# Appendix K

# Project IN-CORE Climate Analysis

# Climate Resilient Communities from AT&T




- Kristin Duffy, Regional Director, External Affairs, New York , AT&T
- Jessica Filante, Director, Corporate Responsibility, AT&T
- Sebastian Guo,  Data Analyst, Corporate Responsibility, AT&T


- **September 4th, 2024**

# Agenda

- Intros and Acknowledgements
- Climate Resilient Communities Overview
- Climate Analysis Readout
- Q&A





AT&T

# Intros and Acknowledgements

# Climate Resilient Communities Overview

DRAFT



AT&T

# Climate Resilient Communities Overview

- **ClimRR Portal Training**
  - In 2022, Argonne National Laboratory, AT&T and FEMA launched the Climate Risk and Resilience Portal (ClimRR)
  - As part of this commitment, we're providing training from climate experts on how to use the tool

- **Insights Report**
  - Funded by AT&T, Project IN-CORE is providing a detailed climate analysis for Albany County

- **Communications Support**
  - AT&T will work with community to identify opportunities to highlight findings to key stakeholders through webinars, press releases, case studies





AT&T

# Climate Analysis Readout

**Key Takeaway:** Albany is projected to see more precipitation as they enter the mid-century.

**13%**

increase in inches of winter precipitation for some areas in the county.

**4°**

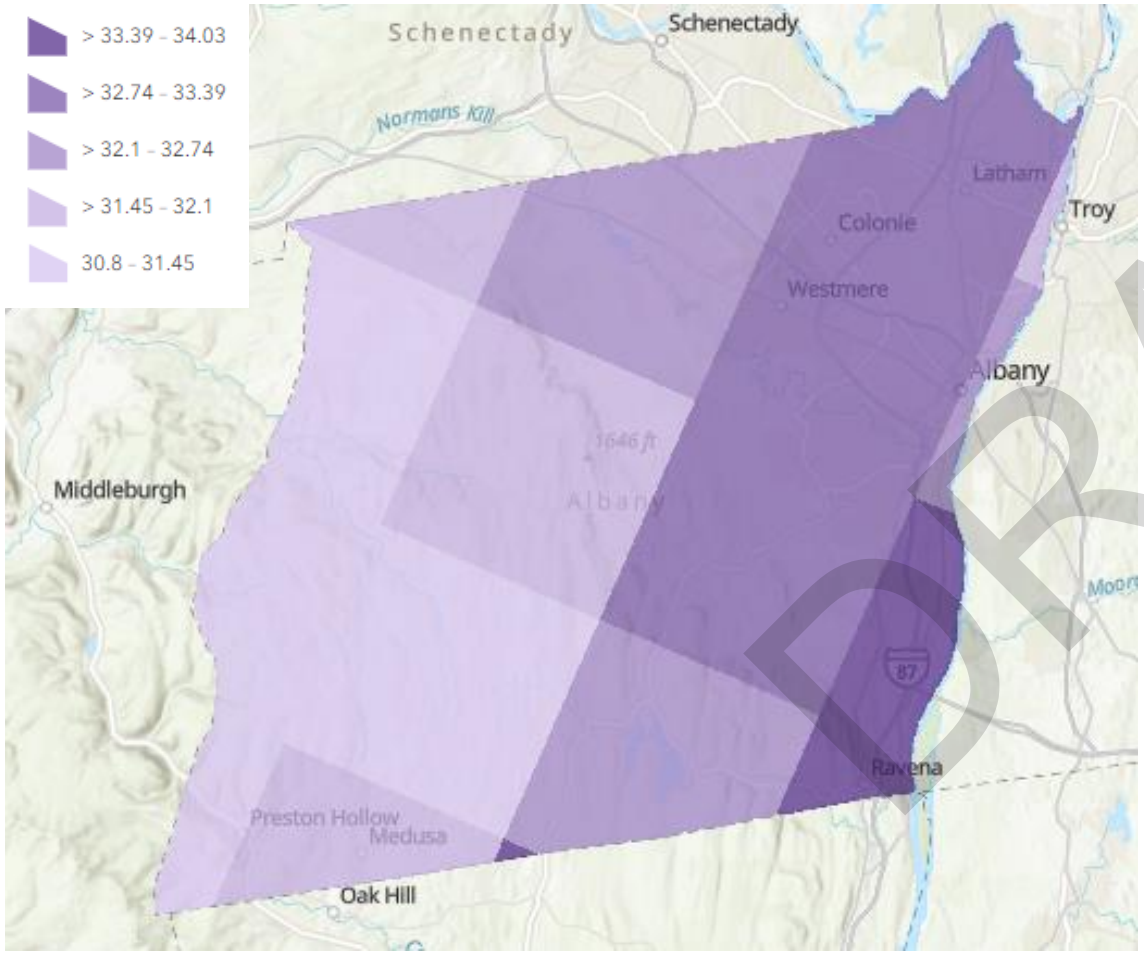
increase in winter temperatures across the county.

**7-inch**

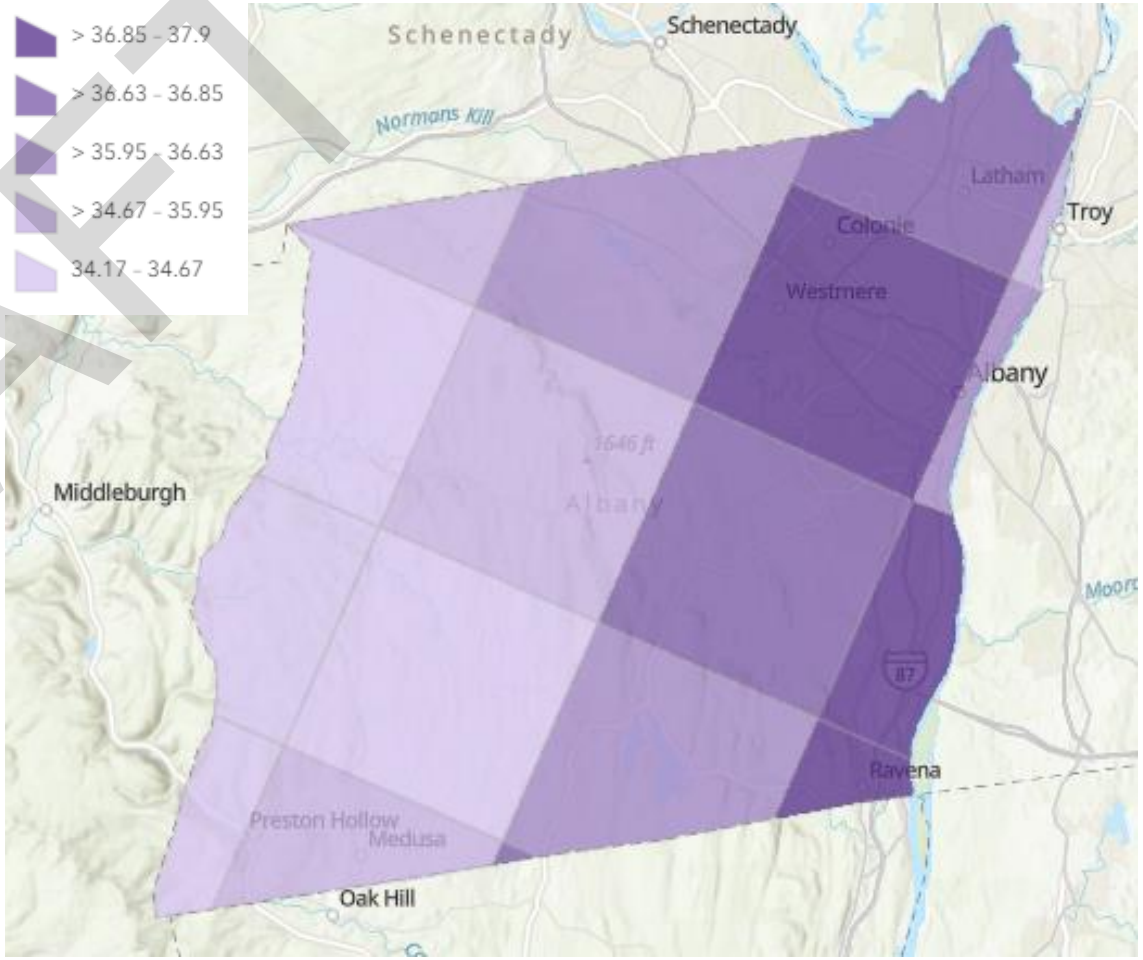
increase in precipitation for some watersheds in the county.

# Winter Temperature Changes

## Increases in winter max temperatures will drive increases in freeze-thaw cycles



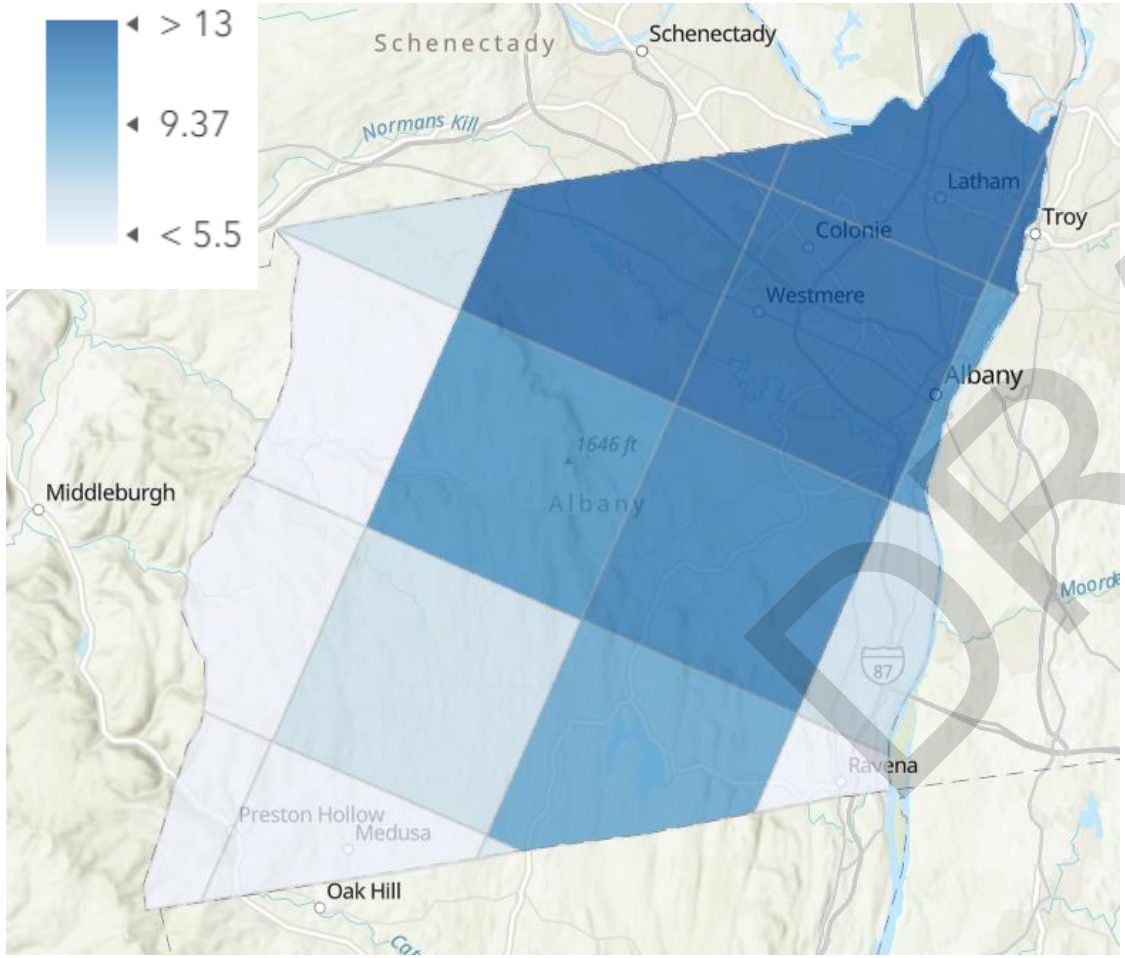

Average Max Winter Temperature (Historical, 1995-2004)



