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Improving Small Community Flood Resilience: The Multiple Strategies of Watershed Partnerships

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Improving Small Community Flood Resilience: The Multiple Strategies of Watershed Partnerships

A Thesis Presented

By

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ABSTRACT

IMPROVING SMALL COMMUNITY FLOOD RESILIENCE:

THE MULTIPLE STRATEGIES OF WATERSHED PARTNERSHIPS

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Flooding in New England is often seen as a coastal concern, but inland, in the mountainous rural communities of New England, river floods present serious threats to communities and livelihoods. Recent large storm events such as Tropical Storm Irene, and rising concerns over climate change, have catalyzed conversations over the vulnerability of communities across inland New England to flooding. This thesis examines two very different watershed organizations in New England; the White River Partnership and Deerfield Creating Resilient Communities. Both are working towards flood resilience in their communities. My approach is not to judge "best practices" or to evaluate what is better about one versus the other, but rather to highlight a range of approaches, institutions, policies and applications that enable flood resilience. By examining two very different institutions in depth, I will identify, explain and explore a variety of ways in which regional watershed partnerships can build partnerships and improve local flood resilience.

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS …….. iii

ABSTRACT……. iv

LIST OF TABLES …… viii

LIST OF FIGURES …… ix

INTRODUCTION 1

CHAPTER

I: CONCEPTUALIZING RIVER FLOOD RESILIENCE THAT ACCOMMODATES DYNAMIC FLUVIAL-GEOMORPHIC CHANGE 6

A. Resilience 6

B. Fluvial geomorphology and lessons for communities 8

C. Problems with structural solutions 9

C. Moving towards improved management and resilience: Using natural river processes 10

E. The limitations of flooding policies and programs at federal, state and local levels 18

F. Challenges for New England small towns and communities 21

G. Connecting small towns to flood resilience tools: building bridges 24

H. Watershed groups and how they are successful 27

I. Summary: What elements are needed for watershed partnerships to aid in improving small community flood resilience? 31

i. What is needed to achieve fluvial geomorphology informed resilience 31

ii. What capacities and resources communities need to achieve these goals 32

iii. What watershed partnership groups need in order to provide support to communities 32

II: THESIS GOALS, CASE STUDIES AND METHODS 33

A. Thesis Research Goals 33

B. Unusual watershed partnership groups, effective at helping communities become more resilient to river floods: White River Partnership and Deerfield CRC 34

i. The White River Partnership 37

ii. Deerfield Creating Resilient Communities 38

C. Methods 39

i. Research Methods 39

ii. Finding themes 41
iii. Emergent theory 42
III: WATERSHED PARTNERSHIP HISTORIES 44
A. The White River Partnership 44
i. Early history 45
ii. Development and growth 48
iii. Moving towards flood resilience 49
iv. Recent history and Tropical Storm Irene 50
B. Deerfield Creating Resilient Communities 53
i. Early history 55
ii. The changing role the watershed and the rise of 'security' 57
iii. Building security-watershed networks 59
v. Creating Resilient Communities to present day 62
IV: WATERSHED PARTNERSHIP STRATEGIES 67
A. Fluvial geomorphology-informed resilience 77
i. Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest ecological benefit, is by accommodating natural river movement 77
ii. Access to accurate and usable information on river science 79
iii. Identification of local areas either of geomorphic hazard or possible mitigation areas 83
iv. FGM-informed flood resilience planning 85
v. Prevention of further development on lands where there is high fluvial hazard risk 86
vi. Conservation of lands where lands can provide room for river movement and flood mitigation 88
vii. Protect lands and property in vulnerable zones, but avoid exacerbating FGM risks elsewhere 89
viii. Build and modify infrastructure to accommodate fluvial geomorphic forces and change 91
B. Communities capacities and resources 93
i. Ability to effectively use their own authorities and resources 93
ii. Access to supplemental authorities and resources 95
C. Watershed partnership needs 97
i. Institutional strength 97
ii. Institutional longevity 100

iii. Excellent relationships with communities, businesses and residents 101
iv. Familiarity with federal and state agency programs and excellent relationships with agency staff 103
V: COMPARISON OF CASE STUDIES AND THE MULTIPLE LESSONS OF WATERSHED PARTNERSHIPS 105
A. Histories to Strategies 106
B. A Menu of Strategies to Address Flood Resilience 107
C. Watershed partnerships and the communities they serve 114
D. Watershed Partnerships as Institutions 116
VI: CONCLUSIONS, SUMMARY AND FURTHER WORK 120
A. Conclusions and Summary 120
B. Places for Continued Work 123
BIBLIOGRAPHY 124

LIST OF TABLES

Table Page

1. Strategies for Watershed Partnerships to Address Flood Resilience 71

2. Menu of strategies and how they can be used by watershed partnerships 110

LIST OF FIGURES

Figure Page
1. Case study map 36

INTRODUCTION

Flooding in New England is often seen as a coastal concern, but inland, in the mountainous rural communities of New England, river floods present serious threats to communities and livelihoods. Recent large storm events such as Tropical Storm Irene, and rising concerns over climate change, have catalyzed conversations over the vulnerability of communities across inland New England to flooding. While many people in these communities are aware of their own vulnerability, they are also attuned to their own responsibility to manage rivers and flooding hazards, as well as to the many challenges and limitations which face small communities across the region. People, governments and communities are finding new and innovative ways of adjusting to the new challenges presented by these increasing concerns, often within extremely limited financial and political capacity. Some of the best of these strategies represent a move toward what could be called community flood resilience. In this thesis I define a flood resilient community as one that accommodates changes in river water and sediment flow, while continuing to protect infrastructure and livelihoods.

There are many ways in which people, governments and communities are shifting towards flood resilience. Some use new scientific approaches, founded on the science of fluvial geomorphology. Others use new or modified governance, institutional, and policy approaches.

Yet, in many cases there remain extensive constraints and limitations to the abilities of

small towns across New England to improve their own flood resilience. Science regarding rivers and flooding is complicated and keeps changing. Existing state and federal policies and programs are complex and difficult to navigate. Towns in rural New England frequently have no or very limited staff assigned to work on these issues and therefore, overcoming the hurdles presented by science and policy can seem insurmountable.

This is the problem which frames my research: while flooding presents serious hazards to small communities across New England, and there is now scientific information that can guide improved flood resilience over the long term, as well as a number of governmental programs that can help, towns face limited resources and lack capacity to access new river science and existing policies and programs and are therefore challenged to become more flood resilient.

My research investigated the concerns and solutions expressed by community residents in parts of New England impacted by Tropical Storm Irene in 2011. My findings point to the crucial role of intermediary partners – partner groups that help people in local communities' access and use state and federal programs as well as up-to-date river science. These groups assist communities to access resources they would otherwise be unable to access on their own. I investigated two intermediary organizations working in rural New England, the White River Partnership and Deerfield Creating Resilient Communities. Both these groups can also be categorized as watershed organizations. Combining the ideas of intermediary partners and watershed organizations, I call these

two groups watershed partnerships.

Watershed organizations have been studied across the country since the 1990s and have been found to be highly diverse in their makeup, goals and strategies (Leach and Pelkey 2001; Moore and Koontz 2003; Sabatier et al. 2005). Overall, watershed organizations have been demonstrated in certain cases to be effective in engaging multiple stakeholders to address specific issues such as water quality, restoration, storm water, land use and even political action (Leach and Pelkey 2001; Moore and Koontz 2010; Sabatier et al. 2005). Attempts have been made to categorize watershed organizations and develop toolkits to understand how and why certain watershed organizations work and others fail (Koontz and Johnson 2004; Moore and Koontz 2003; Diaz-Kope and Miller-Stevens 2014). Yet the developed typologies still fail to encompass the possibilities for all watershed organization. The limited analyses to date may even limit what is expected from these groups. This paper seeks to continue to enlarge the research completed on watershed organizations by adding two additional case studies of groups that fall outside most typologies of watershed groups. I describe and analyze each group's goals, work and successes. Building from these case studies this paper will specifically address how watershed organizations can address community concerns over flooding and resilience.

This thesis examines two very different watershed organizations in New England; the White River Partnership and Deerfield Creating Resilient Communities. Both are working towards flood resilience in their communities. My approach is not to judge "best practices" or to evaluate what is better about one versus the other, but rather to highlight

a range of approaches, institutions, policies and applications that enable flood resilience. By examining two very different institutions in depth, I will identify, explain and explore a variety of ways in which regional watershed partnerships can build partnerships and improve local flood resilience.

Chapter 1 will overview the background of the concept of flood resilience, science of fluvial geomorphology, the history of flood management and how it is changing, and the role of watershed partnerships. Chapter 2 reviews my methods and case studies. I will give some background to each case study and detail how a problem-centered interview process was used to gather data, a thorough story was built for both case studies, and how an emergent analysis allowed for me to glean both case-specific and wider lessons. Chapter 3 focuses on the histories of both case studies and how they came to be successful examples of watershed organizations. Chapter 4 identifies the successes of each case study in promoting community river flood resilience, and analyzes the specific strategies employed by each case study to achieve these successes. Chapter 5 compares the strategies of the two case studies and uses emergent theory to draw out a range of options which could be applied elsewhere to spread methods to improving flood resilience.

Overall, this research project seeks to illuminate several different strategies which two case study watershed partnerships are utilizing to advance flood resilience in their regions. While my case studies are only two pieces in a much larger river management world in New England, by studying their methods and strategies, I aim to highlight

lessons to be learned from their efforts and how their work fits into the larger flood resilience conversation.

CHAPTER I

CONCEPTUALIZING RIVER FLOOD RESILIENCE THAT ACCOMMODATES DYNAMIC FLUVIAL-GEOMORPHIC CHANGE

A. Resilience

For the purposes of this thesis, the ideal flood resilient community accommodates changes in river water and sediment flow, while continuing to protect infrastructure and livelihoods.

Resilience has been researched and defined in many different ways. Resilience in natural systems involves the ability of a biophysical system to maintain connections and working relationships within the system during and after a disruption, e.g: riverine ecological processes still function after a flood (Holling 1973; Folke et al. 2006). We can incorporate fluvial geomorphology more specifically into this concept to address flood resilience. According to Kline and Cahoon, incorporating fluvial geomorphology into resilience requires managing rivers in ways that allow them to reach a state of equilibrium where they are able to maintain reasonably stable geomorphic parameters (2010). As rivers carry more than water, such as sediment, vegetation, etc., the power of the river can vary depending on what is in the river and how much resistance it encounters. As a river reaches a balance between erosion and deposition, a relatively stable shape is reached with minimal changes to its lateral and vertical dimensions. Therefore, during everyday flow a river is not likely to change its channel form, and the system is overall balanced. After a major flood, a relatively balanced system like this is

able to return to this kind of general stability and balance relatively quickly and easily. It is thus a resilient river system.

This conception of resilience has also been adapted to social systems and the ability of communities to respond to change in their environment. Specific to nature-based disturbance, such as flooding, researchers studying resilience within communities seek to lower the vulnerability of infrastructure and livelihoods to damages from disasters and enhance the ability of communities to recover (Cutter et al. 2008). This can include building infrastructure that is large enough to pass flood waters and developing lines of communication so that during disasters people are not isolated.

Some research has gone further to consider the coupling of socio-ecological resilience and the ability of social systems to adapt to changes in their environments. This idea is also known as adaptive capacity (Folke 2006). This is critical to understanding resilience to flooding because it involves both large changes to biophysical systems, such as larger and more frequent floods and the changes to the channel during those floods, and how communities will need to adapt to deal with these changes. Especially with the pressures of climate change, communities will need to be able to maintain and enhance livelihoods and infrastructure even in the face of long-term riverine change, whether that change is in river form or typical river process.

Combining these biophysical and social elements leads us to a two part concept of resilience: by adhering to the principles of fluvial geomorphology and using natural river

processes to create more stable river systems, it is also possible to create more stable infrastructure and enhance livelihoods.

B. Fluvial geomorphology and lessons for communities

The science of fluvial geomorphology has advanced the understanding of rivers and how human impacts can alter natural river processes. Communities have long inhabited banks of rivers in New England and benefited from their resources including mill and electric power, fish and other ecological habitats, rich floodplain soils and many others. Seeking to control rivers and minimize damages from flooding, management policies and practices during the 20th century largely focused on straightening, channelizing and placing flood control structures along banks (Kline and Cahoon 2010). Newer management techniques have shifted to focus on natural processes and lowering the negative impact of human activities on the river landscape.

The sciences of fluvial geomorphology and ecology have shown that rivers naturally meander, move sediment and flood (Kline and Dolon 2008). While controlling these river processes may benefit particular locations in the short term by limiting damages from flooding, in the long term, such controls can increase the potential damage from storms all along the river, reduce the productivity of habitats, and overall be counterproductive to the initial management goals (Kline and Dolon 2008).

An example can be seen in the typical structures built to protect urban centers from

changes in river flow. By straightening and confining the channel with large rocks or concrete, people try to ensure that the river is unlikely to change form through that stretch of protected space. However, downstream the river will act like a firehose that it has been bent and then released (Dolon and Kline 2010). Natural bends in the river slow the river's speed. When straightened, the river picks up speed. Increased speed means higher force on the streambed and stream bank, as well as infrastructure in the river's path. Land and infrastructure downstream of the protected area will face increased erosion and damage during high flow events. Even if rocks or concrete contain a river during normal high flows, during extreme events or over extended periods of time, these protection measures can fail, causing even greater damage to the immediate area and requiring costly repairs (Dolon and Kline 2010).

C. Problems with structural solutions

While structural solutions can protect specific areas of development, it has some clear flaws. First, the construction, maintenance and continuous repair makes structural solutions to flood management costly. The need to replace a bridge, culvert or retaining wall every time one fails during a flooding event results in a cycle of cost and dependence (Dolon and Kline 2010; Vogel et al. 2016). Once a protective structure is built, people have a false sense of security that they can continue to develop or use the area which is protected. However, once threatened by a flooding event, the protective structure will continue to need to be repaired or replaced (Dolon and Kline 2010; Vogel et al. 2016). This cost cycle is straining both the abilities of municipalities to shoulder

these costs as well as state and federal programs aimed at disaster recovery, and will only get worse with the impacts of climate change.

Second, this style of intrusive protection, such as hard rock stabilization, also damages the health of the river and aquatic ecology. Connectivity between land and the river through the floodplain is lost when hard structures are placed along riversides (Dolon and Kline 2010).

And third, it is becoming increasingly clear that these structural solutions do not work efficiently or effectively. A s described above, while a rock wall may protect one specific area, such as a building, it only directs the energy of the river downstream (Dolon and Kline 2010). Thus, the wall does not lower the overall flood risk, it only redirects it. This can also be seen with structures such as small bridges which can become clogged with sediment, thus increasing the flood risk upstream (Dolon and Kline 2010). Thus, while these hard structural solutions to reducing flood damages can work temporarily, over the long-term they can become costly to maintain and can damage the biophysical environment.

D. Moving towards improved management and resilience: Using natural river processes

It is possible to move towards a less intrusive and, in the long term, less costly solution to lowering the negative impacts of river floods. By adhering to the key concepts of fluvial

geomorphology, communities can be protected from many flood damages and be more resilient to future flood events. Throughout this thesis I will refer this collections of management options as fluvial geomorphology-informed or FGM-informed flood management or resilience.

What does this look like on the ground? Central to FGM-informed resilience is that new management techniques need to allow room for rivers to move. As a river cuts across the landscape, the meanders it forms naturally cause the river to slow and form floodplains. Meanders and floodplains help slow and dissipate both the water and sediments. This slowing of the water limits the damage from high water events. Development needs to be limited in areas with high flood dangers. Simply, the less valuable infrastructure placed in harm's way, the lower the risk of flood damage and the lower the cost of protection (Kline and Cahoon 2010). And, less intrusive methods for protecting existing infrastructure in high risk areas need to be promoted as alternatives to hard structural solutions. These ‘softer’ solutions can include tree plantings or opening floodplain access nearby, and these solutions aim to keep or improve connectivity between the river and its floodplain ecosystem (Polster 2003). Every part of this alternative solution will require complex compromises between human land use and natural river processes.

For a set of options of how these goals can be implemented, we can examine the example of the Vermont Rivers Program or VRP. The goals of the Vermont Rivers Program are to protect and restore natural river and floodplain processes to enhance water quality, ecological health, and flood resilience (Vermont Rivers Program 2016). Flood resilience

under the VRP is thus indelibly tied to water quality and ecological health, and all are achieved by restoring natural river and floodplain processes.

The first step in improving flood resilience (and water quality and ecological health) under the VRP is to conduct studies on the river's geomorphic characteristics and condition. This is completed through a Stream Geomorphic Assessment. The assessment gathers the baseline data required to understand the geomorphic state of the river (Dolon and Kline 2010). These assessments can inform a variety of management options. Practically, the data gathered from assessments can be mapped to designate fluvial hazard zones (FEH zones). Fluvial hazards can include both inundation and erosion, though for the mountainous areas of New England erosion is the main cause of damage (Dolon and Kline 2010). Understanding where the FEH zones are around the river allows towns and residents to know where the areas of highest flood damage risk area, and make management decisions based on this information. Towns and residents use this information to identify structures in harm's way, places where the risk is lower and land can still be used for development, or open places which can be used to dissipate flood energy (Dolon and Kline 2010).

Once an FEH zone is established, a "river corridor" can be mapped to include both this hazard zone and then additional room for the river to meander and move. The designated 'river corridor' is one of the VRP's main river management tools. The river corridor includes floodplain area and an additional buffer zone around the river which allows the growth of a natural riparian ecosystem and allows the river to form meanders across the

landscape (Kline and Dolon 2008). River corridors lower flood vulnerability by allowing rivers to flow unconfined, allowing floods to slow by dispersing across floodplains, and in the end, establishing what Kline and Cahoon call a balanced river system (2010; also see above section on fluvial geomorphology) This river corridor is then designated as a protected area and can be regulated. By mapping all of the rivers in Vermont and establishing where the river corridor is around each segment of river, Vermont has been able to designate a new protected status and regulate activity in this zone (Kline and Cahoon 2010).

Once the corridor is established, towns can use the maps and designate new planning zones. This translation from scientific maps to zoning regulations can be particularly difficult. Especially if a town is already part of FEMA's Flood Insurance Program, the town will already be using FEMA's Flood Insurance Rate Maps to identify flood zones. However, these maps frequently do not include erosion hazards and therefore are not the best tool for towns in mountainous New England. Having multiple maps which show different flood hazard zones can cause conflict over where should be included or not in any zoning changes. In Vermont, additionally funding have been offered to towns which adopt the 'river corridor' map and regulate development and other activities according to this new protected status. This monetary incentive helps to balance the potential loss of some lands from future growth and development.

