Building Community Resilience
Incorporating Hazard Mitigation, Climate and other Changing Realities

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UNC Asheville's NEMAC

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"Helping people understand—and reach decisions in—a changing world."

- **Applied Research** and technology development focused on integration of climate, socio-economic and environmental data sets
  - Data and GIS
  - Visualization and Story Telling
  - Risk Based Decision Making
- **Decision Support tools** for Resilience, Vulnerability and Risk, Flood Mitigation, Emergency Response, Water Resource Issues, Planning
- **Collaboration** among government, academia and private enterprise that focuses on Public/Private Partnerships dealing with Resilience

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US Climate Resilience Toolkit
National Climate Assessment & Indicators

US Forest Service Eastern Forests Environmental Threat Assessment Center

Asheville Climate Resilience Partnership

Local and State Government

Companies

Others

Our society will not make decisions based on a single future driver

- People must be able to **integrate** climate information with other value drivers
- They must **trust** the source of information
- As part of a community, we rely on a set of **services** and we are willing to pay for those services – through taxes, cost of living, etc.
- Those services may be **stressed** by a variety of things – but we can usually plan based on trends, etc.
- Services that are **interrupted** are harder to deal with

Water Resources

Development Pressure

Rapidly Changing Energy Costs

What is Resilience?

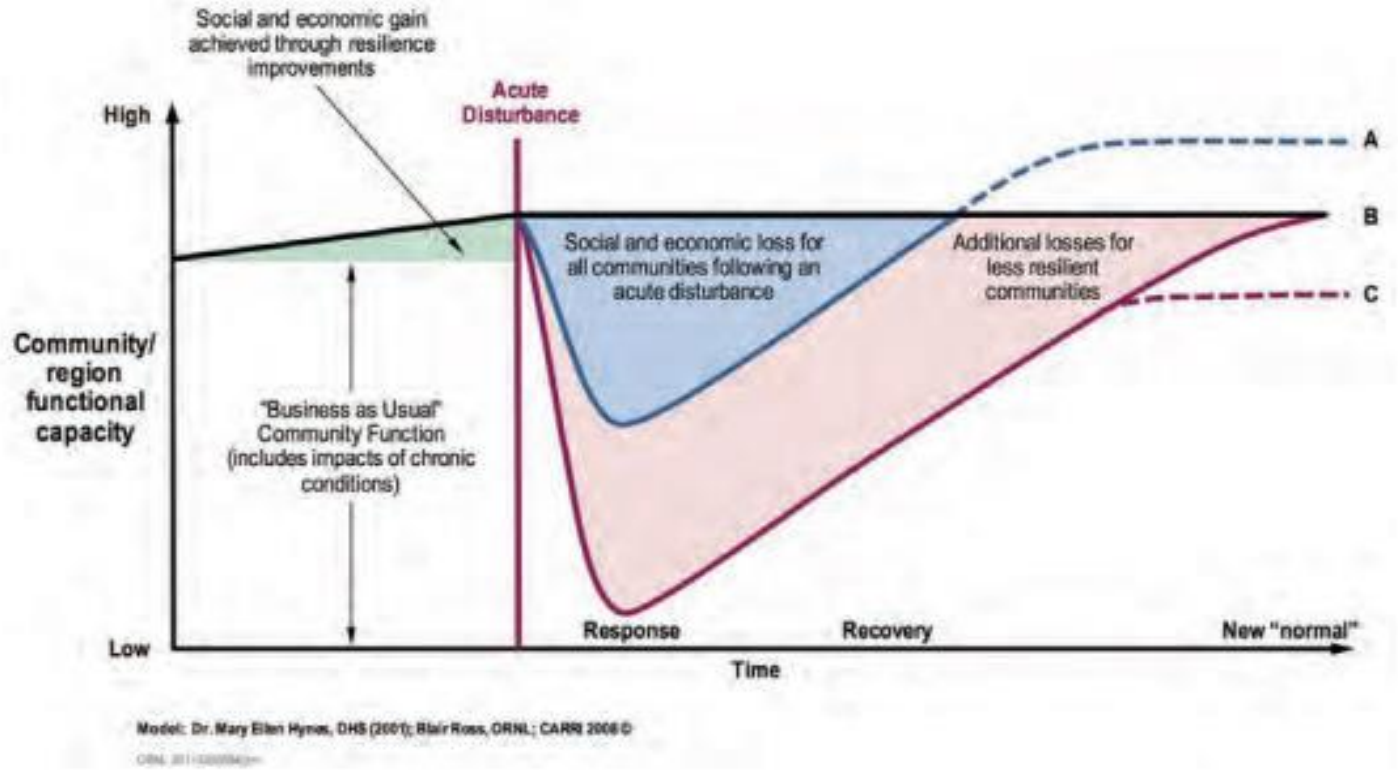


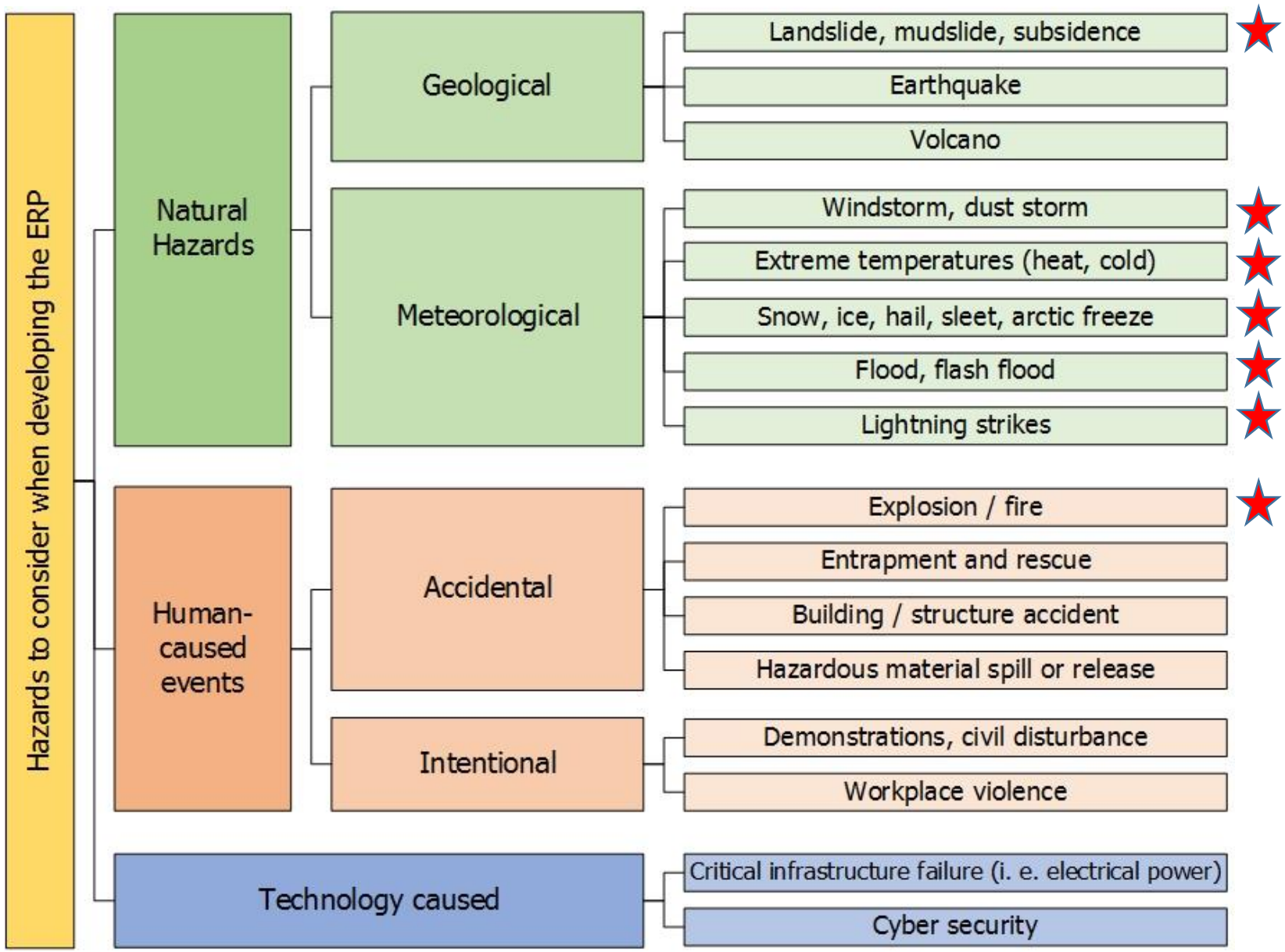
Figure 2: Resilience Loss Recovery Curve

Source: White et al. (2015), p. 203

Adapted from model developed by M.E Hynes, B. Ross, and CARRI (2008), presented at the DHS University Summit, Washington, DC

- **Resilience** is the capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption.
- Resilience addresses **existing hazards** while simultaneously preparing for **increased frequency of hazards** due to change.

Hazard Mitigation/ Emergency Response Approach



http://www.cbm-hse.com/emergency-response-planning/

Flood of 1916

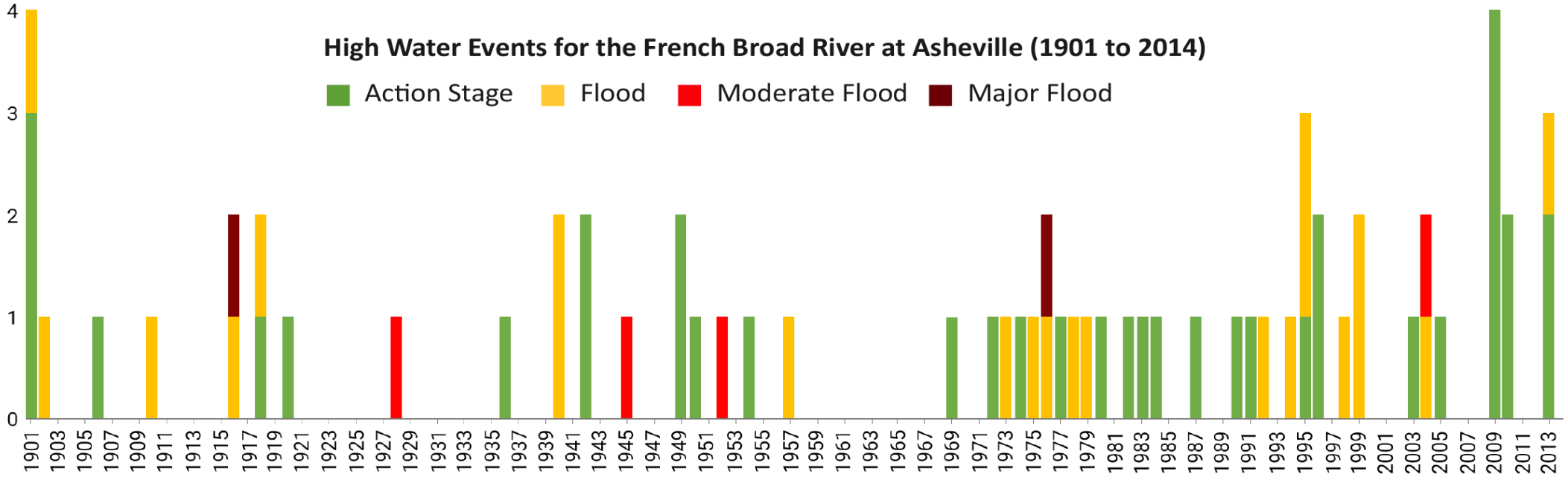
Image of the French Broad River in July 1916, taken by photographer Steve Nicklas
Obtained from the NOAA Photo Library