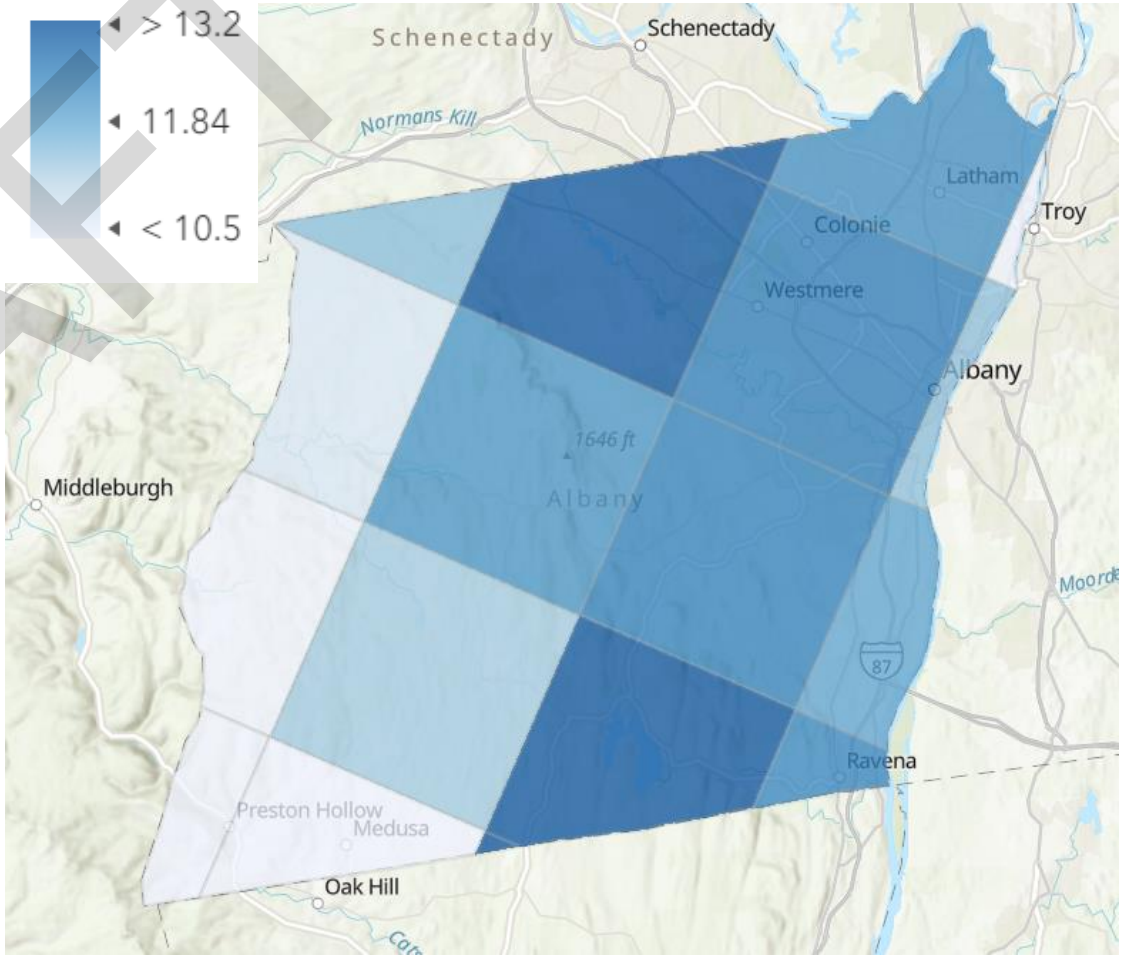

Average Max Winter Temperature (Mid-Century, 2045-2054)

# Winter Precipitation Changes

## Winter precipitation in general will increase



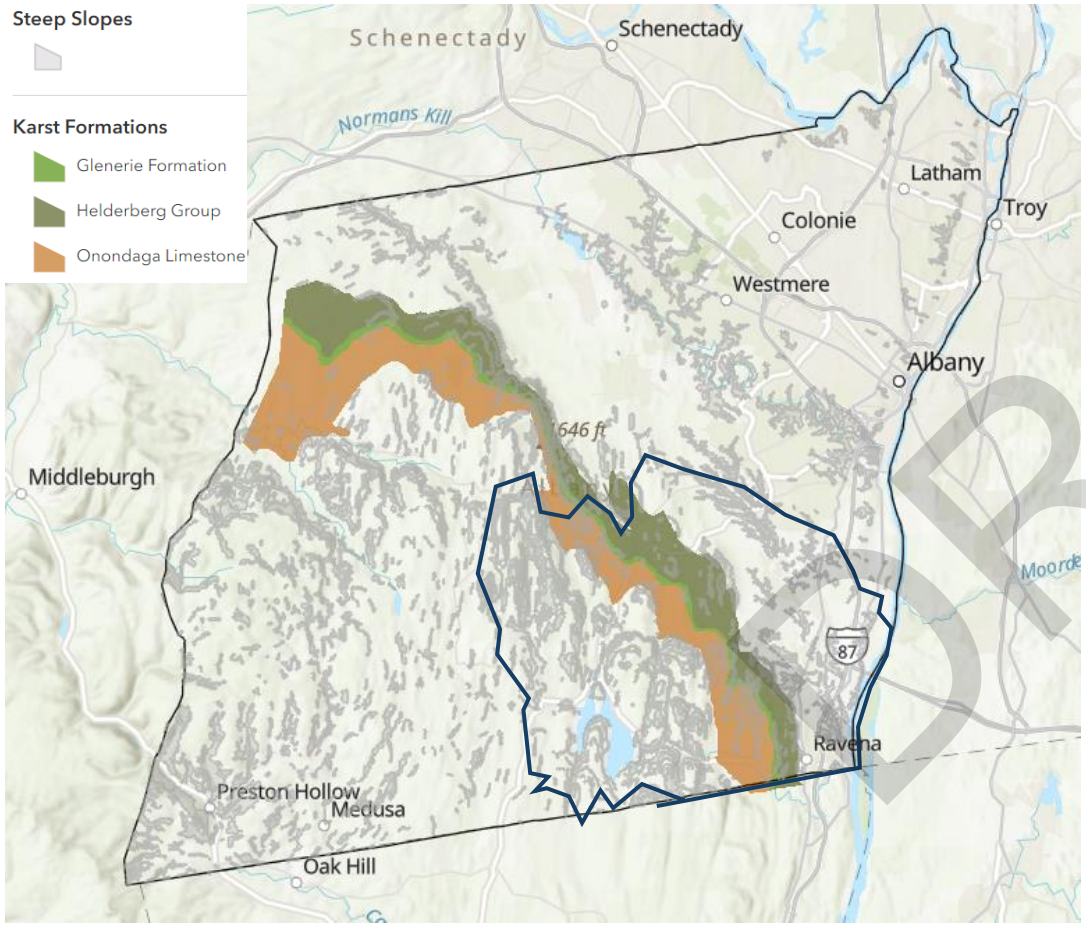

Percent Change of Maximum Winter Precipitation (Historical (1995-2004) to Mid-Century (2045-2054))



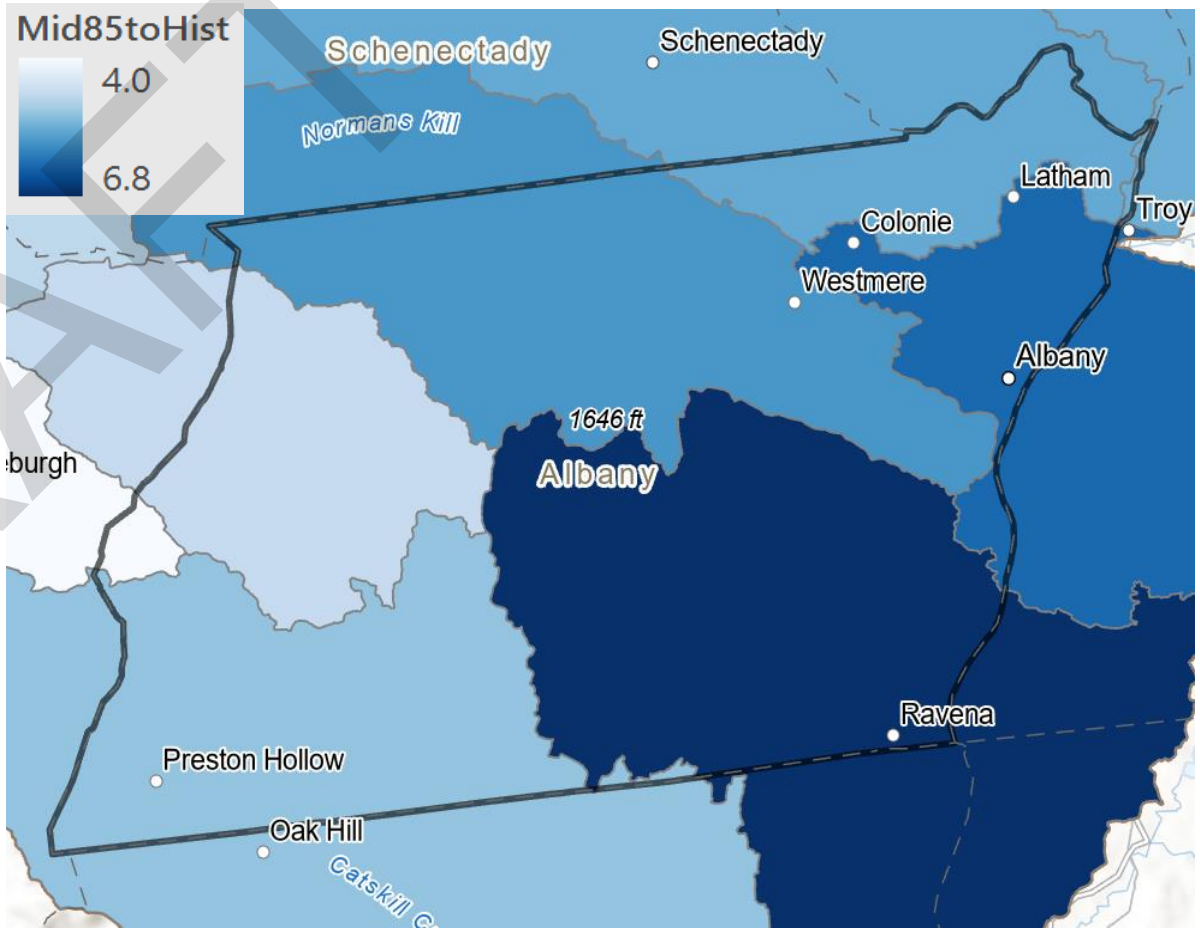

Percent Change of Mean Winter Precipitation (Historical (1995-2004) to Mid-Century (2045-2054))

