for municipalities with "fewer resources" (see figure 14). Another response mentioned advocating for the Malden River Greenway, and another called for watershed-wide coordination specifically with upstream municipalities. This activity concluded with a brief discussion to review the responses.

Prioritizing actions. Next, the facilitators reviewed possible grant opportunities to fund the priority actions that the group identified, highlighting opportunities from the Barr Foundation and the MVP program. Then, they led the group in discussing these priorities and whether or not the priority would be addressed in the short-term (expressed as "phase 1"), in the long-term ("phase 2"), or not at all. Ms. Wormser presented criteria for prioritizing projects that she and Ms. Hulet had developed, including choosing projects that are "important and/or urgent," work that "cannot be done by any one of the municipalities on its own," projects that are

"exciting/innovative/replicable," and projects that are "not duplicative of other efforts." Priorities were identified as follows:[12]

Phase 1: Ready to develop project teams and seek resources

1. Create a voluntary Mystic River collaborative.
2. Develop a scenario-driven regional stormwater management model.

Phase 1 or Phase 2: Differing opinions on whether we're ready to go

3. Statewide incentives and standards: Advocate for statewide resilience incentives or standards for projects like as-of-right solar and green roof installations, Municipal Separate Storm Sewer System (MS4) bylaws, and updated building codes governing heat, flooding and wind.
4. Living Laboratory: Make the Mystic a living laboratory for green-gray infrastructure pilots to evaluate best practices and lessons learned for flood mitigation and upstream stormwater retention; and/or develop a 25-mile, flood resilient greenway along the Mystic and its tributaries.
5. Regional infrastructure: Work regionally to make key regional infrastructure such as public transit and the electrical grid more resilient.

Phase 2 or No: Need more information before acting, or beyond what we should be doing

6. Regional stormwater funding: Manage stormwater on a regional basis, either through coordinating municipal funding and regulations or through a regional stormwater utility.

Group members identified other possible projects that could be considered in the future, but were not current priorities.

A general discussion surrounding group priorities and project funding followed this more specific prioritization process. This discussion touched upon five major categories:[13]

1) **Collaborative membership.** One group member pointed out that there are no elected officials in the collaborative, and asked the group to consider the advantages and limitations of this. The group also agreed that communities with fewer resources in the watershed should benefit from those communities with greater resources.

[12] Please note this text has been adapted from RMC documents and minutes.
[13] Language adapted from meeting minutes.

2) **Stormwater modeling.** While group members emphasized that a stormwater model that captured the interactions of stormwater across municipal boundaries was necessary to be of significant use to the collaborative, concerns were raised about the complexity and the expense. Other limits to an accurate model discussed included: the presence of private stormwater infrastructure, security concerns about sharing public stormwater infrastructure data, and whether a model could account for the nuances of coastal flooding versus inland flooding. Members with knowledge of and experience with stormwater models offered some insights into these concerns.

3) **Need for a common vision and baseline data.** One group member suggested that it is difficult to prioritize and implement discrete projects without establishing a common vision for the collaborative. Another reminded the group that it is imperative to establish which climate change projections (particularly for sea-level rise) to use in municipal and regional plans within the watershed. Others brought up issues that should be considered when defining the collaborative's common vision, such as differentiating between climate change adaptation and emergency preparedness, and whether the group should focus solely on water or also consider the urban heat island effect. There was a general emphasis on prioritizing projects that will benefit the watershed as a whole, such as regional building codes that account for climate change impacts.

4) **Funding sources and strategies for obtaining funding.** The possibility of obtaining federal funding was introduced because of the high density of critical infrastructure in the lower Mystic watershed, including Logan Airport, fuel storage, the New England Produce Center and the Amelia Earhart Dam. While Homeland Security keeps data on critical infrastructure, this information is not public. The group generally agreed that the regional focus of this collaborative may be an advantage when generally applying for funding.

5) **Public messaging and community engagement**. One member suggested that as the collaborative works to better understand cross-boundary climate change impacts on municipalities, it is important that these interdependencies are communicated effectively to the public, particularly since people in this region are very aware of the goings-on in larger municipalities such as Boston. Another member emphasized the importance of keeping the river as the central focus of the collaborative's work, as it should be framed and communicated as an essential natural resource for the wider community.

Wrap-up and logistics. As the meeting concluded, the group agreed to continue meeting at the Partners Healthcare building and moved the start time for future

meetings to 10:00 AM. Facilitators also encouraged group members to continue to brainstorm ideas for the group name.

Follow-up. The facilitators did not send a specific follow-up email, but they did send a reminder email the day before the next meeting, with the adjusted time, the meeting agenda, and a link to the shared Google drive.

November meeting

Table 5. Key features of November meeting.

When	November 14, 2018, 10:00AM – 12:00PM
Where	Parnters Healthcare, 399 Revolution Drive, Somerville, MA
Meeting Objectives (taken directly from official agenda)	• Review key expectations regarding governance of the collaborative • Confirm plans for MVP and Barr Grants • Settle on list of "emerging projects" and identify possible working groups • Settle on a collaborative name
Distributed Meeting Documents	• Agenda • Draft Vision and Priorities Mystic Climate Collaborative Meeting: October 25, 2018

Priority projects and funding opportunities. After short introductions and another "ice-breaker," Ms. Hulet and Ms. Wormser reviewed the meeting agenda with the group. Ms. Wormser began by reviewing the grant opportunities from the Barr Foundation and the MVP Program in more detail. She then asked the group to review the list of potential projects that had been created and refined during the last two meetings, as the project list needs to be finalized before moving forward with any grant applications. The group was given time to review this list individually and to write down any edits or suggestions, which they then discussed.

Collaborative governance. Next, the collaborative facilitators asked the group to individually review the draft governance document developed by Ms. Wormser and

Ms. Hulet, and write down their edits individually. Ms. Hulet and Ms. Wormser then facilitated a discussion on these suggestions.

Finding a name. Finally, the facilitators led an activity to brainstorm and agree upon a group name. Considerations included "collaborative" versus "coalition," the inclusion of the word "climate" in the name, conveying the action-oriented nature of the group through the name, and ensuring the name stands out from other local group names. After narrowing the list down and a final vote, the name "Resilient Mystic Collaborative" was chosen.

Follow-up. Ms. Wormser emailed the group after the Thanksgiving long weekend with a link to an online survey. The purpose of this survey was "to agree to or edit [the] proposed governance structure [discussed at the meeting] to avoid spending a full meeting doing so in person" (J. Wormser, personal communication, November 23, 2019)

Holiday break between meetings

Due to the holidays, there was a large gap between the November and January meeting. However, there was still ample communication between Ms. Wormser and the collaborative via email. She shared the results of the governance survey with the group in mid-December, as well as other relevant articles and resources, including:

- News about the 2018 national climate assessment and recent data on climate change impacts in the Northeast,
- Data collected by the US Geographical Survey on the levels of the Mystic River during the 2018 nor'easters,
- An advocacy letter for municipalities in the watershed to sign to demonstrate to state agencies that they support improvements to the Amelia Earhart Dam,
- Additional funding opportunities for municipalities, and
- Recent sea-level rise data compiled for MyRWA.

January meeting

Table 6. Key features of January meeting.

When	January 16, 2019, 10:00AM – 12:00PM
Where	Partners Healthcare, 399 Revolution Drive, Somerville, MA
Meeting Objectives (taken directly from official agenda)	• Continue building agreement on coalition governance • Form working groups
Distributed Meeting Documents	• Agenda

Getting started. This meeting began with another "ice-breaker" activity. Ms. Wormser then reviewed the agenda and thanked members for completing the governance survey after the November meeting.

Funding opportunities. After this introduction, Ms. Wormser provided the group with updates on grant applications. While the MVP Planning Grant applications were now open, she emphasized that the MVP Action Grants would be a great fit for many of the project ideas the group had identified. One member asked about the possibility of applying for an MVP Action Grant as a region instead of as a single municipality, which the group agreed would work better for RMC projects. Ms. Wormser explained that the state has expressed interest in regional grant applications, but that every municipality involved would have needed to complete the MVP Planning Grant process in order for the region to be eligible. Ms. Wormser also provided an update on the Barr Grant, as the application date had been delayed until summer 2019.

Amelia Earhart Dam advocacy. Ms. Wormser then provided an update on advocacy for the Amelia Earhart Dam, which she framed as an early success for the collaborative. The support letter that Ms. Wormser had asked every municipal

leader in the watershed to sign in December had led to a meeting with relevant state employees. While nothing had been definitively decided at this time, Ms. Wormser emphasized that it was regional, collaborative support that began this productive conversation.

Mapping regional data. Next, Ms. Wormser announced that MyRWA was in process of developing an online mapping tool to address the lack of consistent, watershed-wide data. Since MyRWA had access to some data from a well-respected consulting group, they started to compile this information for the RMC. Ms. Wormser presented coastal flooding probability maps and coastal flooding depth maps, and asked the group what other data layers they would like to access through this tool. Members raised the following points:

- Is it feasible to include stormwater flooding and stormwater infrastructure data in coastal flood maps? Does this data exist, and if so, could the mapping platform support this level of complexity?
    - Yes, this may be feasible, but only for a limited number of target areas, as one municipality has experience working on this with a consultant.

- It is important to provide clear background information and metadata so anyone would be able to understand the tool since it would be on a public website. (Two members volunteered to work on this background information.)

- MAPC should host this mapping tool on their website since they already host similar mapping tools.

- The following data layers would be useful: flood depth; roads; land parcels; public transit systems; building footprints; streams; water sub-basins; demographics including socioeconomic information, age, and language; community assets (schools, for example); and integration between stormwater flooding data and flood data from the Boston Harbor Flood Resilience Model previously developed by a consulting group.

Governance survey. Ms. Hulet then turned the discussion to the RMC's governance strategy. She used a PowerPoint presentation to show the group the results of the governance survey that had been distributed prior to the meeting. Ms.

Hulet then explained that there were three main questions that received disparate results and required discussion. Those questions and the following decisions made by the group were as follows:

1) Which municipalities will participate in the RMC, and what roles will nonmunicipal organizations play?
    - Now that the original ten municipalities have laid the foundation for the group, all municipalities within the watershed will be invited to participate in the Steering Committee.
    - A process for adding municipalities to the group if they accept the invitation must be developed.
    - A process must also be developed to distinguish which nonmunicipal organizations can participate.
    - Nonmunicipal employees are highly encouraged to be a part of the conversation and contribute their unique perspectives to the Steering Committee, but ultimately, municipal staff will be the ones to vote on any decisions the group will make since decisions may have financial and political impacts for municipal leaders.
    - Project groups, as decided by the Steering Committee, will be more inclusive and can include more nonmunicipal experts than the Steering Committee as appropriate.

