Post Extreme Event Learning Tool Application

February, 2024
Mid-Hudson Valley, New York

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*This report was submitted to the Town Supervisor of the affected town in the Mid-Hudson Valley of New York. The names of the supervisor and town have been omitted for privacy concerns.

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Executive Summary

Statement of the Problem

During the afternoon and early evening of July 9, 2023, thunderstorms and slow-moving showers heavily impacted the Northeast of the United States, resulting in a devastating flooding event. In some locations, extreme precipitation rates were as much as 9 inches of rain in 3 hours, which led to flash floods and landslides. One of the epicenters was the Mid-Hudson Valley in New York State, specifically eastern Orange County, Northern Rockland County, Northern Putnam County, and Northern Westchester County. On February 29, 2024, the Post Extreme Event Learning Tool (PELT) was applied with key flood policy stakeholders in the Mid-Hudson Valley of New York State. The PELT application was directed by Hunter College-CUNY Team of the Consortium for Climate Risk in the Urban Northeast (CCRUN).

The area in focus received around 4-6 inches of rain in just a few hours. The devastating flooding washed out main roads and flooded and washed away homes. Debris was also scattered across many roads from the fast-moving flood waters. Creeks, streams, and brooks overflowed their banks. The timing of the storm contributed to the impact. As the storm hit on a Sunday afternoon, many people were out on the roads and caught off guard by flash flooding conditions. Many motorists were stranded and had to be rescued with swift water equipment. A local Police Chief stated they received 300 distress calls but had only two officers on call, so the dispatcher had to prioritize people based on severity, which resulted in the police being unable to respond to many calls and people. The Emergency Management service reported numerous flooded roadways, water rescues, and a few mudslides. As the map below shows, using data collected in the days after by the Superintendent of Highways, Sanitation and Buildings & Grounds, there were 25 documented damages across the town with an estimated cost of $3,445,000 for repairs.

On February 29, 2024, the Post Extreme Event Learning Tool (PELT) was applied with key flood policy stakeholders in the area. The workshop's objective was to use PELT to help the local key policy stakeholders understand more completely what happened during the flood event and what might be relevant and valuable next steps to take in the long-term recovery process and improved flood resilience practice. The PELT application was directed by Hunter College-CUNY Team of the Consortium for Climate Risk in the Urban Northeast (CCRUN).

What is PELT?

PELT is a co-production process designed to occur following an extreme event or disaster (e.g., major flood event, tropical storm, extreme heatwave) and is led by local partners and facilitators ensuring that grounded and local knowledge and priorities shape the engagement. PELT guides community representatives through reflection on their experiences, identification of key drivers of impact, and development of potential adaptation pathways. The entire process is designed to take place over a few months and can be adjusted to meet the local needs. PELT occurs in three phases and the time spent in each phase is variable depending on the size of the event, the speed and extent of the immediate recovery, and the community's recovery and hazard mitigation planning aims and capacity.

Major Workshop Findings

1. The July 2023 rainstorm, along with a series of other rain events, caused widespread loss and damage locally.

2. Major impacts include major roadways being flooded or eroded by fast-flowing water and landslides, creeks and streams overflowing their banks, residential and other buildings being flooded with a few feet of water, people being stranded in homes and cars due to flash floods and roads being inaccessible. Several roads, bridges, and rail lines in the area were closed for weeks in order to make repairs.

3. The participants' lived experiences and the data provided by New York State Climate Projections for 2024 suggest that extreme rain events will occur more frequently.

4. Workshop participants defined themselves and their communities as having a heightened sense of risk from extreme rain events (participants gave an average of 4.3 out of 5).

5. Economic impacts, residential flooding, and land development decisions are seen as the most significant impacts of the extreme rain event. The participants define transportation infrastructure as the most important to focus on. Poor drainage, old and aging infrastructure, poor emergency response and recovery collaboration, and the locations of roads in exposed sites were reasons given for the vulnerability of transportation infrastructure.

6. Many of the participants believed that the town's current vulnerability is connected to background drivers (e.g., who owns the land, the location of roadways, and roadside culverts as the main stormwater drainage system) and context drivers (e.g., poor planning decisions and a lack of previous action by former government administrations).

7. Along with physical impacts, participants were keen to highlight the emotional distress and trauma connected to the event as many of the participants occupied positions of power and authority yet felt unable to resolve many of the issues that arose fully.

8. Participants often expressed frustration with past development decisions or lack thereof, as well as bureaucratic 'red tape' that limits the capacity to make necessary changes that would reduce risk and increase resilience.

9. Current tax and insurance policies were described as being counterproductive for increasing resilience. For example, having a generator in case of power outages increases home insurance and tax rating.

10. Participants stated how they need approval from county and state officials to make necessary risk reduction decisions such as removing silt and debris from creeks. These approvals can be very time demanding and complex.