Within these now-designated protected planning zones, towns can now avoid locating new development in areas with high risk of flooding and identify any existing

developments which will need to adapt. This can be done in a multitude of ways. Non-developed areas within the river corridor are the easiest to deal with. Once mapped, these lands are subject to the protected status of the corridor and future development is heavily limited (Kline and Cahoon 2010). This can still be controversial for privately owned land and often requires delicate face-to-face negotiations. However, areas which are already developed in some way and in the river corridor are more difficult.

Occasionally, properties are deemed simply too high risk and both new development is prohibited and old developments are removed and the land turned into a conservation property. This can be done through several methods. A popular option is conservation land buy-outs (Cohen 2013; FEMA 1998). Using government funds, a property can be purchased from private owners and then set aside as designated floodplain. That once-developed land can now be left alone. Another option is conservation easements. These can also be completed with buy-outs or can be done on still privately own land (FEMA 1998). Easements prevent future development and limit certain activities on the property. In exchange the landowner will receive tax benefits (FEMA 1998). Both of these options, as well as others, offer the opportunity to turn once high-risk developed land into protected undeveloped floodplain.

Where development cannot be avoided, there are a variety of creative mitigation options. Some options included: raising homes above flood level; moving valued aspects of property back from the river; and moving important pieces such as heaters and generators higher within structures (FEMA 2010).

If physical mitigation to a structure is not possible, there are many protection alternatives. There are many places across New England where historic buildings or other high-value development lie within the river corridor and are at risk of flooding. These structures are frequently already protected with hard structures such as rock walls. Some hard protection may still be necessary in order to protect towns from flooding. However, there are other 'soft' options for protecting including: opening land up upstream, downstream or across from the structure to slow waters; planting native species along banks whose roots will stabilize soils and lesson erosion; embedding tree roots into the soil again to lessen erosion and buildup banks; placing large boulders in the river rather than alongside it; and many others (Komer 2015; Polster 2003). It is not the goal of river corridors to eliminate people rather to develop less intrusive methods for building and living near rivers.

One place the VRP is still seeking to improve is improving infrastructure. The VRP has been successful in partnering with other agencies like the Vermont Department of Transportation to address some of these needed changes. Across New England (and much of the rest of the country), the issue of undersized culverts and stream crossings is especially important. Many towns in New England regularly face issues with stream crossings not being large enough to pass the waters, sediments, and debris during high water events. Upgrading stream crossings to larger sizes and to designs which allow more river movement would prevent the need to frequently repair and replace stream crossings. However, upgrading crossings is costly and sometimes bureaucratically difficult for small

towns. After a flooding event, such as Tropical Storm Irene in 2011, many towns wanted to upgrade failed crossings to larger sizes and improved designs. After a flood emergency, FEMA often helps fund replacements of failed crossings. However, FEMA regulations state that they will only fund towns to upgrade crossings if it is already required by town standards. Also, the upfront cost of building a larger structure is much larger than simply replacing the old one; however, the long term costs of continuing to replace old inadequate structures is often greater than upgrading structures now (Mears, David K. and Sarah McKearnan. 2013). Culvert and bridge sizing standards need to be changed both at the federal and state level, however for now towns can prioritize crossings according to those at highest risk and spread the cost out over time. Many of these needed changes are already being made in the wake of problems raised after Irene, but there are still many inconsistencies between federal, state and local standards (see Vogel et al. chapter 2 for more details (2016).

From this description of the VRP and some of the positive management choices Vermonters made after Irene, we can construct a list of tasks and tools that communities can and should use to become more resilient to river floods.

Requirements for Fluvial Geomorphology-Informed Resilience

1. Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest ecological benefit, is by accommodating natural river movement.

2. Access to accurate and usable information on river science, fluvial geomorphology

3. Identification of local areas either of geomorphic hazard or possible mitigation areas

4. FGM-informed flood resilience planning

5. Prevention of further development and encroachment on lands where there is high fluvial hazard risk

6. Conservation of lands where lands can provide room for river movement and flood mitigation

7. Protect lands and property in vulnerable zones, but avoid exacerbating FGM risks elsewhere

8. Build and modify infrastructure to accommodate fluvial geomorphic forces and change

While these changes to FGM-informed management and long-term resilience appear simple enough on paper, in reality many of these changes remain out of reach for small towns. The VRP has partnered with other state agency and other groups around the state to promote education and training for town official and residents. Resources and incentives are essential to encouraging towns and residents to take FGM-informed action to improve flood resilience. Outside of Vermont, and even still in Vermont to a considerable extent, this concept of FGM-informed resilience remains an ideal until practical methods for overcoming small town limitations can be further developed and better supported.

E. The limitations of flooding policies and programs at federal, state and local levels

It is not a simple task to transform the way we manage rivers in order to protect communities from river floods from a structural approach aimed at straightening, deepening and armoring channels to a non-structural approach that allows rivers room to move. Among other things, it requires clear regulation and assistance for towns which deal with the direct implementation of these policies at the local level. Policies and programs need to discourage development in dynamic floodplains but also find ways to incorporate the protection of livelihoods into management plans. There are several existing policies and programs that address river and flood management. None, however, have yet been able to make the transition to this new approach in a way that enables small towns and communities to implement it easily and fully.

The most well-known government program in place for addressing flooding hazards is the National Flood Insurance Program (NFIP) under the Federal Emergency Management Agency, or FEMA. NFIP discourages buying a home and developing in floodplains by requiring homeowners to buy flood insurance for properties at risk of flooding (see FEMA 2016). FEMA uses its National Flood Insurance Rate Maps to determine which homes fall in flood risk zones. These maps mainly based on water inundation risks determined by elevation.

A town may join the NFIP program by applying to FEMA and adopting FEMA's standards. If a town joins NFIP residents may purchase flood insurance through the

program, otherwise residents are ineligible. The NFIP is the only option for flood insurance for most homeowners as most private insurance companies do not offer flood insurance. Once a town is part of NFIP, residents who wish to purchase a home which falls in a flood zone through a mortgage are required to purchase flood insurance. An additional reason for towns to join the NFIP is that it is a requirement in order to apply for all other FEMA grants (FEMA 2016).

FEMA also offers Flood Mitigation Grants which towns can apply for to take action before a flood occurs (FEMA 2016). These grants were also used retroactively after Irene to pay for infrastructure repairs (Mears and McKearnan. 2013). This is currently the largest pot of recurrent financing for larger mitigation projects.

If town wants to participate in any of these FEMA programs as well as receive assistance money after an emergency, there are extensive entry level requirements such having an updated Hazard Mitigation Plan. Hazard Mitigation Plans are an excellent method for towns to gather primary data on flooding and other hazards.

While NFIP and other FEMA programs are the most comprehensive flood management programs and offer the largest pot of funding, they are frequently inaccessible to small towns which lack the resources to apply for and implement these programs. Gathering the needed data and organizing it into actionable plans takes extensive up-front funding and expertise than usually only be achieved by hiring a consultant. Also, while NFIP is the most comprehensive option currently available to towns, the program itself is consistently

under-funded and not capable of meeting demand (Burby 2006).

Beyond the direct regulation of FEMA and NFIP on flooding hazards, many other federal programs offer programs or have policies in place which impact how towns manage their rivers. The NRCS, under the USDA, has several programs aimed at farmlands and lowering flood damages. The EPA runs a Watershed Program which can fund projects aimed at managing rivers and lowering flood damages (for other examples of federal programs see Vogel. 2016). Again, these large federal programs, while they offer great opportunities, remain out of reach and not tailored to the needs for small communities.

At the state level, Vermont is a leader, especially in New England. The Vermont Rivers Program assesses the geomorphic condition of the state's rivers and determines places of high flooding risk and then assists communities to adjust river management (see previous section). The Vermont Rivers Program, unlike FEMA, incorporates fluvial erosion hazards into their maps and flood mitigation program. The VRP also offers incentives for towns to incorporate these more complete maps into their planning and zoning. It also provides technical assistance to towns wishing to conduct fluvial assessments and implement new management strategies. While through these more incentive-based and on-the-ground methods for regulating river management the VRP is improving small town access to flood resilience measures.

Local municipalities and regional groups across New England are also taking on the task of better understanding and preparing for floods. In Vermont, many towns have already

adopted the VRP's river corridor maps into their planning efforts and zoning rules. And in Massachusetts, Towns in the Deerfield River Watershed have numerous fluvial geomorphic assessments both completed and in process. However, this town-by-town approach often leads to incomplete studies of watershed and positive efforts in one town can be easily cancelled out through the negative actions of a nearby town. Towns also lack the resources to lead to movement on their own to improve flood resilience.

The end result is that despite these pioneering policies and programs, as well as many other efforts and programs to better manage rivers, many towns and communities across New England remain vulnerable to flooding hazards (Kline and Dolon 2008; Kline and Cahoon 2010).

F. Challenges for New England small towns and communities

These outside resources are frequently not reaching small New England towns due to the many challenges in navigating complex river and flood science, management options and policy which face small towns (see also Vogel 2016). While towns in New England have the jurisdictional authority to regulate their lands, they have limited resources including financial and staff.

Municipalities in some states in New England are under Dillon's rule, such as Vermont, and others home rule, such as Massachusetts. Regardless, towns across New England have traditionally more authority compared to towns across the rest of the country. This is first due to the weakness or lack of counties and county governments, combined with

the fact that most land in New England is in a municipality; together these mean local land use is mainly under the control a municipal government. And second, even if a state is technically Dillon's rule, towns in New England have strong sense of independence and respect for local practices (for more detail on town authorities in New England see Vogel 2016). Thus, towns in New England have a uniquely strong position to control their own lands and the authority to do so.

Nonetheless, towns – especially small rural towns – have trouble doing all that would be required of them to advance local flood resilience. Unfortunately, while federal and state agencies have the financial and regulatory capacity to develop policies and programs, these programs often place costly burdens on towns to implement them and frequently are not attuned to the specific needs of towns.

Many of the lessons learned after Tropical Storm Irene pointed to the difficulties small towns and communities face in navigating complex river and flood science, management options and policy (see Mears, David K. and Sarah McKearnan 2013; Clancy, Justin B. and Jessica Grannis 2013; Vogel 2016). After an event such as Irene, the federal response was largely inadequate for small towns. Response staff were spread too thin, were temporary and rotated frequently, and lacked an understanding of local need and situations. Coordination between these temporary response personnel was sometimes inadequate and many locals found themselves stranded for days or weeks with limited assistance. The recovery process pointed out inconsistencies in regulation standards, and resulted in towns waiting for months to years for reimbursement or funding.

Planning outside of an emergency can also be too tedious for small towns to manage on their own.

In some cases, towns are receiving mixed messages, such as different flood hazard maps, one from FEMA which is inundation based, and others from agencies such as the VRP which are based on erosion hazard (Kline and Dolon 2008). For town leaders to understand their options and which practices will best benefit their towns requires a level of expertise often not present in town government. New management practices also require large investments by towns for activities such as building new structures, buying out riverside property, matching the funds received from grants, completing studies, etc. These are often simply not possible in towns with limited budgets (comments from personal interviews; also see Dolon and Kline 2010).

This disconnect between available policies and programs at the federal and state level, and town needs and capacities, often results in towns being unable to take advantage of existing opportunities and leaves them vulnerable to future flooding. A large scale change of federal policies will not be cost-effective or practically possible in the near future. Small towns are also unlikely to be able to hire large numbers of staff or generate more resources. Therefore, a solution to this problem will need to address improving the local capacity of these small towns, and making existing policies and programs work better for local municipalities. Small towns need a way to fully take advantage of their own authority over land use, and also of federal and state policy, in order to address flood

resilience.

To summarize, two key needs for communities to enhance their livelihoods while improving flood resilience are:

1. Ability to effectively use their own authorities and resources
2. Access to supplemental authorities and resources

There are groups which are operating between towns and state and federal government, attempting to overcome this disconnect.

G. Connecting small towns to flood resilience tools: building bridges

In order to address small community flood resilience in New England, the disconnect between state and federal programs and policies, and the application of those programs and policies at the local level, needs to be addressed. Towns need assistance which preserves their local scale concerns and autonomy but can extend their limited resources.

In order to overcome the many challenges facing small towns and strengthen their own autonomy, several needs should be addressed: accurate and usable information of river processes; tools to include FGM-informed resilience in planning; and resources to implement resilience measures.

There are examples around New England, where some towns have found assistance from

groups which are able to bridge some of these gaps. I call these “intermediary groups” because of their bridging role. These intermediary groups vary greatly in make-up, funding, and goals but generally operate in the grey area between federal and state governments and municipalities (for more information on intermediary groups in New England see Vogel 2016).

There has been extensive empirical and theoretical research on the role of bridging objects and boundary organizations. Boundary organizations can mediate between the two often different worlds of the social and the science (Guston 2001). Boundary organizations typically form when scientific and social work are completed in tandem to produce outcomes for regulation or other products, they are responsible to both fields, thus avoiding jeopardizing the quality of either field (Guston 2001). Boundary organizations typically operate in political negotiations, in contrast bridging organization typically form where natural resource management is occurring on the group. Some work has been looking into how ‘bridging organizations’ help facilitate discussion between multiple levels of natural resource management (Berkes 2008). These organizations can especially aid in the improvement of socio-ecological resilience as they create spaces for social learning, conflict resolution and the creation of common interests. (Folke et al. 2005; Schultz 2009). These ideas can help inform an understanding of what I call ‘intermediary partnerships’ by highlighting and analyzing the crucial role of an institution which bridges the science-social science divide (boundary organizations) and also the levels and institutions of natural resource management (bridging organizations).

Examples of these intermediary groups are certain Regional Planning Commissions and Regional Councils of Governments. Other intermediary groups include non-profit groups, such as the Connecticut River Watershed Council and local level ad-hoc or watershed groups. Intermediary groups are not uniform and vary in abilities, however the successes of a few strong examples point to the possibilities of these groups to be key in improving small towns' access to policies and programs.

Through initial research into groups around New England addressing the needs of small communities, I was able to identify some of the key roles these various groups are playing in the region. These intermediary groups have been able to assist towns in accessing additional resources and applying for federal programs. Overall, they help towns overcome some of the initial hurdles when attempting to navigate the government policy and program world and address specific needs of communities. These needs can include: interpreting and explaining scientific information, filling out extensive paperwork, writing grants, clarifying requirements of programs, designing projects and hiring contractors, and providing trainings. The services each group provides depend on the resources available to the group and the needs of the communities they serve. Despite their huge variety, these groups appear to provide an invaluable service to small towns.

One of the most important roles these intermediary groups can fill is as a resource for education and outreach materials on topics essential to FGM-informed resilience. Towns often lack a reliable and useful source of scientific information. An intermediary group can often as an expert resource for towns to both explain the complexity of science such

as fluvial geomorphology and also translate the science into usable information.

While it is difficult to generalize the roles and methods of these groups, it is clear that they are playing a critical role for the small towns which utilize them. Acting as an intermediary between towns and high levels of government allow them to remain attuned to the unique needs of small towns which is frequently a huge limitation for large scale policies and programs. These groups are also able to act as experts in the more general policies and scientific principles, and then act as a resource for towns. By researching and understanding the methods of two of these groups, I aim to highlight one possible crucial element to improving small community flood resilience.

As there a huge variety of these intermediary and watershed groups, I will focus this research on a combination of these ideas I am calling watershed partnerships.

H. Watershed groups and how they are successful

Watershed groups appear in the literature as early as the 1960s, but research picked up momentum in the 1990s with the sudden increase of watershed groups that started in the 1980s (Leach and Pelkey 2001). These groups were often collaborations between federal, state and local governments, as well as citizens and other interest groups, and they became the focus of many new government programs (Sreeja et al. 2011; Griffin 1999; Cohen and Davidson 2011). In the United States, several agencies put out the call for agency collaborative projects between state and local governments which resulted in the

rise of watershed partnerships.

The extensive research already completed on watershed partnerships around the United States has resulted in huge variety of data. Groups are formed around issues ranging from water quality to dam construction to recreation access (Moore and Koontz 2003; Sabatier et al. 2005). Some groups are initiated and led by government agencies, some are entirely grassroots, and still others are combinations of these and other interested parties (Moore and Koontz 2003). Overall, watershed partnerships vary in their motivations, mission, members and effectiveness in accomplishing their different goals. Even the definition of what constitutes a watershed partnership varies greatly. I will be drawing on two of the most encompassing definitions available:

> Leach and Pelkey 2011: "Watershed partnerships, which go by many other names including committees, councils, advisory groups, and task forces, are assemblies of stakeholders who periodically convene to discuss or negotiate the management of streams, rivers, or watersheds. Partnerships can be highly formal processes commissioned by government agencies, but they are frequently informal organizations without bylaws, minutes, or officers." (pp. 378)
>
> Kenny et al. 2000: "A primarily self-directed and locally-focused collection of parties, usually featuring both private and intergovernmental representatives, organized to jointly address water-related issues at the watershed level or a similarly relevant physical scale, normally operating outside of traditional governmental processes or forums, and typically reliant on collaborative mechanisms of group interaction characterized by open debate, creativity in problem and solution definition, consensus decision-making, and voluntary action." (pp. 2).

From Leach and Pelkey, I took the widely different identifying characteristics of watershed partnerships. And from Kenney I took the central concept that these groups operate under their own processes, outside of typically understood governmental processes. From both, it is clear that watershed partnerships can vary widely in their

nature but all rely on interactions with the diversity of interested parties within a watershed.

While extensive research has been completed on watershed organizations and how they have successfully worked with stakeholders to management water resources, little work has looked into how they can address flooding and the concepts of fluvial geomorphology (Leach and Pelkey 2001). Research has mainly focused on ability of watershed partnerships, in case study specific areas, to address ecological, water quality and other issues of water as a resource (Sabatier et al 2005; Koontz and Johnson 2004).

Also, while these groups are frequently described by typologies of origin and leadership - either agency-led citizen-led or mixed, both of my case studies fail to be accurately described by existing typologies (Moore and Koontz 2003; Diaz-Kope and Miller-Stevens 2014). Both groups have characteristics and success stories which would not have been predicted by existing typologies. For example, if I had simply characterized my case studies as agency or citizen led, I would not have been able to fully describe the makeup of each case study. While the findings of most comprehensive research completed on watershed partnerships points to the extraordinary variance in the membership, strategies and intentions of watershed partnerships, work remains focused on generalizing these groups rather than highlighting the vast range of options. In this thesis I will be addressing the possibility of watershed partnerships to address small community flood resilience and highlighting the range of successes such grounds have achieved.