# Landslides – Geology and Precipitation

## Bedrock geology around Albany can increase landslide susceptibility in mid-century



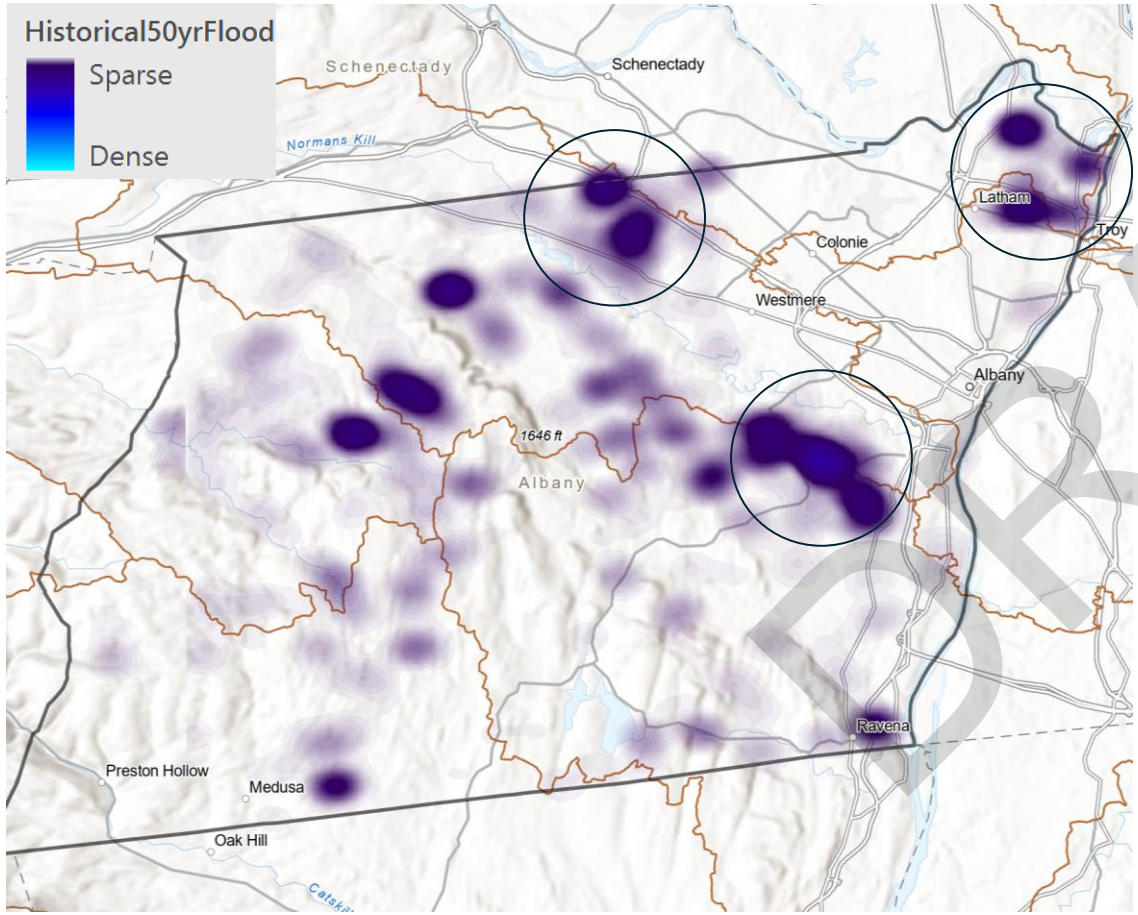

Karst Formations and Steep Slopes



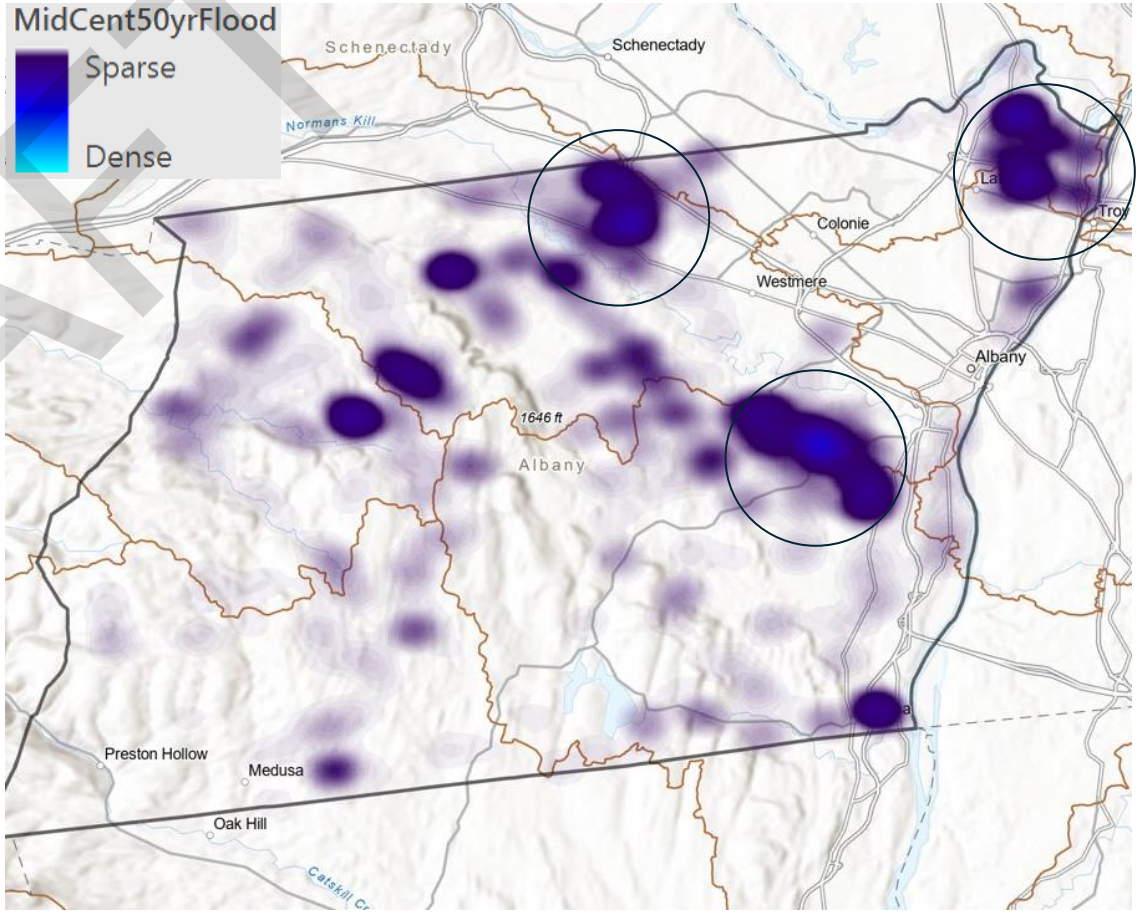

Change in inches of annual precipitation between Historical (1995-2004) and Mid-century (2045-2054) RCP 8.5