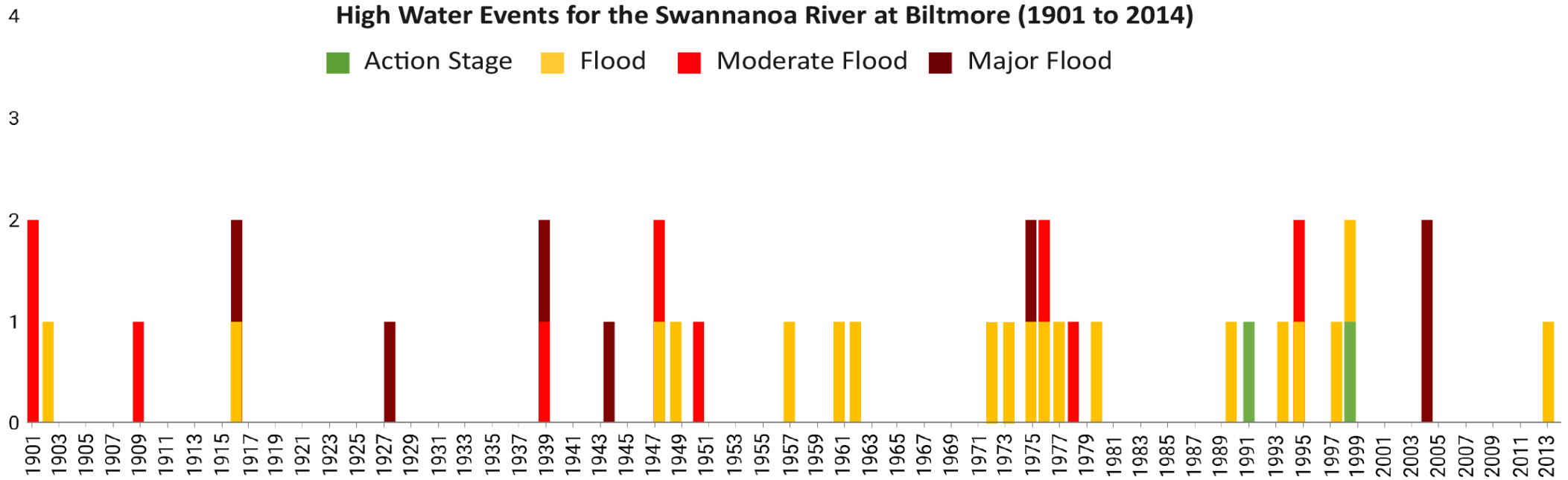
Hwy 74 bridge between Mecklenburg and Gaston Counties wreaked during the 1916 flood. Photo by Cushman. From the Book “The North Carolina Flood (1916) Published by William Bell via Google Images

WRECK OF HIGHWAY BRIDGE CONNECTING MECKLENBURG AND GASTON COUNTIES. AT BELMONT. WAS BUILT TWO YEARS AGO AT A COST OF $100,000.
(Photo by Cushman, Charlotte.)

Major Flooding in 2004

- Impact related to loss of life and property, loss of commerce, loss of drinking water
- Community established a Flood Damage Reduction Task Force to build resilience
- Decision support tools were created and a flood mitigation plan was approved by the city and county
- Action taken! Numerous actions were put in place





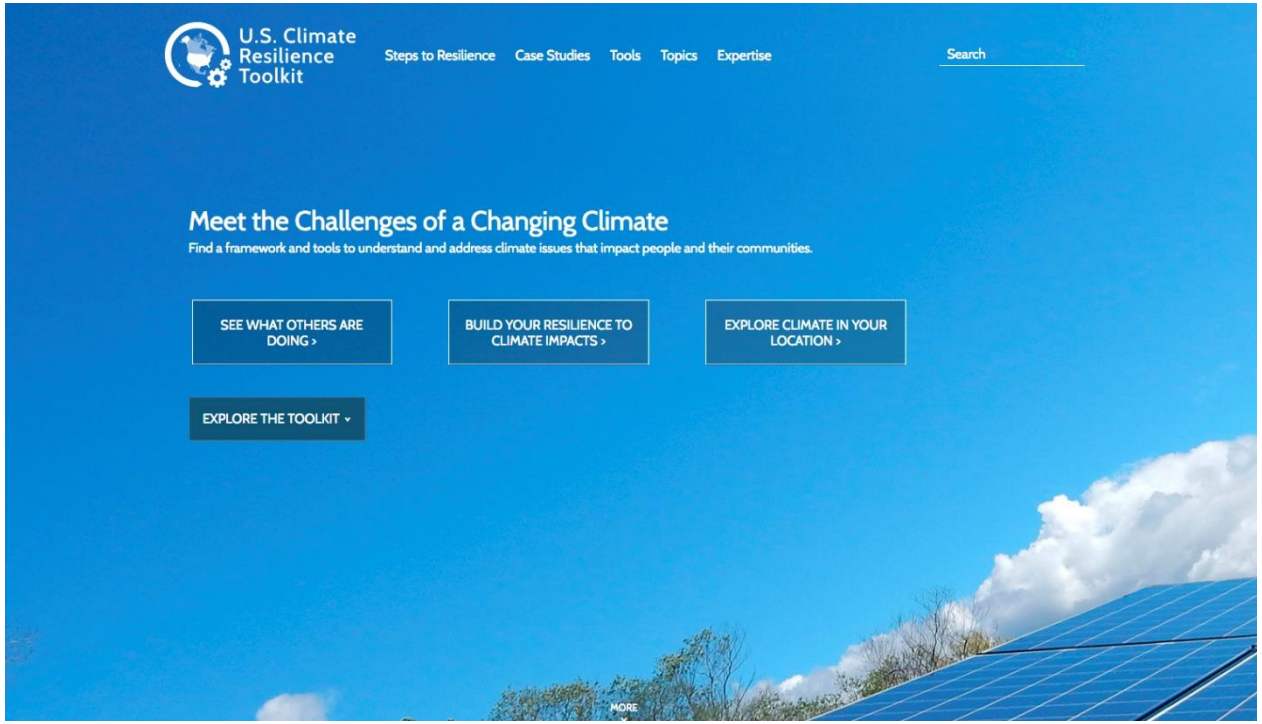
Note: Frequency and severity of hazard events (and how they are changing) are a key part of resilience analysis