Despite these shortcoming, this literature has been helpful in discovering what key help the institutions themselves become successful in sustaining themselves and making tangible impacts in communities. Leadership is critical to organization and gaining ground for any watershed group. Disorganization and a lack of a plan leads to a short-lived effort (Doppelt and Onsgaard 2006). Organizations may be able to make short term changes through having strong leadership, but the group also needs to have long-term plans which include funding and secure membership (Leach and Pelkey 2001; Koontz and Johnson 2004; Moore and Koontz 2003; Doppelt and Onsgaard 2006). Beyond organization the group itself, without the trust of the residents, efforts of the watershed group will not have any long-term success. Groups need to have a presence felt in the community (Sabatier et al. 2005; Doppelt and Onsgaard 2006). And lastly, watershed groups cannot operate in isolation. They do not have the resources or expertise. Therefore, connections and partnerships to agencies and other outside groups can bring additional assistance (Leach and Pelkey 2001; Koontz and Johnson 2004; Moore and Koontz 2003;Doppelt and Onsgaard 2006)

Therefore, key elements that a watershed organization will need to support communities are:

11. Institutional strength
12. Institutional longevity
13. Excellent relationships with communities, businesses and residents
14. Familiarity with federal and state agency programs and relationships with agency

staff

In this thesis, I will be examining two case studies: one formal, agency-initiated, but still self-directed, the White River Partnership in Vermont, and one ad-hoc, totally conversation-driven, Deerfield Creating Resilient Communities in Massachusetts. Both groups have their watershed scales in common, as well as their connections with people and groups around the watershed, but differ in their strategies, goals and structure. I will use these groups to consider how communities can become more flood resilient.

I. Summary: What elements are needed for watershed partnerships to aid in improving small community flood resilience?

There is a range of elements which will need to be addressed in order for watershed partnerships to aid communities in flood resilience as detailed above. The following summary list will be used to organize much of my analysis below.

i. What is needed to achieve fluvial geomorphology informed resilience

1. Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest ecological benefit, is by accommodating natural river movement.
2. Access to accurate and usable information on river science, fluvial geomorphology
3. Identification of local areas either of geomorphic hazard or possible mitigation areas
4. FGM-informed flood resilience planning

5. Prevention of further development and encroachment on lands where there is high fluvial hazard risk

6. Conservation of lands where lands can provide room for river movement and flood mitigation

7. Protection of lands and property in vulnerable zones, while avoiding exacerbating FGM risks elsewhere

8. Construction and modification of infrastructure to accommodate fluvial geomorphic forces and change

ii. What capacities and resources communities need to achieve these goals

9. Ability to effectively use their own authorities and resources

10. Access to supplemental authorities and resources

iii. What watershed partnership groups need in order to provide support to communities

11. Institutional strength

12. Institutional longevity

13. Excellent relationships with communities, businesses and residents

14. Familiarity with federal and state agency programs and excellent relationships with agency staff

CHAPTER II

THESIS GOALS, CASE STUDIES AND METHODS

This chapter will outline research focus of this thesis. The first section will explain the thesis goals to highlight the possible range of strategies used by watershed partnerships to improve small community flood resilience. Next, there will be a brief introduction to the watershed partnership case studies researched for this thesis. The last section will detail the methods used for data collection, analysis and theory development.

A. Thesis Research Goals

To improve flood resilience of small communities, river and flood management will need to be changed to accommodate both natural river processes and the needs of communities. Principles informed by fluvial geomorphology, such as allowing river meanders to form and rivers to access floodplains, can help lower the negative impacts of flooding and damages to towns. Small towns need access to the best available science and that science needs to be presented in a useable format. This can be accomplished through fluvial geomorphic studies like those completed by the VRP which then get translated into fluvial hazard or river corridor maps. This science then needs to be incorporated into both short and long term planning. Hazard Mitigation Plans can be a good option for towns as they both can provide comprehensive planning options as well as allow the town to apply for large FEMA grants. Both this FGM-informed science and these plans need to then be implemented into various on-the-ground projects from land

buy outs to improving infrastructure, such as widening culverts.

The two watershed partnerships studied in this thesis are assisting communities to address these concerns. While watershed partnerships have been studied in the larger literature, there has been little research into their ability to address flood resilience concerns or apply fluvial geomorphology. Past research has attempted to group watershed partnerships into generalized categories, such as agency or citizen led, and define the activities these groups can be successful at, such as water quality monitoring. This narrow focus on generalizing watershed groups is detrimental to understanding how and why they can be successful. Instead, by researching the needs expressed by communities and how two watershed groups are addressing them, I aim to highlight the possibilities of these groups to improve flood resilience in a variety of ways.

This research will look at two case studies of different varieties of watershed organizations and how they are navigating this new set of concerns to help communities become more flood resilient.

B. Unusual watershed partnership groups, effective at helping communities become more resilient to river floods: White River Partnership and Deerfield CRC

The two case studies were selected through early interviews and informal conversations with people involved with river management about how they viewed flood resilience and

which groups were doing work related to this in the region. There are many other groups in New England working at different scales to address flood resilience. These two case studies were selected because they were mentioned multiple times as successful in aiding small towns in becoming more resilient. They are not necessarily the exclusive examples of such groups in the region. In order to understand if these groups truly are successful in addressing flood resilience, and if so how these groups became successful, I needed to examine both the history of each group and the details of current practices. These two elements will be split into two chapters, chapters 3 and 4, and then compared in analysis chapter 4 through 6.

The two case studies are the White River Partnership in Vermont and Deerfield Creating Resilient Communities in Massachusetts. Both case studies may share similar scale in operation, an inter-community watershed organization, but they have distinct histories, goals, and structures which allow them to address gaps in science, policy and their application. I will look specifically for places where each group has succeeded in applying river and flood management according to natural river processes, as well as instances where towns had improved access to government policies and programs.

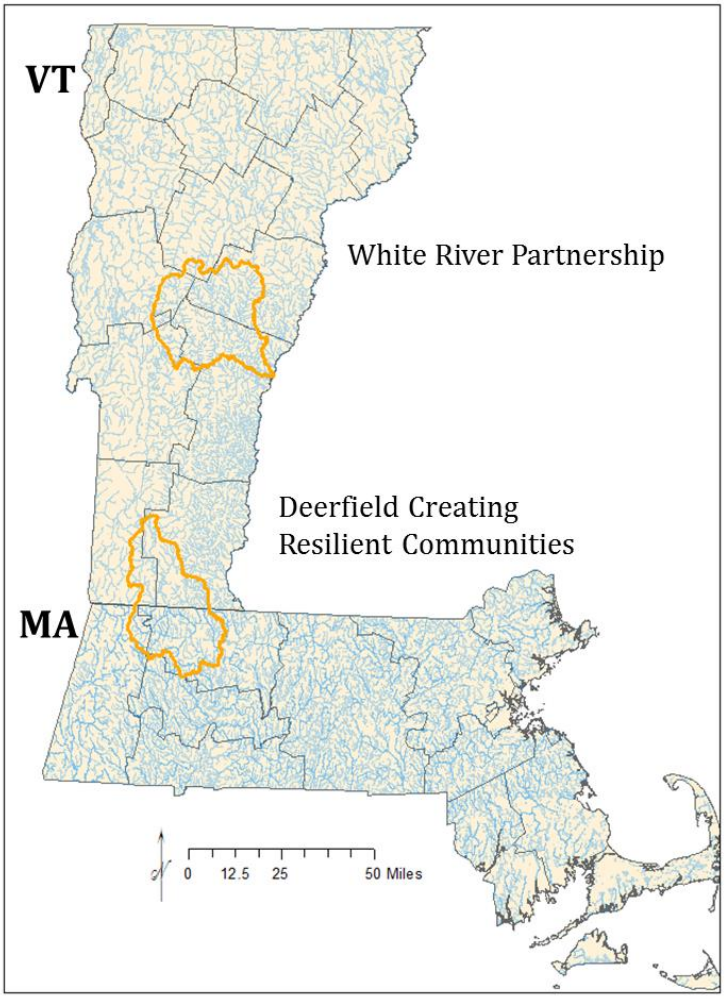

Figure 1: Case study map. White River Partnership in Vermont and Deerfield Creating Resilient Communities in Massachusetts.

i. The White River Partnership

The White River Partnership is "a grassroots, non-profit organization that brings together people and local communities to improve the long-term health of the White River and its watershed" ("The White River Partnership" 2016).

The White River in Vermont begins in the Green Mountains and joins with the Connecticut River in the city of White River Junction. As the longest undammed tributary to the Connecticut River, the White River has significant value in its ecological connectivity, and an interesting history. While much of Vermont's water quality and protection funds have traditionally gone to Lake Champlain, the White River has drawn a significant portion of citizen interest and protection projects as well due to its importance as a resource and its general ecological health.

Today, the White River Partnership is an independent non-profit organization whose primary goal is to engage residents in ensuring long term the health of the watershed ("The White River Partnership" 2016). Some of the group's greatest successes in moving towards improved flood resilience include: incorporating fluvial geomorphic principles into river management, educating residents on river science including fluvial geomorphology and working with both the local community as well as outside institutions to increase the available resources for improving flood resilience.

The White River Partnership is an example of a formalized watershed organization, with

well-established resources and membership base. In order to consider how this group has managed to successfully achieve this status and pursue issues of flood resilience, I will consider the steps taken and strategies utilized through its history, what may have directed choices and changes and how they are operating today.

ii. Deerfield Creating Resilient Communities

The Deerfield River is also a tributary to the Connecticut River, beginning in the Green Mountains of Southern Vermont and entering the Connecticut River in Greenfield, Massachusetts. The watershed is nearly cut in half by the state boundary between Vermont and Massachusetts. It is prized for its whitewater rapids and fisheries. Contrasting to the White River, the Deerfield River is considered 'one of the hardest working rivers in America'. Some of the earliest hydroelectric power dams of the Connecticut River Watershed were built along the Deerfield in the 1910s and served as models for future development along the Connecticut (Vogel and Lacy 2012). Residents along the river have a history of protecting and valuing the river, as in the White River case. Watershed groups have long been monitoring water quality and educating the public about the importance of water resources.

Creating Resilient Communities formed in the Massachusetts portion of the Deerfield Watershed in 2011 after Tropical Storm Irene and up until today, most of the group's work has been in Massachusetts. What sets Creating Resilient Communities apart from other watershed groups is the strong leadership of municipal representatives. While today, meetings are attended by a wide range of people from agency workers to non-

profit representatives, the roots of the group are town selectboard members and the networks they have formed through their municipalities.

Compared to the White River partnership, however, as well as to some previous and concurrent Deerfield watershed groups, it remains ad hoc and not formalized. Therefore, Deerfield Creating Resilient Communities will be able to provide insights into how a watershed organization can work towards more resilient management of rivers in the absence of financial resources or formal partners.

C. Methods

In order to address these questions, I built institutional histories for these case studies and placed them within the larger history of watershed protection in their regions. An emergent analysis was utilized to allow for each interviewee and case study to tell their own story while still leading to a deep analysis (Charmaz 2006; Witzel 2000).

i. Research Methods

The primary source of data came from a series of semi-structured interviews completed for each case study. Interviewees were selected by first identifying the important set of stakeholders for each case study beginning with the leaders of each case study. Further interviewees were selected by the snowball technique of asking interviewees who they suggest we speak to and then following up on suggestions until it is clear that every major stakeholder group has been spoken to. Stakeholders included: watershed group leaders and members, watershed group partners, agency employees, landowners, residents and

relevant experts in the field.

Interviewees were semi-structured meaning that the interviewer, myself or other researchers, asked open-ended questions which encouraged the interviewee to express their own viewpoints and discuss what they felt as the most important to the overall subject. The interview process involved inductive-deductive information sharing between the interview and the interviewee. This allowed the free-flow of opinions and knowledge of the interviewee but also ensured a systematic checking of information (Witzel 2000). Interviews lasted between an hour and two hours. A few central themes in every interview included: the position of the interviewee and their relevance to flood resilience in the region, how their role relates to the case study, their opinions on current management techniques and what could be different, their understanding of river science and the overall role of the case study in both the community and the watershed.

Interviews were conducted between 2012-2015. All interviews were transcribed into text format and tagged with relevant location and setting information, central points and any other notes (challenges, request, etc.). Transcriptions were completed on a continuous basis which allowed preliminary analysis to inform future interview questions, reflection on research goals and identifying of additional interviewees. Interviews will be cited throughout this thesis in two ways, either collectively, as ‘interviews’ for concepts derived from multiple interviews, or individually by the interviewees name and date of interview.

ii. Finding themes

The analysis took place in phases to move from raw interviews to the emergent strategies of each case study. First, as suggested by Witzel, all collected data contributed to the development of institutional histories for both the White River Partnership and the Creating Resilient Communities. Analysis began with interview data being compiled chronologically. Once all of the data from the interviews was organized, any temporal and thematic gaps in the chronology were able to be identified. The chronology was then supplemented by alternative sources, including policy documents, other research studies, newspaper reports and other relevant sources, to complete a full history of the case study watershed partnerships within the larger context of regional watershed management. These chronologies allowed the case studies to be illuminated according to the case's own story yet within an historical context.

Next, a first round of emergent coding drew out any mentions of strategies in every interview (Charmaz 2006). Examples of strategies were: combining emergency response resources with neighboring towns, completing a restoration project, going door-to-door with educational materials, holding stakeholder meetings, etc. Examples from each interview were combined with the rest of the data from other interviews in order triangulate a strong set of strategies.

The specific examples were then grouped according to similarities into themes. Examples of groupings were: Accessing resources (monetary, technical, etc.), building networks, education and outreach, etc. Therefore, while individual examples varied between

interviewees, by combining the data and slightly generalizing responses, I was able to generate a robust story from each case study which illuminates their strategies. This process is similar to other coding methods but allows for flexibility in the strategies and categories. The case study histories are provided in Chapter 3.

iii. Emergent theory

Once I had a range of strategies and themes, I was able to compare these to the needs of communities to improve flood resilience as detailed in Chapter 1. I looked for instances where themes revealed that the watershed group successfully addressed one or more of the needs. Activities that enabled the group to advance community flood resilience, either directly through changed management or through indirectly through capacity- or institution-building, I call successes. I was then able to go back to the more extensive list of strategies I had developed and identify those which were being used to achieve each success. These needs, successes, strategies and then specific examples of strategies for each case study constitute the analysis developed in Chapter 4. They are summarized in a Table on p. 71.

From this completed table of needs and strategies, I was then able to consider how these range of options supported the larger goal of community flood resilience, both for the case studies and for towns more generally. My end goal was to develop an emergent theory on how this wide range of options for small towns can support the incredibly complex issue of flood resilience. It was clear that rather than creating a defined prescription for solving this issue, these two watershed groups offered a diverse menu of

options for how small towns could alter management of lands and rivers, grow their capacities, and be better supported. In fact, through comparison of my results to similar work completed on the needs of communities, flood resilience, and the role of watershed groups, it seemed a confined set of suggestions would not be helpful to groups like these who were finding such creative solutions to fitting strategies to the needs of communities. In the end, I chose to base my theory on the need to support the creative range of possibilities of watershed partnerships. My emergent theory thus emphasizes the need to support their work rather than critique or narrow it to some prescribed set of practices. I hope to encourage other such groups, and other researchers, to build off the examples set by my case studies to tailor strategies to address flood resilience to fit the variety of needs of small towns and the groups themselves. Analysis and discussion of this emergent theory are provided in Chapter 5.

From this forward and backward analysis, I was able to identify and describe of a range of strategies that are being used by leading watershed groups in New England. As a case study analysis the generalizable applications are limited. However, the menu of strategies and options could be helpful to other similar situations and groups.

CHAPTER III

WATERSHED PARTNERSHIP HISTORIES

I have found both the White River Partnership and Creating Resilient Communities to have been successful in addressing several of the issues facing communities across New England in improving flood resilience. The White River Partnership has been particularly successful in increasing available education and outreach to improve residents' understandings about river science. Creating Resilient Communities focused more on bringing financial resources to the watershed. Both groups have increased communities' access to outside resources such as grants, personal, science and programs aimed at improving river and flood management.

Both case studies have important lessons for the success of watershed partnerships and how these groups can address flood resilience in regional communities. By understanding their histories, the importance of each step in a group's development from funding to hiring staff can be highlighted.

A. The White River Partnership

The White River Partnership or WRP is a formalized watershed partnership located in the White River Watershed, Vermont (see map on pp. 36). This section will explore the history of his group and provide context for the analysis in chapter 4.

The WRP stands today as a successful multi-stakeholder watershed organization. It began in a similar way too many other watershed partnerships across the country: through a

federal program aimed to improve watershed health, connectivity and stakeholder participation. However, not every watershed partnership born out of these circumstances stood the test of time as the White River Partnership has. The Partnership has managed to overcome many of the hurdles such as funding, involvement and leadership to become an institutional resource to improve flood resilience in the White River watershed.

i. Early history

The 1980s to1990s marked the beginning of a new era for river management. In Vermont, as well as the rest of the country, many people were starting a conversation around the best methods for managing rivers according to watersheds. Agency workers and professionals were raising questions over the effectiveness of managing rivers according to boundaries and goals which did not take into account river processes across the whole system (Dan McKinley, US Forest Service, interview, 9/4/14)

Several government agencies funding programs aimed at encouraging watershed scale planning (Cole et al. 2002). In 1991 the federal Environmental Protection Agency started its Watershed program. The US Forest Service, under the Department of Agriculture, started its 'Community-Based Watershed Restoration Partnerships' initiative in 1999 (Doppelt and Onsgaard 2006). The White River Partnership would be one of the groups funded under this Forest Service initiative.

In the White River Watershed in Vermont, a group of employees in the Green Mountain National Forest and local residents in the watershed proposed bringing watershed

management to their rivers. Dan McKinley, explains how the change in mindset came about:

> "The district ranger I was working with at the time, we got to talking about how really using political boundaries is not a very good way to do system management, we ought to do on landscape scale. (Dan McKinley, US Forest Service, interview, 9/4/14)"

Working on a landscape scale would include not just human concerns or environmental processes, but a merger of social, economic and environmental goals for the watershed. McKinley stressed that he did not just want these to be the goals from the National Forest or other governmental agencies, but the interests and concerns of local residents (Dan McKinley, US Forest Service, interview, 9/4/14).