2) What is the extent of the commitment expected for members?
    - Municipalities will identify both a primary staff person and an alternate staff person that will attend collaborative meetings.
    - Member municipalities/organizations should be represented at every meeting; if they begin to miss around 20% of meetings, then there should be a discussion with collaborative facilitators about their ability to participate.
    - When it is expected that an important vote will take place at an upcoming meeting, the group will be notified in advance to ensure their attendance and so they can confer in advance with municipal decisionmakers.

3) What does consensus mean for the collaborative when it comes to decision-making?
    - The RMC Steering Committee will vote by consensus on the use of their resources and priority projects.
    - If consensus cannot be reached, at least 80% of the group must agree.
    - If there is a conflict of interest, members can recuse themselves from voting.
    - At the time of this writing, quorum for a vote is 7 out of 10 municipalities.
    - Each municipality will receive one vote, even if more than one municipal staff member attends meetings.

- A process for voting outside of meetings must be established when members are unable to attend voting meetings.
- If a decision made by the RMC will impact municipalities not within the watershed, there will be a discussion to identify a process through which these municipalities can be included.

Forming project groups. Once this discussion was concluded, the group finalized the list of priority projects and agreed on which members would participate in each group. Ms. Hulet wrote the running list of projects on the white board: stormwater modeling, coalition development, policy/advocacy, upper Mystic stormwater management, lower Mystic regional infrastructure resilience, and social resilience. While one member suggested grouping "stormwater modeling" with "upper Mystic stormwater management," it was decided that the groups would remain separate since stormwater modeling may also account for coastal flooding.

Once each project group was agreed upon, members selected the groups in which they would participate. Some volunteered to be the "co-chair" of each group to organize logistics. Ms. Hulet and Ms. Wormser also signed up for groups as "co-chairs."

Wrap-up. Everyone agreed that each project group would meet either in person or have a conference call before the next collaborative meeting on February 27th; Ms. Wormser and Ms. Hulet asked each project group to agree on a meeting date and to report this meeting date back to them before leaving the meeting. To conclude the meeting, Ms. Hulet explained that the next meeting would focus on collaborative learning frameworks so that the group members can understand and learn best practices for collaborating.

Follow-up. A week and half after the meeting, Ms. Wormser distributed the meeting minutes and asked the municipalities who were absent to approve the agreed-upon governance structure and voting procedures.

V. Findings: Understanding the RMC through frameworks on collaboration

Now that I have outlined the progress of the Resilient Mystic Collaborative (RMC) from its initial conception through its most recent meetings, I will use the information I gathered from the survey that I created and distributed to RMC members, my interviews with collaborative facilitators, and my observations to analyze the ways in which the progression of this collaborative aligns with current frameworks on interorganizational networks (as described in chapter two).

As noted, the frameworks that I use to analyze the RMC were developed after studying collaboratives addressing environmental management (in the case of Selin & Chavez's 1995 work), and watershed management (in the case of Bentrup's 2001 work) since there is little work done on the progression of climate change collaboratives at the watershed level. I discuss the ways in which the RMC has experienced the first three stages of collaborative development as described by Selin, Chavez and Bentrup—*antecedent*, *problem-setting*, and *direction-setting*—as well as the overarching stage Bentrup (2001) calls "acquiring or redirecting of resources" (p. 746). I conclude this section by evaluating RMC's success from outcome- and process- oriented perspectives, drawing from the literature gathered in Popp et al.'s 2014 comprehensive review.

A. Tracking the RMC through Selin, Chavez & Bentrup's framework for collaborative development

Stage one: Antecedents

In their 1995 article on collaboratives formed for environmental management, Selin & Chavez explain that the antecedents leading to the formation of a collaborative body can involve a *crisis*, the intervention of a third-party *broker* or mediator, a legal *mandate*, a *common vision*, the will of other *existing networks*,

strong *leadership* that takes the initiative to begin collaboration, and/or some *incentives* to do so (p. 191). Bentrup (2001) agrees, but adds that the *lack of data* and/or the present *threat of regulations* without a mandate can also serve as antecedents to collaborative formation in the cases of the watershed-based collaboratives for environmental management that he studied (p. 746).

While there was no legal mandate for the formation of the RMC—making it an emergent collaborative (Popp et al., 2014)—nor was mediation between watershed municipalities by a third-party broker required due to a standing conflict, I have found evidence of the other antecedents as explained by Selin, Chavez and Bentrup: leadership, crisis, common vision, existing networks, incentives, and the lack of data.

Leadership, crisis, common vision, and existing networks. Selin and Chavez (1995) write, "Collaboration is sometimes championed by a strong leader whose energy and vision mobilizes others to participate" (p. 191), which is certainly the case for the RMC. Ms. Wormser and Dr. Herron were proactive and approached municipalities about their needs (J. Wormser, personal communication, February 7, 2019), so it was their strong leadership that initiated the collaborative process that became the RMC. Two-thirds of survey respondents also indicated that their trust in MyRWA's leadership abilities was a reason that they decided to participate in the RMC (figure 15).

This leadership initiative was heavily influenced by the perceived and acknowledged crisis of climate change impacts, as described in the case study, which simultaneously suggests a common vision among collaborative members and leaders. In the survey conducted for this study, two-thirds of respondents indicated that flooding was a main concern for their municipality, but that solutions to these

problems are necessarily regional and require the collaborative advantage (Appendix A, question 9). Almost all respondents indicated that their municipality or the community that their organization serves is "facing obstacles to climate change adaptation planning that are better addressed at the watershed scale" (figure 15), further emphasizing that in response to these crises, members share a common vision for collaborative work. This shared understanding may have been a result of the MVP process since this encouraged and allowed municipalities to spend time thinking about the impacts of climate change on their municipalities.

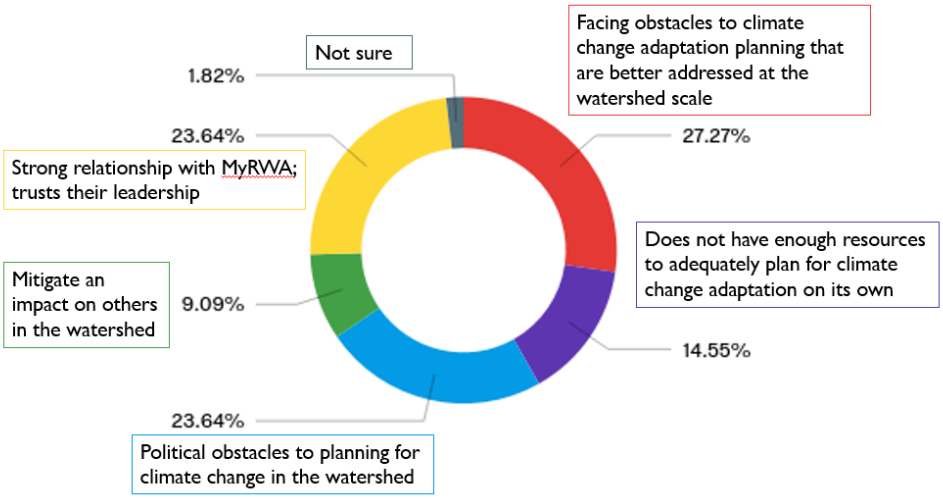


Figure 15. Responses to the survey question, "Please explain why your municipality/organization decided to participate in the Resilient Mystic Collaborative. Check all that apply."

MAPC's Metro Mayors Climate Preparedness Task Force served as an important existing network that also seems to have facilitated the RMC's formation. One municipal employee specifically noted during the October meeting that she felt the meetings were productive and moving quickly because of the trust amongst RMC members from their experience with MAPC. Half of survey respondents indicated that their decision to participate in the RMC was influenced by their experiences in other collaboratives—and three-quarters of respondents said that

they also participate in the Metro Mayors Climate Preparedness Task Force (Appendix A, question 4).

It is important to note that the nonmunicipal employees that participated as topic advisors were also tied through an existing network, although less directly since they were a part of Ms. Wormser's professional network , and had played valuable roles in climate resiliency efforts in the City of Boston (J. Wormser, personal communication, February 7, 2019). While this does not necessarily mean that these individuals had existing relationships with the other collaborative members, their preexisting relationship with Ms. Wormser may have impacted their decision to participate: all nonmunicipal members who participated in the survey for this study selected "I have a strong relationship with the Mystic River Watershed Association, and I trust their leadership" as a reason for their participation.

Incentives. There are no explicit incentives for joining the RMC—municipal staff are not being paid extra to participate—but there are plenty of implicit incentives for collaboration. Ms. Wormser suggests that this may also be a result of the MVP program: by already having received a grant to address climate change vulnerabilities, stakeholders are aware that there are funds available for this kind of work (personal communication, February 7, 2019). More grants are becoming available for regional, collaborative approaches to climate change adaptation, like the Barr Foundation and the MVP program, so it is now in stakeholders' best interests to collaborate.

There are also political benefits to working together, which seemed to be attractive for stakeholders when deciding to participate in the RMC. Thirteen out of eighteen survey respondents indicated that one of the reasons they decided to participate includes, "There are political obstacles to planning for climate change

adaptation in the watershed, and I believe that collective action is the only way to overcome these obstacles." As much of the critical infrastructure in the watershed is owned by the state or other larger entities (like the Amelia Earhart Dam, which is owned by the Massachusetts Department of Conservation and Recreation (DCR)), change can only happen if these agencies are persuaded to take action, and there is likely to be strength in numbers thanks to the collaborative advantage.

There are other political and administrative benefits to working collaboratively as a region, especially regarding building and zoning codes. While individual municipalities can make their own policy changes,[14] any changes in zoning or building codes to incorporate resiliency in one municipality might spur developers to simply move to a neighboring municipality to avoid compliance. Thus, this kind of policy change would need to be adopted by all municipalities in the watershed around the same time in order to truly be effective. Both municipal and nonmunicipal stakeholders mentioned this "race to the bottom" problem in their initial conversations with MyRWA, suggesting this issue served as an incentive for collaboration (J. Wormser, personal communication, February 7, 2019).

Lack of Data. As mentioned, Bentrup (2001) adds "lack of data" to Selin & Chavez's model as another antecedent (p. 746). Many stakeholders mentioned the need for consistent data across municipalities within the watershed both in their initial conversations with MyRWA (J. Wormser, personal communication, February 7, 2019) and during collaborative meetings, particularly regarding stormwater modeling.

[14] According to Massachusetts' "Home Rule" policy, municipalities can create regulations as long as they do not conflict with existing federal or state regulations.

Stage two: Problem-setting

Selin & Chavez (1995) identify problem-setting as the next step a collaborative takes once it has been formed. While Bentrup (2001) largely agrees with Selin & Chavez (1995) on the characteristics of the problem-setting stage, he adds "identify coordinator," a logistical aspect of problem-setting, which according to Bentrup, is based on Barbara Gray's 1989 book, *Collaborating: Finding Common Ground for Multiparty Problems* (p. 740). The early meetings of the RMC involved each of these factors identified by Selin, Chavez and Bentrup: *identify coordinator*, *identify stakeholders, consensus on legitimate stakeholders, common problem definition, recognize interdependence, perceived benefits to stakeholders,* and *perceived salience to stakeholders.*

Identify coordinator. While MyRWA initiated the formation of the RMC, it is important to emphasize that MyRWA hired Ms. Hulet, an outside consultant to assist with meeting facilitation. Both Ms. Wormser and Ms. Hulet expressed their appreciation for having a co-facilitator present during meetings since they can support each other and "bounce off of each other['s]" thoughts (personal communication, February 7, 2019).