USGS science for a changing world

UNC ASHEVILLE NEMAC National Environmental Modeling and Analysis Center

Best Practices for Climate Resilience

U.S. Climate Resilience Toolkit

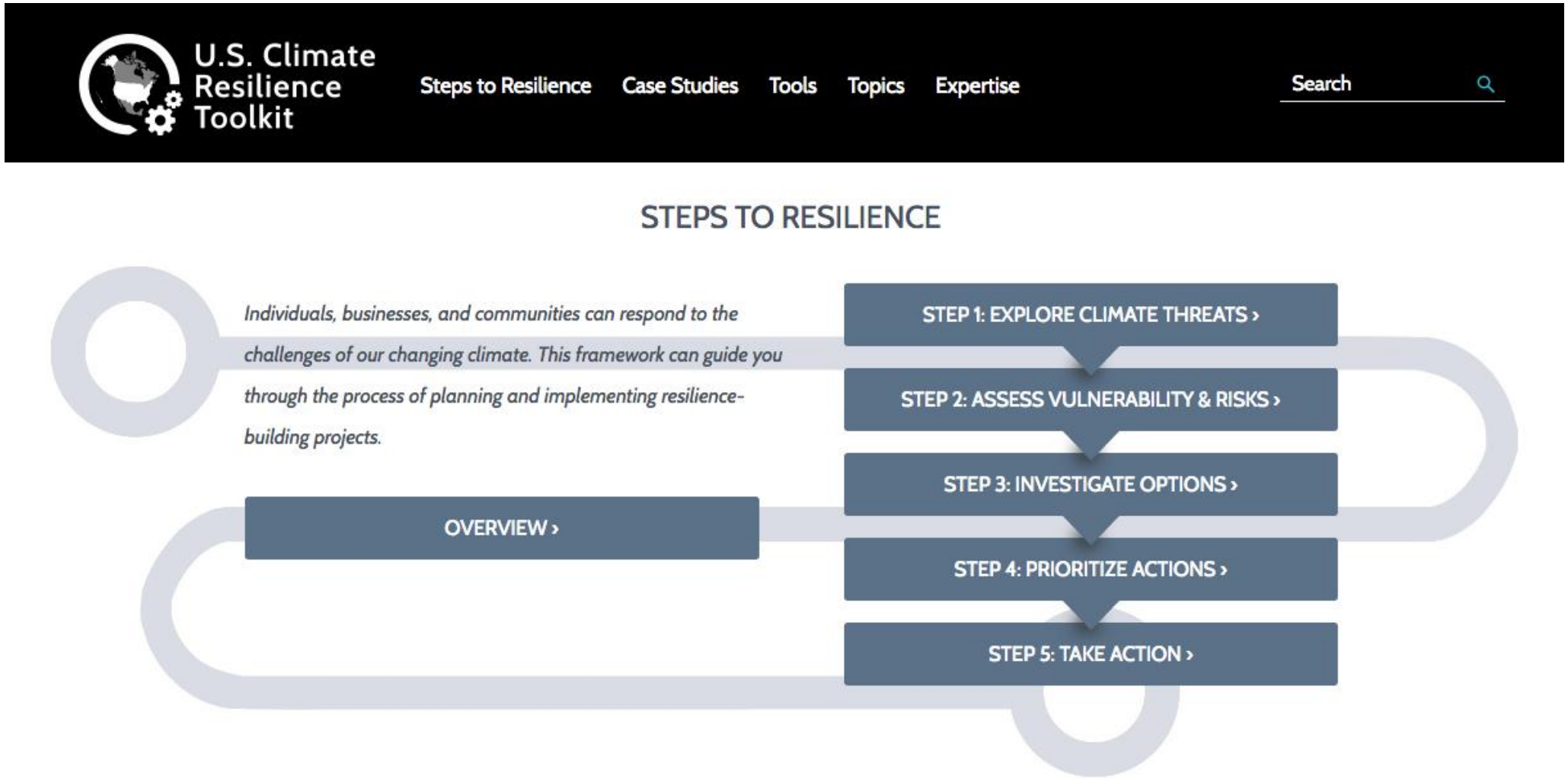


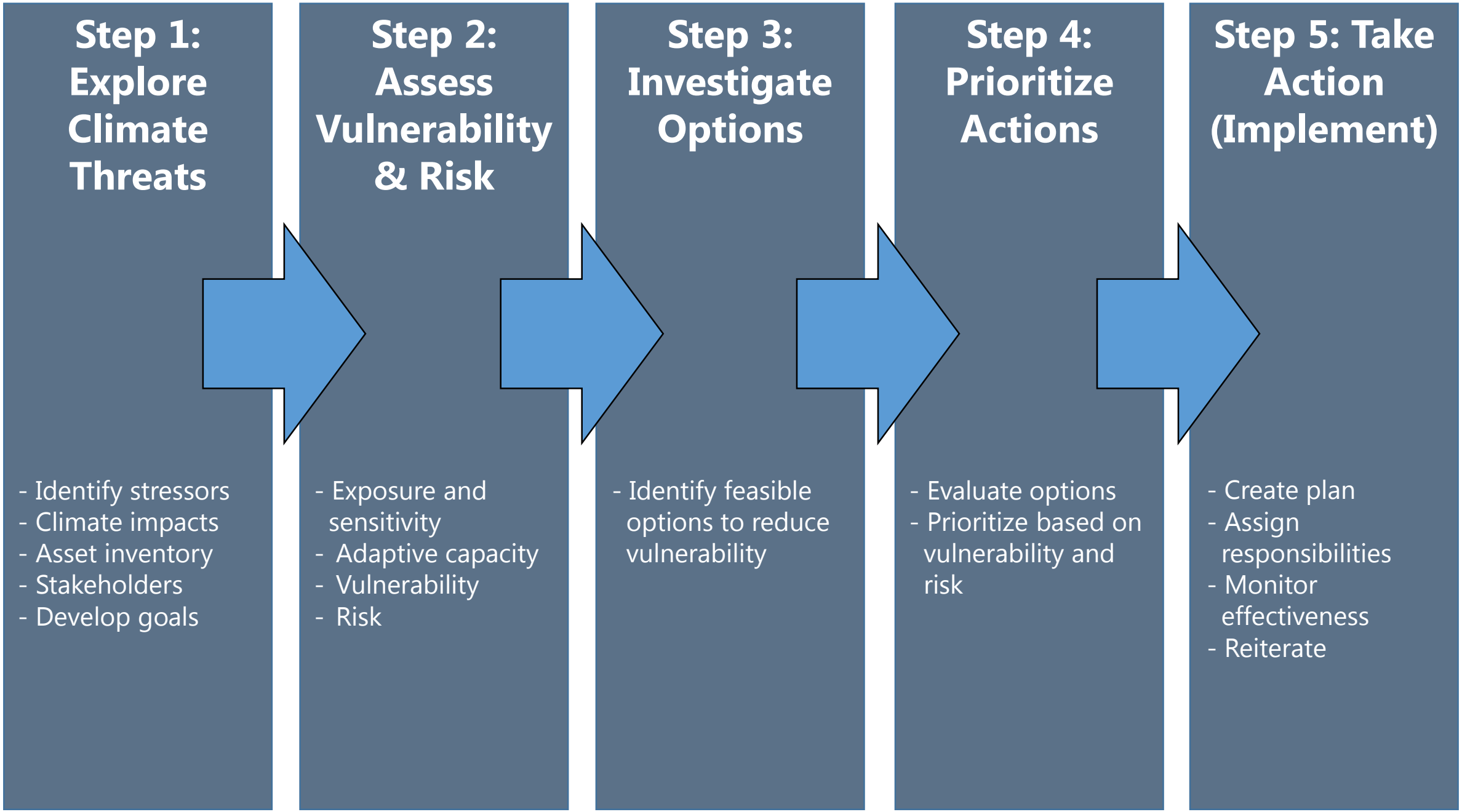
toolkit.climate.gov

City of Asheville's Climate Resilience Plan

Five Steps to Resilience

toolkit.climate.gov

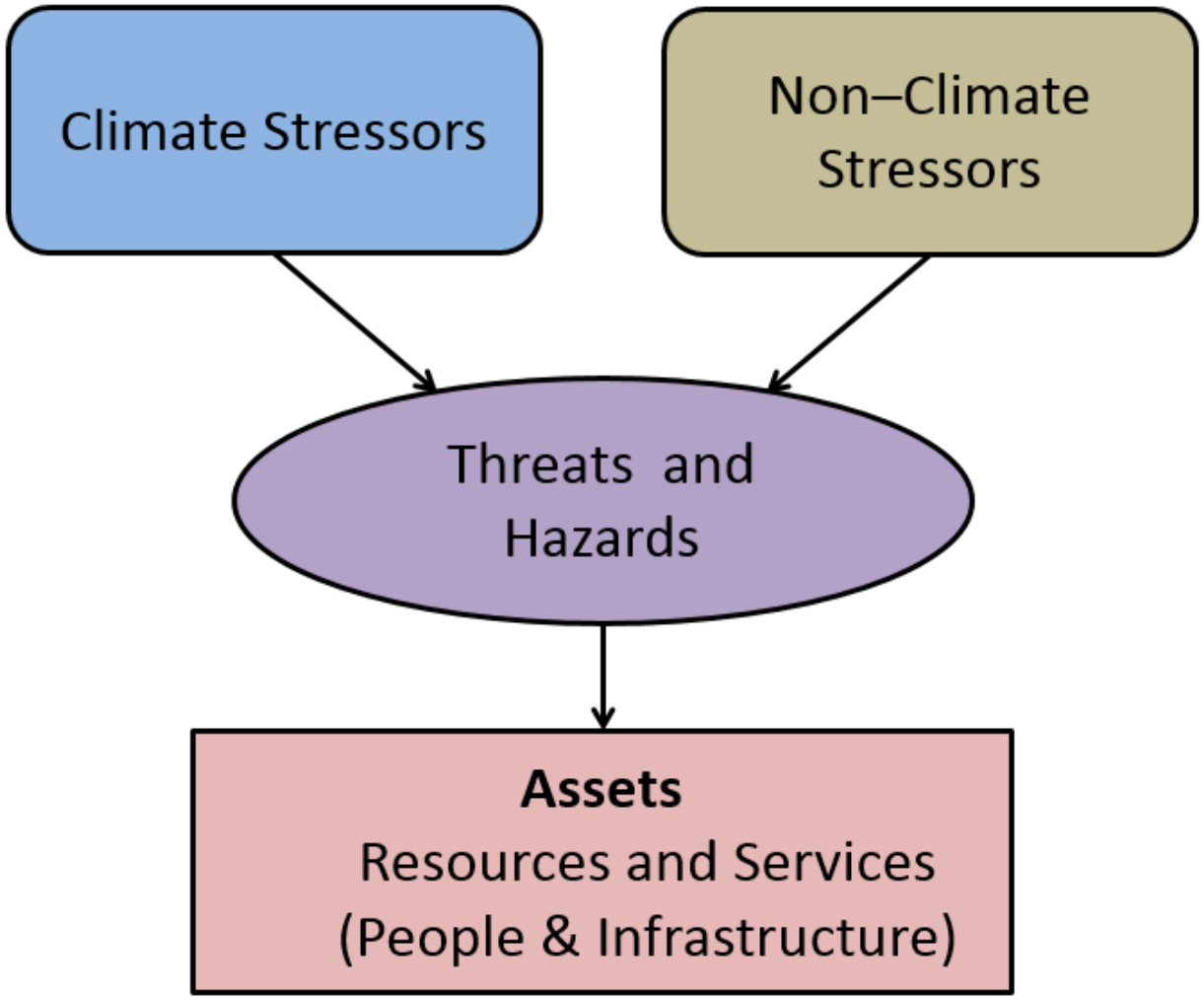



Step 1: Explore Climate Threats
- Identify stressors
- Climate impacts
- Asset inventory