Around 2000, a group of federal and state government employees interested in promoting watershed management in Vermont attended an education series by Dave Rosgen on fluvial geomorphology. They saw this as an opportunity to improve upon past river management techniques which had not been working such as hard bank stabilization, channel straightening and other intrusive methods. Mike Kline, who worked for the state Agency of Natural Resources, was one; he would go on to form the Vermont Rivers Program and formalize the use of fluvial geomorphology in river management for Vermont. Dan McKinley was another. He would take these ideas back to the White River Watershed and use them to help start the White River Partnership.

Working informally with local interested individuals, the Green Mountain National Forest held a series of public forums throughout the mid-90s. These forums began with

educational information on watershed ecosystem science and the offered an opportunity for residents to raise their own concerns and goals for the watershed. Several of the concerns and goals raised centered on bank erosion, vegetation, and public access. After the public meetings, the National Forest began work focusing on these specific concerns of the residents but also began working towards a larger vision of watershed level management.

In order to begin addressing some of the citizen interests, the Green Mountain National Forest partnered with members of an inactive Conservation Commission in the region to form what would soon become the White River Partnership. Conservation Commissions in Vermont are regional advisory groups on mainly natural resource issues. They are created by a municipal vote under state public law 24 V.S.A. 4501. This early volunteer-based White River Partnership started in 1996 and while not yet formalized, began public outreach events right away.

In 1999 the US Forest Service launched the USDA Forest Service Community-Based Watershed Restoration Partnerships' program. In their request for proposals, the Forest Service was looking for partners that would promote ecological stewardship across the 'landscape scale' (Doppelt and Shinn 2002). As the program was under the purview of the Forest Service, all groups needed to work in partnership with a local National Forest. The informal White River Partnership submitted a proposal to be one of those partnerships funded under the program with the support of the Green Mountain National Forest. After being selected as one of 15 partnerships across the country to be part of the

Forest Service program, the White River Partnership received its initial grant of $290,000 and began operating officially (Doppelt and Onsgaard 2006).

After its first year of official operation, the White River Partnership released a summary of its finances and actions taken during the year. Some of the early projects completed included: Green Up (river cleanup) event on Third Branch; created the "DownStream" stream team; "River Days" educational event at the Rochester School; created the Forestry Work group which supported projects between the National Forest and towns; published two newsletters; restored one mile of river; and planted one half mile of trees along the river. The WRP also incorporated as nonprofit[1], developed by-laws, hired its first executive director and developed a business plan.

ii. Development and growth

The seed money received in their early stages was critical to the success of the White River Partnership. The WRP was able to use that money to quickly focus on the needs of the community and make their presence known. In 2000 the Partnership received a $1.2-million-dollar grant which would support them in the years to come. This grant was pooled from various branches of the Forest Service and supplemented by the State and Private Forestry branches. By hiring a capable full-time staff member, the Partnership was able to generate quick results, from on-the-ground restoration to educational events, and therefore, support from towns and future donors.

[1] Officially incorporated as 501(c)(3) organization.

The Partnership identified important early projects. They broke up the White River watershed into sub-watersheds and then found a high-profile project to complete in each region. According to Mary Russ, “we looked at the most obvious eroding bank in a community, and got that landowner on board, then got a bunch of volunteers out, and splashed it all over the papers -- look at what we can do!" (Interview, 8/25/14). These early site-specific projects aided the White River Partnership in generating public support for their presence in the community, created a docket of success stories to back future work, and generally strengthened the position of the Partnership around the watershed.

iii. Moving towards flood resilience

As the White River Partnership continued to expand its presence in the region, the ideas of watershed management and fluvial geomorphology were spreading around the state. The Green Mountain National Forest, still a close partner, was beginning to look more towards to management techniques informed by fluvial geomorphology and process-based river management that avoided ‘spot-fixes’. These ideas influenced the goals of the White River Partnership. Mary Russ explains the importance of the transition to the Partnership:

> “We stopped the squeaky wheel approach to watershed restoration, and we've geared up to the 20K foot level, so now we do a strategic assessments or water quality monitoring, or something that gives us a better sense of what the systematic approaches are, prioritizing approaches, and going after landowners in a strategic way. That said, if we get a call from landowners for a good project, we work it in.” (Interview, 9/25/14)

From this point on the Partnership continued with its goal of improving community knowledge about watershed and river processes and increasing stewardship across the watershed. Water quality monitoring allowed the Partnership to report on the health of the rivers across the whole watershed, increase their presence in schools. The Partnership began completing the Vermont Rivers Program's geomorphic assessments to assess the flood hazards of the watershed. Targeting landowners both upstream and downstream, the Partnership educated residents about how rivers work across the landscape through town meetings as well as door-to door visits. These and other strategies carry through to today at the Partnership.

Also central to the continued success of the White River Partnership has been the continuation of strong finances even after the end of the National Forest specific program funding. Many factors contribute to this including strong leadership and partnerships with a variety of agencies, businesses, non-profits. Many of these factors will be further explored below in the discussion of the Partnership's specific strategies. It was during this period of growth and transition that many of the strategies were being developed.

iv. Recent history and Tropical Storm Irene

On August 8th 2011 Tropical Storm Irene hit Massachusetts and Vermont with devastating force. In the White River Watershed Irene was a 500-year flood, or had a 1 in 500 chance of occurring any given year, and has been surpassed in peak flows only by the flood in 1927 (Springston et al. 2012). Across the state over $400 million dollars has been spent on recovery efforts since Irene (Vermont Public Radio 2013).

Across the rest of the state, stream dredging permits, to remove large quantities of gravel from streams, were lifted by Governor Shumlin. The immediate response by many residents was to respond as quickly as possible with little consideration for the impact actions may have on those upstream or downstream, let alone the ecological health of the river. This was mainly due to the very real concern over public safety and the belief that the rivers should be returned to looking how they did before the storm. Therefore, the most obvious course of action for many residents included removing gravel, large trees and rocks from streams and attempting to confine river flows back to past river channels.

However, several people in the White River Watershed indicated that having groups like the Green Mountain National Forest and the White River Partnership helped many residents respond smarter and understand their options. While 14,3050 ft. of the rivers in the watershed suffered 'major damage', such as extensive changes to channel dimensions, substrate removal or berming, and many communities are still recovering to this date, such groups as the White River Partnership were clear assets to the communities (Vermont Agency of Natural Resources 2013). These groups were able to send out representatives to towns and encourage residents to leave debris in rivers wherever possible, clear out clogged river crossings but not go as far as to dredge stream beds, and to avoid taking other drastic actions in rivers until the condition of the river could be assessed by the Department of Environmental Conservation and the Vermont Rivers Program.

Across Vermont, the total cost of damages is estimated to be over $600 million (Vermont Public Radio 2013). This included federal, state and local costs to rebuild buildings such as state offices, replace infrastructure such as bridges and roads, and restore landscapes. The impacts on the rural communities were truly disastrous but also opened a window for river education. The White River Partnerships recognized this opportunity as crucial. The group ramped up its educational efforts after Irene. Mary Russ described the many types of education the group now support from their school field trip program to community education walk and clean up days.

The Partnership also began taking a stronger position on more resilient river management after Tropical Storm Irene. They brought management options such as land buyouts, fluvial erosion hazard mapping and soft-bank stabilization directly to landowners and municipalities. The Partnership also attended a number of public meetings to hear the concerns of residents and offer solutions to such problems as bank erosion, culvert failure, working with the Federal Emergency Management Agency, or FEMA, and future planning for floods. A more in-depth list and analysis will follow in the next chapter of the activities they have undertaken to promote FGM-informed flood resilience

The White River Partnership has demonstrated how a watershed partnership can develop and change with time and successfully implement fluvial geomorphic based resilience. They maintain a strong and trusted presence in their community. They act as a link between the residents of their watershed and the outside influences which impact their rivers from agency policies to non-profit grants.

Up until recently they have also upheld a strictly non-political position. Mary Russ describes this as an active decision to bring the best river management options and education to their watershed while leaving politics out. However, after Irene, there was frustration over the response to the disaster by residents. Inconsistent policies resulted in drawn-out proceedings for towns and bills they could not afford. Mary Russ described her response to this clear political barrier:

> "There was 100% consensus amongst our partners about this. So we did go to the statehouse and say it's crazy to have 3 culvert standards that didn't jive and FEMA picked the least demanding one to fund, which left us less flood resilient versus more."

While this political participation may not indicate a trend or new direction for the White River Partnership, but does demonstrate the unique position such groups as the Partnership have to hear the concerns of on-the-ground actors such as residents and translate them up to the higher levels of governance. It is this important role of network intermediary that will undoubtedly continue to strengthen the long-term flood resilience in the region.

B. Deerfield Creating Resilient Communities

The second case study is a much more ad hoc and recent group from the Deerfield River watershed, which lies in both Vermont and Massachusetts (see map p. 36). This section details the evolution and history of this group, "Creating Resilient Communities," to provide the context for the analysis that follows in Chapter 4.

Creating Resilient Communities met for the first time in December of 2011, only a few months after Tropical Storm Irene left behind $25 million dollars in damage around Franklin County, Massachusetts. The first steering committee was made up of representatives from town Select Boards, the University of Massachusetts, nonprofits such as American Rivers, watershed organizations such as the Connecticut River Watershed Council, state and federal agencies and a state Representative's office. This diversity of representatives demonstrates the importance of flooding issues across the region but also the lack of leadership from other fields as a single institution has yet to take the lead on addressing flood resilience

The story of Creating Resilient Communities is both nonlinear and incomplete. Though this group is new, there have been repeated efforts to promote watershed organizations and awareness in the Deerfield River, especially in the Massachusetts portion, since at least the 1990s. Watershed health and monitoring has been occurring in the Deerfield Watershed, largely by volunteer citizen interest groups, for decades. However, one newer concern and development that has influenced Creating Resilient Communities is an interest in security and hazards, which has increased across the region with national concerns and the formation of the Department of Homeland Security. Tropical Storm Irene made people understand viscerally that river management and community security are intimately connected. Creating Resilient Communities, which grew up after Irene, can be seen as the merging of water issues and security concerns across Western Massachusetts.

While Creating Resilient Communities remains an unofficial watershed group, their story is one of impressive dedication. Their successes in promoting dialogue, networking, and leveraging of new grants in particular areas and projects are potential models for future river and flood management throughout New England.

i. Early history

It is important to understand that though Creating Resilient Communities is new, watershed organization in the Deerfield River is not.

Watershed management has gone in and out vogue in Western Massachusetts. In 1991 the EPA was one of several federal agencies to launch programs aimed at supporting watershed-scale management. The EPA described its watershed approach as a "focus on watersheds, or drainage areas, [to] provide people living there a meaningful context in which to identify problems and solutions" (EPA 1997). This program offered funding for watershed scale projects which could be applied for by the state. In Massachusetts the state-sponsored group which applied to this program was called the Massachusetts Watershed Coalition.

In 1991 Massachusetts, aiming to take advantage of the EPA's programs, began prioritizing watershed-scale management when a group of citizen watershed organizations formed the Massachusetts Watershed Coalition. In 1993, the Massachusetts Watershed Initiative began as a partnership between the Massachusetts Executive Office of Environmental Affairs (EOEA) and private conservation organizations, spearheaded

by the Massachusetts Watershed Coalition. Trial projects were completed across the state with technical and planning assistance from the EPA. The original goals of the Watershed Initiative were mainly focused on ecological health, habitat protection and water quality. Projects and the overall status of the watershed would be evaluated on a five-year cycle with a complete report. Work would be completed by a network of organizations and volunteers including groups of citizens called 'Stream Teams' and state level 'Basin Teams' (EPA 1997).

In the Deerfield River Basin, these ideas of involved citizens and wide-scale watershed management spurred the creation of independent watershed organizations. The Deerfield River Watershed Association (DRWA), still in existence today, formed in 1988, and some of its original members and supporters were also involved in the Massachusetts Watershed Coalition and Initiative. The DRWA spent its first year receiving public input, incorporating as a non-profit and uncovering the priority ecological projects for the watershed from dam relicensing to water monitoring (Linde 1989). The Deerfield River Watershed Association would continue to play central role in monitoring river health for the watershed while other institutions around them changed.

There were other institutions besides these watershed focused groups experience changes which would have future impacts on activities around the Deerfield Watershed. Between 1997 and 2000, eight of the fourteen counties in Massachusetts were abolished (G. L. c. 34B, § 1-22). Franklin County, where the Massachusetts's portion of the Deerfield River is, was abolished in 1997 and in the same year the Franklin Regional Council of

Governments formed to fill some of the administrative gaps. The Regional Council of Governments is a voluntary, membership based organization with no authority beyond planning capabilities. Towns join the Council to take advantage of joint planning capabilities including transportation, public health, and emergency planning. While FRCOG did not retain old county authorities, it would continue to provide important communication and planning links between towns.

The Massachusetts Watershed Initiative continued to fund and technically support projects through 2003. Four of these projects were in the Deerfield basin; at least one of the monitoring projects took place in partnership with the Deerfield River Watershed Association (Massachusetts Executive Office of Environmental Affairs 2002). In 2002 the Deerfield River Watershed Team was formed in coordination with The Massachusetts Watershed Initiative to gather the data needed for the Deerfield River Watershed Assessment Report, a five-year action plan (The Commonwealth of Massachusetts Executive Office of Environmental Affairs 2004). The plan was the last effort funded under the Massachusetts Watershed Initiative.

ii. The changing role the watershed and the rise of 'security'

The Massachusetts Watershed Initiative was ended in 2003 by Governor Mitt Romney's administration (Deerfield River Watershed Assn. Inc. 2003). The reasons for the ending of the program were highly political and often unconfirmed, but the loss of state support ended many successful programs and projects. For a few years, old members of the Massachusetts Watershed Initiative continued to meet. DRWA volunteers also continued

to perform water quality monitoring.

Political opinion was shifting away from watershed management in Massachusetts and the rest of the country. At the same time, another concern was coming to the forefront: homeland security. In 2000, the Federal Emergency Management Agency, or FEMA, Disaster Mitigation Act was passed which required states to develop Hazard Mitigation Plans (Public Act 106-390). This started a conversation amongst political actors and community leaders around vulnerable infrastructure and how infrastructure which is likely to fail could be considered a security hazard.

The September 11 attacks in 2001 forever changed the security landscape. FEMA was incorporated into a new Department of Homeland Security, created by Congress in 2003 (P.L. 107–296, 116 Stat. 2135). The role and expectations of FEMA changed to focus on security rather than natural disasters. Concerns over counter terrorism caused the resources available to FEMA for natural disaster response to shrink significantly (Waugh 2006). Security and what it means to be secure became associated with external threats.

The impacts of this were felt all the way down in the Deerfield region. For example, even in small towns across New England, all public service workers were required to become trained in the National Incident Command System (Carolyn Ness). According to Ness, it was highly unusual for the trainings to extend beyond the police and firemen. In 2004, the Massachusetts Executive Office of Safety and Security, or EOPSS, created five homeland security planning regions in Massachusetts and appointed a sixteen-member

multidisciplinary Advisory Council for each region. Many public servants were introduced to this changed idea of security. One of these new regional homeland security advisers was Ness, who was already heavily involved in public health, and a select board member in her town of Deerfield.

iii. Building security-watershed networks

In 2005 a large flood hit the Deerfield. On Columbus Day weekend, New England experienced heavy rains and there was flooding across the watershed. However, according to Carolyn Ness, the heavy damage across rural Western Massachusetts was not on the radar of public officials.

> "There was no response, we ended up calling the governor's office and honestly I had somebody tell me there wouldn't be any damage because there isn't anything out here. I had over 4.5 million dollars' worth of collapsed roads in my town. Greenfield had their whole trailer park completely washed out. This is a vulnerable population, this is elders on medication, and handicapped. I couldn't get anybody on the phone."

Thus, Carolyn Ness had her first opportunity to declare a state of emergency and tried to catch the attention of the State. Ness declared a local state of emergency on the Sunday of Columbus Day weekend, then six days later, the Governor retroactively declared a state of an emergency which triggered FEMA funds to be allocated to the region for response and recovery. Ness called going through this process her "learning curve". After the 2005 floods she gradually she put together a network of connections including people in the Homeland Security Advisory Council, The Natural Resources Conservation Service's (NRCS) Conservation Districts, and other community leaders. In partnership with the

local NRCS office,

A strong partner in this hazard planning effort were the Homeland Security Regions. A rising concern in the security realm was that river floods posed tremendous threats to infrastructure including roads, bridges, and other crossings – and thereby threats to community security, for failed bridges, roads and power or telephone lines could mean no access to phones or emergency supplies and facilities. This concern would continue to grow in importance throughout the years.

2007 saw another strong storm and series of flooding events around the region. Carolyn Ness continued to grow her network of small Western Massachusetts towns by attending the national meeting of Homeland Security Planning Advisers and representing all of Massachusetts.

iv. Irene, before and after

2011 brought another level of disaster that no one was prepared for in rural regions of New England.

Tropical Storm Irene arrived in Western Massachusetts and Vermont on Sunday night, the 28th of August, 2011. Within hours, rivers have raised to historic levels not seen since the 1927 floods and townspeople were watching roads wash away, isolating many people across the region. The hour-by-hour accounts of events were alarming and illuminated the many gaps between local and federal responders, and between best-river-

practices and traditional management strategies. It also revealed the vulnerable position of Western Massachusetts towns compared to what everyone believed possible.

Within hours' residents found themselves cut off from the rest of the town as roads and bridges washed out. Many portions of Western Massachusetts are not covered by cell phone service, so once land lands were damaged people found themselves with no means of communication. Once if the storm passed, residents found themselves with little to no guidance on what to do. FEMA's response to the event was slow and according to reports from residents, when they did arrive they lacked any information on the needs of the towns and were underprepared to deal with the level of damage. The NRCS, according to Carolyn Ness was much more swift and helpful in their response as they have local offices and therefore, some existing knowledge about the towns .

Carolyn Ness knew that this would be a turning point in river and flood management in Western Massachusetts and she was determined to bring resilience to the forefront of the discussion over both security and conservation.