11. A desire existed amongst participants to develop formal agreements between the different sectors of local, county, and state governments, so that everyone knows who is in charge of what when it comes to extreme event recovery and reducing risk.

12. Many participants emphasized the need for policy reforms to encourage anticipatory planning and facilitate more effective disaster response and recovery efforts. Discussions around proactive planning focused on using education, outreach programs, and clear messaging to enhance community engagement and decrease risk.

Key Messages

1. It is important to create clear, adaptable, and flexible climate resilience plans that focus on addressing the increasing climate risks and developing adaptation pathways forward.

2. Proactive planning will be important to have clear divisions of responsibility for reducing risks associated with the town and increasing resilience as the likelihood of further extreme events increases.

3. It will be important to maintain the momentum generated from this workshop and the attention and focus present in the aftermath of extreme events by continuing to have these conversations where everyone is in the same room on a regular basis.

4. Having an annual meeting to discuss that year's extreme events, the town's response, and how to address the risks and improve the response could be an important step to increasing resilience.

5. Conversations must be between all relevant stakeholders (i.e., community members, local government officials, county, state, and federal officials) to properly address risk drivers and develop successful adaptation pathways.

6. Having structures and institutions in place to ensure any funds are used wisely, effectively, and timely to address the increasing vulnerability associated with climate change will help reduce the drivers of risk.

7. It will be useful for local governments to develop more in-house capacity to use mapping applications to compile and manage data more routinely, so they are ready to use these tools and data in obtaining necessary funding and proactive resilience planning.

8. Efforts need to be made at the state and federal level to make funding streams for local governments more transparent, so they can obtain necessary funding to make the necessary changes to infrastructure (roadways, buildings, creeks, etc.) to reduce flood risk.
9. The stress associated with local, county, and state positions when dealing with bureaucracy and risk reduction needs to be considered for fear of losing key knowledge holders and institutional memory when people leave jobs.

10. There need to be structures in place when people do move on from their posts so that key knowledge is not lost and the same conversations are not had over and over, preventing meaningful progress from being made.

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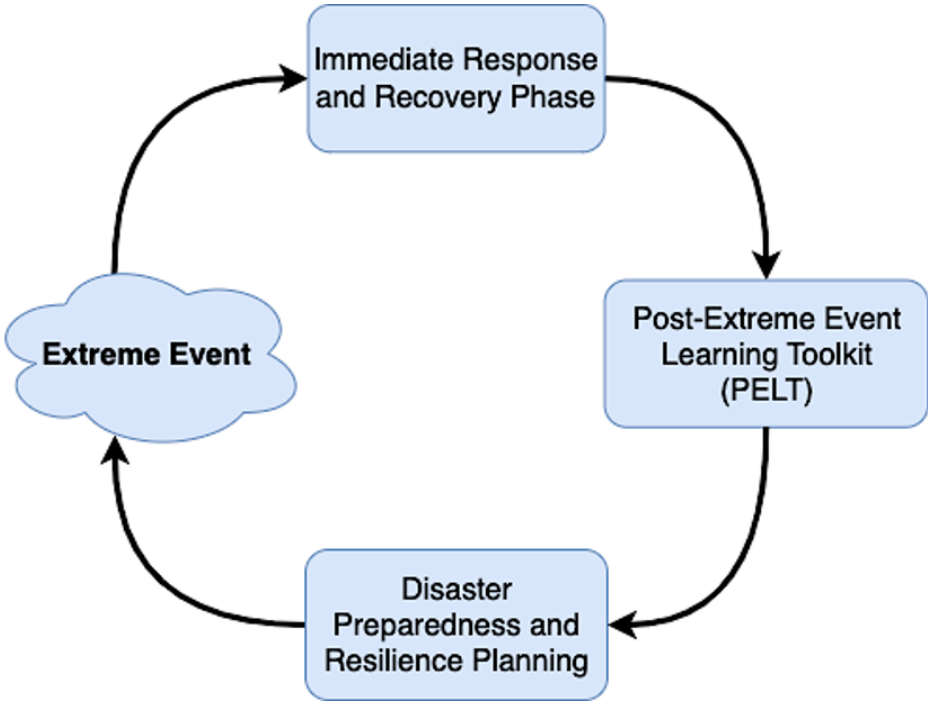
1. Introduction:

On July 9-10 2023 a large pluvial flooding event (with upwards of 9 inches of rain falling within a 3 hour period) significantly impacted the exurban areas approximately 60 miles north of the New York City in Rockland and Orange Counties of New York State. The municipalities of focus suffered loss and damage due to widespread flooding. In one nearby community, one resident was killed as floodwaters swept them away from just outside their residence. In the aftermath of the event and subsequent flooding episodes that took place, the Hunter CUNY CCRUN team were asked to develop a Post Extreme Event Learning Tool application to help in the definition and specification of policy response strategies.