Identify stakeholders and consensus on legitimate stakeholders. Once Ms. Wormser identified specific municipal thought leaders and local subject-matter experts with the capacity and background knowledge to lay the foundation for the RMC, collaborative members engaged in discussions about the definition of a *legitimate* stakeholder. These discussions were formalized during the January 2019 meeting when it was agreed that each municipality would receive one vote in the Steering Committee, and nonmunicipal members could not vote but were encouraged to share their perspectives.

Common problem definition, recognizing interdependencies, and perceived benefits and salience to stakeholders. In each meeting, the co-facilitators led the collaborative members in activities and discussions that helped to further define the problems that they felt they had in common. This ultimately resulted in the "Resilient Mystic Collaborative Governance Document" that outlines their vision, key motivations and initial goals (Appendix B).

Acknowledging and defining these common problems are closely related to the "recognizing interdependencies" step; Selin & Chavez (1995) explain that in this stage, "Participants start to appreciate the interdependencies that exist among them and realize that problem resolution will require collective action" (p. 192). Both the facilitators and the collaborative members have emphasized the importance of identifying problems that are relevant to the watershed as a region and that necessitate a collaborative solution. This relationship between interdependencies and common problem definition is clearly demonstrated in the RMC's focus on stormwater modeling, which was discussed as a top goal for the RMC in the first meeting and was identified by 70% of municipal employees in the survey when asked what vulnerabilities of their municipality that they hoped the RMC would address (Appendix A, question 10). As the RMC members worked to define collective problems, other interdependencies came to light including financial resources, the overarching value of Mystic River as a common asset, and political advocacy.

The interdependencies acknowledged by the group in these early meetings suggest that they also feel that the RMC is important for them as individual members due to the collaborative advantage. As Bentrup (2001) explains, "Stakeholders will generally participate in the planning effort if the issues are

perceived as important and benefits are believed to outweigh the costs…" (p. 740). Activities at RMC meetings reflect these benefits for collaborative members, including the brainstorming exercise at the October meeting in which members considered the RMC's benefits for themselves and for other members. Additionally, fourteen out of eighteen survey respondents answered the question, "In your capacity as an employee please name three goals that you hope the Resilient Mystic Collaborative will achieve" (Appendix A, question 10). These responses demonstrate that these members believe that participating in the RMC will benefit them in some way, from providing them with data and information on best practices to supporting advocacy efforts.

In each meeting thus far, the opportunity for collaborative grant funding has been discussed at length; there are many grant opportunities that are specifically for regional collaboratives, and thus would be out of reach for any municipality on its own. Some of the members specifically indicated in the survey that receiving regional funding is a goal that they hope the RMC will achieve (Appendix A, question 10).

Stage three: Direction-setting

As the problem-setting stage is a formalization of the antecedents that brought the collaboration together, the direction-setting stage is a further formalization of collaborative goals set to solve the problems that they have identified. Selin & Chavez (1995) explain that it is during this stage that "participants begin to identify and appreciate a sense of common purpose…" (p. 192). Bentrup (2001) makes a few adjustments for his watershed-based collaborative model by moving *formalizing relationships* (which Selin & Chavez (1995) placed in the following "Implementation" stage) under direction-setting, and

by adding *establishing baseline data*. Each element of direction-setting is evident in the progression of the RMC, including those added by Bentrup (2001): *setting ground rules, formalizing relationships, exploring options, organizing sub-groups, reaching agreement, establishing goals, joint information search,* and *establishing baseline data.*

Setting ground rules and formalizing relationships. Although collaborative "ground rules" and relationships among members had been developing since the first RMC meeting, the January 2019 meeting at which the RMC formalized their governance structure marked an important step in direction-setting. While this was discussed in the previous section on consensus of legitimate stakeholders, it is important to note that the decisions made through this discussion and finalized in the RMC Governance Document (Appendix B) established how the collaborative members related to each other: some had voting power and some did not. However, while these relationships were *formalized*, they are not *legalized*, as members do not have a legal obligation to participate in the RMC.

Table 7 contains the chart that the collaborative facilitators compiled to explain the RMC governance structure, establishing the responsibilities of the steering committee and working groups by category. Please note that this chart comes from a working document and is subject to future changes.

Table 7. The governance structure of the Resilient Mystic Collaborative, as of April 2019. Source: Hulet & Wormser, 2019.

EXPECTATIONS	STEERING COMMITTEE	WORK GROUPS
Scope of work	Identify priority needs, document and communicate best practices.	Develop, advocate for, and work on solutions within each work group's defined scope of influence/concern.
Deliverables	The Steering Committee is responsible for	Work groups are responsible

	developing and implementing the watershed-wide work plan, providing analytical support through expert partners, guiding advocacy, and producing funding proposals.	for developing and implementing work plans for their defined scope of influence and working with the steering committee to secure the analytical support, advocacy, and funding necessary to complete projects.
Membership	Municipal staff (voting members) and nonmunicipal content experts (non-voting)	Relevant steering committee members plus other key stakeholders as determined by the group.
Attendance	Municipalities name primary and alternative members to participate in meetings and decisions. Consistent participation by the primary member is expected. Nonmunicipal members do not designate alternates and are expected to participate consistently.	Work group members do not generally name alternates. All members are expected to participate consistently.
Decision making	Operate by consensus, meaning no one opposes the decision. When consensus cannot be achieved, at least 80% of the members present for the vote must agree. 7 of 10 municipal members is considered a quorum (to be revisited as more municipalities join the RMC). Meetings should proceed only if a full quorum is participating. Municipalities are decision makers and each municipality has one vote. Nonmunicipal participants are non-voting, but may participate fully in all conversations leading to decisions.	Each work group operates along roughly the same principles as the steering committee, though they may make their own adjustments, as necessary.
Meeting Frequency	Roughly quarterly after start-up year	More frequent, as needed
Internal communications	Confidential within group. Facilitators will finalize and circulate documents, keep all documents available on Google Drive or Dropbox.	Same
External communications	TBD	Same

Public participation	TBD	TBD
Facilitator responsibilities	Manage necessary materials and tools such as agendas, process documents, meeting notes and action items, collective agreements, etc. Design and run meetings that are productive, respectful, and efficient. Coordinate between-meeting conversations that enable cohesive collaboration	Same, when applicable (not all project groups will be facilitated)

Exploring options, organizing sub-groups, reaching agreement and establishing goals. During the January 2019 meeting, the list of common problems defined through stakeholder interviews and prior meetings were compiled into a list of possible working groups by the collaborative facilitators. These were then discussed and approved by the group. All working groups (except the stormwater modeling group) met at least once before the February meeting.

Joint information search and establish baseline data. Stakeholders have emphasized the importance of establishing baseline flooding data since their initial interviews with MyRWA. This remained a central issue at each meeting and became the main purpose of a working group. It is important to note that because all municipalities within the group were already familiar with the baseline climate projections used through the state's MVP program, there were no conflicting opinions as to which climate projections should be used for this watershed-wide data collecting.

"Acquiring or redirecting of resources": A continuous action

One of Bentrup's significant changes to Selin & Chavez's model is an emphasis on the continuous process required to ensure the collaborative always has access to the appropriate funds and resources to do their work (Bentrup, 2001, p.

746). Fortunately, the RMC was funded from the start with the Barr Foundation grant that allowed MyRWA to hire Ms. Wormser full-time. The collaborative is currently applying for additional funding from the Barr Foundation (J. Wormser, personal communication, April 5, 2019).

Besides funding the operating costs of the RMC, projects developed by the working groups will also require funding. This includes the stormwater model, for which one municipality contributed significant funds. For other projects, Ms. Wormser keeps RMC members updated on future grant opportunities that may be relevant for working groups; for example, the upper Mystic stormwater management working group will be working on an MVP grant application to fund regional stormwater management planning.

One municipal member of the RMC expressed concern during the February meeting about applying for so many grants. Even if the RMC and its working groups receive adequate funding, many of the municipalities and organizations within the collaborative are understaffed and may not be able to keep up with the work these grants require.

B. Indicators of success: Outcomes and process

Evaluating the success of a collaborative group ranges in complexity: the simplest evaluation works to understand if the collaborative has produced any outcomes that it hoped to accomplish. However, we can also use a multi-level analysis to determine the success of the *process* of collaboration at different levels (Popp et al., 2014). I use both approaches to consider the overall success of the RMC at this stage in its development.

Outcome-oriented evaluation: Meeting its goals

As of this writing, it is too early to determine if the RMC has been successful in meeting its goals. However, they have made progress towards improving the capacity of the Amelia Earhart Dam and creating a watershed-wide stormwater model. Although the DCR has not taken any definitive action on dam improvements, the advocacy letter signed by all municipal leaders in the watershed led to a meeting between DCR and MyRWA, keeping this policy conversation going. An early iteration of the watershed-wide stormwater model has been created and is being adjusted after RMC members provided feedback in February. Neither project is "complete" by any means, but the RMC was able to do some initial work to begin to address these desired outcomes while still in its formational stages.

Process-oriented evaluation: A multi-level analysis

As Popp et al. (2014) explain in their literature review of interorganizational networks, collaborative groups should be evaluated at many different levels at every stage of the group's development. These levels include the individual member, the member organization or agency, the collaborative network itself, and the wider community served by the collaborative group. Success at all levels suggest overall success of the collaborative group (Provan & Milward, 2001, p. 421). The case study on the RMC reveals indicators of success at each of these levels during its early stages of development.

Popp et al. (2014) explain that successful impacts of a collaborative group on the individual member may translate into "increased job satisfaction" or "increased capacity" (figure 3). When asked to share any other reflections on their participation in the RMC, most survey respondents explicitly noted an overall positive individual experience, using words such as "enlightening" and "helpful." One respondent

replied, "I continually learn from the experiences of others," emphasizing that participation in the RMC has encouraged their personal and professional growth (Appendix A, question 13). The collaborative facilitators have noted that all collaborative members appear engaged during meetings, as members tend not to look at their phones or laptops (personal communication, February 7, 2019). Furthermore, more than half of respondents named sharing relevant data and best practices as one of their top three goals that they hope the RMC will achieve (Appendix A, question 10). This kind of informational sharing may help individuals improve and ease their own work since they do not have to search and compile this critical data on their own, indicating that their job satisfaction and/or capacity may increase when these data-gathering projects are complete.[15]

There are also factors at the organizational level that indicate collaborative success. Primarily, a collaborative is successful at the organizational level if it achieves that collaborative advantage: goals that any one organization would not be able to accomplish on its own (Provan & Milward, 2001). Thus far, the tasks that the RMC has been pursuing support this goal, which required input from multiple municipalities and organizations. Provan & Milward (2001) further explain that the acquiring of resources for the collaborative group is another indicator of success, particularly when these resources would not have been available to single organizations, which the RMC has also accomplished (p. 420).