# Flooding

## Potential flood risk to buildings increases around cities in Albany



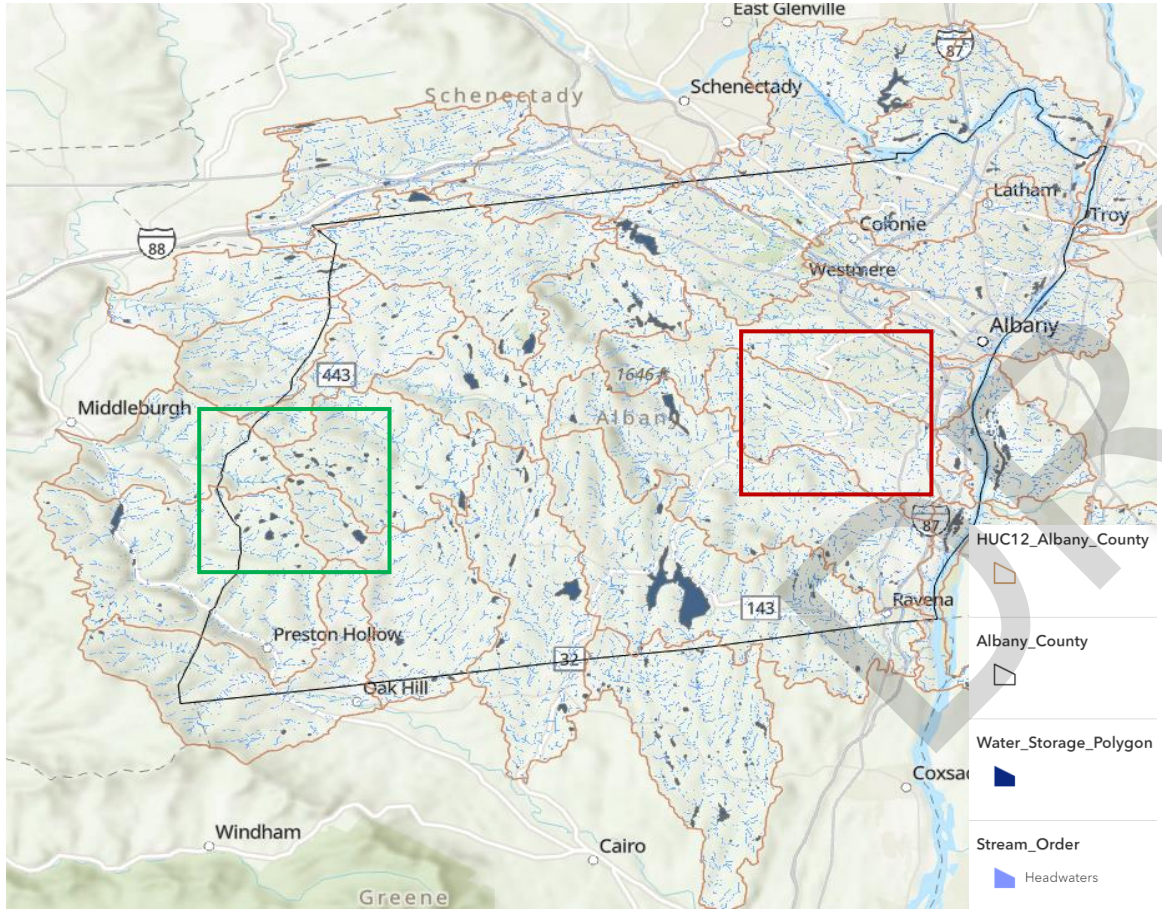

Historical 50-year flood



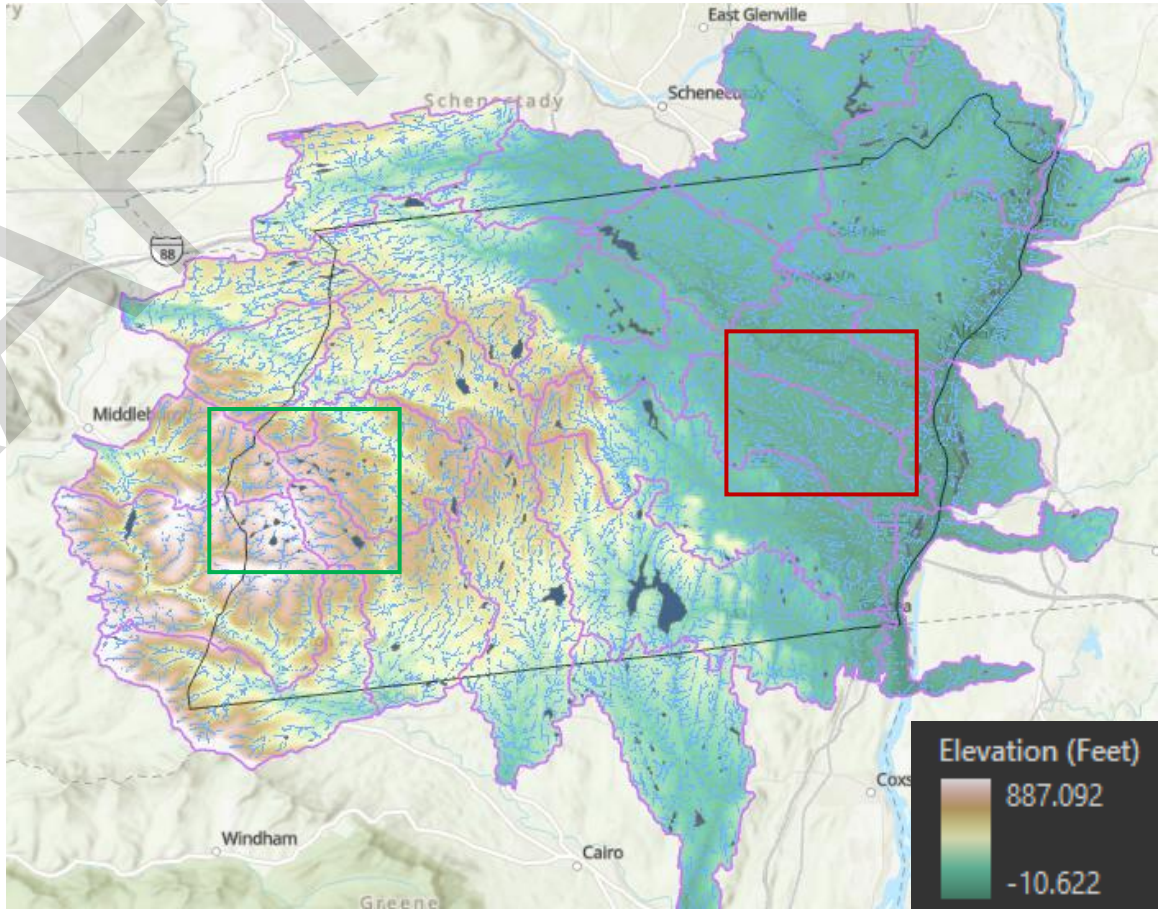

Mid-Century 50-year flood

# Flooding - Headwater Storage

## Mitigating riverine flooding through private water holding



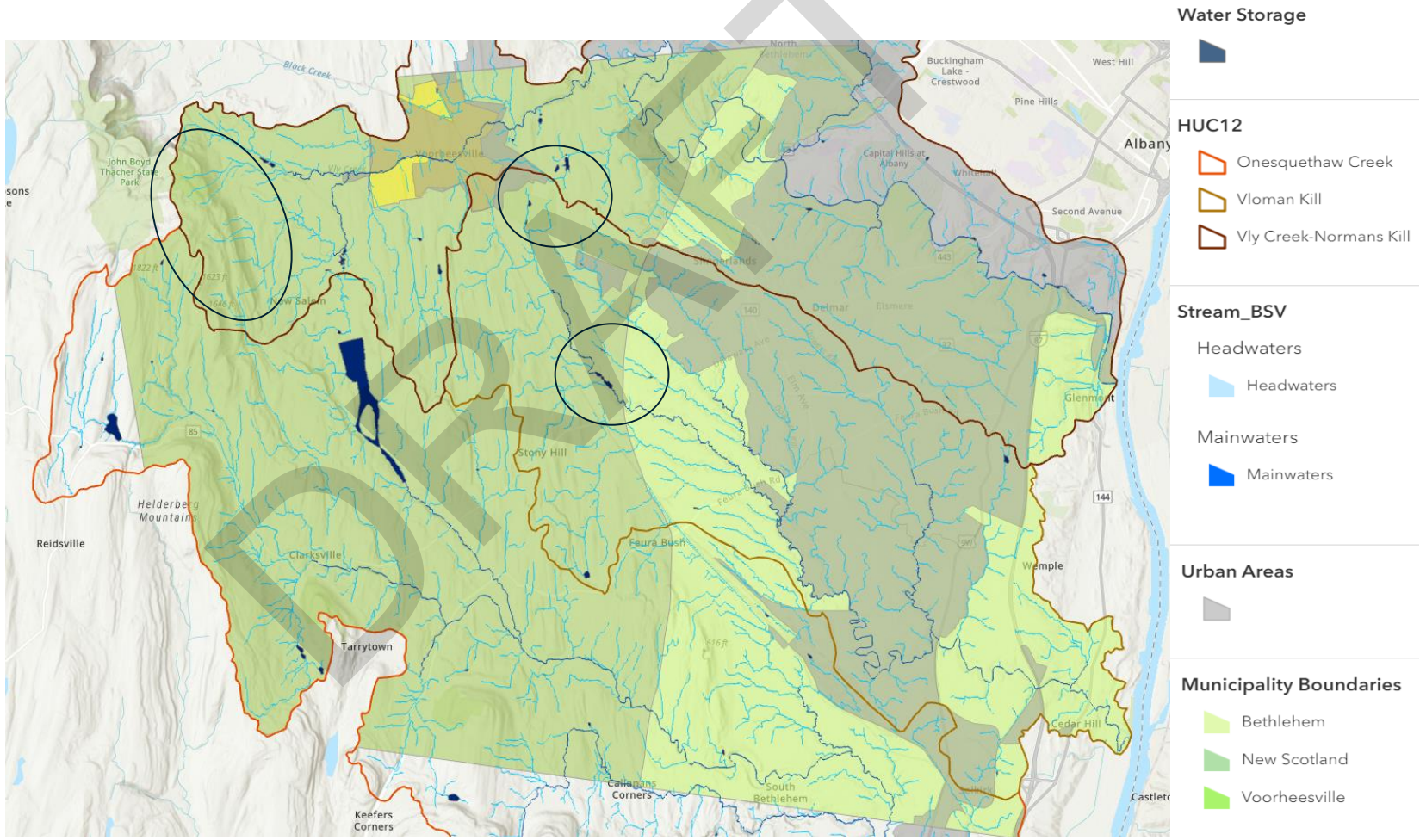

Headwaters and Water Storage Options




Headwaters and Water Storage Options Overlain with Elevation

# Flooding – Bethlehem/Voorheesville

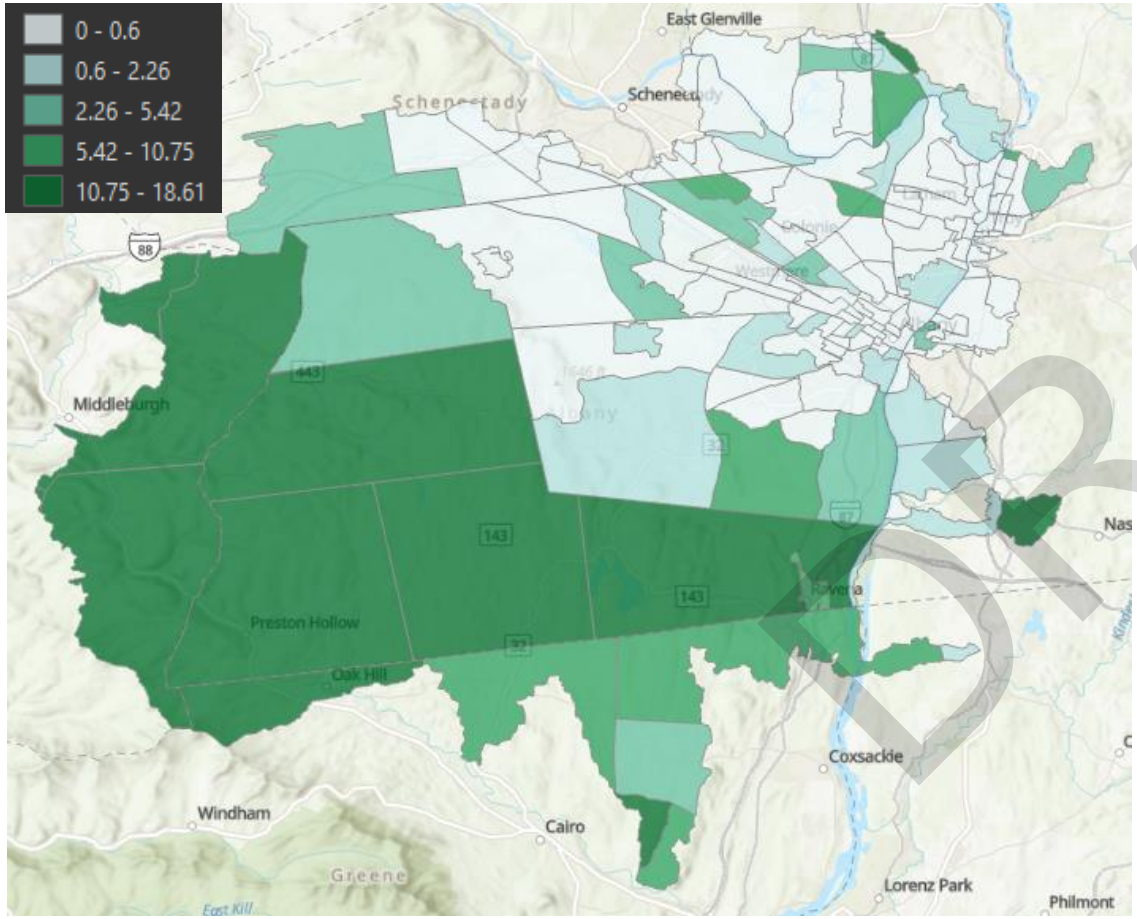
## Flood water storage presents opportunities for inter-municipality collaboration