The Post Extreme Event Learning Toolkit, or PELT, is a co-production process designed to be used in the months following an extreme event or disaster (major flood event, tropical storm, drought, extreme heat, etc.). This decision-support toolkit brings together community stakeholders from multiple sectors to participate in a workshop (minimum 2.5 hours) to take advantage of " windows of opportunity" following extreme climate events. PELT provides communities vital time and space to define new policy pathways to address future extreme events and climate change more generally. The process seeks to transform short term, post-event momentum into long-term learning and action. The application of the PELT results in a set of locally-relevant recommendations and conclusions on climate challenges facing the community.

Before the workshop, the PELT team conducts a pre-workshop session with local practitioners to understand the context, their goals for participating in the PELT process, and what outputs are most beneficial. Following the initial outreach the PELT team prepares up to date climate data/questions for the workshop. Through a set of curated questions the workshop collects shared lived experiences of the event, promotes discussion around what the major impacts were, delves deeper into the drivers for these impacts, and plots desired adaptation paths forward. Attendees learn from others' experiences and viewpoints with the PELT team acting as a mirror synthesizing themes and re-raising key points mentioned earlier on. Following the workshop, the PELT team synthesizes the findings and recommendations and shares with the community so they can progress with next steps on how to achieve their adaptation pathways.

Figure 1. When PELT Occurs: PELT takes place in between the Immediate Response and Recovery and Disaster Preparedness and Resilience Planning phases



2. Background: July 9th, 2023 Storm and the February 29th, 2024 Workshop

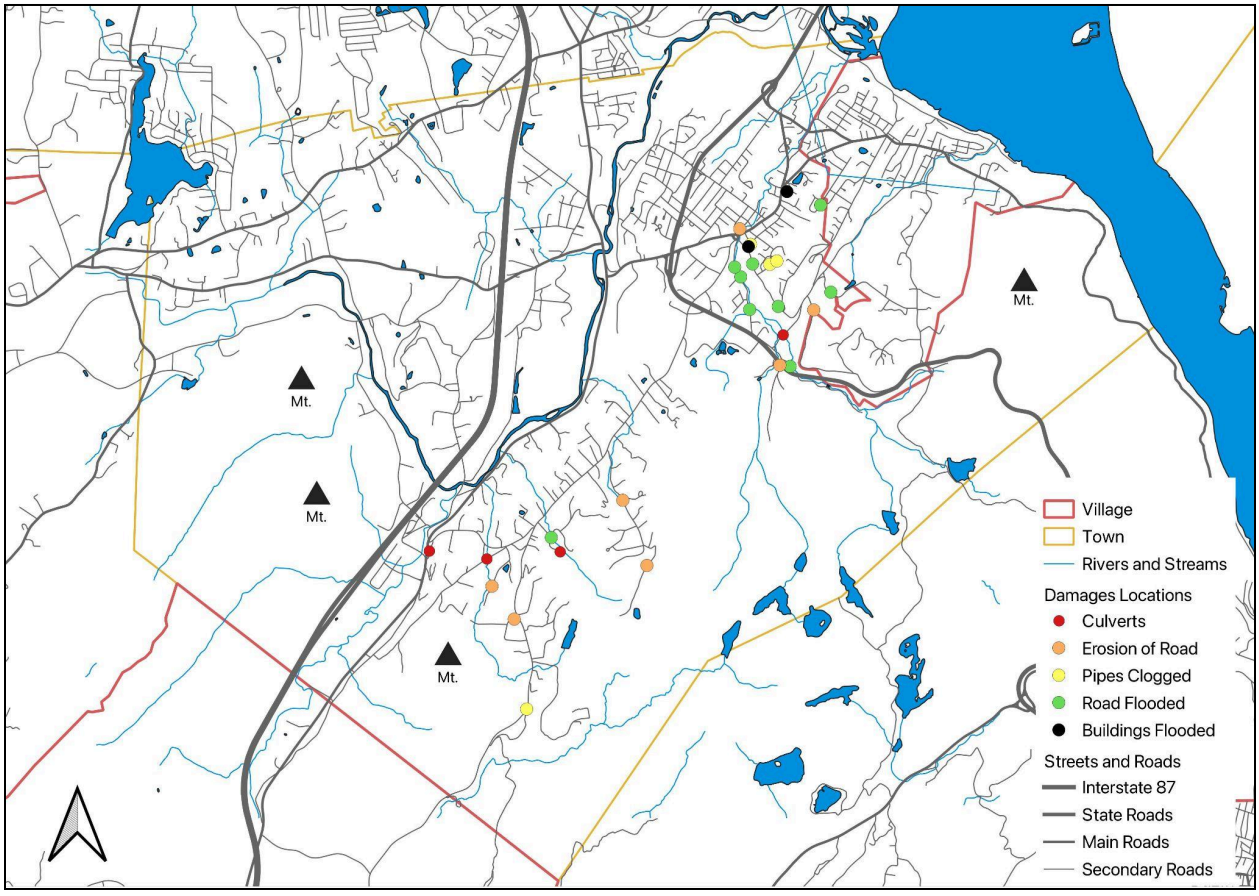
During the afternoon and early evening of July 9, 2023 torrential downpours from slow moving showers and thunderstorms brought 4 to 9 inches of rain in about three hours to the most severely impacted locations across the Hudson Valley, New York. This rainfall occurred over already saturated grounds from recent rainfall. The devastating flooding washed out main roads, caused landslides and flooded homes and businesses. Creeks, streams, and brooks overflowed their banks. Debris was scattered across many roads from the fast-moving flood waters. Many motorists were stranded and had to be rescued with swift water equipment. Service on the Metro-North Hudson Line railroad was severely impacted by the flooding resulting in further disruption to transportation infrastructure.