- Stakeholders
- Develop goals
Step 2: Assess Vulnerability & Risk
- Exposure and sensitivity
- Adaptive capacity
- Vulnerability
- Risk
Step 3: Investigate Options
- Identify feasible options to reduce vulnerability
Step 4: Prioritize Actions
- Evaluate options
- Prioritize based on vulnerability and risk
Step 5: Take Action (Implement)
- Create plan
- Assign responsibilities
- Monitor effectiveness
- Reiterate

City of Asheville Climate Resilience Planning

- Series of 6 workshops over 5 months
- Climate resilience team
  - 14 City Departments
- Data-informed process with measurable indicators
- Final report
- Integrated with Comprehensive Planning Process
  - 25-year vision
- Transparency

Step 1: Explore Climate Threats



Climate Stressors

- Extreme Precipitation
- Drought
- Temperature Variability

Threats

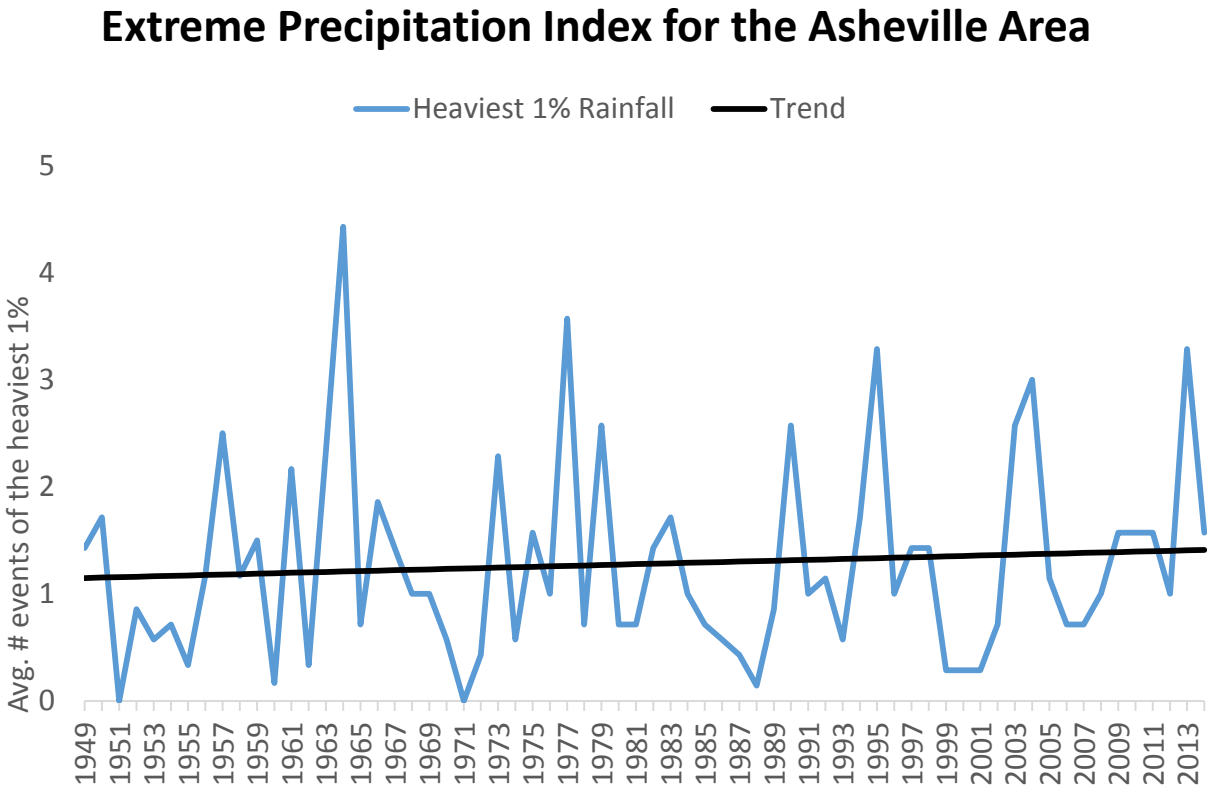
- Flooding
- Landslides
- Water Shortages
- Wildfire
- Heat Waves/Extreme Heat

What are the Primary Climate Stressors and **Threats** for Asheville?