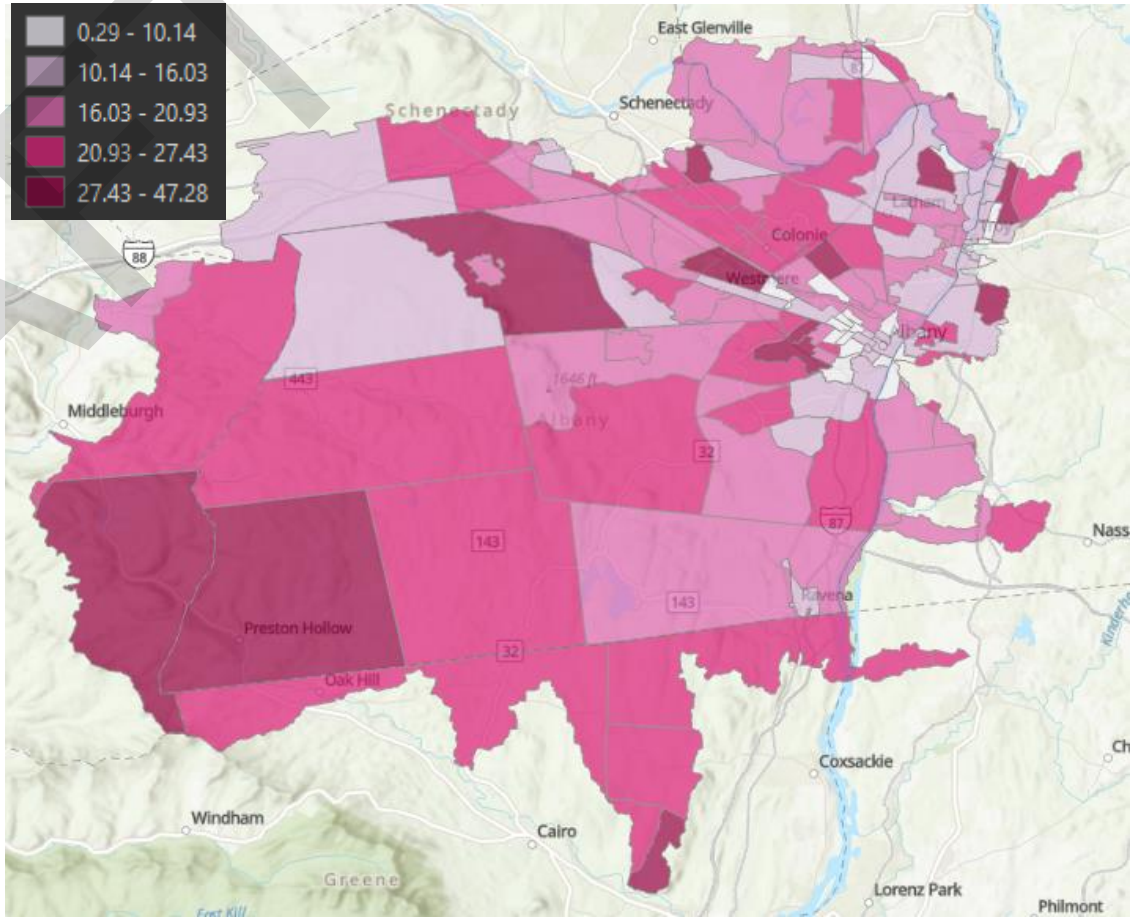

Bethlehem Municipality and Surrounding Areas

# Flooding – Social Vulnerability

## Increased flood risk can have worse effects in Western Hill towns with greater mobile home and aging populations




Mobile Homes as a Percentage of Total Housing Units




Percentage of Population Age 65 or Over

# Q&A

# Albany County Climate Analysis Using ClimRR Data

## ClimRR Background

In the maps below you will find publicly available climate data from the Climate Risk and Resilience Portal (ClimRR) that has been combined with other publicly available datasets to provide region-specific climate insights. ClimRR provides peer-reviewed climate datasets in a nontechnical format and puts high-resolution, forward-looking climate data into the hands of those who need them most. Community leaders and public safety officials can now understand how changing climate risks will affect the populations they serve. Access to this information will assist leaders as they strategically invest in infrastructure and response capabilities to protect communities for future generations. ClimRR has been made publicly available at no cost by Argonne, AT&T, and FEMA in order to enable greater climate resilience among local communities. ClimRR currently has climate projection maps available for temperature, heat index, precipitation, winds, and fire weather.

## Introduction

Albany County is located in upstate New York, a few counties north of New York City. It is bounded to the East by the Hudson River and to the North by the Mohawk River. The geography of the county ranges from mostly flat in the North/East and hilly in the South/West. The climate is of the humid continental type that is typical of the United States Northeast interior. It is characterized by hot humid summers and cold winters with severe snowfall.

The maps included in this Story Map take a look at the effects of different climate hazards on Albany County, New York. All data presented here has been modeled by dynamically downscaling an ensemble of three separate global climate models using the Weather Research and Forecasting model (WRF), which is a regional climate model of North America. In order to more easily digest the maps, it will be helpful to provide a few definitions and clarifications:

- **RCP4.5** represents a scenario in which human GHG emissions peak around 2040, then decline.
- **RCP8.5** represents a worst-case scenario in which human GHG emissions continue to rise throughout the 21st century.
- **Historical** maps are also the result of climate modelling. They do not reflect actual recorded values from the past but rather the model outputs when historic GHG emission values are used as inputs.
- Timeframes:
    - **Historical/Baseline:** 1995-2004
    - **Mid-Century:** 2045-2054

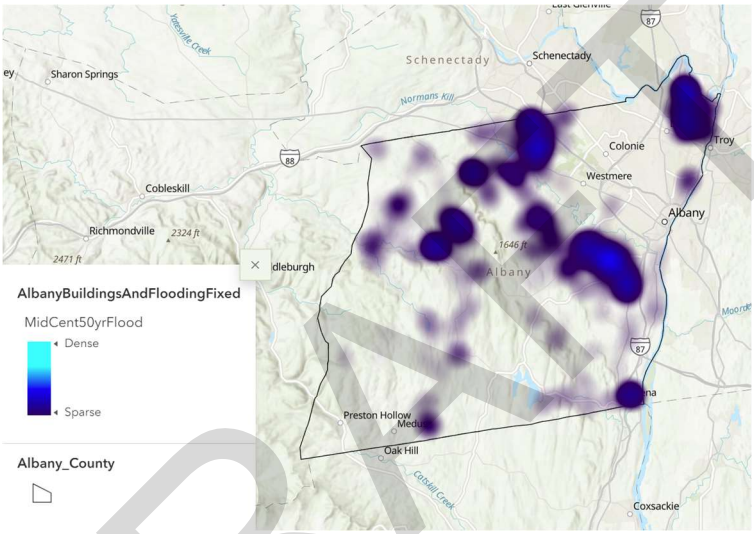
## Incorporating Equity

ClimRR is designed to be interactive with FEMA's Resilience Analysis and Planning Tool (RAPT) to provide local data on social vulnerability and community characteristics. RAPT includes geospatial information system (GIS) data layers of community characteristics that represent potential challenges to disaster resilience, important data layers for equity considerations, and community

infrastructure locations and characteristics. For example, users could focus planning efforts on communities most vulnerable to the impacts of flooding events by viewing projections of at-risk flood areas in the future alongside community data on populations with disabilities or those that are have less structurally sound housing

## Flooding

Flooding is a risk that is prevalent around Albany County. Riverine flooding is found near the Hudson and Mohawk rivers and there is risk for flooding around the steep hills in Western Albany. The map below looks at potential pluvial flood risk to buildings in the Mid-Century under the RCP 8.5 scenario. There is heavy risk around the cities of Cohoes in the NE, Delmar in the East, and by Voorheesville.

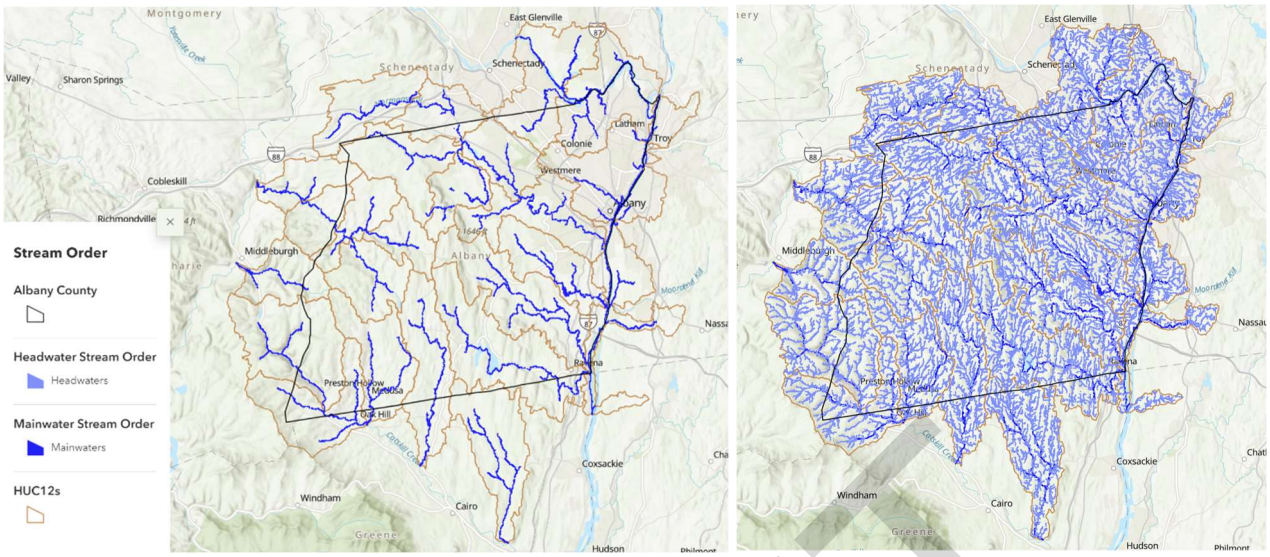



## Headwaters Overflow Storage

As flooding becomes a more prevalent problem in future decades, innovative solutions are required to address the extra pressures extreme precipitation adds to water ways and stream networks. One way to do so is by utilizing upland water storage closer to river headwaters during flood events to store extra rainfall and flood waters. If the water can be captured before it leaves the headstreams, water flow hopefully decreases before it reaches downstream areas that tend to be more densely populated.