Across the region, several roads were closed for weeks to complete repairs after the storm. The Popolopen Bridge near Fort Montgomery had to be closed for about a month for repairs as the flooding damaged the bridge, affecting motorists who rely on US 9W as this is a main connection from Bear Mountain State Park into Fort Montgomery and points north. One State Route road was washed out and as of Spring 2024 remains closed for repairs. Other main roads severely impacted included US 9W, US 9, US 6, US 202, Route 9D, Seven Lakes Drive, Long Mountain Circle, Palisades Parkway, Old State Road, and Taconic State Parkway.

The town in focus was heavily impacted by this extreme rain event and received around 4-6 inches of rain in just a few hours. The timing of the storm contributed to the impact as the

heaviest rainfall occurred between 4-6 pm on a Sunday afternoon, so many people were out on the roads and caught off guard by flash flooding conditions. A local Police Chief stated in the workshop that they received 300 distress calls but had only two officers on call, so the dispatcher had to prioritize people based on severity which resulted in the police being unable to respond to multiple calls. The Emergency Management services reported numerous flooded roadways, water rescues, and a few mudslides. As the map below shows using data collected in the days after, the Superintendent of Highways, Sanitation and Buildings & Grounds, there were 25 documented major damages across the town with an estimated cost of $3,445,000 for repairs.

Figure 2. Map of damages located across the town (Source: Map created by Charlie Overton using data of damages collected by the town's Superintendent of Highways, Sanitation and Buildings & Grounds)



2.1) Phase 1: Pre-workshop data gathering

Beginning September 2023, it was determined that a town in the Mid-Hudson Valley would be a good site to deploy PELT, and the Hunter CUNY CCRUN team alongside Simon Gruber, a longtime resident of the area and member of Hunter College's Center for Sustainable Cities, contacted multiple town supervisors to gauge interest. There was some general interest from a few towns in the area, but one replied saying that he had a desire to create a comprehensive resilience plan for the town and was interested in having a PELT workshop in there to help with this process. We felt this intention of learning from the event to build a plan

for the future fit well with our objectives for PELT. So, on December 14, 2023 the Hunter CUNY CCRUN Team conducted a site visit of the town and met with the Town Supervisor. During the meeting, the PELT process was described in more detail and the Supervisor outlined his aims for conducting a workshop. Following this meeting the team and Town Supervisor went to see areas which were heavily impacted by the July 2023 storm, as well as subsequent pluvial flooding events. The Town Supervisor explained how high precipitation rates mixed with water flowing off the nearby mountains overwhelmed roadside culverts and nearby streams and creeks causing water to overflow onto road surfaces. The team also visited the Emergency Management Services (EMS) headquarters which experienced heavy flooding during the extreme event as a nearby stream breached its banks. Following our meeting with the Town Supervisor, the Hunter CUNY CCRUN team met with a local State Forest Manager, to hear about their experiences of fast moving flooding and landslides off the nearby mountains which resulted in one of their workman sheds getting washed away and another sustaining heavy damage.

Team members visiting sites of significant local flooding

Team members meet with Forest Manager to survey sites of significant flooding

2.2) Phase 2: Workshop, February 29, 2024

Following the phase 1 trip, the Hunter CUNY CCRUN team developed the format for the workshop, the second phase of PELT. The aim of the workshop was to take advantage of "windows of opportunity" following extreme climate events to identify key climate risk needs and locally-relevant climate adaptation options. At the workshop community stakeholders from multiple sectors participated by answering a series of questions on Mentimeter and engaged in meaningful discussions about the answers they were seeing on the screen. This helps the whole group synthesize what happened during the event, why this happened, and how does the community move forward. Learning takes place by providing the space for participants to take a self-inventory of their own knowledge about the extreme event while simultaneously learning what they don't know based on others' experiences and knowledge of the event.