[15] Note that Popp et al. (2014) also discuss the impact of the collaborative group on the individual client being served by the collaborative. In the case of the RMC, those being served are the people of the Mystic River Watershed, which also directly corresponds with the wider community. Therefore impacts on these individuals will be discussed collectively in the following section on community-level impacts.

Another important aspect to consider in gauging the success of a collaborative group on the organizational level is the cost of participation for individual organizational members. While there is no explicit cost to participating in the RMC, the member organization is essentially donating employee time when a municipal or nonmunicipal staff person attends a meeting. For many, this cost seems to be worth it, as suggested by the positive responses by most of the respondents who offered their reflections on participation in the final survey question. However, one nonmunicipal member indicated that this cost might be too great for their organization (Appendix A, question 10). Although they explain that "it is worthwhile to be in the [collaborative] space," they also explain that "the group is focused heavily on municipalities" and this "one perspective/ set of priorities is heavily weighted in the group over others [which] can lead to a sense of disengagement for those that do not share the perspective/ priorities." While this may change during the next stages of the collaborative, this may indicate an unequal distribution of success at the organizational level thus far.

Popp et al. (2014) and Provan & Milward (2001) describe a few different indicators of success at the level of the collaborative group itself. Growth and retention of members may indicate success at the early stage of the collaborative, which Provan & Milward (2001) describe as "the simplest way of evaluating network-level effectiveness" (p. 418). When asked about the success of the RMC, Ms. Wormser explained that she feels that "we're gaining momentum and not losing it," citing the overall increase in participants, and the fact that members have signed up for project working groups and have attended working group meetings outside of the Steering Committee (personal communication, February 7, 2019). Provan & Milward (2001) also explain that multiplexity indicates collaborative success, which

they describe as "the strength of ties between network agencies" (p. 419). When asked in a survey if they felt their interactions with other collaborative members increased, decreased or stayed the same after the start of the RMC, almost half of respondents selected "increased" while the other half selected "stayed the same" with only one respondent who chose "I'm not sure," (Appendix A, question 12). This suggests that many relationships have strengthened through participation in the RMC.

The final indicator of collaborative success in this multi-level analysis as defined by Popp et al. (2014) and Provan and Milward (2001) is the impact of the collaborative on its surrounding community. In this case, determining community-level success would require analyzing the effects of the RMC on the Mystic River Watershed as a whole, which are the outcomes discussed in the previous section. While their goals discussed in this study aspire to increase the resilience of the watershed to climate change impacts, it is far too early in the process to determine if these goals have been met.

VI. Conclusions

A. Collaboratives in a climate change context: Changes to Bentrup's model

Antecedent: Availability of data

Bentrup (2001) argues that a lack of data can serve as an antecedent for collaboration, which seems to be true for the RMC as articulated in the previous chapter. However, I argue that the availability of data is also important to consider as a possible antecedent for collaboration. Ms. Wormser attributed the early progress of the RMC to the fact that two municipalities had already done crucial data collection. Her early conversations with experts also helped her to understand the

avenues available for further data collection and analysis. Additionally, many of the group members had already used the same climate change projections for their individual MVP projects since the MVP Program provides climate change projection data for participants. This accelerated the process of data collection for the RMC as stakeholders already understood and agreed on the resources for accessing and aggregating this information (J. Wormser, personal communication, February 7, 2019). By both recognizing the need for more data and understanding the processes involved in accessing this data, the RMC was well positioned to begin its collaborative work.

Antecedent: Lack of regulations

While Bentrup (2001) argues that the threat of regulations is an antecedent for watershed collaboratives, the lack of regulations may also serve as an antecedent for the RMC. I argue that there are two regulatory gaps that influenced the RMC's creation: the lack of regional government structures in Massachusetts and the lack of policies that directly address climate change vulnerabilities.

As explained in chapter two, regulatory power within Massachusetts is granted to municipalities, not counties nor regional planning agencies. This poses a barrier for addressing multi-jurisdictional problems (like stormwater management) at scales larger than the municipality but smaller than the state. While Cape Cod addressed this problem by petitioning for and winning "home-rule authority" for Barnstable County to create the Cape Cod Commission (CCC), this is not the norm.[16]

While Massachusetts certainly encourages cities and towns to address climate change impacts through the MVP program, there is no regulatory

[16] Dukes County (Martha's Vineyard) is the only other county with home-rule authority in Massachusetts.

requirement for municipalities to consider their climate change vulnerabilities in municipal regulations or planning processes. Many stakeholders mentioned in their early conversations with MyRWA that they believe zoning codes and building codes need to be updated to account for the additional flooding that climate change is bringing to this area, and that it should be done at a regional scale to avoid the development "race to the bottom," as described in the previous chapter.

Of course, arguing for or against climate change adaptation regulations requires further study: literature on environmental collaboratives cites frustration with top-down environmental policies as a reason that the collaborative approach gained popularity in the 1990s (Kenney et al., 2000). It would not necessarily solve our current problems, but the fact remains that stakeholders identified needs that the government are not currently addressing, and are working collaboratively to address them.

Problem-setting: A capacity paradox

Many of the steps in the problem-setting stage of Selin, Chavez and Bentrup's respective models focus on identifying and agreeing upon legitimate stakeholders. However, not all stakeholders identified as "legitimate" necessarily have the capacity to participate in the collaborative work—even if that collaborative work could provide access to resources that could expand that stakeholder's capacity. In the case of the RMC, members have agreed that all municipalities in the watershed should be invited to participate. However, Ms. Wormser expressed concern about the staff capacity of some other municipalities to attend meetings (personal communication, February 7, 2019) (figures 7 and 8 show the staffing and revenue capacity of municipalities throughout the watershed). The concern expressed by a member at the February meeting—that they might require

additional funding for hiring staff that could provide appropriate support for RMC projects—further reflects this paradox. To resolve this paradox, I argue that supporting legitimate stakeholders who do not have enough capacity to participate should be included in this "problem-setting" stage to ensure all legitimate stakeholders are able to reap the benefits and bear the costs of participating in the collaborative.

Direction-setting: Actionable goals

The direction-setting stage of collaborative formation is goal-oriented. For collaboratives designed to tackle vague and complex goals such as climate change, I argue that it is critical that these goals are actionable and achievable to keep the productive momentum of the collaborative.

Developing solutions to identified problems and implementing them are important to collaborative members: the first sentence in the RMC's governance document is "We are action-oriented" (Hulet & Wormser, 2019). One survey respondent emphasized that one of their goals for the RMC is to "ACTUALLY implement" programs, projects and initiatives that they plan (Appendix A, question 13). The RMC's process for advocating to improve the Amelia Earhart Dam exemplifies this kind of goal-setting. This goal was very specific; instead of setting "improve flood resiliency of the watershed" as a goal, the group recognized that they needed to lobby state government to allocate funds in the Environmental Bond Bill to install a fourth pump. While this goal has not yet been achieved, the RMC identified early, realistic actions that work towards this goal: compiling a letter of support signed by all municipal leaders in the watershed and arranging meetings with state officials. The completion of these small actions was framed as a collaborative success by the facilitators to collaborative members during the

January 2019 meeting and via email, fostering a positive and productive atmosphere for the RMC. While I cannot argue that this leads to true success until there is a definitive outcome for the Amelia Earhart Dam, this kind of actionable goal setting clearly played a role in the early development of the RMC and represents process-oriented success.

Building trust

Both Bentrup's and Selin & Chavez's articles mention the importance of building trust among members of the collaborative, but this is not an explicit part of either model. Building trust relates to the existing networks antecedent (since the presence of existing relationships can encourage collaborative work) as well as to the problem-setting stage; Bentrup (2001) notes in his discussion of "Problem-Setting Considerations" that "[i]nformal face-to-face dialog during the problem identification stage was necessary to reduce stereotypes and establish trust among stakeholders" (p. 743). However, although implicit in the antecedent and problem-setting stages, I argue that it is important in its own right to become a separate, overarching step in the model that can and should be considered at any stage.

In addition to the trust established between collaborative members through participation in MAPC's Metro Mayors Climate Preparedness Task Force, Ms. Hulet purposefully integrates "ice-breaker" activities in every meeting to give collaborative members the opportunity to connect.

There is also evidence of trust between collaborative members and the collaborative facilitators, which Ms. Wormser explains: "When people don't trust meeting facilitators, they tend to question the agenda. People are allowing us to facilitate" (personal communication, February 7, 2019). By adjusting the meeting time and location to accommodate member needs, as well as ensuring that meeting

time is used productively, Ms. Hulet and Ms. Wormser are reassuring collaborative members that they value their time, further fostering trust in their leadership.

B. Lessons learned: Challenges and opportunities offered by climate change adaptation planning at the watershed scale

As a result of this study on a collaborative approach to climate change planning at the watershed scale, I have identified several challenges and opportunities that this model offers municipalities for addressing multi-jurisdictional problems aggravated by climate change like stormwater management.

Challenges

Resources. The most obvious challenge that this approach presents is the intensive amounts of time and resources that it requires, particularly at a larger scale. The RMC was only possible thanks to grant funding that allowed MyRWA to hire Ms. Wormser as a full-time staff person and Ms. Hulet as a facilitator. While they are in process of applying for more funding, relying on grants is not a sustainable approach for collaborating. Municipal employees are working their RMC participation into their standard workload without extra funding for now, but one member noted that if their participation is expected to increase as RMC projects expand, they may also require additional staffing or financial resources. The other example collaboratives explored in chapter three further suggest that collaboration is resource-intensive. The RTWN's monthly meetings and consistent communication between members, and the extensive staffing and budget of the CCC emphasize the commitment required for collaboration.

Not every municipality has these resources to participate in collaboration, which I describe in the previous section as a "capacity paradox;" while the act of collaborating can expand an organization's capacity by allowing it to address

problems that it would not otherwise be able to address (the collaborative advantage), it requires a certain capacity to participate. In some cases, not having all stakeholders participate in a collaboration could actually impede the work of the collaborative itself. For example, if data is required from a certain municipality to create an accurate stormwater model for a watershed but that municipality does not or cannot provide it, then the stormwater model will be less accurate.

Factors that serve as both challenges and opportunities

Data. The need for consistent data across a given region served as an impetus for both the SFRCCC and the RMC. Although it was not a central impetus for the CCC, data still plays a large role in its work since it is constantly compiling data as a regional planning agency.