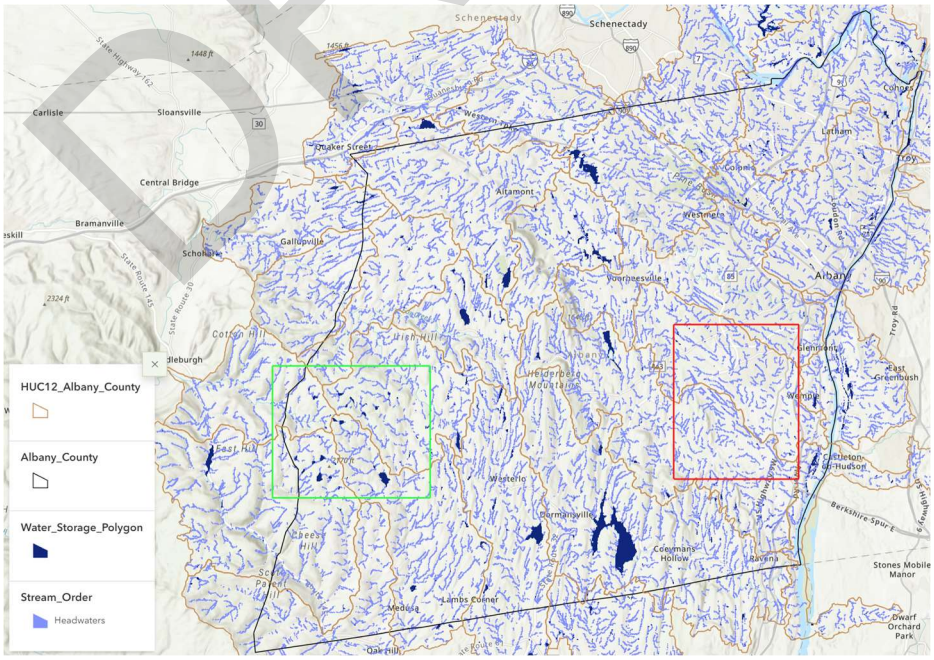
### Water Streams Labelled by Stream Order

The map below shows the streams around Albany County with lighter colored streams corresponding to headwaters and darker colored streams corresponding to main waters (i.e. the Hudson River, the Mohawk River, and kills/streams/rivers that flow into the Hudson and Mohawk). The orange boundaries are the county split by HUC 12s and delineate different watersheds around the area.



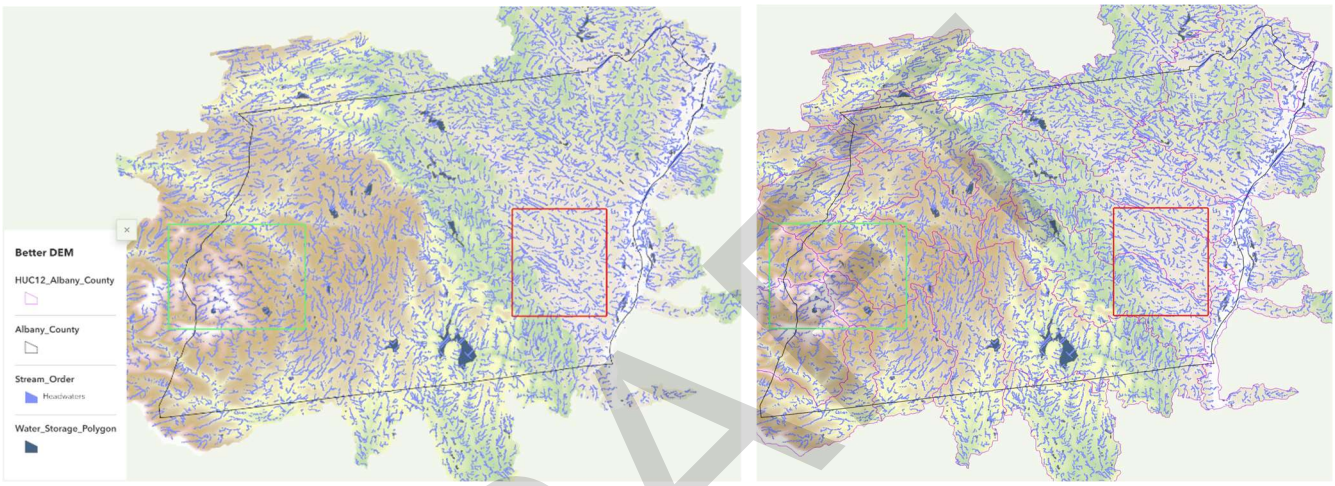

## Stream Headwaters Intersected with Water Storage

The map below extracts the streams of order 1 and 2 from the stream map above to get a sense of where the headwaters are in Albany County. Additionally, a layer containing water storage areas is overlayed on top of the headwater layer. The water storages consist of ponds, lakes, reservoirs, and other areas where water pools. The water storage layer was intersected with the headwaters to gain an understanding of potential overflow storage during heavy precipitation events. Most of the water storage areas tend to be concentrated in Western and Central Albany, in the higher-elevated "hill towns". These areas also tend to be more rural and sparsely populated compared to the regions of Eastern Albany. The green and red rectangles depict areas with heavy water storage density and low water storage density, respectively.



### Headwaters with Water Storage and Elevation

The map below shows the headwaters and water storage areas with an elevation map. Western Albany tends to be at higher elevation than Eastern Albany, meaning that water storage areas in Western Albany will be more integral in capturing flood overflow before the water flows down the hills and reaches faster velocities that can cause flash flood events in the central areas of Albany County. Even though the Eastern areas by the Mohawk and Hudson rivers don't have as much water storage potential, these areas tend to be at lower elevations and flatter. This means the water flowing through these areas won't have the faster velocities of water flowing down the steep slopes in the Western hills of Albany County.

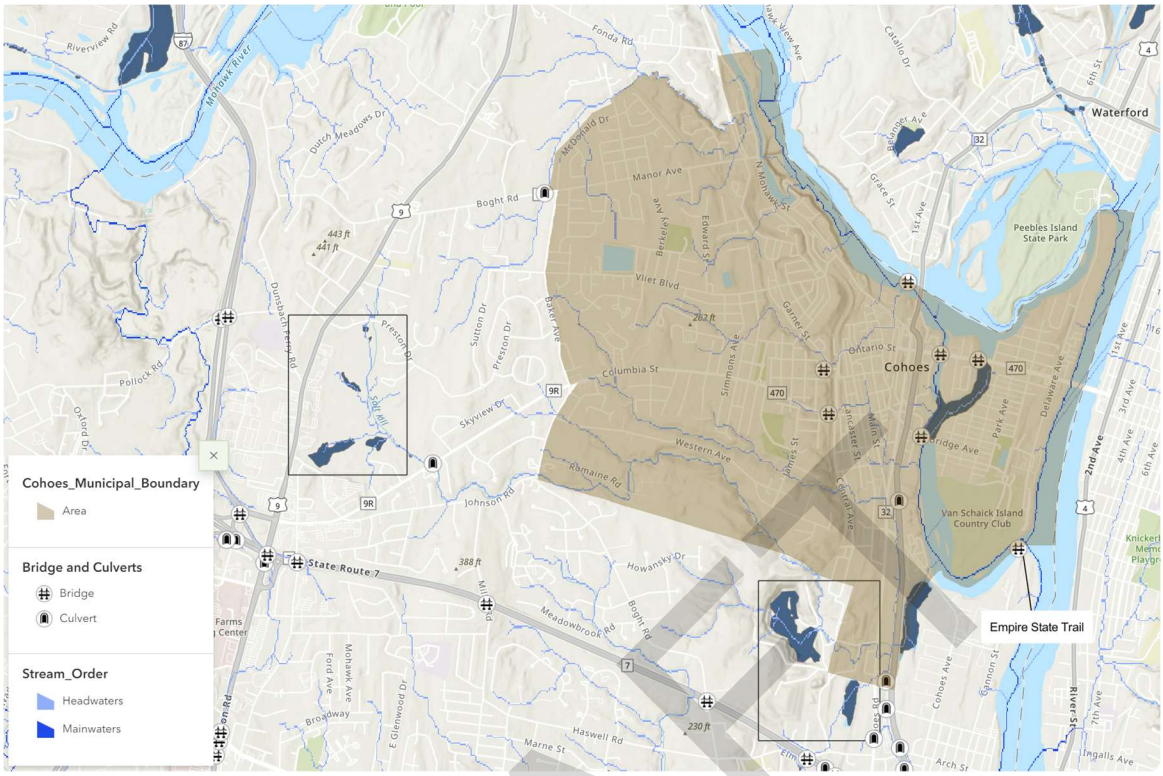



## Flood Water Storage Case Studies

The next two maps take a look at specific cities/regions around Albany County and how different areas could potentially utilize upstream water storage to implement different hazard mitigation actions to reduce the impacts of flooding on downstream urban areas (especially those areas near rivers/water bodies). The second case study also considers opportunities for inter-municipal collaboration as representatives begin identifying potential storage facilities in upstream areas that cross municipal boundaries.

### Cohoe Case Study

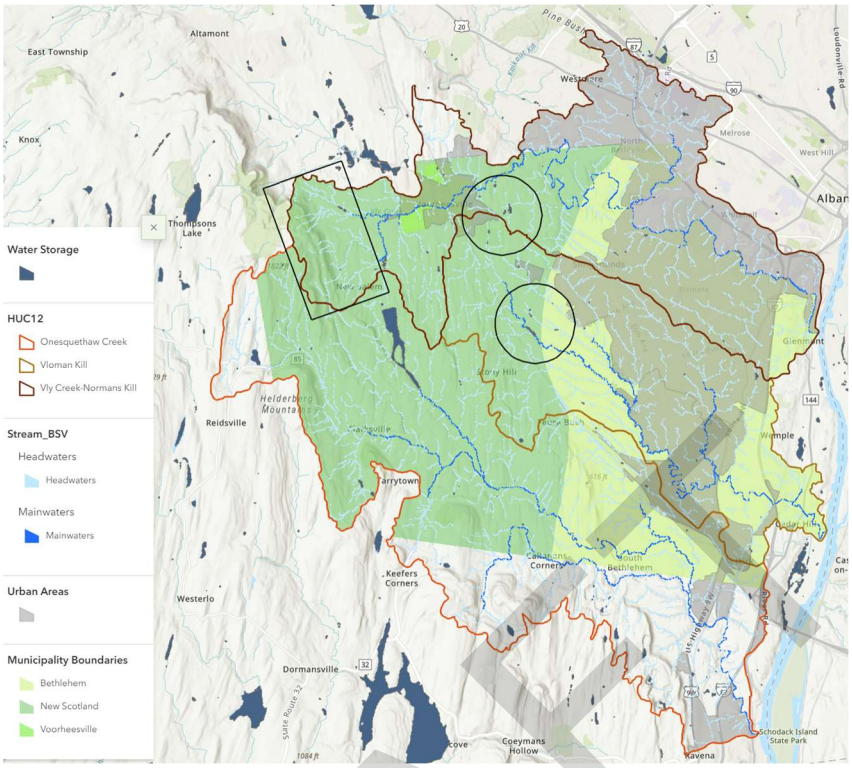
To understand the potential benefits of upstream water storage more clearly, we take a look at the city of Cohoes located next to the Mohawk River. As the Mohawk's water levels rise during flood events, bridges along the river could be flooded, causing traffic flow to stall. The newly updated Albany County HMP's mitigation action is to “conduct an engineering analysis to determine whether there are additional ways to protect utilities under bridge decks (e.g. water and sewer lines, electric) from flooding.” One way to protect these utilities is by utilizing water storages upstream of the city. To the south of Cohoes, there are bodies of water below the municipal boundaries of Cohoes that could potentially be utilized to prevent the Mohawk River from overflowing. These southern bodies of water flow into the Mohawk close to the Van Schaick Island Country Club and could reduce the flooding levels before they reach the bridge connecting the Country Club to Cannon Street.