Thus, with her friend and consultant Debbie Shriver, a couple of months after Irene, she called a meeting of an impressive range of decision makers in her region from fellow selectboard members to academics from the University of Massachusetts Amherst. Thus began Deerfield Creating Resilient Communities.

v. Creating Resilient Communities to present day

Early work completed by Creating Resilient Communities was done in partnership with the Franklin Conservation District. The Conservation District acted as the official organization that could apply for grants using the recommendations from Creating Resilient Communities. The original steering committee of the CRC was formed at a December 13, 2011 meeting, to discuss flood resilience in the region after Tropical Storm Irene. Some of their specific early concerns included: the increased frequency of large storm events causes notable changes to river stability, the deposition of so much sediment that river beds were now much higher and future floods might threaten bridges and the lack of financial resources to deal with these problems. Meeting attendees and steering committee members represented town select boards, emergency management and conservation commissions, state and federal agencies, non-profits, regional planning councils, private consultants, property owners, academics, and state representatives and senators. Organizations represented include: MA Division of Ecological Restoration, National Fish and Wildlife Service, USDA NRCS, MA Geologic Survey, Deerfield River Watershed Association, Connecticut River Watershed Council, The Nature Conservancy, Rushing Rivers Institute, Fuss & O'Neill, Inc., Shriver Consulting, Northampton Emergency Management, Franklin Conservation District, FRCOG, Buckland Selectboard, Hawley Selectboard, Conway Selectboard, Deerfield Selectboard, and the University of Massachusetts.

The group put together a proposal for $500,000 from the State in order to formalize the group and address flood resilience through several strategies. They aimed to:

> "provide specific recommendations on river and stream corridors, develop or oversee the development of watershed scale plans for natural resource, conservation, and provide a high level of technical assistance and guidance to individuals and town boards "regarding natural resources" (0riginal CRC grant request 2011).

This funding would have come from State Supplemental Budget. Franklin Conservation District sent the request to Representative Kulik (D-MA) with the intention to "aid community restoration and help towns prepare for future extreme events." The proposed work would include outreach to town select boards and networking with other agencies like the EPA that might provide additional sources of funding for restoration work in the Deerfield River Watershed and other projects. The request was not approved, however, because of the limited money in the State Supplemental Budget.

From them on the group continued to meet approximately once every three months to discuss and coordinate projects, fund-raising efforts, and other efforts happening across the Deerfield Watershed. Attendance continued to grow and spread to more towns and agencies though the core group changed little. The main focus of meetings was following the progression of certain grants and pots of money which members of the group applied for to use in the watershed. Towns were well represented at these meetings, and townspeople emphasized their communities are small and rural with little to no budget. Thus finding funds to support their flood resilience goals is often the first step.

At one meeting, Carolyn Ness comically referred to Creating Resilient Communities as a 'support group' for those concerned about flood resilience in Western Massachusetts. Her comments reflect how both crucial but under-recognized flood issues are across rural

Western Massachusetts. Coastal regions of Massachusetts are often in the spotlight in regards to flooding and climate change, and most of the available funds go to coastal protection. Groups across Western Massachusetts have increasingly been able to gain access to such programs as the Long Island Sound Initiative but as residents saw in Tropical Storm Irene, disasters which occur inland often do not receive the same attention.

Along with the development of networks to leverage funding, Creating Resilient Communities members have been finding new ways to increase the availability of other resources. One way they found was to continue to merge security and flooding. In 2013 they pushed the state and federal government to consider stream crossings such as culverts and bridges as places of high security risk, or 'critical infrastructure.' They hoped to increase both community security and the availability of resources to towns. This was a coordinated effort between the Department of Homeland Security, local Emergency Planning Offices, and a University of Massachusetts research team promoting ecological stream crossings. The central goal was to get culverts to be included on a FEMA list of critical infrastructure called Automated Critical Asset Management System or ACAMS.

Creating Resilient Communities assisted in networking between those interested in pushing culvert replacement for both ecological and security reasons, and those doing the actual road work, such as state Department of Transportation employees. A member of Creating Resilient Communities steering committee member who was also a National

Security Advisor, presented the ideas to train transportation personal in documenting culverts and identifying ones which may need maintenance or replacement. This effort resulted in funding and support from FEMA to train all local transportation personal in Global Positioning System usage to get culverts into the ACAMS database. However, after a year of operation the program was cut.

Creating Resilient Communities was also working on other infrastructure concerns. Many of the areas damaged in Tropical Storm Irene, were simply unknown to state and regional agencies due to their remoteness. This insight led to the development of a map where local residents were able to mark areas of frequent damage.

2014 brought even more interested parties to the Creating Resilient Communities meetings and the group decided that it was time to reach across the border to the other half the Deerfield River Watershed in Vermont. On April 30th, 2014, the first cross-border Deerfield Watershed meeting was held with representatives from Vermont and Massachusetts. Conversation centered on differences between how Vermont and Massachusetts approach river and flood management as well as opportunities for collaboration. Many Vermont attendees voiced support for building grassroots efforts across the watershed, and many representatives continue to attend meetings.

With increases in budget cuts and governmental fiscal concerns through the year and into 2015, Creating Resilient Communities continued to focus on combining multiple forces across the watershed to complete studies and restoration projects and promote river

education. A recent table of the projects being completed by current Creating Resilient Communities members revealed that over $5.5 million dollars' worth of research and projects is going into the Deerfield river watershed. An example is: the Massachusetts Department of Environmental Protection (MassDEP) awarded a 604b Water Quality Management Planning Grant to the Franklin County Council of Governments to conduct a Fluvial Geomorphic and Habitat Assessment of the East Branch North River. This study will be able to be used by towns to plan and prioritize projects, as well be a strong base of support for future grant applications.

Creating Resilient Communities remains an unofficial and volunteer group. Supporters come from all over the watershed and represent an impressive base of municipal concern over flood resilience. While much of their work takes place around a group of tables, it has been a forum for extremely productive conversation.

The histories of each of these groups is diverse and points to how different watershed partnerships can be in their goals and formation. Each watershed partnership had different reasons for forming. The White River Partnership is a much older and established example of a watershed partnership. While much younger, Creating Resilient Communities is interested in solving many of the same flood resilience concerns as the White River Partnership. Therefore, while these groups may have entirely different histories, they have both arrived at point in time where improving small town flood resilience is one of their central concerns. How, these groups specifically address flood resilience will be explored in the following section.

CHAPTER IV

WATERSHED PARTNERSHIP STRATEGIES

As explained from Chapter 1, there are several elements needed to achieve fluvial geomorphology-informed flood resilience, and for communities and partnership groups to be able to achieve and help with these needs:

First, in order for watershed partnerships to address resilience according to my definition, the group will need to promote fluvial geomorphology as the critical scientific base for further action and then find ways to implement fluvial geomorphology informed management. As described in Chapter 1, section H, watershed partnerships are in a strong position to improve understanding of scientific principles and then implement those principles into action on-the-ground. These groups act as a bridge, either by bringing in needed information or a member of the group acting as the scientific expert and then distributing it to residents. Watershed groups are particularly good as doing this as they understand both what the best available science is, again either through outside partnerships or in-house expertise, and also what the needs are of the community. Thus, a watershed partnership is able to tailor the information to the needs of the community and present in a way which will understandable and accepted by the community.

Besides the ability to bring in information and present it to the community, watershed partnerships can also act either as catalysts for action or take action themselves. As watershed groups can tailor the information to the needs of the community, they can also

identify places around the community where these ideas can be implemented. This is due to members of the watershed group also being community members, Staff or members of the watershed group, hear about critical places, such as a failing culvert, and can locate on their own, where flood resilience work needs to be done. However, before any of these actions can be taken, it is important to know what elements are needed to improve flood resilience.

What is needed to achieve fluvial geomorphology informed resilience?

1. Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest ecological benefit, is by accommodating natural river movement.
2. Access to accurate and usable information on river science, fluvial geomorphology
3. Identification of local areas either of geomorphic hazard or possible mitigation areas
4. FGM-informed flood resilience planning
5. Prevention of further development and encroachment on lands where there is high fluvial hazard risk
6. Conservation of lands where lands can provide room for river movement and flood mitigation
7. Protection of lands and property in vulnerable zones, while avoiding exacerbating FGM risks elsewhere
8. Construction and modification of infrastructure to accommodate fluvial geomorphic forces and change

As mentioned above, it is critical that flood resilience measures not only address the biophysical part of resilience, i.e. the river itself, but also enhance the ability of communities to deal with flooding hazards. Without this part of the equation long-term resilience is not possible, as the memories of why all of the above parts of implementing flood resilience measures were important will fade over time. As many of my interviewees commented, people's memories are short. During and after a flooding event, the importance of flood resilience is clear to everybody, but in order to ensure long-term flood resilience, the needs of the community must also be included. Watershed partnerships, again, are in solid position to make this happen for many of the same reasons listed above. As both members of the community and members of the watershed group, those involved with the group understand what is important to residents of their community and where places for improvement are.

As mentioned in Chapter 1, towns in New England have a strong sense of independence and also the authority to manage their lands. Through taking advantage of this tradition and mindset, watershed partnerships can house many of the flood resilience tools in the community. Residents can be allowed to make decisions about land management, infrastructure improvements and projects to improve a river's ability to move. And when a town simply lacks the needed funds and other resources, a watershed partnership is positioned well to find outside assistance through partnerships with agencies, applying for grants and others.

What capacities and resources do communities need to achieve these goals?

9. Ability to effectively use their own authorities and resources

10. Access to supplemental authorities and resources

Lastly, while watershed partnerships look good on paper and appear to positioned perfectly to act as a bridge between towns and outside groups and resources, unless the group itself is functional, all other efforts will be fruitless. As summarized in Chapter 1, groups similar to watershed partnerships have been studied in the past to identify characteristics which allow them to successfully solve problems and sustain themselves. My research also added to the understanding of how these groups can build up a strong base and also grow trust in the community. It is clear that in order to act as a bridge, the group itself needs strong membership and resources, such as funding, to sustain itself. It also needs partnerships on either end of the bridge to provide a useful service; this includes relationships with residents in the community and with outside groups including agencies, other nonprofits and others.

<u>What do watershed partnership groups need in order to provide support to communities?</u>

11. Institutional strength

12. Institutional longevity

13. Excellent relationships with communities, businesses and residents

14. Familiarity with federal and state agency programs and excellent relationships with agency staff

In this chapter I analyze whether and how the White River Partnership and Deerfield Creating Resilient Communities met and addressed these needs, and how. I call these successes and strategies,

Each watershed partnership addressed these needs through different methods and succeeded in different ways. Not every element was always addressed and each watershed partnership prioritized different needs. I analyzed each watershed partnership, first looking for which needs were met successfully, either completely or partially. With these "successes" identified, I delved deeper into the data to discern the strategies they used to achieve their successes. Below is a summary table of what is needed for towns to improve flood resilience and each watershed partnership was successfully able to address these needs.

Table 1: Strategies for Watershed Partnerships to Address Flood Resilience

Small Town Needs	**Watershed Group Success**	**Strategies**	**White River Partnership Examples**	**Creating Resilient Communities Examples**
FGM Informed Resilience				
1.Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest ecological benefit, is by accommodating	Increases in understanding and application of fluvial geomorphology.	-Scientific expertise or access to experts -Education and outreach platform -Using roundtable style discussions	Residents now know who to call when they have questions on flood resilience - the 'river people'	Starting the conversation amongst decision makers about what resilience should look like

natural river movement.				
2. Access to accurate and usable information on river science aka fluvial geomorphology	Outreach, education and training of community leaders and residents	-Scientific expertise or access to experts -Education and outreach platform -Working with other community groups such as schools -Continuous presence in community with events -Door-to-door activism -Using the individual influence of members to promote FGM based management	The WRP puts on outreach events for all residents from grade school work days to scientific tours of local rivers	CRC supported and partnered with an effort to get town public works employees trained in culvert assessments
3. Identification of local areas either of geomorphic hazard or possible mitigation areas	Completion, assistance and support of fluvial geomorphic assessments	-Working with agencies already doing assessments -Completing smaller scale assessment of local rivers -Working with universities -Sharing of project and funding information	Partnering with state agencies to complete fluvial geomorphic assessments with attention to local detail	Support for fluvial erosion assessments completed by partners

4. FGM-informed flood resilience planning	Long term planning based on state and federal programs	-Work with agencies and town governments on long-term planning -Coordinate between towns to improve larger scale planning -Sharing of project and funding information -Working with regional planning authorities	The WRP offers assistance to towns in incorporating the rules of programs such as FEMA's NFIP and the VRP into town planning	Working with and supporting members efforts to implement Hazard Mitigation planning for towns
5. Prevention of further development and encroachment on lands where there is high fluvial hazard risk	Implementing development rules within a certain distance of the river	-Work with agencies and town governments to implement maps -Education and outreach platform	Implementation of the VRP's River Corridor maps and associated land regulation	Still gathering primary data on flood hazards, not currently a priority
6. Conservation of lands where lands can provide room for river movement and flood mitigation	Using conservation techniques to protect land where the river can move naturally	-Understand options for conservation land -Work with government programs to set aside land for conservation -Education and outreach platform	Assist towns in land 50 land buy-outs	No currently a priority, but does come up in group discussions
7. Protect lands and property in vulnerable zones, but avoid exacerbating FGM risks elsewhere	Use alternative protection techniques where possible and finding ways to compromise to still protect valuable infrastructure	-Offer assistance to landowners -Education and outreach platform -Find places where alternative protection can used -Offer information on alternative	Working with private landowners to implement alternative protection methods using new creative ideas	Discussions on protection have ended in agreement that when possible, hard bank stabilization should be avoided

		protection methods -Using roundtable style discussions -Sharing of project information		
8. Build and modify infrastructure to accommodate fluvial geomorphic forces and change	Increase instances where infrastructure is replaced with awareness to FGM	-Offer assistance to landowners -Work with other regional authorities to prioritize infrastructure improvement -Sharing of project and funding information	Replaced and upgraded six culverts for residents	Support finding creative sources of funding for culvert upgrades
Community Capacity and Resources				
9. Ability to effectively use their own authorities and resources	Increase awareness of residents ability to improve resilience in their own towns	-Understand municipal government processes -Understand state and federal government processes -Education and outreach platform -Offer assistance to landowners (rather than take complete control) -Tailor education and information to fit town needs -Network between municipal leaders to share resources	Offer resources and assistance to towns and landowners to lessen reliance on outside resources	Share project information to improve communication and efficiency

		-Sharing of project and funding information		
10. Access to supplemental authorities and resources	When needed, improve access to outside resources to implement resilience at the town level	-Know of multiple sources of outside resources -Understand grant and program application process -Work with agencies to increase available resources -Apply for grants and programs -Sharing of project and funding information -Share new funding sources -Network with agency representatives	Assistance in applying for federal and state programs and grants	Building partnerships with outside organizations such as nonprofits and universities
Needs of the watershed partnership				
11. Institutional strength	Bring in strong leadership and support for the partnership	-Strong leaders -Dedicated volunteers -Paid staff -Board of directions -Membership -Municipal lead group -Members from agencies, nonprofits,	Has a board of directors which meets to discuss the goals and activities of the group	Membership has expanded to include representatives of the Vermont side of the Deerfield River, now meetings are attended by representatives of both sides of the state border

		municipalities, a university		
12. Institutional longevity	Build a strong base to ensure the continuation of the partnership	-Strong financial base -Paid staff -Nonprofit status -Established presence	Secured funding and official nonprofit status	Still a young group, not yet clear
13. Excellent relationships with communities, businesses and residents	Build trust with residents and communities	-Membership of town members -Leaders are both group members and residents -Continuous presence in community with events -Long standing -Open planning meetings -Municipal lead group -Members are residents -Networking between towns to improve communication	Open board meeting to all residents	Membership made up of representatives from towns around the watershed
14. Familiarity with federal and state agency programs and excellent relationships with agency staff	Increase internal knowledge on agency programs and opportunities, and network with agency representatives	-Working continuously with agencies -Follow the changes and status of state and federal programs -Friendships with agency staff	Long standing partnership with the Green Mountain National Forest	Personal relationships of members with agency representatives including the NRCS

		-Proven results to agencies -Long standing relationships -Finding creative uses for state and federal funding		

Below are detailed each group's successes and the strategies they used them to achieve them, organized by my developed list of elements needed for watershed partnerships to aid communities in achieving FGM-informed river flood resilience.

A. Fluvial geomorphology-informed resilience

i. Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest ecological benefit, is by accommodating natural river movement.

White River Partnership

In the White River Watershed, the White River Partnership has been encouraging both changes in practice and mindset about river processes and river management. Comments from employees of the Partnership, the regional planning commission, Two Rivers Ottauquechee Regional Commission, and local landowners claim that more individuals and municipalities taking natural river processes into consideration before taking action in river management.

Examples can be seen across the watershed from land buyouts to riparian buffer projects. Not all of these changes can be directly attributed to the White River Partnership, but also to external partners such as the Vermont Rivers Program, the Forest Service and U.S. Fish and Wildlife. In all cases, landowners indicate that they now simply know who to call, 'the river people', before making decisions.

Key strategies are the WRP's long term education and outreach efforts in the watershed and the importance of trust amongst local residents and the organization. Also important, are connections to scientific expertise and outside agency resources to provide the best available scientific knowledge and outside resources to implement projects.

Creating Resilient Communities

For Creating Resilient Communities, the ability of the group to take direct action in the watershed is limited as they group is informal and has no funding. However, they are acting as a forum for discussion around future planning and projects which include fluvial geomorphic principles. Central to the goals and concerns of the group is improving long term flood resilience with the limited resources of the small towns across the watershed. And the leader of CRC described it, "rivers will flood, this is the new normal" (Carolyn Ness interview 5/28/13).

Operating under this idea, members of the groups have been discussing at meetings what the most cost effective measures can be taken for long term resilience but also have short term results to lower flood damage. Both scientific expertise and open information

sharing were critical in advancing discussions. Partnerships with universities and agency employees provided most of the needed scientific information and projection information from towns, agencies, consultants and regional planning groups helped plan for the entire Massachusetts portion of the watershed.

ii. Access to accurate and usable information on river science

The White River Partnership

Education stands as a crucial component of the White River Partnership's work in the community. Education, mostly with regional schools, has been a priority for the White River Partnership as they understand how important public engagement is to building a more knowledgeable and resilient community (Mary Russ, interview 8/26/13). The White River Partnership works with over 600 teachers and students each year to help connect some of the youngest residents of the watershed to their rivers and ecosystems. Schools work on monitoring water quality, assisting on restoration projects and in general bringing kids out to experience the watershed (Mary Russ, personal communication).