However, developing accurate data at a helpful scale can also be seen as a challenge for collaboratives, particularly when addressing climate change and stormwater. While Massachusetts provides data on climate change projections to municipalities through its MVP program, climate change projections are constantly being adjusted, and will remain in flux as climate scientists work to understand the extent and timing of the effects of greenhouse gas emissions based on global greenhouse gas emissions reductions. Although changes are occurring at a global scale, the local effects of changes in precipitation are important in New England and will influence the usefulness of stormwater models developed for the Mystic watershed. According to some collaborative members, sharing stormwater infrastructure data can pose a security issue. In addition, ensuring that accurate and updated information is always being used for any data-intensive project requires ongoing work, and thus poses an ongoing expense.

The role of the public. The CCC demonstrates that the public can serve an important role in forming collaboratives. However, the public has not played a role in the RTWN, SFRCCC or RMC. This is notable since these three collaboratives are working to address climate change impacts, which will ultimately affect the public. Although understanding the role of the public in climate change adaptation is beyond the scope of this study, it is important to acknowledge that including public participation in a collaborative of this kind could be challenging and would require extra resources.

Opportunities

Regional resources. Through collaboration, municipalities can access resources that would not otherwise be available to them. This is particularly true if more grant funding becomes available for regional climate change collaborations, such as through the MVP program. The RTWN has already used MVP funds for projects within their watershed, and the RMC is working on grant applications at the time of this writing. In the RMC, municipalities have even shared their resources with each other, as one municipality is contributing significant funding and staff time to the development of the watershed-wide stormwater model. Sharing the resources of higher-capacity municipalities with lower-capacity municipalities was mentioned as a specific goal early in the RMC's development.

Building relationships. While both the RMC and the RTWN cite existing relationships as an antecedent to their collaboration, it is important to emphasize the opportunity that collaboratives provide for further building these valuable professional networks. Not only do the meetings themselves encourage interaction between members, but their joint membership has led to an increase in their interactions outside of the collaborative.

C. Recommendations for further study

Since the RMC has only just begun, there are many remaining questions about the nature of collaboration for climate change adaptation planning at the watershed scale.

Primarily, we do not yet know how the RMC will move through the implementation stage and what outcomes they will produce. As discussed, their process thus far indicates that they have successfully navigated the first three developmental stages. However, as the working groups begin their on-the-ground projects and the steering committee begins to make more decisions, conflicts may arise. A better understanding of the literature on the function of conflict in a collaborative setting and the ways in which the RMC may or may not experience conflict could offer valuable insights into collaborative work of this nature and scale.

As membership grows in the RMC—as of April 2019, four new municipalities responded to the invitation to collaborate—it will be important to consider the ways in which power dynamics between members impact the group's process and outcomes. This could include a difference between foundational members and more recent members, and/or a difference between representatives from more-resourced municipalities and less-resourced municipalities.

By understanding the extent to which the RMC's goals are met and the ways in which power dynamics impact the group as it grows, it will also be important to reevaluate the composition of core decisionmakers. As noted, there are no elected officials in the RMC, and relationships between the municipal employees and the elected officials to whom they report were not explored. Once the group produces more concrete outcomes, the interaction between politics and the collaborative process may become more apparent.

Finally, I recommend further study on climate change collaboration at the watershed scale as a growing trend, particularly as Massachusetts expands the MVP program. The MVP program played a significant role in the formation of the RMC, and also plays a role in the RTWN's work. This suggests that it could inspire further watershed collaboration as municipalities discover the collaborative advantage in the context of climate change.

Appendices

A. Survey questions and responses

WHAT IS THIS STUDY ABOUT?
In fulfillment of the Masters' Thesis requirement of the Master of Arts in Urban & Environmental Policy & Planning at Tufts University, I am researching the challenges and opportunities offered by collaborative climate change adaptation planning at the watershed level. I have posed the following research question: *To what extent does collaboration at the watershed-level allow municipalities to create climate change adaptation strategies that overcome barriers to the multi-jurisdictional stormwater problems intensified by climate change?* In addition to reviewing the current academic literature on climate change adaptation planning, watershed management, and collaborative approaches to planning, I will also be composing a case study on the development and early evolution of the Resilient Mystic Collaborative.

WHAT AM I ASKING YOU TO DO?
I will also be asking you to fill out a short online survey to better understand the motivations of you and your employer for participating in the collaborative. By filling out this survey, you are consenting to the use of your responses in this study. I will not ask for any identifying information in this survey. You may skip any questions that you do not wish to answer.

WHAT ARE THE RISKS AND BENEFITS TO YOU?
There are minimal risks to participating in this study. There are no direct benefits to you for participating in this study. However, it may be beneficial to the collaborative as a whole to have its early progress documented as a case study. I hope that this study will demonstrate that watershed collaboratives prove to be an effective model for climate change adaptation planning.

IS THERE COMPENSATION FOR PARTICIPATING?
No, there will be no compensation for participating in this study.

IF I'M IN THE RESILIENT MYSTIC COLLABORATIVE, DO I HAVE TO PARTICIPATE IN THIS STUDY?
No, taking part in this study is completely voluntary and has no impact on your participation in the Resilient Mystic Collaborative, on your relationship with the Mystic River Watershed Association, or on your relationship with Tufts University. If you decide that you do not wish to take the survey, you may refuse to proceed in filling out the survey. If you decide to take the survey, you may skip any questions you do not wish to answer.

WILL THE INFORMATION THAT I PROVIDE BE USED FOR FUTURE RESEARCH?
Please note that it is possible that the information published in the final draft of this study could be used for future research. If any identifiers are removed from any identifiable private information that you provide by participating in this study, such deidentified information could be used for future research studies without additional informed consent from you.

TO WHOM CAN I DIRECT MY QUESTIONS?
As the researcher conducting this study, I am happy to answer any questions. You can email me at any time at carolyn.meklenburg@tufts.edu, or ask any questions in person. If you have any questions or concerns regarding your rights as a subject in this study,

you may contact Lara Sloboda, Operations Manager of the Institutional Review Board (IRB) at (617) 627-3276 or access their website at http://viceprovost.tufts.edu/sberirb/.

- ☐ By checking this box, I confirm that I have read and understood the above information, and that I consent to participating in this study by taking this survey.

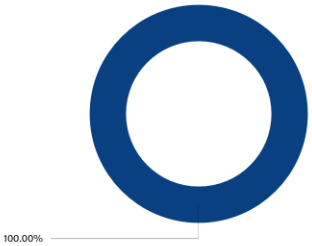
1. Please select in what capacity you are participating in the Resilient Mystic Collaborative.

- As a municipal employee
- As a nonmunicipal employee

Past Experiences with Municipal Climate Change Adaptation Planning (**NOTE: This section was not displayed for those who selected "Nonmunicipal employee" for the question above).**

2. Has your municipality participated in the Municipal Vulnerability Preparedness Program through the Commonwealth of Massachusetts? Please select one.

- Yes

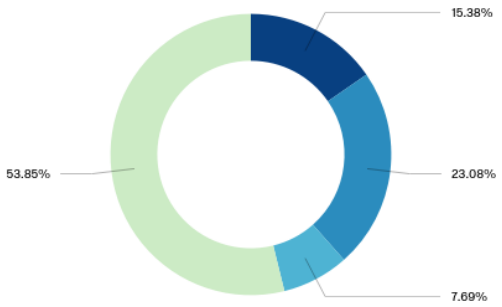


Other choices not selected:

- ☐ No
- ☐ I do not know what the Municipal Vulnerability Preparedness Program is

If yes, what part of the process are you in? (The response choices reflect that successful completion of the MVP Planning Grant is required to be eligible for the MVP Action Grant.) Please select one.

- We are in process of applying for an MVP Planning Grant.
- We have received an MVP Planning Grant and are in process of completing our vulnerability assessment.
- We are a designated MVP community: we have received an MVP Planning Grant and have completed our vulnerability assessment.



- [x] We have received an MVP Action Grant, and are working on a resilience-related project.

Other responses not selected:

- [ ] We have received an MVP Planning Grant, but have not begun any related work.
- [ ] We are a designated MVP community, and are in process of applying for an MVP Action Grant.
- [ ] We have received an MVP Action Grant, but have not begun any related work.
- [ ] We have received an MVP Action Grant, and have completed a resilience-related project.
- [ ] We have received an MVP Action Grant, have completed a resilience-related project, and hope to apply for another MVP Action Grant.
- [ ] Other: _____

3. What did you learn about your communities' vulnerabilities while developing your MVP plan that you hope the Resilient Mystic Collaborative will help address? Please describe.

We were able to identify and prioritize projects that will mitigate future flooding conditions
Still at the early stages of the application process
Flooding and extreme heat were the major vulnerabilities identified during the MVP planning processs. So far the RMC has focused on flooding but I'm interested in if other types of vulnerability (e.g. heat) will be addressed.
While we completed stormwater modeling for Medfored, we acknowledge that this cannot be wholly accurate unless other communities in the watershed are taken into account.
Some of our vulnerabilities are heat and water related and heat and water do not respect municipal boundaries. In particular, our stormsewer system is connected to the systems of neighboring communities so they impact each other. Changes made in neighboring systems have the ability to impact each other. I hope to coordinate with communities in my watershed to reduce risks to my community and to capitalize on economies of scale.
2030 inundation 2070 inundation. Flood Resiliency.
Sea level rise is a problem requiring a regional approach.
Somerville's three primary climate risks are heat, inland flooding from precipitation, and coastal flooding. Through our vulnerability assessment (which was done prior to the MVP program), we learned that the two major coastal flood pathways affecting Somerville are outside of the City's jurisdiction. One is through Charlestown and the other is caused by the flanking and over-topping of the Amelia Earhart Dam. Because of this, it is critical that we work regionally and

collaboratively with our neighboring municipalities and state agencies to address these risks.
While we didn't learn new technical knowledge, this exercise garnered public support for necessary infrastructure enhancements, retrofits, and other interventions. RMC can help address these pressing issues through regional advocacy, knowledge/best practice sharing, and by remaining a willing participant throughout our projects' life cycles.
many of our district scale solutions require state + regional collaboration. the RMC provides a platform for collab.

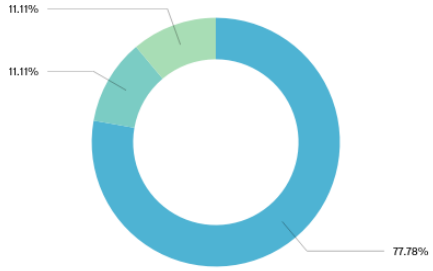
Past Experiences Working in a Collaborative

4. Have you previously been a part of a "collaborative" in either your current job or in a previous position, OR in your current job, are you currently involved in a collaborative other than the Resilient Mystic Collaborative? Please check one.

Yes

No

I'm not sure



If you would like to provide the name[s] of any past or current collaboratives outside of the Resilient Mystic Collaborative in which you have participated/currently participate, please do so below.