- Heavy precipitation (increasing frequency of extreme events)
  - **Major riverine flooding** events
  - **Nuisance flooding and runoff** resulting in erosion and stormwater impacts
  - More **landslides**
- Drought (increasing severity)
  - **Water shortages** and stress on water systems
  - Impact on agriculture
  - Greater chance of **wildfire**
- Temperature variability (changing variability and more extreme heat events)
  - For homes without air conditioning, more stress on vulnerable populations
  - Night-time low temperature will increase
  - Increased:
    - Length of growing seasons (but variability in last frost)
    - Number of cooling degree days
    - Number of consecutive hot days

Key findings from the Third National Climate Assessment

Climate Stressors and Threats in Asheville



Note: It is not the heavy precipitation itself that is the threat, it is what it causes (flooding and landslides).

City of Asheville Assets

What are key assets, and how do we characterize them?

- 14 departments represented
- 56 key assets identified
  - Infrastructure
  - Services

Planning Area and Asset
Built Infrastructure
Buildings and Infrastructure (City-owned)
Historic Structures
Commercial Development
Centers and Corridors
Commercial properties
Communications
Communication systems
Fiber infrastructure
Radio and cell towers
Community Development and Housing
Affordable housing
Community Centers
Residential housing and structures
Riverfront development (ownership, uses)
Underserved Neighborhoods
. . .

Asset-Threat Pairs

How will the highlighted climate threats have an impact on things I care about (assets)?

Asset	Threat
Commercial Properties	Flooding
Residential Properties	Flooding
Residential Properties	Landslides
Water supply mains	Flooding and associated erosion
Roads	Flooding
Roads	Landslides

Step 2: Assess Vulnerability & Risk

- **Vulnerability**: the susceptibility of societal assets due to physical and social factors
- **Risk Scoping**: likelihood, consequences and future change
- Assets grouped into 14 categories
- Six threats considered
- Ultimate goal is to develop strategies that reduce vulnerability and/or risk

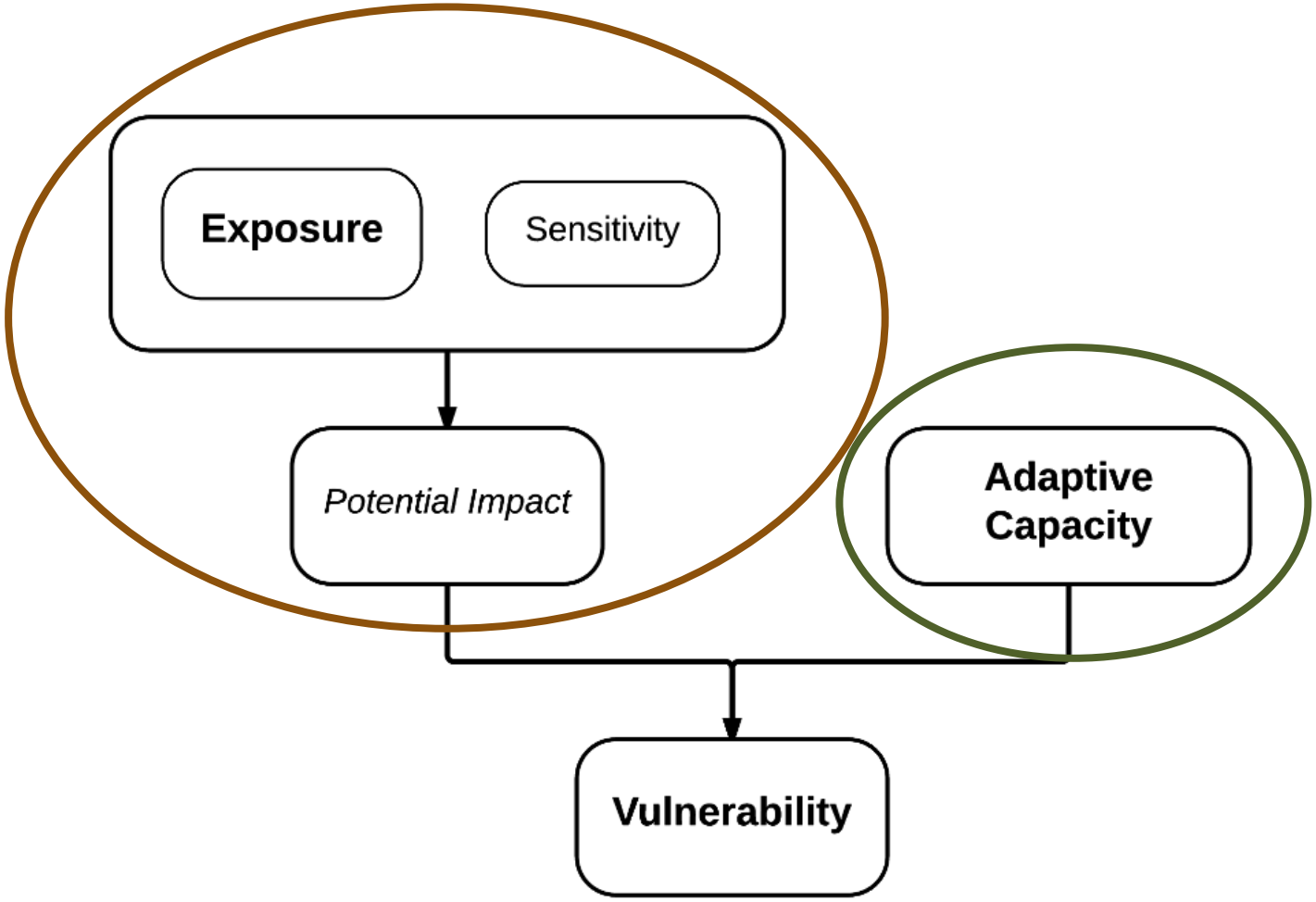
Asset	Threats					
	Flooding	Landslides	Wildfire	Nuisance Flooding	Water Shortage	Extreme Heat
Bridges	✓					
City-owned Facilities	✓	✓				
Commercial Properties	✓	✓		✓		
Critical Infrastructure	✓	✓		✓		
Food Infrastructure	✓					
Industrial Properties	✓	✓				
Natural Areas for Habitat and Conservation			✓		✓	
Parks and Recreation	✓					
Residential Properties	✓	✓	✓			
Residents/People				✓		✓
Roads	✓	✓				
Supply Chains	multiple					
Transit	✓					
Water Supply/North Fork Dam					✓	