**Bethlehem and Voorheesville Case Study**

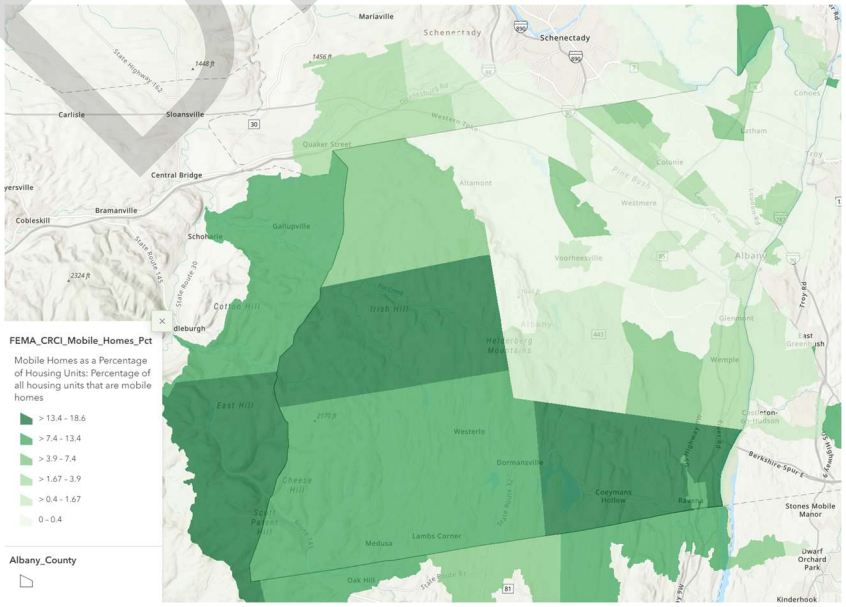
The usage of water storage as flood overflow presents an opportunity for inter-municipality collaboration on hazard mitigation and community resilience. In this map, we take a closer look at the city of Bethlehem and its surrounding regions. To the west of Bethlehem lays New Scotland and the village of Voorheesville with the green colors on the map depicting municipal boundaries. On closer look at Vloman Kill, there are potential water storages in Colonie Golf and Country Club near Voorheesville and in Unionville. The intersecting streams of these water storages ultimately flow into Dowers and Vloman Kill in central Bethlehem, which cross through urbanized areas of Bethlehem. While these water storages are located outside of the jurisdiction of Bethlehem, utilizing them could be of use to Bethlehem's Municipal Government and could lead to chances to encourage partnerships between New Scotland and Bethlehem. Some of these water bodies do not look large and probably are where water naturally stagnates as the stream flows, but these areas can be expanded and dug out to increase water storage potential.

The map also looks at the Village of Voorheesville and its surrounding watersheds and storage capacity. In the Western part of Vly Creek-Normans Kill to the West of Voorheesville's boundaries, there are a collection of water storages identified by Picard Road and by 85A. Many of these storages are fed by headwaters that originate on top of the Helderberg Escarpment, a ridge that runs parallel to state highway 157. The elevation of these headwaters could potentially lead to faster stream flows down towards Voorheesville compared to other streams that flow through flatter areas. Thus, the use of water storages could be paramount to capture the steep-flowing water before it reaches the more urban areas of Voorheesville.

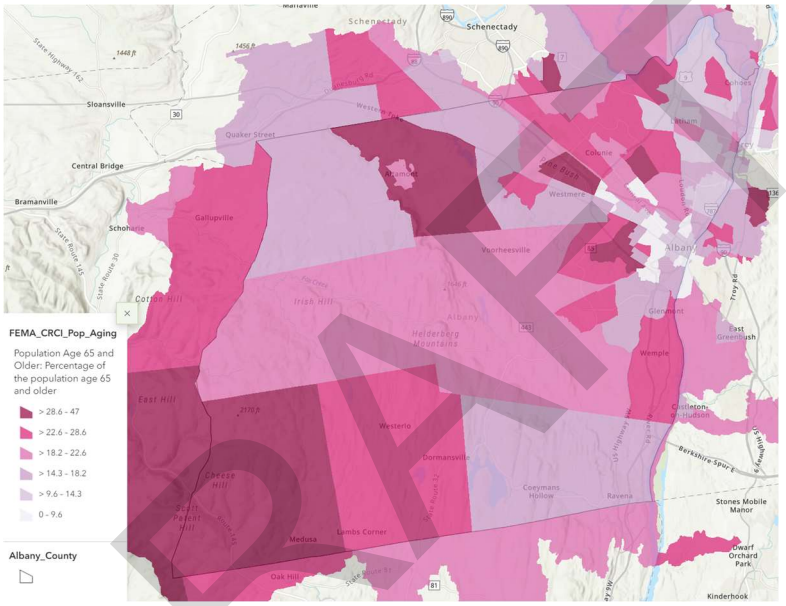



## Vulnerability and Flooding

Below are two maps that display the relationship between different vulnerability factors and the frequencies of headwater storage. The first looks at the percentage of aging populations in Albany County. Populations in the Western hill towns of Albany County tend to have larger aging populations, amounts that are higher than the national average of 21.2%. These larger aging populations can be another factor to consider when reviewing emergency evacuation procedures during floods as these populations may be more difficult to mobilize during heavy precipitation events.



The second map looks at the percentage of mobile homes of total housing units by census tract. Mobile homes tend to be more vulnerable to flooding, as these homes are structurally weaker as they tend to not have the same concrete foundations as traditional homes. Areas in Western Albany contain a higher proportion of mobile housing units (some areas have triple the national average of 5.6%) which is also where the hill towns are located and where many of the rivers and streams in the county originate. Thus, if heavy precipitation were to occur in these higher up areas, it could quickly sweep away these mobile homes if the flood waters are not dealt with. Because these mobile homes tend to be located in hill towns that are more physically isolated compared to larger cities, these populations may be at a higher flood risk even if these regions may not have the same level of infrastructure or assets as their Eastern counterparts.




## Winter Storms

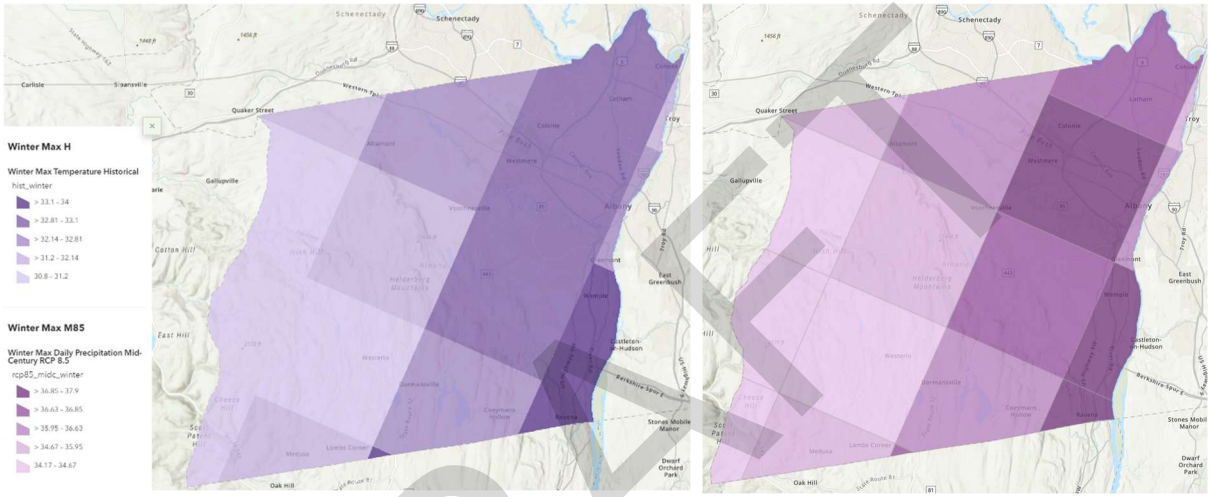
Severe winter precipitation in Albany County is historically expected. This is due to its location between air masses of polar and tropic air that collide around Albany County and from east coast Nor'easters. Future projections of extreme winter weather can be difficult to clearly delineate because climate projection science is not yet granular enough to explain the behavior of all storms. However, a few important factors when considering potential trends in future winter weather have been summarized here. These include winter seasonal temperatures and changes in average and maximum winter precipitation.

### Winter Maximum Daily Temperature (Historical and Mid-Century RCP 8.5)

This map shows the maximum daily winter temperatures in the historical period and mid-century under the RCP 8.5. During the historical period, much of Western Albany averages a maximum temperature below 32 degrees. As the projections move into the mid-century every single average maximum temperature passes 32 degrees and these same areas in Western Albany now have maximum temperatures greater than 32 degrees. The increase of winter maximum temperatures allow air to hold more moisture, which could point to increases of precipitation during winter

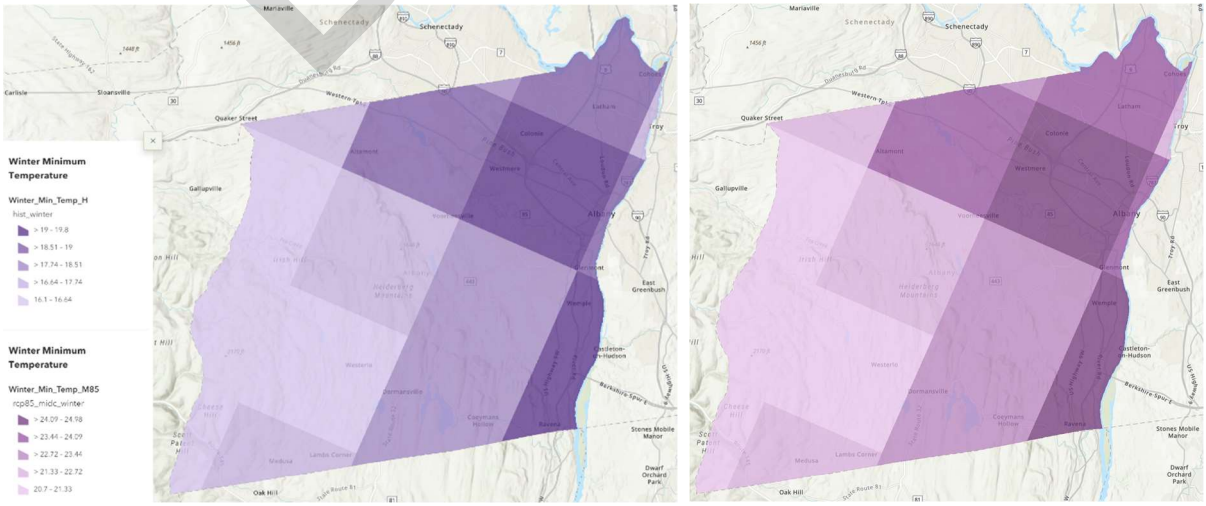
months. However, since the type of precipitation could be increases of sleet or other wintry mixes instead of pure snow due to the increase of temperatures. These increases of winter temperatures could also be beneficial to agriculture, as earlier snow melts could extend the growing season in the spring.