Discussions prior to the workshop between the facilitating team and client help understand the context surrounding the extreme events impact on the wider community and what factors are important to participants. The workshop was split into three steps: the first step gathered the participants' individual experiences alongside discussion of the experiences and impacts of the wider community. During this stage the participants chose one major impact from the event to focus on for the rest for the workshop. The second step delved deeper into how at risk the participants believed they were to current extreme events and what they saw as the drivers of risk and major impacts. The drivers fall into three categories of Background (i.e., root historical and cultural conditions) Context (i.e., existing policies and regulatory frameworks) and Immediate (i.e., circumstance specific to the time and location of the extreme event). Then, the Hunter CUNY CCRUN team asked questions about what participants believed their future risk to an extreme event and these major impacts occurring again was. Next, we asked which of the drivers are important to address to reduce the risk of major impacts. Importantly, to maintain a realistic approach, participants were told that they cannot simply move every driver to zero. What the participants determine as being the most important drivers to address dictates how the conversation around adaptation pathways forward proceeds. By seeing in real time the changes from current drivers of impacts to future drivers all participants see where the group believes the focus should be moving forward. Either background, context, or immediate drivers or a combination of them become the main priority.

Following these discussions, the final step of the workshop turned to desired adaptation pathways to reduce the risk of these impacts occurring in the future. The aim is to join the participants goals for adaptation with the discussions held during the workshop in a concrete way so participants are able to map out next steps. Do participants want better drainage systems or invest in green infrastructure or nature-based solutions? Is there a need to address where transportation routes are located? Is there a desire for clearer agreements between scales of government? Or as we suspect, a combination of all. The process seeks to transform short term, post-event momentum into long-term learning and action. PELT provides communities vital time and space to define new policy pathways to address future extreme events and climate change more generally. The application of the PELT results in a set of locally relevant recommendations and conclusions on climate challenges facing the community and possible adaptation practices to move forward.

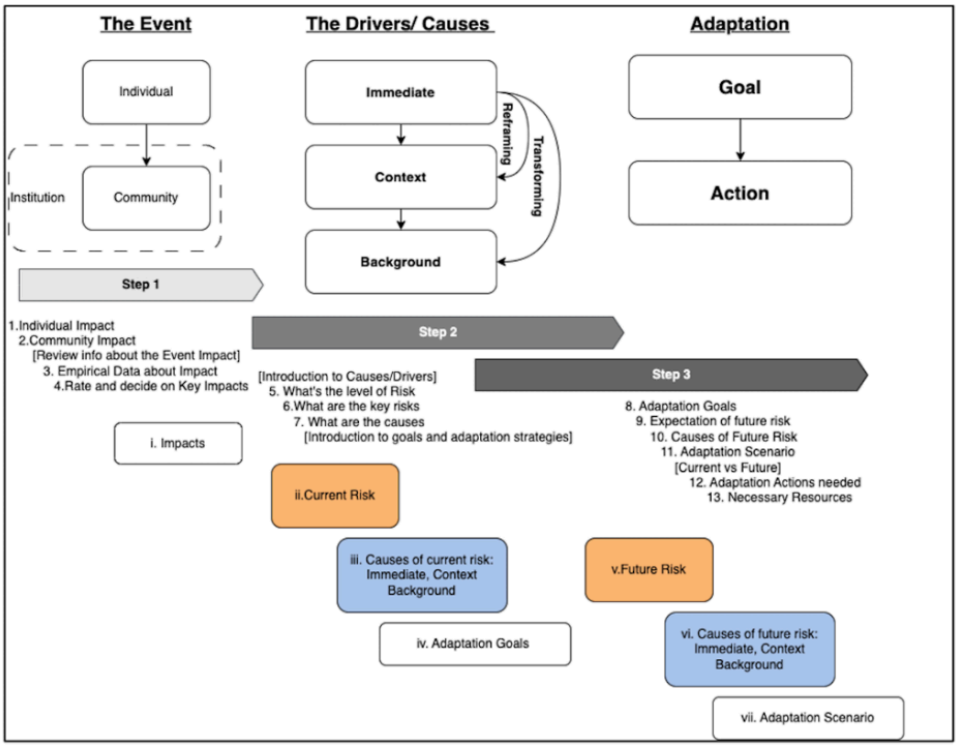
The workshop was held on February 29th, 2024 at a local science center and participants included: **Town Supervisor**; **New York State Representative**; **Police Chief**; **Highway Superintendent**; **Emergency Management Director**; **Deputy Supervisor for Town**

Supervisor; **Town Conservation Advisory Council, & Public Policy & Community Outreach staff for Hudson Highlands Land Trust**; **Water Superintendent**; **Trustee on Village Board**; **Executive Director State Forest**; **State Forest Manager**; **Deputy Director, Office of Community Development for the County, and resident of the town**; **Constituent Services Specialist for local NY State Senator**

The Hunter CUNY CCRUN Team included **William Solecki**, Professor of Geography at Hunter College and the CUNY Graduate Center, **Simon Gruber** of the Center for Sustainable Cities at Hunter College, and CUNY Graduate Students **Parisa Setayesh** and **Charles Overton**.