With the shift in mindset towards river processes, the education goals of the White River Partnership also shifted to promoting more wide-scale management and connecting people and environments upstream and downstream across the watershed. Mary Russ describes how the Partnership approaches community education and fluvial geomorphology principles:

> "It will continue to be a hard road transitioning to the idea that rivers behave the way they do…. So our approach was not divisive, people knew we were the river people, they knew we wouldn't get angry with them if they did it wrong – we were approachable. We don't get involved in policy or politics. Our advocacy is based on education." (Interview 8/26/13).

Employees of the Partnership saw Tropical Storm Irene as a critical education opportunity. People from different towns were asking questions and looking for good information sources (Mary Russ, interview, 8/26/13). And since the recovery, the conversation includes more reflection on how to let rivers move rather than simply digging out sediment and building up protection (multiple employees interview, 8/25/14). As Mary Russ says since Irene, "So, we're not starting from ground zero any more" and in general, residents are more receptive to new ideas about how to manage rivers (interview 8/25/14). This is heralded as an important step since it requires both a change in practice and in mindset. As a Regional Planner for the area said, "biggest part of emergency management, as a challenge, is getting people to believe that the disasters going to happen" (Kevin Geiger, Two Rivers Ottauquechee Regional Commission, interview 8/25/14). With an event such as Tropical Storm Irene, conversations over how to deal with future events is easier.

Another method of public engagement and education the White River Partnership is informing land owners near or on streams about their river management options. By going door-to door and presenting information about what programs exist to aid landowners in both protecting their property and move towards a watershed approach to

management, the White River Partnership has assisted neighbors across the watershed in their land management (multiple employees interview, 8/25/14).

Creating Resilient Communities

One of the most important functions of Creating Resilient Communities meetings has been the sharing of river and flood stories (meeting notes). Frustrated municipal leaders and residents have been able to come together and compare stories from around the watershed. In order to address frustrations with continued river flooding and lack of state or federal action, leaders in the group reached out to local scientific experts to attend meetings and help plan changes to local river management (Carolyn Ness personal communication). Researchers from the University of Massachusetts, representatives from local watershed associations and agency employees from NRCS regularly attend meetings, communicate with members and assist understanding of river processes.

These partnerships have led to the development of toolkits and information resources for residents, municipalities and decision makers in the region (see https://extension.umass.edu/riversmart/). Therefore, while Creating Resilient Communities does not have the same direct education platform as the White River Partnership, it has been able to foster a network of indirect education. Leaders of the group decided early on that existing mechanisms for understanding local rivers and managing them, such as hard bank stabilization and the belief that flooding was a rare occurrence, were not working (Carolyn Ness interview 5/28/13). Though reaching out to local experts, leader in Creating Resilient Communities brought the needed knowledge

and resources to change management to the table (meeting notes; Carolyn Ness interview 5/28/13).

In order to spread both understanding and offer practical options to implement FGM-informed flood resilience, Creating Resilient Communities has been seeking ways to bring more trainings to those work near and in rivers. One example was a program called the Automated Critical Asset Management System or ACAMS. ACAMS is a list of critical infrastructure maintained by FEMA and is designed to help towns have a centralized data bank on infrastructure. Having consistent information on infrastructure can aid towns maintain infrastructure and more efficiently address problems. However, up until recently culverts have not been included in this database.

Creating Resilient Communities, and specifically Carolyn Ness, aided in advocating for culverts to be added to ACAMS. Other participants included local Emergency Planning Offices, a University of Massachusetts research team promoting ecological stream crossings, and the regional office for the Department of Homeland Security. Specifically, CRC promoted offering trainings to those doing the actual road work, such as state Department of Transportation employees. This effort resulted in funding and support from FEMA to train all local transportation personal in Global Positioning System usage to get culverts into the ACAMS database. However, after a year of operation the program was cut. However, the training itself was seen as a success

iii. Identification of local areas either of geomorphic hazard or possible mitigation areas

Both groups have been able to increase the number of fluvial geomorphic research, assessments and projects completed in their watersheds. Changing how river management is done, from highly intrusive to more accommodating of natural river processes, requires gathering primary data to turn in flood hazard maps.

White River Partnership

In partnership with the Vermont Rivers Program, The White River Partnership has completed many scientific river studies in order to support a larger goal of a state-wide fluvial geomorphic database. The White River Partnership has assisted or completed seven of Vermont Rivers Program's Geomorphic Phase Two Assessments the White River Watershed. These and additional assessments have been compiled to complete river corridor map for the entire watershed.

These studies improve information available to residents and help people understand the processes taking place in their river. These studies often result in River Corridor or Erosion Hazard maps which show regions along the river at risk to fluvial erosion as well as water inundation; though similar to other maps out there, mainly FEMA Flood Insurance Rate Maps, these Erosion Hazard maps provide a much more comprehensive picture of how rivers in Vermont move and change with time and thus can show what areas may be subject to erosion and flooding (Kline and Cahoon 2010).

These maps can now be used to inform municipal actions, such as development and zoning, landowner actions and other projects around the watershed. These assessments are critical to the State's effort to have a streamlined map system to better understand the state of all of their rivers and manage them accordingly (Mary Russ personal communication). Mary emphasizes that they are in the perfect position to work on these studies. Employees of the Partnership understand the local details of regional rivers and have hear about problem spots (interview 8/26/13). And while state employees are also specially trained to complete these studies, they often lack the local perspective, such as how the river is used, where it frequently floods or what resident use priorities area.

Creating Resilient Communities

As with several of the other strategies employed by Creating Resilient Communities, the group's approach to increasing the available scientific data has been through supporting the work of their members to who have ability to perform fluvial geomorphic studies or hire somebody else to do so. All studies, assessments and projects have been indirect; through members taking action through their own organizations. For example, the Franklin Regional Council of Governments has applied for grants and completed several fluvial geomorphic studies around the region to help inform river management projects. These assessments and maps are then brought back to the group and shared with the other members in order to avoid overlap and make the information more available for use around the watershed.

iv. FGM-informed flood resilience planning

White River Partnership

The White River Partnership, along with partners, offers landowners and towns assistance in understanding how to include fluvial hazards in into regional and town planning for the future (Mary Russ interview 8/26/13; interview 8/25/14).

One way the WRP encourages resilience planning is by assisting towns in applying to state and federal programs which offer planning programs and assistance. FEMA offers a Flood Insurance Program to towns and cities around the country to help residents understand the risk of building near rivers and then prepare for future flooding events. The state of Vermont also has a Erosion Hazard Areas which build upon the inundation risks included in the FEMA program to add an additional layer of risk communication to residents. Both of these programs provide regulation and zoning rules for areas with flooding risk. Towns can incorporate these rules into the town resilience planning.

Mary Russ also emphasizes this shift from spot-fixes, and localized planning, to a large scale interest and watershed scale research (interview 8/25/14). Here, she says the biggest challenge is that it is a "big watershed… is that there's way more work than we can do." And while they still go to site-projects when called by a landowner, they are now much more focused on larger scale mapping and planning (Mary Russ interview 8/25/14). While these projects might not target one landowner, they often require coordinating

between multiple parties and groups. The larger vision has accompanied the group's long-term goal of watershed resilience to flooding.

Creating Resilient Communities

While Creating Resilience Communities itself has no funding and no direct ability to take action in the watershed, several members do. By pulling in representatives from state agencies, including NRCS and the Department of Transportation, regional planning groups, such as the Franklin Regional Council of Government and the University of Massachusetts, Creating Resilient Communities has harnessed the resources of several influential parties in the region (meeting notes). Since the start of the group, the Franklin Regional Council of Governments has completed 3 FEMA Hazard Mitigation Plans for towns in the Deerfield which include sections on river flooding and Erosion (FRCOG personal communication). Therefore, while Creating Resilient Communities does not have the ability to directly impact action across the watershed, the meetings act as a forum for project inspiration and planning.

v. Prevention of further development on lands where there is high fluvial hazard risk

White River Partnership

The WRP is more involved with active on-the-ground projects than development planning. However, limiting development in areas with high flood risk is part of their education platform (personal communication). The main strategy the WRP uses to promote the limitation of development on floodplain is through the implementation of

VRP ‘river corridor’ maps in towns throughout the watershed. Through designating the river corridor area, the region which falls within the corridor is protected from major development.

Limiting development near rivers also frequently comes up in conversations with private landowners. When going door-to-door or when called for advice, employees of the WRP offer options to the landowner starting with limiting any sort of development too close to a river. Therefore, while promoting non-development within high risk areas is not the primary concern of the WRP, it does get included in many of their other activities.

Creating Resilient Communities

Similar to the WRP, Creating Resilient Communities does not focus on preventing development near rivers rather, members are more concerned with dealing with current infrastructure and adapting towns to future flood damage. However, the as preventing development in areas of high flood risk does frequently pair with other needs such as the high cost of recovering from floods and planning for future events, it is a topic which has the likelihood of becoming of greater concern. As much of the watershed still needs to be assessed and mapped for fluvial hazards, many members of CRC are primarily concerned with securing funds to complete these studies and address urgent concerns such as infrastructure replacement. Once these primary steps have been completed, long-term planning is likely to expand to include these concerns.

vi. Conservation of lands where lands can provide room for river movement and flood mitigation

White River Partnership

After Tropical Storm Irene, it became apparent in the White River Watershed that the high costs of flood recovery were simply not worth maintaining property in fluvial hazard zones. In one town alone in the White River Watershed, 50 land buyouts were pursued by the town to help minimize flood damage in the future (Mary Russ, personal communication). Staff from the Partnership and the Two Rivers Ottauquechee Regional Commission, consulted with town officials and either the Department of Housing and Urban Development or FEMA, to educate people about their options and consider where the buyouts would be most effective (Mary Russ interview 8/25/14; Kevin Geiger, Two Rivers Ottauquechee Regional Commission, 8/25/14). Here, the group's positive relationship with residents was especially helpful. Known as 'the river people', residents were able to call for advice and assistance before taking action on their own (Mary Russ interview 8/26/13). According to a Regional Planner, Mary and Greg are seen as 'local boots on the ground' and can facilitate management choices (Kevin Geiger, Two Rivers Ottauquechee Regional Commission, interview 8/25/14). These lands now act has larger floodplains which, when flooded, act as an area for the river to dissipate the energy carried by the flood. These open areas help protect both the river itself from drastic changes to its form, and the lands and development nearby.

Creating Resilient Communities

Creating Resilient Communities has not yet been able to focus on conservation as a flood resilience tool. The group is still focused on gathering the primary data needed to plan such project.

vii. Protect lands and property in vulnerable zones, but avoid exacerbating FGM risks elsewhere

White River Partnership

As the White River Partnership still responds to the requests of residents, it deals with many concerns over protecting property. In the group's early development, employees responded to the wishes of the public which was mostly "bank stabilization and protecting their farmland" (Dan McKinley, US Forest Service, interview, 9/4/14). However, has the group's employees and partners learned more about fluvial geomorphology and watershed scale processes they realized:

> "On a landscape scale we realize we were just doing these spot fixes. They were not going to be real effective over the long term and we often were just treating the symptom of some other watershed process." (Dan McKinley, US Forest Service, interview, 9/4/14).

Alternatives to hard-bank stabilization such as rock or concrete wall, can be soft-bank projects, like tree plantings, which still allow the river to move and transfer energy as to not damage lands upstream and downstream. Therefore, since the early 2000s, the group has shifted both its own practices and its educational platform to include fluvial geomorphic principles (Mary Russ interview 8/25/14; Dan McKinley, US Forest Service, interview, 9/4/14). This shift has closely followed the rise of the Vermont Rivers Program. With the growing support of a state program focused on fluvial

geomorphology, the White River Partnership was able to gain important partnerships and resources for their projects (Mary Russ interview 8/25/14).

By 2015 the Partnership had completed 225 projects which range from private land bank restoration projects to improving local river recreation access (Mary Russ personal communication). One example is a bioengineering project on a local farm. After Irene, the landowner and farmer of Hurricane Flats farm in South Royalton, Vermont wanted to find a way to both protect his farm but also minimize his impact on the river (site visit 8/26/13; Greg Russ personal communication 8/26/13). The White River Partnership designed an innovative project which used local tree roots to stabilize the bank while encouraging the growth of a floodplain. Exposed roots protect the soil from bank erosion and deflect water energy across the channel; the roots also provide important fish habitat and add nutrients back into the stream. Native tree plantings were used to further stabilize the bank. Overall the project was an example of soft bank stabilization which both seeks to minimize land loss to erosion but also limit the negative impacts on stream morphology and habitat.

Creating Resilient Communities

As with many of the other tangible element of FGM-informed flood resilience, CRC has not yet progressed to the stage of being able to implement on-the-ground action. However, protection of infrastructure, buildings and land is a common topic of discussion among residents and town leaders who were left with heavy damages after Tropical Storm Irene. CRC has been able to act as forum for discussion on how best to face future

flood hazard. The group has been able to successfully steer the conversation against such measures as large rock walls, gravel removal and similar measures and instead discuss alternative protection measures including opening floodplain upstream of valuable property and more soft-bank stabilization measures.

viii. Build and modify infrastructure to accommodate fluvial geomorphic forces and change

White River Partnership

The White River Partnership includes improving infrastructure especially properly sized stream crossings in their education platform for towns and residents. However, thus far they have mainly worked with landowners and replacing undersized culverts on private land. Since Tropical Storm Irene the WRP has worked with landowners to replace six culverts which either failed or did not function properly during the storm (Mary Russ 8/25/14).

The WRP has also been called in for advice by the Agency of Natural Resources on how to improve culvert standards in Vermont. This conversation led to the Mary and Greg Russ of the WRP attending a meeting on FEMA culvert standards in Washington D.C. And as Mary explained: "So we did go to the statehouse and say it's crazy to have 3 culvert standards that didn't jive, and FEMA picked the least demanding one to fund, which left us less flood resilient versus more" Mary Russ interview 8/26/13). This was the first time that the WRP has taken a larger scale stance on the issue of more flood

resilient infrastructure and it is possible in the future that this will grow in importance to the group.

Creating Resilient Communities

Improving the flood resilience of town infrastructure has been a central concern of CRC. As the group formed in response to Tropical Storm Irene, much of the group's early discussion was on storm recovery, the inefficiency of applying for money to rebuild unsound infrastructure and looking for ways to avoid the costly cycle of repairing and replacing infrastructure in towns. Thus far the group has been unable to take any direct action on this point, however, information sharing on different individual cases has been crucial for finding ways to improve infrastructure more widely.

The group put together a map of damage sites all around the watershed to help identify places of retreat damage and areas which were not being well addressed. This helped identify priority work sites and also gave members some perspective on where damage was occurring around the watershed.

Members who have had success in receiving funding to replace infrastructure such as culverts and other stream crossings have been able to share their creative means for finding finance sources. As FEMA was not commonly funding work in the region and especially not to upgrade culverts to a large size, many people have turned to alternative sources of money. For a list of these creative sources see the section below on outside resources.

B. Communities capacities and resources

i. Ability to effectively use their own authorities and resources

White River Partnership

The White River Partnership's original goal was to engage residents with the environmental processes of the watershed they lived in. In order to gain support, the WRP's main initial strategy was to address the main concerns of the residents mainly through projects such as bank stabilization. As the group gained support and was able to better establish themselves in the community, the WRP was able to expand their strategies to include more education and outreach activities. By increasing the available information to residents, the WRP aimed to reduce the amount of external assistance towns needed to plan and take action to improve flood resilience. Residents are now able more easily put projects such as floodplain restoration, as infrastructure improvements, as they either make decisions on their own or had an easily accessible source of assistance in the WRP.

The WRP has also been able to offer assistance in the overall resilience planning process. By aiding towns in completing river assessments, establish river corridors, determine at a high risk from flood damage and implementing, towns are now in a stronger position to withstand future flooding events with less outside assistance. The goal of flood resilience is to prepare towns to suffer less damage after an event and therefore, require fewer outside resources to recover. Through building knowledge about river processes and

implementing FGM-informed projects around the watershed, the WRP has been able to tangibly increase the flood resilience of the towns its serves.

Creating Resilient Communities

Creating Resilient Communities formed in the first place because there was no group in existence which was addressing the flood hazard concern of small towns to a satisfactory level. Small towns felt ignored and abandoned. Since Tropical Storm Irene, CRC has been attempting to find ways for small towns to harness their limited resources and their incredible drive to improve flood resilience at a town level rather than relying on outside help. Thus CRC is a municipal led organization and its underlying goal is to improve the community capacity of the small towns which make up the Deerfield Watershed.

This has mainly been done by providing a forum for town leaders to share information and ask questions of the outside assistance the group has brought in through its partnerships with agencies, nonprofits and the university. Resource and funding sharing in the Deerfield Watershed did not begin with Creating Resilient Communities. It has been an important strategy of small towns in order to maximize the limited resources available to each town. As Carolyn Ness stresses, one of her main goals as a town Selectboard member is to reach out to surrounding towns and develop co-management plans for everything from emergency response to wastewater treatment (interview 5/28/13).

Through information and project sharing, members of Creating Resilient Communities have tried to avoid overlap in study areas and instead address problems across the entire watershed. This has required towns upstream and downstream to share goals and intentions, and the coordinate projects accordingly. This improvement of communication across the watershed has increased the collective community capacity of towns.

ii. Access to supplemental authorities and resources

White River Partnership

The White River Partnership is able to assist communities in both the needed time and financial aspects of changing river management. The staffs employed at the White River Partnership are able to dedicate extensive time required to apply for grants, fill out paperwork and in general, pay attention to the tedious detail which accompanies finding outside assistance. Mary Russ stresses that this element of time should not be under appreciated. While the group was unofficial and volunteer run, everyone involved needed to find extra time outside other full time jobs. Activities would be limited to a few times a month. Now, with two full time staff and one-part time staff, the WRP is able to operate full time. Applying for grants and wading through paperwork is frequently simply too time consuming for small municipal governments, so the addition of one additional person can make all the difference.

Creating Resilient Communities

The main goal of Creating Resilient Communities is to bring funding and resources to the Deerfield River Watershed (meeting notes; Carolyn Ness personal communication).

University research projects and state funding surveys have also been spurred by conversations negotiated at Creating Resilient Communities meetings. A recent compilation of all work being completed in the region shows that over $5.5 million dollars' worth of research and projects is currently going into the Deerfield River Watershed (meeting notes). The majority of that money is going towards two types of projects: Tropical Storm Irene recovery and infrastructure rebuilding and basic scientific studies of the many rivers which make up the whole watershed.