This increase of maximum temperatures could point to more freeze-thaw cycles in the mid-century decades as temperatures fluctuate past the 32-degree mark more and more. These freeze-thaw cycles could increase freezing of roads as the snow melts during the day and ices over at night. Increases in freeze-thaw cycles can also lead to higher events of frost weathering, which can displace rocks around the county and potentially increase landslide susceptibility.



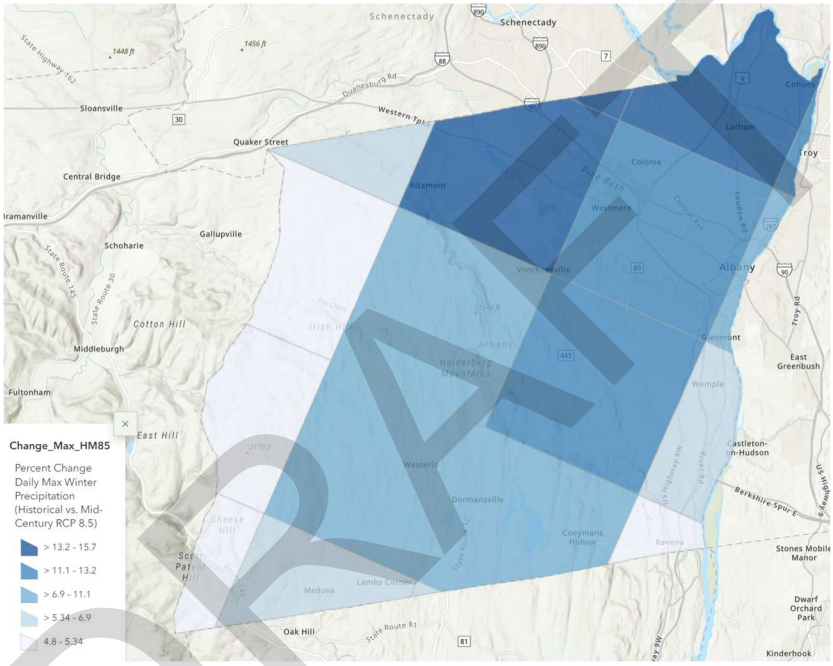

**Winter Minimum Daily Temperature (Historical and Mid-Century RCP 8.5)**

This map shows the minimum daily winter temperatures in the historical period and mid-century under the RCP 8.5. Both historical and mid-century minimum values stay below freezing, which adds to the theory that as maximum winter temperatures rise past 32 degrees, the number of freeze-thaw cycles will increase. Furthermore, the minimum temperatures will increase at around 4 degrees across the county which could point to less severe winter temperatures in general as Albany moves into the mid-century.



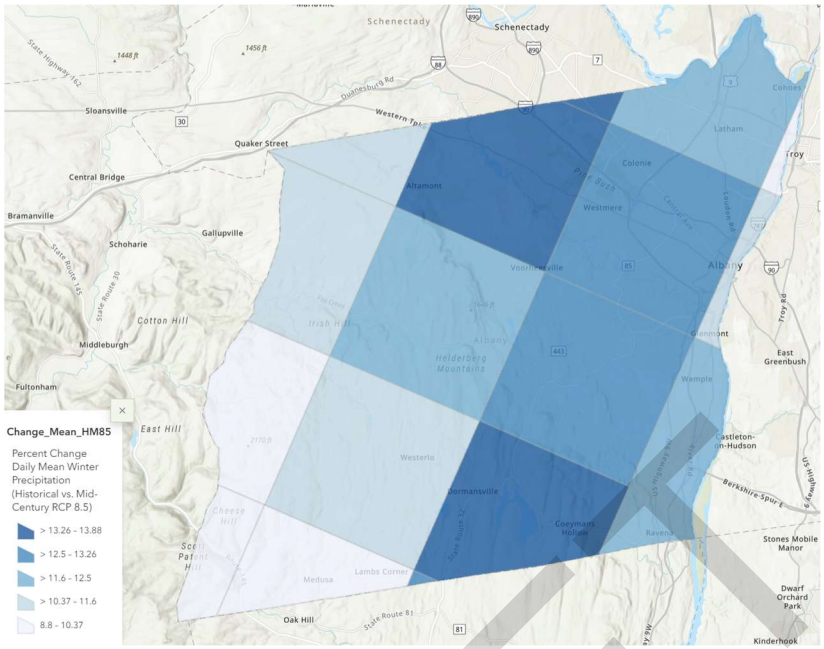
## Change in Winter Max Precipitation

This map shows the projected percent change of daily max winter precipitation between historical and mid-century periods. There will be a projected increase of max precipitation across the whole county which could increase maintenance requirements as more plows and de-icing measures are required for keeping the roads safe. The largest changes in maximum daily winter precipitation are concentrated in NE Albany, which tends to be more heavily urban compared to other quadrants of Albany County. Snow management costs in these urban areas can be more expensive as there are larger populations that require deployment of plows and other equipment. On the other hand, due to urban warming effects, the snow in these heavily populated areas should melt quicker compared to less heavily populated areas.




## Change in Mean Winter Precipitation

This map shows the projected increase of mean daily winter precipitation from historical to mid-century periods. Similarly to the changes of max daily winter precipitation, there are large increases of mean winter precipitation in NE Albany, but unlike max projections, SE Albany will see a large increase of mean precipitation. Thus, as Eastern Albany progresses through the decades, the general winter storm size is expected to increase. Combining this visual with the previous one, Albany County will be seeing a curve shift of winter precipitation as both larger and smaller winter storms will increase in severity and frequency as Albany enters the mid-century.



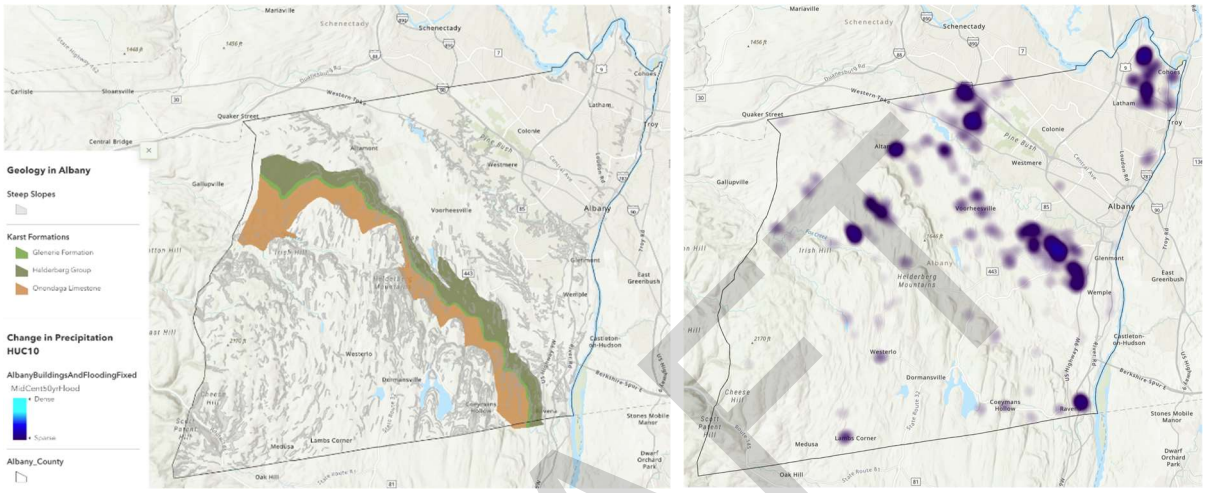

## Landslides

Landslides are downward movements of sloped land masses due to the force of gravity. These hazards are extremely complex and can be caused by a multitude of different factors which include the collapse of groundwater reservoirs, earthquakes, base erosion from water flow, soil instability, and ice melt. Albany County already has built out a comprehensive picture of landslide risk and thus this section of the analysis will augment the pre-existing analysis by looking at the effects of precipitation change on different dimensions of landslide hazards. A few different geological factors that Albany County has already looked at are bedrock geology, steep slopes, and soil composition. Combined with increased projections of precipitation, landslide frequency could increase as Albany County enters the mid-century and end-century periods.

### Bedrock Geology and Karst Formations

Karst landscapes are found throughout Albany County. These formations are characterized by soluble carbonate rocks like limestone. When groundwater interacts with these formations, sinkholes and other uneven topography can form. Combining these sinkholes with steep slopes can help pinpoint locations of landslide potential as the collapsing Karst formations can reduce soil stability and increase the ease of which soil can fall down these heavily sloped areas. Furthermore, overlaying the areas of Albany County with projected increases of precipitation in the mid-century can help identify areas that have a higher risk of unstable surface conditions. For example, the watersheds in Eastern Albany will receive the largest increase of precipitation (up to 6 inches, which amounts to approximately a 15% increase). The areas around Tarrytown and Callanans Corners not only will receive large increases of precipitation but are also located on top of Karst formations which could increase their risk for ground disturbances that culminate in landslides.

Steep slopes are also prevalent around Albany County, particularly in Southern and Central Albany. Increases of precipitation around highly sloped areas can cause increased runoff and decrease the base soil stability of the slopes which in turn increase the odds of landslide occurrence. As the precipitation graph only looks at changes in precipitation, this means that the increase of risk in SE Albany is the largest. This doesn't necessarily mean that this area is at the highest risk as Albany moves into the mid-century, as different areas could have larger precipitation values but not as large changes in precipitation.




## Soil Composition and Landslides

The map below investigates the different types of soil around Albany County. Soil with high clay content and low bulk density or low organic matter are more susceptible to landslides. Alfisols, a soil order common in NW/Central Albany tend to have high clay concentration and thus are looser and more unstable. Histosols, which are scattered around Albany have higher organic matter content and thus are less likely to crumble in landslides. Entisols and Inceptisols, which make up most of the soil in NE and S Albany, are relatively newer soils and have low clay levels. In NW Albany where Alfisols are concentrated the projected increases of rainfall are moderate. However, there are also some Alfisols in Central-Eastern Albany, which will be receiving heavier rainfall in the mid-century and could pose problems to soil stability.