3. Workshop Results

Figure 3. PELT workshop steps.



[Read from left to right, the figure shows the progression of the workshop moving from Step 1 (impacts and experiences of the event), Step 2 (drivers/causes of the event), and Step 3 (adaptation pathways to address causes). The numbers under each step represent the prompts asked during each step and the bubbles with roman numerals represent key themes and data we aimed to gather in each step. The bubbles and arrows above each step depict the direction of thinking aimed for. The aim is for participants to move from an individual understanding of the event to a collective community understanding, a shift in focus from the immediate causes of the event to broader context and background, and from adaptation goals to action]

3.1 Impacts

The workshop began with a deep dive into the immediate and lingering impacts of the storm on July 9th, 2023. However, the participants immediately made it clear that these flooding events were happening more frequently and this workshop could be applied to a number of events over the past year. Participants, primarily experts in post-event response, were invited to share

personal and observed impacts through Mentimeter, focusing on infrastructure damage, emotional stress, and resilience strategies.

Personal Impacts: Participants noted direct damages such as property flooding and emotional distress, highlighting the varied storm impacts across the community.

Community Impacts: Broad infrastructure damages and psychological stresses were identified as pervasive. The discussions revealed a community struggling with the reality of changing expectations towards government roles in disaster management.

Similarly, there were discussions around some community members unaware of the changes needed or unwilling to make necessary changes that would reduce flood risk for the larger community. In some cases, property owners made changes that exacerbated the flood risk of their neighbors.

Observations of Impacts: Participants were asked for specific observations of damage or impacts, moving beyond keywords to more detailed descriptions. This discussion aimed to identify which impacts to focus on in subsequent steps. The responses included a range of observed damages, from residential flooding to broader infrastructure issues and electrical disruptions. This part of the discussion emphasized the need to prioritize certain impacts for focused action and adaptation strategies.

In order to have a more focused and targeted discussion in the following steps, participants were asked to rank their concerns so that we can focus on the most important one and the result was **Transportation Infrastructure**.

3.2 Drivers/Causes

This section of the process explored the drivers and causes behind the impacts, delved into systemic vulnerabilities, policy gaps, and environmental conditions contributing to community susceptibilities, and aimed to uncover the foundational issues precipitating the observed damages and psychological impacts highlighted in the earlier session.

Environmental Conditions: The discussions acknowledged the aggravating role of environmental conditions, including the increasing frequency and severity of extreme weather events due to climate change, underscoring the urgent need for comprehensive climate resilience planning.

Infrastructure Vulnerabilities: Participants identified key vulnerabilities in the community's infrastructure, such as outdated drainage systems and roads in areas prone to flooding, exacerbating extreme weather events' impacts. The location of some critical transportation infrastructure in the path of water flowing down off the mountains was highlighted as a background driver of major flooding impacts.

Policy and Planning Gaps: A significant concern raised was the inadequacy of existing policies and plans to anticipate and mitigate the effects of such events, pointing towards a need

for more forward-thinking and adaptable strategies. Participants expressed frustration at the town's inability to be proactive and remove silt or debris from rivers and creeks, which would reduce the risk of flooding without state approval.

Some policies, such as home and flood insurance, were discussed as counterproductive to increasing homeowner resilience. One participant told a story of a local town resident looking to sell his generator because it had led to higher monthly insurance and tax payments.

There was further frustration when discussing the requirements attached to federal funds, especially money from FEMA, to only build back to what was there before. Participants mentioned how the town was unable to use FEMA funds to make changes that would reduce the risk of something similar happening in the future. This was combined with confusion on how and where to acquire the funds to make these changes.

3.3 Adaptation Pathways

In addressing adaptation pathways, the workshop focused on identifying actionable strategies and innovative approaches to enhance community resilience in the face of climate change and extreme weather events. Participants drew on their experiences and expertise to propose individual, community, and systemic solutions.

Infrastructure Resilience: There was a consensus on the need to strengthen infrastructure to withstand extreme weather events, including upgrading drainage systems and implementing sustainable urban design practices.

Policy Reform: Participants emphasized the importance of policy reforms that encourage anticipatory planning and facilitate more effective disaster response and recovery efforts. This includes creating flexible regulatory frameworks that can adapt to changing environmental conditions and community needs.

Proactive Planning: Participants agreed that planning could be improved to move away from the current reactive forms of planning, which wait for an extreme event to happen before making necessary changes. Instead, they should be more proactive in addressing the increasing impacts of climate change.

Community Engagement and Education: A significant focus was placed on enhancing community engagement through education and outreach programs. These programs aim to empower residents with the knowledge and resources needed to participate actively in resilience-building efforts.