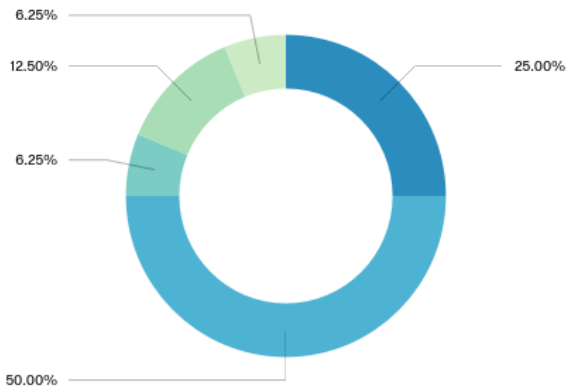
NE Stormwater Collaborative, Project Impact, Regional Planning
Mystic River Watershed Association Stormwater Collaborative
EPA and MassDEP stormwater collaborative. Arlington Belmont Cambridge Flooding Group. Metro Mayors Coalition.
MAPC Metro Mayors Coalition
Metro Mayor's Coalition Climate Preparedness Taskforce
Boston Metro Mayors Resiliency Task Force, New England Municipal Sustainability Network
Metro Mayors Climate Preparedness Taskforce
Metro Mayors Climate Preparedness Commitment. Cambridge Compact for a Sustainable Future.
This depends on how you are defining "collaborative" I also participate in the Metro Mayors Climate Preparedness Taskforce

Metro Mayors Climate Task Force Livable Streets Alliance Land Line Coalition
Healthcare Without Harm
Mystic River watershed steering committee (not technically a collaborative)
MAPC - Metro Mayors Task Force

5. Do you feel that the collaboratives in which you serve[d] are/were able to reach goals that your municipality/organization would not have been able to meet without participating in the collaborative? Please check one.

Yes, all of the collaboratives of which I am/was a part reached goals that my municipality/organization would not have been able to accomplish on our own.

Some of the collaboratives of which I am/was a part reached goals that my municipality/organization would not have been able to accomplish on our own, but some did not/have not.



No, none of the collaboratives of which I am/was a part reached goals that my municipality/organization would not have been able to accomplish on our own.

The collaborative[s] of which I am a part are too new to determine if any goals are being met.

Other: _____

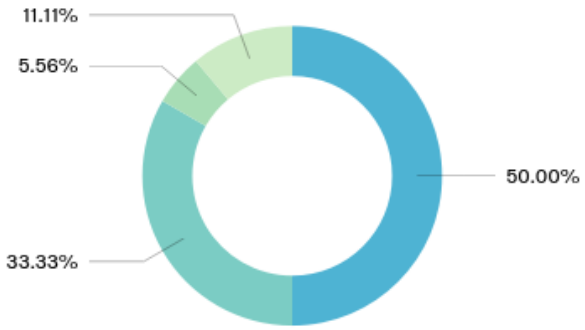
Note: The single "Other" response was written in as the following:
"Being part of the collaborative gives us access to stormwater related educational materials and ideas that we would otherwise have to come up with on our own, if at all."

6. Did your experience[s] in past or other collaboratives influence the decision for your municipality/organization to participate in the Resilient Mystic Collaborative? Please check one.

Yes

No

No, but the experiences in collaboratives that colleagues at my municipality/organization have had or are having influenced the decision for our municipality/organization to participate in the Resilient Mystic Collaborative.



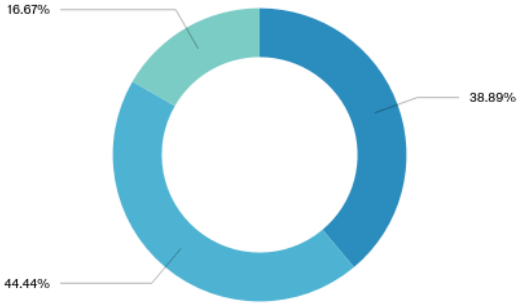
I'm not sure.

Your Participation in the Resilient Mystic Collaborative

7. Did you make the decision to participate in the Resilient Mystic Collaborative, or did someone else in your municipality/organization make the decision? Please check one.

Yes, I made the decision to participate in the Resilient Mystic Collaborative.

The decision to participate in the Resilient Mystic Collaborative was collectively made between me and others at my municipality/organization.



No, someone else at my municipality/organization made the decision that our municipality/organization would participate in the Resilient Mystic Collaborative.

8. Please explain why your municipality/organization decided to participate in the Resilient Mystic Collaborative. Check all that apply.

My municipality/community my organization serves is facing obstacles to climate change adaptation planning that are better addressed at the watershed scale.

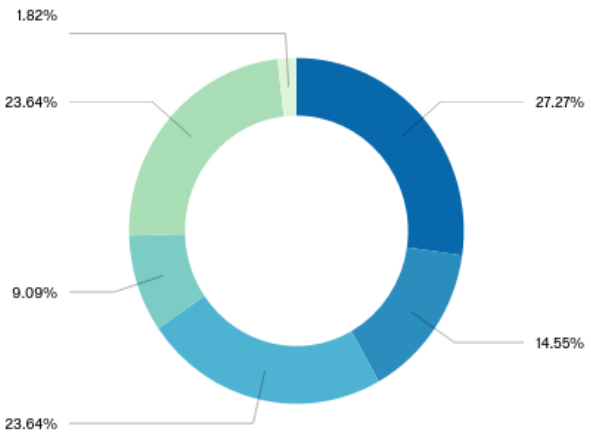
My municipality/community my organization serves does not have enough resources to adequately plan for climate change adaptation on its own.

There are political obstacles to planning for climate change adaptation in the watershed, and I believe that collective action is the only way to overcome these obstacles.

I know my municipality/ community my organization serves has an impact on others in the watershed, and I hope that working collectively will mitigate that impact.

I have a strong relationship with the Mystic River Watershed Association, and I trust their leadership.

I don't know why my municipality/organization decided to participate in the Resilient Mystic Collaborative.



Other response not selected:

☐ Other: _____

9. What impact of climate change on your municipality/community your organization serves concerns you the most in your capacity as an employee? Please rank the following concerns from 1-8 or 9 with 1 being the issue of most concern and 8 or 9 being the issue of least concern.

Ranking	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Increased urban heat island effect	1	0	5	1	2	6	1	0	0
Increase in intensity of precipitation events	6	3	6	0	0	0	1	0	0
Increase in riverine flooding	2	6	1	1	0	2	2	2	0
Increase in frequency of intense storms	4	2	4	4	1	0	1	0	0
Sea level rise	3	2	0	2	1	2	2	4	0
Increase in drought	1	1	0	2	1	1	1	8	1
Increase in temperature swings	0	1	0	3	3	3	6	0	0
Disparate impact of climate change on vulnerable populations in our region	3	0	1	2	6	0	2	2	0
Other:	0	1	0	0	0	0	0	0	2

10. In your capacity as an employee, please name three goals that you hope the Resilient Mystic Collaborative will achieve.

Identify community vulnerabilities, have a preparedness plan and train on the plan
Receive regional MVP funding. Coordinate efforts between communities. Information and best practices sharing.

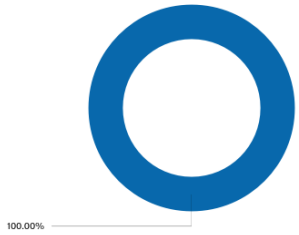
1. Complete stormwater model for the watershed. 2. Successful lobbying for improvements for the AED. 3. Better understanding of how to assist populations that are disproportionately impacted by climate change hazards.
1. Better sharing of data and expertise throughout the region and with the public. 2. Increased collaboration of municipalities on shared issues/problems and increased shared advocacy. 3. Increased community involvement in planning processes at the municipalities.
collaborating on addressing precipitation impacts on a watershed scale, including modeling of future impacts and addressing storage potential in the upper watershed. Collaborative communication to better reach all of our residents.
helping in establishing PPP, aiding in legislative activities, advocating for grants and regional projects.
Raise understanding of regional climate risks, develop coordinated advocacy to state agencies and Legislature, develop public private partnerships with businesses and institutions
A shared regional vision for climate resilience in the Mystic Watershed including prioritization of projects/actions, action by state agencies to improve resilience in Mystic Watershed as a result of RMC advocacy, and coordinated action by municipalities that complement each other to be greater than the sum of the parts.
Demonstrate that watershed-scale collaboration on climate impacts is important and necessary; fix the AED; figure out a plan for making the produce center more resilient
Obtain RMC funding & funding for local projects; Publicize climate issues and impacts to educate regional populace; Facilitate the sharing of knowledge, best practices, and analyses (such as storm water modeling)
Cooperative planning, prioritizing resilience projects, and cooperative implementation of resilience projects
Collective action to enhance resilience of the Amelia Earhart Dam. Better understanding of flood vulnerability due to storm surge in the Lower Mystic. Better understanding of flood vulnerability due to extreme/more frequent precipitation in the Upper Mystic.
Watershed plan with clearly identified projects; Modelling to better understand solutions; Identify and obtain funding for projects
improve the stormwater management in the watershed; establish a framework for others to replicate where program, projects, and initiatives are ACTUALLY implemented; develop priority projects backed up by regionally coordinated information

11. Setting aside the RMC, have you worked, or do you currently work, with any of the other collaborative members in some capacity—joint projects, another committee or collaborative, general professional networking, etc.?

Yes

Other responses not selected:

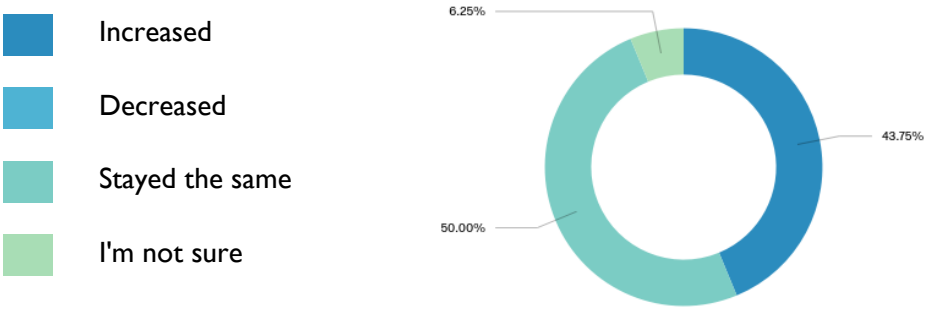
- No
- I'm not sure.



If yes, how many? Please explain below.

I serve on the NE Stormwater Collaborative as a co-chair
We work with several of our neighbors on other projects and collaboratives.
5
5
5 - MyRWA, City of Chelsea, Boston & Everett, MAPC
I work closely and frequently with Somerville, Melrose, Cambridge. Most of the other communities participate in the MyRWA Stormwater Collaborative and some participate in the EPA Urban Waters initiative around the Mystic River.
neighboring municipalities
3
Everyone who is on the Metro Mayors Task Force
4
1
4 if you mean people, 3 if you mean how many joint projects
3, as Board member of MyRWA
1 Woburn
MAPC

12. Please assess your municipality's/organization's interactions with collaborative members outside of the Resilient Mystic Collaborative since the start of the Resilient Mystic Collaborative:



13. Do you have any other reflections on your participation thus far in the Resilient Mystic Collaborative that you would like to share?