At Creating Resilient Communities meetings, several grants and programs have been followed in particular:

> -The Farm Bill through the USDA
> -And in particular within the Farm Bill, PL566 which allocated money for watershed assessments and planning for Conservation Districts
> -EQIP, through NRCS, funding and innovative uses of those funds
> -The Long Island Sound Initiative, also NRCS, and ways to leverage money for watersheds which ultimately impact the Sound (such as the Deerfield).
> -The Emergency Watershed Program, NRCS
> -The State Environmental bond bill
> -The larger picture, State Supplemental Budget
> -And, the various grants which pass through the University of Massachusetts, such as the one which funded this research

Most of the interest in these grants continues to be creative sources of funding for various projects around the Deerfield including infrastructure repair and restoration efforts (meeting notes). Of particular interest is culvert repair and replacement. Culverts rose to the top of the list when it came to critical infrastructure vulnerable to flooding. However, funding culvert replacements is complicated as frequently funding will not cover a replacement of a larger, and thus more resilient, size (meeting notes; interview). There

are several sources of potential funding for these projects beyond the typical source which would be local town budgets. Many of the sources above would fall into that category, but many other creative sources have been leveraged by small towns across Western Massachusetts, including:

-Massachusetts Department of Transportation, Chapter 90 Program funds (which funded over half of culvert replacements according to a 2014 study by the Massachusetts Division of Ecological Restoration).
-Hazard Mitigation Program Grant (FEMA)
-Community Development Block Grant (HUD)
-Massachusetts Department of Transportation, Transportation Improvement Plan or TIP
-Massachusetts Department of Transportation, Small Town Road Assistance Program or STEPS

C. Watershed partnership needs

i. Institutional strength

For a watershed partnership to be able to act a resource to communities it first needs to be a strong institution. The White River Partnership and Creating Resilient Communities are two examples of very different watershed institutions. A few key aspects stand out as defining characteristics of each group.

White River Partnership

First, the White River Partnership is led by two trusted and dedicated leaders. Mary and Greg Russ are respected members of the community and therefore, the organization they work for carries some of that existing respect. Mary and Greg also work exceptionally hard, networking and constantly looking for places to improve the group.

Second, the WRP has a solid financial base with a diverse set of funding sources. Since the original grant, the group has continued to receive funding from the Forest Service. They also have paid membership and donations. Funding is always a concern however, according to Mary Russ and they are always looking for new sources.

They WRP is also supported by a variety of other community leaders. The group has a Board of Directions which is made up of business owners and residents of the watershed. Board meetings occur monthly and are also open to the public for discussion on the activities of the group.

And lastly, the WRP has access to a variety of volunteers to complete projects. Many rivers in the watershed have their health monitored by school programs. The WRP also regularly hosts tree plantings and restoration projects which are completed by volunteer groups also with the staff of the WRP.

Creating Resilient Communities

Creating Resilient Communities would never have come into existence in the first place if it was not for the dedication of Carolyn Ness and Debbie Shriver for Creating Resilient Communities. As I have mentioned before, while flood resilience has been raised as an issue in the Deerfield watershed before, but no single group has stepped up before to take the lead on addressing this problem, especially for the small towns which have borne the

brunt of the damages and costs. Carolyn and Debbie continue to show incredible dedication to the group and remain volunteers.

Creating Resilient Communities meetings take place approximately every 3 months and are conversations literally around a round table. Topics follow the needs and updates of towns from around the region as well as contributions from agencies, universities and nonprofits (meeting minutes). One member called each meeting a crucial support group for municipal leaders (meeting minutes). Each member is given equal opportunity to raise topics and open discussion to the rest of the group. Often the conversation follows available resources and funding sources which will be explored in the next strategy (meeting minutes).

Attendance of the meetings has been growing since 2011. Also, up until 2014 meetings were attended exclusively by residents of the Massachusetts portion of the Deerfield watershed. On April 30th, 2014 the first cross-border meeting between Massachusetts and Vermont brought the interest counterparts of both states together to plan common goals and information sharing (meeting minutes). Since then meetings have not been formally inclusive of both states, but different representatives from Vermont do come down to Deerfield, MA for meetings.

These round tables have been important for growing stakeholder networks. Residents are able to raise issues alongside agency workers who may be able to address them (meeting minutes). In the case of the Vermont-Massachusetts meeting, people were able to

compare and contrast strategies with their counterparts across the border. This was especially interesting for government agency workers who may not have had this opportunity before; and many expressed interest in continuing this sharing of information despite different agency mandates and requirements (meeting notes).

Despite almost all attendees having demanding full-time jobs, all have expressed how important planning and contributing to these meetings is to them (meeting notes). Many attendees recognize the limits of towns and governments in building a more flood resilient Deerfield Watershed alone; but now members of Creating Resilient Communities are combining resources and knowledge in order to improve the likelihood of a more resilient future.

ii. Institutional longevity

White River Partnership

The White River Partnership is an especially strong example of a successfully sustained watershed organization. The White River Partnership has existed since 1996 and the group has been able to maintain a strong presence in the community for this entire time. First, the White River Partnership has successfully built a strong financial foundation with continued grants and membership dues. Without a strong financial base, access to material resources, including a work space, and paid staff, many of the other successes would not have been possible.

After the initial grant from the Forest Service, the White River Partnership put together a wide variety of smaller funding sources to secure long-term security. Currently they receive grant money from over 20 sources from private foundations to government agencies. This combined with individual donations and paid members, provides funding for the everyday activities and staff of the Partnership. When the group goes out and plans a project with a member of the community, they will then typically apply for an outside grant to fund that particular project. Thus, the Partnership has two distinct funding strategies: they bring in funding for their own programs as well as assist others in applying for project grants. This addresses both the long-term stability of the group itself and the financial limitations of the communities they operate in.

Creating Resilient Communities

CRC has not yet been in existence for long enough to determine if the group will stand the test of time.

iii. Excellent relationships with communities, businesses and residents

White River Partnership

The WRP has spent the time to slowly developed local support and trust through active on-the-ground projects. In order to change how resilience was viewed and acted upon by the community, this trust was, and continues to be, essential. They are now considered the go-to-people for questions and concerns about activities regarding the river. If residents have concerns on their own property or about the town they live in, they have a phone number they can easily use to get answers. The WRP is run efficiently by paid staff, but all of its meetings are open to the public and its direction is still led by the

residents of the town. Therefore, the group has gained a truly trust position in the communities it serves.

This sort of deeply ingrained trust can only be built through patience and time. The WRP has answered the needs of its community through visible projects and community-centered goals. All of the strategies outlined above for implementing FGM-informed resilience and improving community capacity can be applied to achieving this success. The staff of the WRP can act as impartial scientific experts, intermediary agents to outside resources such as agency programs, and at the still time, still be members of the community, neighbors to those they serve.

Creating Resilient Communities

Perhaps the most impressive success of CRC has been its ability to bring together members of different towns all over the watershed. Town politics can be extremely inter-town dependent and small town resident can identify strongly with their own town. Cooperation between towns can often, therefore, be extremely difficult. Carolyn Ness made one of her main goals as a town leader to be outreach to surrounding towns (interview 5/28/13). She has been able to develop resource sharing programs for her area. From vaccinations to emergency shelters, while the individual town resources may be limited, by sharing between many towns, both efficiency is improved and the overall cost lowered (Carolyn Ness interview 5/28/13). Carolyn Ness has accomplished this largely by reaching out to other individual town leaders. Small towns in Massachusetts often are supported by volunteers, sometimes with one or two paid staff people. Thus identifying

who is in a position of power and influence in a town is not a simple as it would be in a larger city. Often individuals such as other selectboard members, fire and police chiefs are invested in the well-being of the towns they serve and are the individuals that other town leaders, like Carolyn Ness, can look to for partnerships (interview 5/28/13; Debbie Shriver interview 5/20/13). Thus, CRC is a strong institution due to the fact that it represents the collective strength of the towns all across the watershed.

iv. Familiarity with federal and state agency programs and excellent relationships with agency staff

White River Partnership

Up until this point, the White River Partnership has been focused on their own watershed, which has been proven to be quite successful. One of the reasons the group has been so successful in garnering local support has been the group's non-political positionality (Mary Russ interview 8/26/13). Mary explains how the group has intentionally stayed away from working in the policy and politics realm of river management because, as she says,

> "We were content to fight the good fight… But after Irene we noticed that a lot of state and federal policies were really getting in the way of doing the work that we thought needed to be done. There was 100% consensus amongst our partners about this."

Therefore, while the White River Partnership will most likely continue to focus their work in their own communities and rivers of the watershed, policy makers continue to seek out the advice of those they see as involved and successful in river management.

According to Madeleine Lyttle, the White River Partnership has been so successful in changing the way river management in done in on the community level that they make excellent case studies for when they need to advocate for policy.

> "Mary and Greg are very intelligent people. They make a great case. You can take them to D.C. and show them off. They're intelligent. They know what they want. We took them to Washington and marched them around and let them do the talking. (US Fish and Wildlife, interview 8/25/14"

The White River Partnership has not only successfully reaches out to their local community, but has expanded their partnerships with state agencies and nonprofits. These connections outside the community allows for the best scientific and policy practices to be accessed by the community via the Partnership.

Creating Resilient Communities

While many interviewees reported difficulty in finding places of flexibility in large grant programs, these town workers have worked hard to apply many sources of funding to improving flood resilience in their towns (interview; Debbie Shriver interview 5/20/13). Members of Creating Resilient Communities who have used some of these sources of funding in their own town stress the importance of the person in charge of allocating those funds. Knowing the person making site visits and reviewing applications can make a difference in how flexible or simply likely the money can be (Carolyn Ness interview 5/28/13; Debbie Shriver, interview 5/20/13). The local NRCS office has proved to be a strong ally to small Deerfield towns. Carolyn Ness, reports that her local contact at the NRCS office was the first, and for a long time, the only, agency worker to respond to her

request for help in the aftermath of Tropical Storm Irene (interview 5/28/13). And while the NRCS does not have any available funds for flood mitigation in particular, between local office workers and residents, creative ways for found to get right into the damage and repair river ways and infrastructure (interview 8/13/14). It is these sorts of partnerships and resource opportunities that most interest Creating Resilient Communities. While just recently a push was made to access some of the much larger pots of money available across the country, finding small places of flexibility have proven effective to diversify the funding sources for flood resilience work across the region (meeting notes).

CHAPTER V

COMPARISON OF CASE STUDIES AND THE MULTIPLE LESSONS OF WATERSHED PARTNERSHIPS

This chapter will explore the how and why each watershed partnership was able to develop and use the strategies they did. By providing a 'menu' of options I aim to offer possibilities to other towns and emerging watershed partnerships. The menu is far from

comprehensive, rather it highlights some of the more successful and unique strategies of each case study partnership and why that strategy worked for the particular set of circumstances setting up that partnership. I also discuss more in-depth how the history of each partnership contributed to their current flood resilience strategies, how the partnership approaches the communities it serves and what about the institutional make-up of each group is significant. Overall, this chapter aims to highlight what elements of each group allowed it to be successful and in doing so I aim to offer options to other possible towns and partnerships who also seek to improve their flood resilience.

A. Histories to Strategies

The goals of Creating Resilient Communities and the White River Partnership are at significantly different points in their development and members have different motivations for pursuing flood resilience across their watersheds. Nonetheless, different catalysts and connections have allowed them both to address flood resilience in their communities.

Creating Resilient Communities was born out of an immediate need to lower flood damages after a series of large storm events. Members' central concerns have been the need for rapid recovery, and practical solutions to flood resilience. Creating Resilient Communities is still very young for an institution and has already overcome some large hurdles such as the fragmented relationships and communication between towns, agencies and other organizations in the watershed.

The White River Partnership has changed their position and goals over several years and now is able to use its years of experience to address community concerns over flooding. Creating Resilient Communities remains informal and relies on open communication. In contrast, the White River Partnership have full time staff who direct operations and speak for the Partnership.

These differences are mainly a function of the time each group has had to develop the group and the different starting place of each group. It is difficult to know what direction Creating Resilient Communities will take -if it will continue to be informal and volunteer based, if it will join with one of the other membership organizations or if it will formalize and take a path similar to the White River Partnership <or if it will go away as the parts/pieces get taken care of or as members get pulled off to focus on other things>. The future of the White River Partnership may also change if staff in the group decides to take a more active role in changing policy. These groups differences point to the huge range of watershed partnerships. Understanding how and why each group made key changes can help explain the position and strategies used in the group today.

B. A Menu of Strategies to Address Flood Resilience

As described above each watershed partnership has developed many strategies to address flood resilience in the communities in the watersheds. Each group has been successful in addressing community flood resilience in their region. However, the scale and strategies of each group have been markedly different. For this chapter's analysis, I looked at several factors to consider the strategies of each case study and how and why the

characteristics of the group allowed them to be successful.

There are a few key places where both groups have been successful according to their own reports and the commentary from residents. There are also places for improvement.

With their long history, the White River Partnership has been aiming to change both the mindset of residents around the watershed about best practices which include. The group has used education and on-on-ground presence to attempt to achieve this goal. In addition, the WRP has increased the available information for residents to use in making decisions. Key collaborations with the Vermont Rivers Program have generated fluvial geomorphic maps for the entire watershed and members are reporting increased citizen awareness of fluvial geomorphic factors in river management. The Partnership and the Vermont Rivers Program still report the need to increase awareness and studies, however. Mary Russ, of the White River Partnership, points out that their watershed is too large just for the Partnership to influence on their own or without increasing the size of the WRP itself. She also notes that while Tropical Storm Irene did allow for further education, it also demonstrated the pervasiveness of old beliefs in river management. While some people called the Partnership for advice, most still simply reached for a shovel or an excavator and went to remove gravel and debris, only further damaging the rivers after the flood.

Yet, the White River Partnership and the Vermont River Program have made enormous strides in changing river management in their state. The role of the White River

Partnership points to the importance of having a strong and long-term institution. The group is able to pay attention to local needs and detail which may be lost on outside agency employees. They are also able to be the trusted presence for landowners who may otherwise be suspicious of outside activity.

Deerfield Creating Resilient Communities has not been able to take direct action in the Deerfield River Watershed as of yet. However, leaders of the organization do not have a strong partner such as the Vermont Rivers Program working at higher levels of government to enact change. In fact, Creating Resilient Communities formed around the frustration about the lack of agency response and awareness to community flood issues in Western Massachusetts. Therefore, Creating Resilient Communities' success in improving flood resilience has been by starting the conversation in the watershed and gaining the attention of outside parties. Carolyn Ness stresses the overall weak and ineffective response to Tropical Storm Irene across the Deerfield watershed. Many town leaders simply did not know what to do in the wake of such a damaging event. Carolyn formed Creating Resilient Communities to act as a forum to aid towns in getting help to improving flood resilience across the watershed. And early indicators show that this group has been able to influence actions across the watershed through these conversations. Members of the group who are able to take action in the watershed, such as universities and regional planning groups, have either aided towns or themselves completed several fluvial geomorphic assessments for the watershed. Public outreach has begun to provide towns with the needed resources to make decisions about river management which address both the community's needs and the long term resilience of

the river.

It is difficult to compare my two case studies of watershed partnerships to each other, as their priorities and strategies were markedly different. However, it both groups are clearly striving towards improve flood resilience according to the list of requirements I laid out above. Both groups have embraced FGM-informed flood resilience and are incorporating the key ideas into their education and application of flood resilience in their communities. Therefore, the strategies detailed above offer a selection of methods to address flood resilience at the town level. Yet what works in the White River Watershed may not work in the Deerfield Watershed and vice versa. Both partnerships have focused on addressing the needs of the local communities, and in doing so have developed specific strategies unique to that place.

It would be ill-informed to draw out a complete list of strategies used by both groups and offer them as a list that any other community could use to address their own flood resilience concerns. A one-size-fits all approach will simply not work at the town scale. Each town will have its own constraints and needs. However, by examining the histories and specific needs of each of these case studies, I hope to show that FGM flood-resilience can be addressed at the town level and that watershed partnerships can greatly aim in tailoring flood resilience strategies to the needs of communities.

To offer the bringing of a menu of strategies and to start exploring how these strategies could be used by other towns and watershed partnership, I organized certain successful

strategies in a table according to the needs of towns they addressed and specifics on how they were successful. The 'how's' focus on what elements of the case study worked particularly well for that case study such as organization, age, resources, etc. Using these metric other towns and watershed partnerships could explore what strategies might also work for other cases.

Table 2: Menu of strategies and how they can be used by watershed partnerships

Strategies	**Needs addressed or met**	**Options for use**
Network with federal and state agency personnel so they understand and work to assist municipalities' problems, capacities and needs	2. Access to accurate and usable information on river science, and identification of local areas either of geomorphic hazard or possible mitigation areas 9. Access to supplemental authorities and resources 13. Familiarity with federal and state agency programs and excellent relationships with agency staff	Can be achieved more formally such as with WRP: -Implement existing programs, such as river corridors, and develop professional relationships -Over time, the ability of the group to get results is proven and agencies trust the WRP as a partner Or can be achieve more informally like with CRC: -Immediate need, such a Irene, allowed residents to have more contact with certain agencies -Those agencies which were more useful became partners to town leaders -These partners were then invited to be part of CRC
Education and outreach on fluvial geomorphology-informed resilience	1. Awareness that the best long-term way to reduce river flood damage with the lowest cost, greatest security, and largest	Can be achieved more formally such as with WRP:

	ecological benefit, is by accommodating natural river movement. 2. Access to accurate and usable information on river science aka fluvial geomorphology 5.Prevention of further development and encroachment on lands where there is high fluvial hazard risk 6. Conservation of lands where lands can provide room for river movement and flood mitigation 7. Protect lands and property in vulnerable zones, but avoid exacerbating FGM risks elsewhere 9. Ability to effectively use their own authorities and resources And others depending on need	-Design education plans based on a specific goal (ig: increase knowledge about river corridors) -The offer events, programs or go door-to-door to educate people -After some time, residents will know that they can turn to the group for information Or can be achieve more informally like with CRC: -The CRC leaders knew that something needed to change to improve community flood resilience, so they reached out to other community members to start the conversation -Those with expertise were able to offer information -Members could then speak to connections and slowly diffuse the information
Develop scientific expertise	1-8, All elements of FGM-informed resilience	For the WRP, leaders already had scientific backgrounds so developing additional expertise was not especially difficult -Staff had access to scientific information -Had the time to do additional research as full-time staff -When additional assistance was needed, staff could reach out to partnerships such as the Vermont Rivers Program

Find an outside scientific source	1-8, All elements of FGM-informed resilience	For CRC leaders it was necessary to seek information from outside sources -First leader, found one reliable source and partner -Then from there, members could reach out to other contacts and build a network of needed experts
Offer direct assistance to towns and landowners	2. Access to accurate and usable information on river science aka fluvial geomorphology 5. Prevention of further development and encroachment on lands where there is high fluvial hazard risk 6. Conservation of lands where lands can provide room for river movement and flood mitigation 7. Protect lands and property in vulnerable zones, but avoid exacerbating FGM risks elsewhere 8. Build and modify infrastructure to accommodate fluvial geomorphic forces and change 9. Ability to effectively use their own authorities and resources 13. Excellent relationships with communities, businesses and residents	For the WRP with paid staff, offering direct assistance is a great way to build trust in a community -Staff can go door-to-door -Can respond to requests for help -Can implement projects on public OR private land
Formalize as an institution	11. Institutional strength 12. Institutional longevity	The WRP has helped ensure its long term survival by formalizing as an institution -The group incorporated as a nonprofit, which required organization and dedication to apply

		-Has a clear mission, goals, and plan to achieve those -Limited staff, so funding and organization can remain efficient
Act as an ad-hoc roundtable forum for discussion	11. Institutional strength	The CRC has chosen to keep open membership and seek strength in numbers -As long as the group remains diverse and engaged, the desire and abilities of members can be addressed -Good option for a more fragmented watershed (towns lacked central government, no clear leader for cause)

C. <u>Watershed partnerships and the communities they serve</u>

Important to both groups was not simply addressing the science side of resilience, but also including the needs of the communities living alongside rivers in management decisions. Especially noticed during storms such as Tropical Storm Irene was the destructive power rivers can have to community livelihoods and infrastructure. Both Creating Resilient Communities and the White River Partnership seized upon Irene as an opportunity to engage residents to hear how the needs of the community can work with the natural processes of rivers.