4. Interpretation and Assessment of Responses

4.1 Impacts

The responses underscored a seasoned understanding of the complexities surrounding disaster response, reflecting both the immediacy of personal and communal disruptions and a broader

discourse on adaptive strategies. The emphasis on emotional stress points to a profound recognition of such events' psychological toll on individuals and communities alike.

Expert Perspectives: The depth of expertise among participants led to rich discussions around actionable objectives despite the observed challenges in collaboration and coordination, suggesting a readiness to move beyond traditional response mechanisms.

Systemic Challenges: The conversations around government expectations and infrastructure inadequacies indicate a shift toward recognizing systemic issues. The call for proactive educational outreach and anticipatory planning underlines a collective push for a more informed and prepared community response.

4.2 Drivers/Causes

The discussion around drivers and causes illuminated a critical awareness among participants of the multifaceted nature of climate event impacts. This awareness reflects an understanding that solutions must be equally multifaceted, addressing immediate vulnerabilities while also tackling the broader, systemic challenges that exacerbate these vulnerabilities.

Collaborative Challenges: The emphasis on collaboration and coordination challenges from the outset highlighted ongoing operational difficulties and served as a call to action for improved cross-sectoral and interdisciplinary cooperation. For example, the town and village are unable to remove silt from rivers and streams, which would decrease flooding risk without permission from state and county officials.

Adjustments: The participant discussions on policy and planning gaps suggest an acute awareness of the misalignment between current approaches and the demands of increasing climate volatility. This misalignment calls for adjusting how communities plan for and respond to environmental threats, emphasizing flexibility, anticipation, and inclusivity in planning processes.

4.3 Adaptation Pathways

The discussions around adaptation pathways revealed a community eager to transform challenges into opportunities for growth and resilience. The emphasis on infrastructure and policy reform points to recognizing that long-term resilience requires systemic changes beyond immediate disaster response.

Holistic Approaches: The call for comprehensive policy reforms and infrastructure improvements reflects a holistic approach to adaptation, recognizing that resilience is multifaceted and encompasses physical, social, and economic dimensions.

Community Empowerment: The focus on community engagement and education underscores the importance of a bottom-up approach in resilience building. Empowering individuals and communities to take proactive steps towards resilience can complement top-down policy and infrastructure initiatives, creating a more cohesive and effective overall strategy.

5. Discussion

5.1 Major Findings

It is clear that the July 2023 rain storm, along with a series of other rain events, caused widespread loss and damage locally. The town and wider area were caught off guard by the storm's severity due to the storm's timing, which hit on a Sunday afternoon. There were major impacts to residential and government buildings across the town, but participants stated how the storm damages were very localized as the storm followed a narrow path through the town. Roads, bridges, and railroad tracks were heavily damaged as flash floods and landslides led to erosion and washouts. Many people were stranded as the only road in and out of some residential areas became inaccessible by automobile. With only two police officers on duty, distress calls had to be categorized based on priority, with multiple people not receiving assistance. Much of the damaged roads and bridges remained closed for weeks or months after the storm, with one state road still closed for repairs 6-8 months after the storm when the workshop was held. The severity of the storm and compounding damages led to large economic impacts in a town already struggling to find the funds to make necessary improvements to infrastructure that would increase resilience.

The participants' lived experiences and the data provided by New York State Climate Projections for 2024 point to extreme rain events happening more frequently. During the workshop the participants gave an average of 4.3 on a scale up to 5 for how at risk they currently felt they were to extreme rain events. Important major impacts that need addressing include the economic impacts, flooding of residences and businesses, and land development decisions with transportation infrastructure voted as the most important to focus on. Poor drainage, old infrastructure, poor collaboration, and the locations of roads were reasons given for the vulnerability of transportation infrastructure. Many of the participants explained how the town's current vulnerability is connected to background conditions (root drivers - e.g., who owns the land, the location of roadways, and roadside culverts as the main stormwater drainage system) and context drivers (poor planning decisions and a lack of previous action by former government administrations). Along with physical impacts of extreme events, participants were keen to highlight the emotional distress and trauma in residents, especially children following the July 9-10 storm. There was additional trauma amongst the participants themselves who occupy positions of power, but were unable to resolve many of the issues that arose.

Overall there is a clear lack of power and authority when it comes to local governments being able to make the necessary decisions that will reduce risk to future flooding extreme events which are becoming more frequent in places like the Mid-Hudson Valley. There were clear frustrations with bureaucratic red tape for how to acquire federal money from agencies like FEMA, and further restrictions on what that money can be used for. Participants mentioned how funds from FEMA can only be used to build back to what was before rather than making improvements. Furthermore, insurance agencies and tax categories are counterproductive to increasing resilience in local communities, such as increasing home insurance payments if the homeowner has a generator. The inability to make certain decisions regarding land use, such as removing silt or debris from creeks and rivers without county or state approval prevent proactive planning and action by town and village governments. In addition, the town in focus suffers from historical conditions that have constructed local vulnerability to flooding (root drivers) such as the locations of roadways, creeks, and a nearby unfinished golf course which

contribute to water funneling down off the surrounding mountains through the town towards the Hudson River. So, there is a need to invest in new ways for the water to flow down off of the mountains, however, due to longstanding land ownership situations the town administrators have little ability to make these changes.