I continually learn from the experiences of others
So far so good!
Very happy with the productivity of the meetings and our goal setting thus far!
The group is focused heavily on municipalities - this wasn't as clear at the outset. Had it been we may have not engaged quite as much, so I guess it's ok, as it is worth while to be in the space. However it should be understood that one perspective/set of priorities is heavily weighted in the group over others and this can lead to a sense of disengagement for those that do not share the perspective/priorities.
I feel like we're just starting, but there's a lot of potential here.
No
Very helpful insight to Watershed-wide planning efforts as they relate to our population health management mission.
It has been enlightening seeing the larger concerns of the full watershed as well as the dedicated professionals involved

B. Resilient Mystic Collaborative Governance Document

Vision:
We are action-oriented. We prioritize, facilitate funding for, and implement cost-effective, multiple-benefit solutions that benefit the watershed as a whole through collective actions and/or site-specific interventions. We have the collaborative structure, trust, and participation to maximize our influence and effectiveness in completing impactful projects and sharing our lessons learned.

Key Drivers:
- Mystic River communities are facing increased risks of harm from extreme and unpredictable weather, including flooding, drought, heat and temperature swings.
- The Mystic River watershed is an excellent place to explore and implement regional, innovative, multiple-benefit projects for both local protection and to share best practices with other watersheds.
- There is strong demand in this region for inclusive project teams with substantial community/stakeholder engagement and decision making.

Purpose:
Harness the collective power and wisdom of the communities in the Mystic River Watershed to identify opportunities and secure the political and financial support to:
- Protect key assets and vulnerable residents within the Mystic watershed from harm due to extreme weather.
- Pilot and ground-truth innovative solutions that emphasize regional coordination, multiple benefits, protection of vulnerable residents, and nature-based solutions.
- Identify existing barriers to municipal and regional climate resilience efforts and work on solutions to overcome them.

Steering Committee:
The Steering Committee is the decision-making body of the RMC. The steering committee identifies, advocates for, and communicates regional priority needs.

All Mystic watershed communities are welcome to participate on an opt-in basis. Founding steering committee members include designated agency staff from the following cities and towns:

- Arlington
- Boston/East Boston
- Cambridge
- Chelsea
- Everett
- Lexington,
- Medford
- Somerville
- Winchester
- Woburn

Additional eligible communities are:

- Belmont
- Burlington
- Malden
- Melrose
- Stoneham
- Wakefield
- Watertown
- Wilmington

- Reading
- Revere
- Winthrop

As appropriate, the steering committee also includes non-voting experts on relevant subject matters (e.g., resilient design and engineering, public health, financing, real estate law, and modeling).

The RMC partners with three entities engaged in climate resiliency, of which only MAPC is expected to participate on the steering committee.

- Mass EOEEA (MVP Program)
- MAPC (Metro Mayors Coalition's Climate Preparedness Task Force)
- Barr Foundation (Climate Resilience Program)

A representative of the Resilient Mystic Collaborative will also participate on the Metro Mayors Coalition's Climate Preparedness Task Force.

Facilitators:
Julie Wormser, Deputy Director, Mystic River Watershed Association (MyRWA)
Carri Hulet, Senior Mediator, Consensus Building Institute (CBI)

Work Groups
Work Groups coordinate closely with the Steering Committee to develop and advocate for solutions to lower regional risks.

References

About CCC: History. (2019). Retrieved April 9, 2019, from Cape Cod Commission website: http://www.capecodcommission.org/index.php?id=14&maincatid=2

About Us. (2019). Retrieved April 29, 2019, from Mystic River Watershed Association website: https://mysticriver.org/about-us

Agency for Toxic Substances and Disease Registry. (2016). *CDC's Social Vulnerability Index* [CSV file]. Retrieved from https://svi.cdc.gov/data-and-tools-download.html

Amundsen, H., Berglund, F., & Westskog, H. (2010). Overcoming Barriers to Climate Change Adaptation—A Question of Multilevel Governance? *Environment and Planning C: Government and Policy*, *28*(2), 276–289. https://doi.org/10.1068/c0941

Arnold, C. A. (Tony). (2010). *Adaptive Watershed Planning and Climate Change* (SSRN Scholarly Paper No. ID 1712027). Retrieved from Social Science Research Network website: https://papers.ssrn.com/abstract=1712027

Aylett, A. (2015). Institutionalizing the urban governance of climate change adaptation: Results of an international survey. *Urban Climate*, *14*, 4–16. https://doi.org/10.1016/j.uclim.2015.06.005

Bennett, A., & Grannis, J. (2017). *Lessons in Regional Resilience: Case Studies on Regional Climate Collaboratives*. Retrieved from Georetown Climate Center website: https://www.georgetownclimate.org/reports/adaptation.html?page=1

Bentrup, G. (2001). Evaluation of a Collaborative Model: A Case Study Analysis of Watershed Planning in theIntermountain West. *Environmental Management*, *27*(5), 739–748. https://doi.org/10.1007/s002670010184

Berggren, K., Mats, O., Viklander, M., & Svensson, G. (2012). Hydraulic Impacts on Urban Drainage Systems due to Changes in Rainfall Caused by Climatic Change. *Journal of Hydrologic Engineering*, *17*(1), 92–98. https://doi.org/10.1061/(ASCE)HE.1943-5584.0000406

Betsill, M. M., & Bulkeley, H. (2006). Cities and the multilevel governance of global climate change. *Global Governance*, *12*(2), 141-. Retrieved from General OneFile.

Binder, L. C. W. (2006). Climate Change and Watershed Planning in Washington State1. *JAWRA Journal of the American Water Resources Association*, *42*(4), 915–926. https://doi.org/10.1111/j.1752-1688.2006.tb04504.x

Burkin, L., Meaney, M., Meklenburg, C., & Sherman, K. (2018). *Growing the Mystic River Greenways* (p. 143). Retrieved from Tufts University website: https://as.tufts.edu/uep/sites/all/themes/asbase/assets/documents/fieldProjectReports/2018/growingMysticRiver.pdf

Cape Cod Commission Technical Services. (2019). Stormwater. Retrieved April 9, 2019, from Cape Cod Commission website: http://www.capecodcommission.org/index.php?id=172&maincatid=49

Cape Cod Water Protection Collaborative. (2019). Retrieved March 12, 2019, from Cape Cod Commission website: http://www.capecodcommission.org/index.php?id=697&maincatid=3

City of Boston. (2016). *Climate Ready Boston* (p. 199). Retrieved from City of Boston website: https://www.boston.gov/sites/default/files/20161207_climate_ready_boston_digital2.pdf

City of Cambridge. (2017). *Climate Change Vulnerability Assessment Part 2: Sea Level Rise and Storm Surge*. Retrieved from City of Cambridge website: https://www.cambridgema.gov/CDD/Projects/Climate/~/media/BF65658ED5C34C6AB9894A5F124F6704.ashx

Compagnucci, L., & Spigarelli, F. (2018). Fostering Cross-Sector Collaboration to Promote Innovation in the Water Sector. *Sustainability*, *10*(11), 4154. https://doi.org/10.3390/su10114154

Connelly, D. R., Zhang, J., & Faerman, S. R. (2008). The Paradoxical Nature of Collaboration. In *Big Ideas in Collaborative Public Management*. Armonk, NY: M.E. Sharpe.

Consensus Building Institute. (2019). Who We Are. Retrieved March 10, 2019, from Consensus Building Institute website: https://www.cbi.org/who-we-are/

Durrans, S., & Brown, P. A. (2001). Estimation and Internet-Based Dissemination of Extreme Rainfall Information. *Transportation Research Record*, *1743*(1), 41–48. https://doi.org/10.3141/1743-06

Emerson, K., & Murchie, P. (2010). Collaborative Governance and Climate Change:: Opportunities for Public Administration. In R. O'LEARY, D. M. VAN SLYKE, & S. KIM (Eds.), *The Future of Public Administration around the World* (pp. 141–154). Retrieved from https://www.jstor.org/stable/j.ctt2tt4cr.22

Emerson, K., Nabatchi, T., & Balogh, S. (2012). An Integrative Framework for Collaborative Governance. *Journal of Public Administration Research and Theory*, *22*(1), 1–29. https://doi.org/10.1093/jopart/mur011

Green, M., Leonard, R., & Malkin, S. (2018). Organisational responses to climate change: do collaborative forums make a difference? *Geographical Research*, *56*(3), 311–324. https://doi.org/10.1111/1745-5871.12286

Gregersen, H. M., Ffolliott, P. F., & Brooks, K. N. (2007). *Integrated Watershed Management: Connecting People to their Land and Water*. Cambridge, MA: CAB International.

Hamilton, L. C., Wake, C. P., Hartter, J., Safford, T. G., & Puchlopek, A. J. (2016). Flood Realities, Perceptions and the Depth of Divisions on Climate. *Sociology*, *50*(5), 913–933. https://doi.org/10.1177/0038038516648547

Hulet, C., & Wormser, J. (2019, February). *Resilient Mystic Collaborative Governance Document*. Resilient Mystic Collaborative.

International Commission for the Protection of the Danube River. (2018). *Update of the ICPDR Strategy on Adaptation to Climate Change*. Retrieved from International Commission for the Protection of the Danube River website: https://www.icpdr.org/flowpaper/app/services/view.php?doc=update_of_the_icpdr_strategy_on_adaptation_to_climate_change.pdf&format=pdf&page={page}&subfolder=default/files/nodes/documents/

Jorgensen, D. L. (1989). *Participant Observation: A Methodology for Human Studies*. SAGE.

Kansas Division of Conservation. (2018, October 29). Watershed Districts. Retrieved December 10, 2018, from Kansas Department of Agriculture website: https://agriculture.ks.gov/divisions-programs/division-of-conservation/watershed-districts

Keast, R., Mandell, M. P., Brown, K., & Woolcock, G. (2004). Network Structures: Working Differently and Changing Expectations. *Public Administration Review; Washington*, *64*(3), 363–371. http://dx.doi.org.ezproxy.library.tufts.edu/10.1111/j.1540-6210.2004.00380.x

Kenney, D. S., McAllister, S. T., Caile, W. H., & Peckham, J. S. (2000). *The New Watershed Source Book: A Directory and Review of Watershed Initiatives in the Western United States*. Retrieved from University of Colorado Boulder, Natural Resources Law Center website: https://scholar.law.colorado.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1031&context=books_reports_studies

Klijn, E.-H., Edelenbos, J., & Steijn, B. (2010). Trust in Governance Networks: Its Impacts on Outcomes. *Administration & Society*, *42*(2), 193–221. https://doi.org/10.1177/0095399710362716

Koebele, E. A. (2015). Assessing Outputs, Outcomes, and Barriers in Collaborative Water Governance: A Case Study. *Journal of Contemporary Water Research & Education*, *155*(1), 63–72. https://doi.org/10.1111/j.1936-704X.2015.03196.x

Kruel, S., Herst, R., & Cash, D. (2018). *Governance for a Changing Climate: Adapting Boston's Built Environment for Increased Flooding* (p. 90). Retrieved from Sustainable Solutions Lab, UMass Boston website: https://www.greenribboncommission.org/document/governance-for-a-changing-climate-adapting-bostons-built-environment-for-increased-flooding/

Lipman, J., & Geist, M. (2011). Cape Cod: Protecting a Land of Sand and Water. In *Regional Planning for a Sustainable America: How Creative Programs Are Promoting Prosperity and Saving the Environment* (pp. 122–132). Rutgers University Press.