Each group engages residents differently. The White River Partnership has an impressive array of citizen and agency partners, as well as a Board of Directors who meet regularly to discuss strategies of the group. However, direct resident involvement in over-all

decision making for the group is not part of their strategy. When the group takes on projects for residents the process is similar to hiring a consultant and when the group initiates activities it is an internal decision. On the opposite end of the spectrum, Deerfield Creating Resilient Communities has open meetings to anyone interested in participating and discussions are led by all variety of residents from around the watershed. As the group initiates very little direct action, conversation amongst participants is their main product as a group.

It is impossible to evaluate if either of these strategies works better than the other, however it is possible to consider how and why each ended using the strategy they did and how either one could be appropriate elsewhere. The White River Partnership has experience a much more linear development path mainly due to the influence of the Forest Service grant they received and their strong partnership with the agency since that point. There has always been a clear line between the group, as an official institution, and the people they were aiming to engage and educate. Through this clear division of responsibility, the WRP is able to hear and evaluate the needs of the community and make decisions in an efficient manner with only a few people. The group is then able to present these plans and ideas back to the community and get feedback. This iterative process of listening and responding to the needs of communities is certainly efficient, but requires the trust of the community that those making key decisions are both knowledgeable, in regards to the science, and still sensitive to the needs of the community. The White River Partnership has gained this trust through years of giving proof back to the community.

In the case of Creating Resilient Communities, there was not such as a clear path laid out from the beginning. The group had not strong partner government agency or mold to follow. There was extensive disagreement amongst community members over what flood resilience should look like but also an urgent need to do something in the wake of Tropical Storm Irene. Carolyn Ness was the strong leader to pull a group of decision makers together. The group is well represented by various experts in different scientific fields, government agency workers, local nonprofits, and most critical, municipal representatives. The CRC is still hammering out what flood resilience needs to look like, and finding round-about ways to implement ideas through partners and supporting the work of others. This is mainly due to the lack of official capacity. The group has no funding and no official status. Perhaps, if members choose to formalize the group, they will end up following a path more like the one of the White River Partnership, but for now this more informal method is working.

Not every community will have the resource of the White River Partnership and not every community will have the amount of dedicated volunteers of Creating Resilient Communities. Yet these two very different cases demonstrate that in either case solution can be found to address the different needs of communities.

D. Watershed Partnerships as Institutions

Watershed organizations are highly diverse and are difficult to compare. Where some strategies work for in some situations, in others that same effort may not be effective.

There has been extensive research and attempts to quantify and qualify watershed organizations; however, they often come with the stipulation that either more research is required or that it remains important to consider the site specific situations. Frequently utilized is a typology system developed by researchers to describe watershed organizations according to the composition of those participation (Moore and Koontz 2003). Three types of groups were identified: citizen-based, agency-based, and mixed, where citizen-based are usually grassroots efforts and agency-based were initiated by a government program (Moore and Koontz 2003). Moore and Koontz used this typology to describe what actions and accomplishments groups were likely to have according to this typology. While a useful descriptive tool, most of the results of this particular study did not hold true for my two case studies. Why it does not disprove Moore and Koontz's research, it simply points to the difficulty in generalizing watershed organizations.

For the White River Partnership about half the generalizations hold true. However notably for a few categories it is lacking. For the general category "Increasing public awareness" it is the most likely for citizen based, with 35% of studied groups, 24% for mixed citizen and agency but only 0% for agency organized groups. The White River Partnership is most accurately described as a mixed-group as it has its initial beginnings with the National Forest Service. The group has maintained a successful educational platform to engage citizens since the beginning of the group and the first public meetings. Agency partners have continued to play an important role in bringing resources and information into the watershed. Then on the other hand, Creating Resilient Communities is almost an entirely run by citizen leaders and yet have not managed to reach out past the

group itself. In this case the White River Partnership has exceeded expectations but Creating Resilient Communities is employing other strategies.

Another typology characteristic is the likelihood to 'influence policy'. These statistics are low for every group, with 23% for citizen based, 7% for mixed and 11% for agency based. Neither the White River Partnership nor Creating Resilient Communities has taken strong action to change existing policies but members have voiced extensive frustrations with them. General finger pointing and blame placed on state and federal agencies have limited members in Creating Resilient Communities willingness to attempt and change policy. However, when we interviewed representatives of state agencies in Vermont and New Hampshire, and federal agencies in Vermont and Massachusetts, they also point out to the limited resources available to them as well.

Yet in the case of the White River Partnership, Mary and Greg's success at engaging citizens and changing management practices in their watershed got the attention of several state and federal agencies. And despite their reluctance, Mary agrees that their experiences point to several flaws which can be fixed in existing policies. For the White River Partnership, acting as a bridge between policies and communities has enabled them to see places where existing policies to not meet the needs of residents and municipalities. A possible critical perspective if policy is going to be changed to improve flood resilience across the region. So here, I argue that limiting the expectations for watershed groups has perhaps led to a level of complacency amongst possible actors. Only by explaining the range of possibilities for these watershed groups can the extent of

their possible influence be seen. For Creating Resilient Communities as well, members range from landowners to agency representative, a very uncommon forum for open discussion. Their possibilities for impact are yet unknown but should be encouraged.

To summarize, the White River Partnership is an example of how an agency initiated watershed organization can successfully grow and establish itself as a trusted resource on watershed issues. Deerfield Creating Resilient Communities demonstrates how a dedicated group of motivated municipal leaders can find ways to leverage resources to bring new possibilities to their communities. While one group has formalized and set strong routes, the other remains ad-hoc and continues to change as new opportunities arise. Both groups have changed the conversation around flood resilience in their regions. By using fluvial geomorphic principles to guide river management and valuing the human presence near river banks, both groups lend hope for future flood resilience.

CHAPTER VI

CONCLUSIONS, SUMMARY AND FURTHER WORK

A. Conclusions and Summary

Creating Resilient Communities and the White River Partnerships represent the wide variety and possibilities for watershed partnerships. While certain aspects of each group fall into some described categories for other watershed partnerships in the literature, several characteristics are unique and creative. The White River Partnership has early beginnings in a federal agency led initiative but unlike many other examples of agency driven groups, has stood the test of time and gained the trust of local towns. Creating Resilient Communities is an example of an ad-hoc stakeholder group driven by shared concerns but is still young and therefore it is difficult to know what direction the group will end up taking. However, both groups have been able to change both the discussion around flood resilience in communities as well as actions around each watershed to include fluvial geomorphic principles in river management. While the White River Partnership is able to take direct action on the ground, Creating Resilient Communities influences actions by sharing information at meetings. While each group stands in contrast to their other, both are able to offer distinct strategies used in influencing river and flood management in communities:

White River Partnership:

- Early seed money and then sustained and diversified funding
- Hired staff

- Long-term planning
- Landowner services
- Multi-level education
- Scientific research and assessment
- On-the-ground projects around community
- Strong relationships with agencies

Creating Resilient Communities:

- Roundtable discussions
- Open member involvement
- Project, funding, data and other information sharing
- Shared planning process across multiple towns
- University partnerships

Both groups:

- Agency partnerships
- Strong and dedicated leadership

Through these and other strategies, both groups have been able to meet multiple markers of success: scientific progress, trusted position in communities, and sustained presence. For the White River Partnership, staff have been able to implement management projects and complete river studies based on fluvial geomorphology. Due to both living and

working in communities across the watershed for over 16 years, staff have gained the trust of residents. And, due to long term planning and secured funding, the group has been able to survive the test of time. For Creating Resilient Communities, through open discussion and sharing of information at meeting, how river management is approached in both research and practice has been changed. However, this impact is less than the White River Partnership for several reasons. First, the group has limited ability to change practices independently; instead members take action on their own. And Second, Creating Resilient Communities lacks the strong statewide support that the White River Partnership has from the Vermont Rivers Program. However, the group does have the advantage of being made up of selectboard members of towns from around the watershed. This allows the group an initial level of trust from residents as membership consists of neighbors and recognized faces. Creating Resilient Communities has been meeting for 5 years but it is yet unclear if they group will continue to be as strong without the immediate memory of damages brought by Tropical Storm Irene. Yet, thus far the group has been able to make significant strides towards improving flood resilience in a short period of time.

Overall, examples from both Creating Resilient Communities and the White River Partnership demonstrate the variety of methods and results in addressing river and flood resilience from watershed partnerships. It is important to recognize the place based influences for each group and the situations in which both groups formed. It would be difficult to draw generalizable conclusions from these two case studies. Instead, analyzing the strategies of each group points to the possibilities for watershed

partnerships to address a variety of issues and still meet the needs of communities in a way which traditional top-down management has not been able to achieve. By offering a variety of strategies but also highlighting the vast differences between the two groups I have aimed to support the actions of these groups and further future research.

B. Places for Continued Work

The inconclusiveness and variety of findings regarding watershed partnerships support the need for further research into the possibilities for watershed partnerships. These groups have proven to be able to tackle a wide –variety of issues in watersheds around the world. In addition, these groups can complete targeted goals while also engaging residents and addressing their concerns better than traditional top-down methods. While less uniform and hard to predict than top-down management, when it comes to detailed concerns, such as flood resilience at the town level, the approaches of groups such as the White River Partnership and Creating Resilient Communities has been able to *begin* making changes where other top-down efforts have been slow to start. However, researching these groups on a case-by-case basis is slow and will require more examples to understand such questions as, "what sorts of catalysts work to initiate watershed partnerships?", "which outside partnerships are the most helpful?", "how can top-down policy work with instead of against these groups?". I propose, rather than trying to pin down exactly which typologies or characteristics researchers can generalize about watershed partnerships, instead focusing research on how to support these groups.

BIBLIOGRAPHY

Burby, Raymond J. 2006. Hurricane Katrina and the Paradoxes of Government Disaster Policy: Bringing about Wise Governmental Decisions for Hazardous Areas. The Annals of the American Academy of Political and Social Science.Vol. 604, pp. 171-191

Clancy, Justin B. and Jessica Grannis. 2013. Lessons Learned From Irene: Climate Change, Federal Disaster Relief, and Barriers to Adaptive Reconstruction. Georgetown Climate Center. Georgetown Law. Available at: <georgetownclimate.org>.

Cohen, Alice and Seanna Davidson. 2011. An examination of the watershed approach: Challenges, antecedents, and the transition from technical tool to governance unit. Water Alternatives 4(1): 1-14.

Cohen, Nancy Eve. 2013. After FEMA Buyouts, Towns Envision Uses For Land. Vermont Public Radio. <http://digital.vpr.net/post/after-fema-buyouts-towns-envision-uses-land#stream/0>

Cole, Richard A., Timothy D. Feather and Phillip K. Letting. 2002. Improving Watershed Planning And Management Through Integration: A Critical Review Of Federal Opportunities. e U.S. Army Corps of Engineers Institute for Water Resources (IWR). IWR Report 02-R-6. < http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/02-R-6.pdf>

Cutter, Susan L., Lindsey Barnes, Melissa Berry, Christopher Burton, Elijah Evans, Eric Tate, Jennifer Webb. 2008. A place-based model for understanding community resilience to natural disasters. Global Environmental Change 18:598–606.

Diaz-Kope, Luisa and Katrina Miller-Stevens. Rethinking a Typology of Watershed Partnerships: A Governance Perspective. Public Works Management & Policy pp 1–20.

Doppelt, Bob and Greta Onsgaard 2006. Lessons Learned From The USDA Forest Service Community-Based Watershed Restoration Partnerships: An Assessment of the Accomplishments, Limitations, and Transferable Knowledge. USDA, Forest Service.

Dolon, Kari and Mike Kline. 2010. Municipal Guide to Fluvial Erosion Hazard Mitigation. River Management Program Vermont Agency of Natural Resources.

FEMA. The National Flood Insurance Program. < https://www.fema.gov/national-flood-insurance-program>

_____. 1998. Property Acquisition Handbook for Local Communities. FEMA. <https://www.fema.gov/pdf/government/grant/resources/hbfullpak.pdf>

_____. 2010. Protecting Your Home and Property from Flood Damage Mitigation Ideas for Reducing Flood Loss. FEMA. <http://www.fema.gov/media-library-data/20130726-1756-25045-1786/protecting_home_book_508compliant.pdf>

Folke, Carl. 2006. Resilience: The emergence of a perspective for. social–ecological systems analyses. Global Environmental Change, Vol. 16 pp. 253–267.

Griffin, C. B. 1999. Watershed Councils: An Emerging Form of Public Participation in Natural Resource Management. Journal of the American Water Reacher Association American Water Resources Association Vol. 35, No.3.

Guston, David H. 2001. Boundary Organizations in Environmental Policy and Science: An Introduction. Science, Technology, & Human Values, Vol. 26 No. 4. pp. 399-408.

Holling, C S. 1973. Resilience and Stability of Ecological Systems. Annual Review of Ecology and Systematics. Vol. 4: 1-23

Kenney, Douglas S., Sean T. McAllister, William H. Caile, and Jason S. Peckham. 2000. The New Watershed Source Book: A Directory and Review of Watershed Initiatives in the Western. United States. University of Colorado Boulder. Natural Resources Law Center.

Kline, Michael and Barry Cahoon. 2010. Protecting River Corridors in Vermont. Journal of The American Water Resources Association. Vol. 46, Issue 2: 227–236.

Kline, Mike and Kari Dolan. 2008. River Corridor Protection Guide. Vermont Agency of Natural Resources. Available at: < http://www.anr.state.vt.us/dec/waterq/rivers.htm>

Komer, Kimberly Jensen. 2015. Vermont Trees for Streams Resource Guide. Vermont Association of Conservation Districts. <http://winooskinrcd.org/wp-content/uploads/Riparian-Planting-Guide-Trees-For-Streams1.pdf>

Koontz, Tomas M. and Elizabeth Moore Johnson. 2004. One size does not fit all: Matching breadth of stakeholder participation to watershed group accomplishments

Leach, William D. and Neil W. Pelkey. 2001. Making Watershed Partnerships Work: A Review of the Empirical Literature. Journal of Water Resources Planning and Management. 127:378-385.

Mears, David K. and Sarah McKearnan. 2013. Rivers and Resilience: Lessons Learned from Tropical Storm Irene. Vermont Journal of Environmental Law. Vol. 14: 177-210.

Moore, Elizabeth A. and Tomas M. Koontz. 2003. A Typology of Collaborative Watershed Groups: Citizen-Based, Agency-Based, and Mixed Partnerships. Society and Natural Resources, 16:451–460.

Pahl-Wostl, Claudia, Marc Craps, Art Dewulf, Erik Mostert, David Tabara, and Tharsi Taillieu. 2007. Social Learning and Water Resources Management. Ecology and Society 12(2): 5.

Polster, David. 2003. Alternatives for bank stabilization – literature review. Duncan, B.C: Polster Environmental Services Ltd. <http://www.dfo-mpo.gc.ca/Library/277708.pdf>

Springston, George, Kristen Underwood, Keith Robinson, and Ned Swanberg. 2012. Tropical Storm Irene and the White River Watershed of Vermont: Flood Magnitude and Geomorphic Impacts. Presentation.

Sabatier, Paul A., Will Focht, Mark Lubell, Zev Trachtenberg, Arnold Vedlitz and Marty Matlock. 200.5 Swimming Upstream Collaborative Approaches to Watershed Management. Cambridge, MA: Massachusetts Institute of Technology.

Sreeja, K.G., C.G. Madhusoodhanan, P.K. Shetty, And T.I. Eldho. 2012. Inclusive spaces in Integrated River Basin Management: discerning multiple boundaries of resource relations. International Journal of River Basin Management Vol. 10, No. 4: 351–367.

Vermont Agency of Natural Resources. 2013. White River Tactical Basin Plan. Watershed Management Division. http://www.watershedmanagement.vt.gov

Vermont Public Radio. 2012. Tropical Storm Irene. < http://www.vpr.net/apps/irene/index>

____. 2013. Mapping the Money. <http://www.vpr.net/apps/irene/index#mapping-link>

“Vermont Rivers Program”. 2016. Vermont Department of Conservation. <http://dec.vermont.gov/watershed/rivers>

Vogel, Eve. 2016. Supporting New England Communities to Become River-Smart Policies and Programs That Can Help New England Towns Thrive Despite River Floods. University of Massachusetts Amherst. <http://scholarworks.umass.edu/water_reports/2/>

Vogel, Eve and Lacy. 2012. New Deal versus Yankee Independence: The Failure of Comprehensive Development on the Connecticut River, and its Long-Term Consequences. The Northeastern Geographer Vol. 4 (2).

“White River Partnership, The”. 2016. <http://whiteriverpartnership.org/>

Witzel, Andreas. 2000. The problem centered interview. Forum Qualitative Sozialforschung. Qualitative Social Research, 1(1), Art. 22, http://nbnresolving.de/urn:nbn:de:0114fqs0001228.