Most of the discussion revolved around what can be done to address lack of power and in the absence of power. The focus was on linking immediate drivers (storm severity and out of date drainage systems) to structural/root drivers (land ownership, road locations, bureaucratic red tape), and the importance again of scale for influencing how and if collaboration works. Can there be greater collaboration between local governments and county/state officials? Along these lines there is a hope for greater inter-agency collaboration amongst the town's representatives following this workshop. Some posed devising formal agreements between agencies to determine who does what and who is in charge of what when it comes to future events. More clear and formal divisions of responsibility could benefit the relationship between local governments and county/state officials. Similarly, the town would benefit from more formal agreements and clearer divisions of responsibility. Increasing communication would achieve the desire amongst participants for a greater integration of water, land, and transport systems. A suggestion was made regarding the possibility of incorporating a watershed scale/lens for analyzing impacts since there is always a need for more data, and this could aid in addressing flood risk that doesn't stick to jurisdictional boundaries.

5.2 Key Takeaways

Some important next steps in the short term will be to have the important conversations about who is in charge of what to create a clear division of responsibility for addressing risks affecting Mid-Hudson Valley towns and villages, as well as for when an extreme event occurs again. Having structures in place before getting funding can help obtain the necessary funds from the state and federal agencies. Also, it can help ensure that funds are spent wisely, effectively, and in a timely manner. Furthermore, it will be useful for local governments to develop skills associated with risk reduction. For example, having more in-house capacity to use mapping applications to compile and manage data more routinely, so they are ready to use these tools and data in grant applications and proactive resilience planning.

It will be important to not lose the momentum generated during this workshop. Similarly, there must be an explicit effort to use energy that is present in the aftermath of extreme events to make necessary changes that address the drivers of the major impacts of the event. Many of the participants expressed that this was the first time participants had ever engaged in this type of workshop and discussion with each other despite all working or living in and around the Mid-Hudson Valley, NY. Having these types of meetings is important to reduce risk by ensuring all decision makers and stakeholders are aware of what the other is doing and on the same page. It was clear that the participants learned from others' experiences, because they discovered what they didn't know and other solutions they hadn't thought of. One path forward would be to create a clear and adaptable climate resilience plan that focuses on addressing the increasing risks as well as adaptation pathways forward. As part of that, having an annual meeting to discuss extreme events, the town's response, and how to address the risks and improve the response could be an important step to increasing resilience.

The call for comprehensive policy reforms and infrastructure improvements reflects a holistic approach to adaptation, recognizing that resilience is multifaceted and encompasses physical, social, and economic dimensions. There is the need for more proactive planning solutions focused on incorporating these different dimensions of resilience. Conversations must happen between all relevant stakeholders (community members, local government officials, county, state, and federal officials) in order to properly address drivers of risk and develop successful adaptation pathways. It is important to have the right structures and institutions in place to address current and future climate related risks to increase resilience. Some participants mentioned the need to have the right institutions and decision making structures in place to be more proactive and deal with FEMA/other bureaucratic issues. Conversely, efforts need to be made at the state and federal level to make funding streams for local governments more transparent, so they can obtain necessary funding to make the necessary changes to infrastructure (roadways, buildings, creeks, etc.) that will reduce flood risk. This will help local officials feel less powerless and potentially experience less trauma due to the inability to take necessary action that will help their neighbors and constituents.

The focus on community engagement and education underscores the importance of including bottom-up approaches in resilience building alongside top-down measures. Empowering individuals and communities to take proactive steps towards resilience can complement top-down policy and infrastructure initiatives, creating a more cohesive and effective overall strategy. Additionally, community education/engagement can be important in managing expectations for what local governments are capable of and gain different perspectives on possible solutions. Therefore, it will be important to get the government messaging regarding resilience and risk to future storms correct. This will aid in local people understanding their own individual risks as well as to the larger community.

Finally, it is important to ensure that the knowledge held with the people who fill important positions at the local and county level are not lost if they decide to leave. These roles are often very stressful, especially when factoring in the lack of power to do what they want to do, which can cause them to aim for positions of more power at the state and federal level. However, the knowledge lost by people leaving means that often the same conversations are had over and over as new people are caught up to speed. This prevents meaningful progress to be made when it comes to reducing risk to extreme events and increasing overall resilience and the local and county level. Again, this means having the correct structures in place to deal with personnel turnover.