Mailhot, A., & Duchesne, S. (2010). Design Criteria of Urban Drainage Infrastructures under Climate Change. *Journal of Water Resources Planning and Management*, *136*(2). Retrieved from https://ascelibrary-org.ezproxy.library.tufts.edu/doi/full/10.1061/%28ASCE%29WR.1943-5452.0000023

Massachusetts Bureau of Geographic Information. (2014). *Community Boundaries (Towns)* [Shapefile]. Retrieved from https://docs.digital.mass.gov/dataset/massgis-data-community-boundaries-towns?_ga=2.104538759.662584396.1556544280-484888571.1534881585

Massachusetts Bureau of Geographic Information. (2012). *Datalayers from the 2010 U.S. Census* [Shapefile]. Retrieved from https://docs.digital.mass.gov/dataset/massgis-data-datalayers-2010-us-census?_ga=2.103449223.662584396.1556544280-484888571.1534881585

Massachusetts Bureau of Geographic Information. (2005). *Impervious Surface 2005* [Shapefile]. Retrieved from https://docs.digital.mass.gov/dataset/massgis-data-impervious-surface-2005?_ga=2.40667685.662584396.1556544280-484888571.1534881585

Massachusetts Bureau of Geographic Information. (2000). *Major Watersheds* [Shapefile]. Retrieved from https://docs.digital.mass.gov/dataset/massgis-data-major-watersheds?_ga=2.232992281.662584396.1556544280-484888571.1534881585

Massachusetts Bureau of Geographic Information. (2017). *MassDEP Hydrography 1:25,000* [Shapefile]. Retrieved from https://docs.digital.mass.gov/dataset/massgis-data-massdep-hydrography-125000?_ga=2.24309309.662584396.1556544280-484888571.1534881585

Massachusetts Bureau of Geographic Information. (2016). *Regional Planning Agencies* [Shapefile]. Retrieved from https://docs.digital.mass.gov/dataset/massgis-data-regional-planning-agencies?_ga=2.263966475.662584396.1556544280-484888571.1534881585

Massachusetts Department of Environmental Protection. (2015). *MassDEP to Review Recent Studies on Precipitation Rates in Massachusetts*. Retrieved from https://www.mass.gov/files/documents/2016/11/xe/mapreciprates.pdf

Massachusetts Department of Revenue Division of Local Services. (2019). *Municipal Databank: General Fund* [CSV file]. Retrieved from https://dlsgateway.dor.state.ma.us/reports/rdPage.aspx?rdReport=ScheduleA.GenFund_MAIN

Massachusetts Department of Revenue Division of Local Services. (2019). *Municipal Databank: Schedule A , Part 8 Personnel Expenditures* [CSV file]. Retrieved from https://dlsgateway.dor.state.ma.us/reports/rdPage.aspx?rdReport=ScheduleA.PesonnelExpenditures.PersonnelExpenditures

Massachusetts Executive Office of Energy and Environmental Affairs. (2018, October). MVP Program Information. Retrieved April 3, 2019, from Mass.gov website: https://www.mass.gov/service-details/mvp-program-information

McGuire, M. (2006). Collaborative Public Management: Assessing What We Know and How We Know It. *Public Administration Review; Washington*, *66*(S1), 33. http://dx.doi.org/10.1111/j.1540-6210.2006.00664.x

Measham, T. G., Preston, B. L., Smith, T. F., Brooke, C., Gorddard, R., Withycombe, G., & Morrison, C. (2011). Adapting to climate change through local municipal planning: barriers and challenges. *Mitigation and Adaptation Strategies for Global Change*, *16*(8), 889–909. https://doi.org/10.1007/s11027-011-9301-2

Mikovits, C., Rauch, W., & Kleidorfer, M. (2018). Importance of scenario analysis in urban development for urban water infrastructure planning and management. *Computers, Environment and Urban Systems*, *68*, 9–16. https://doi.org/10.1016/j.compenvurbsys.2017.09.006

Milly, P. C. D., Betancourt, J., Falkenmark, M., Hirsch, R. M., Kundzewicz, Z. W., Lettenmaier, D. P., & Stouffer, R. J. (2008). Stationarity Is Dead: Whither Water Management? *Science*, *319*(5863), 573–574. https://doi.org/10.1126/science.1151915

Mystic River Watershed Association Goes All In on Climate Resilience. (2018, June 28). Retrieved March 13, 2019, from Mystic River Watershed Association website: https://mysticriver.org/news/2018/6/26/mystic-river-watershed-association-goes-all-in-on-climate-resilience

Office of the Revisor of Statutes. (2018). 2018 Minnesota Statutes. Retrieved December 10, 2018, from Minnesota Legislature website: https://www.revisor.mn.gov/statutes/cite/103D.201

Pahl-wostl, C. (2007). Transitions towards adaptive management of water facing climate and global change. *Water Resources Management; Dordrecht*, *21*(1), 49–62. http://dx.doi.org/10.1007/s11269-006-9040-4

Plocinski, L. M. (2012). *Moving from vulnerability to resilience: A climate change adaptation plan for the Taunton River Watershed* (M.A., Tufts University). Retrieved from http://search.proquest.com/docview/1023814924/abstract/30A776CEB3BF4D85PQ/1

Popp, J. K., Brinton, M., H., MacKean, G., Lindstrom, R., & Casebeer, A. (2014). *Inter-Organizational Networks: A Review of the Literature to Inform Practice*. Retrieved from IBM Center for the Business of Government website: http://www.businessofgovernment.org/report/inter-organizational-networks-review-literature-inform-practice

Preston, B. L., Mustelin, J., & Maloney, M. C. (2015). Climate adaptation heuristics and the science/policy divide. *Mitigation and Adaptation Strategies for Global Change*, *20*(3), 467–497. https://doi.org/10.1007/s11027-013-9503-x

Provan, K. G., & Kenis, P. (2008). Modes of Network Governance: Structure, Management, and Effectiveness. *Journal of Public Administration Research and Theory*, *18*(2), 229–252. https://doi.org/10.1093/jopart/mum015

Provan, K. G., & Milward, H. B. (2001). Do networks really work? A framework for evaluating public-sector organizational networks. *Public Administration Review; Washington*, *61*(4), 414–423. http://dx.doi.org.ezproxy.library.tufts.edu/10.1111/0033-3352.00045

Selin, S., & Chavez, D. (1995). Developing a collaborative model for environmental planning and management. *Environmental Management*, *19*(2), 189–195. https://doi.org/10.1007/BF02471990

Serra-Llobet, A., Conrad, E., & Schaefer, K. (2016). Governing for Integrated Water and Flood Risk Management: Comparing Top-Down and Bottom-Up Approaches in Spain and California. *Water*, *8*(10), 445. https://doi.org/10.3390/w8100445

Shi, L. (2017). *A new climate for regionalism : metropolitan experiments in climate change adaptation* (Thesis, Massachusetts Institute of Technology). Retrieved from http://dspace.mit.edu/handle/1721.1/111370

Shi, L. (2019). Promise and paradox of metropolitan regional climate adaptation. *Environmental Science & Policy*, *92*, 262–274. https://doi.org/10.1016/j.envsci.2018.11.002

State of New Hampshire. (2011). Watershed Management Bureau Fact Sheets: WD-WMB-16 Watershed Districts and Ordinances. Retrieved December 10, 2018, from New Hampshire Department of Environmental Services website: https://www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/index.htm

Streb, C. K. (2010). Exploratory Case Study. In A. Mills, G. Durepos, & E. Wiebe, *Encyclopedia of Case Study Research*. https://doi.org/10.4135/9781412957397.n139

Sullivan, A., White, D. D., & Hanemann, M. (2019). Designing collaborative governance: Insights from the drought contingency planning process for the lower Colorado River basin. *Environmental Science & Policy*, *91*, 39–49. https://doi.org/10.1016/j.envsci.2018.10.011

Todd, C. E. D., Harbor, J. M., & Tyner, B. (2006). Increasing magnitudes and frequencies of extreme precipitation events used for hydraulic analysis in the Midwest. *Journal of Soil and Water Conservation*, *61*(4), 179-. Retrieved from General OneFile.

United States Census Bureau. (2017). *Median household income* [CSV file]. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

Urwin, K., & Jordan, A. (2008). Does public policy support or undermine climate change adaptation? Exploring policy interplay across different scales of governance. *Global Environmental Change*, *18*(1), 180–191. https://doi.org/10.1016/j.gloenvcha.2007.08.002

US EPA. (2018, June 28). The Time to Act on Cape Cod Water Quality Is Now [Speeches, Testimony and Transcripts]. Retrieved April 9, 2019, from US

EPA website: https://www.epa.gov/newsreleases/time-act-cape-cod-water-quality-now

US EPA, R. 01. (2015, June 8). The Mystic River Watershed Initiative [Collections and Lists]. Retrieved October 25, 2018, from US EPA website: https://www.epa.gov/mysticriver/mystic-river-watershed-initiative

Vangen, S., & Huxham, C. (2003). Enacting Leadership for Collaborative Advantage: Dilemmas of Ideology and Pragmatism in the Activities of Partnership Managers. *British Journal of Management*, *14*(s1), S61–S76. https://doi.org/10.1111/j.1467-8551.2003.00393.x

Vynne, S., Adams, S., & Gregg, R. M. (2012, January). *Toward a Resilient Watershed: Addressing Climate Change Planning in Watershed Assessments*. Retrieved from http://static1.1.sqspcdn.com/static/f/551504/16150163/1327100274757/Watershed+Guidebook+final+LR.pdf?token=HFefs%2BcVbkkHN9Sa3rTMrHcZXpM%3D

Water Infrastructure Finance Commission. (2012). *Massachusetts's Water Infrastructure: Toward Financial Sustainability* (p. 131). Retrieved from Commonwealth of Massachusetts website: https://www.mapc.org/wp-content/uploads/2017/09/WIFC-Report-Final-.pdf

Weber, E. P., & Khademian, A. M. (2008). Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings. *Public Administration Review*, *68*(2), 334–349. https://doi.org/10.1111/j.1540-6210.2007.00866.x

Wernstedt, K., & Fanny, C. (2014). Climate Change, Urban Development, and Storm Water: Perspectives from the Field. *Journal of Water Resources Planning and Management*, *140*(4), 543–552. https://doi.org/10.1061/(ASCE)WR.1943-5452.0000308

Yin, R. K. (1994). *Case Study Research: Design and Methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.