Framework for Assessing Vulnerability

Two Primary Concepts:

Exposure and Sensitivity: the presence of assets in relation to a threat and the degree to which they are affected

Adaptive Capacity: the ability to cope with impacts

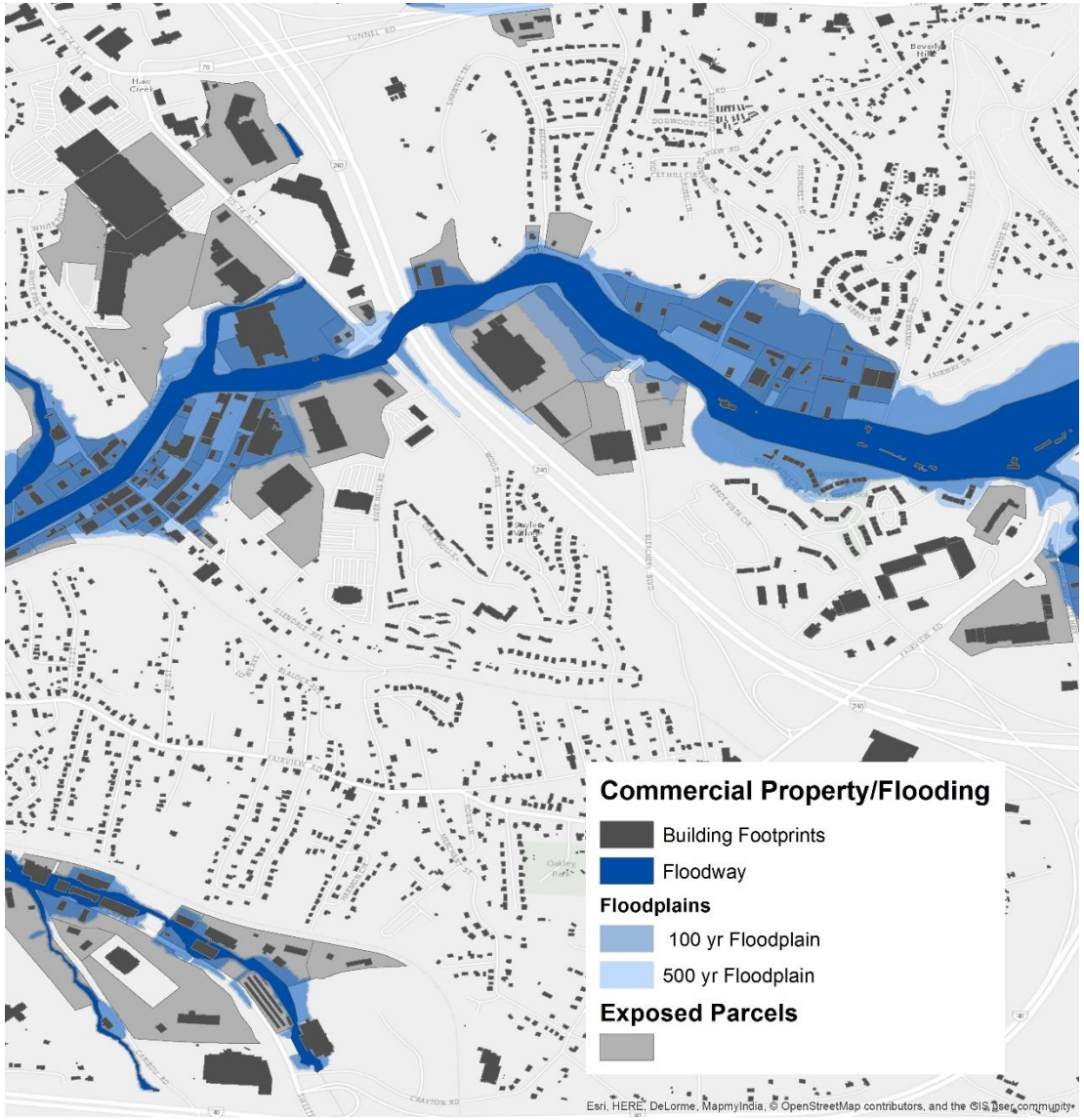


Exposure: Commercial Property/Flooding

- Metric: 500 year floodplain
- Scale of analysis: unit of the asset (parcel-level)

600 parcels

17.4% of total commercial parcels citywide



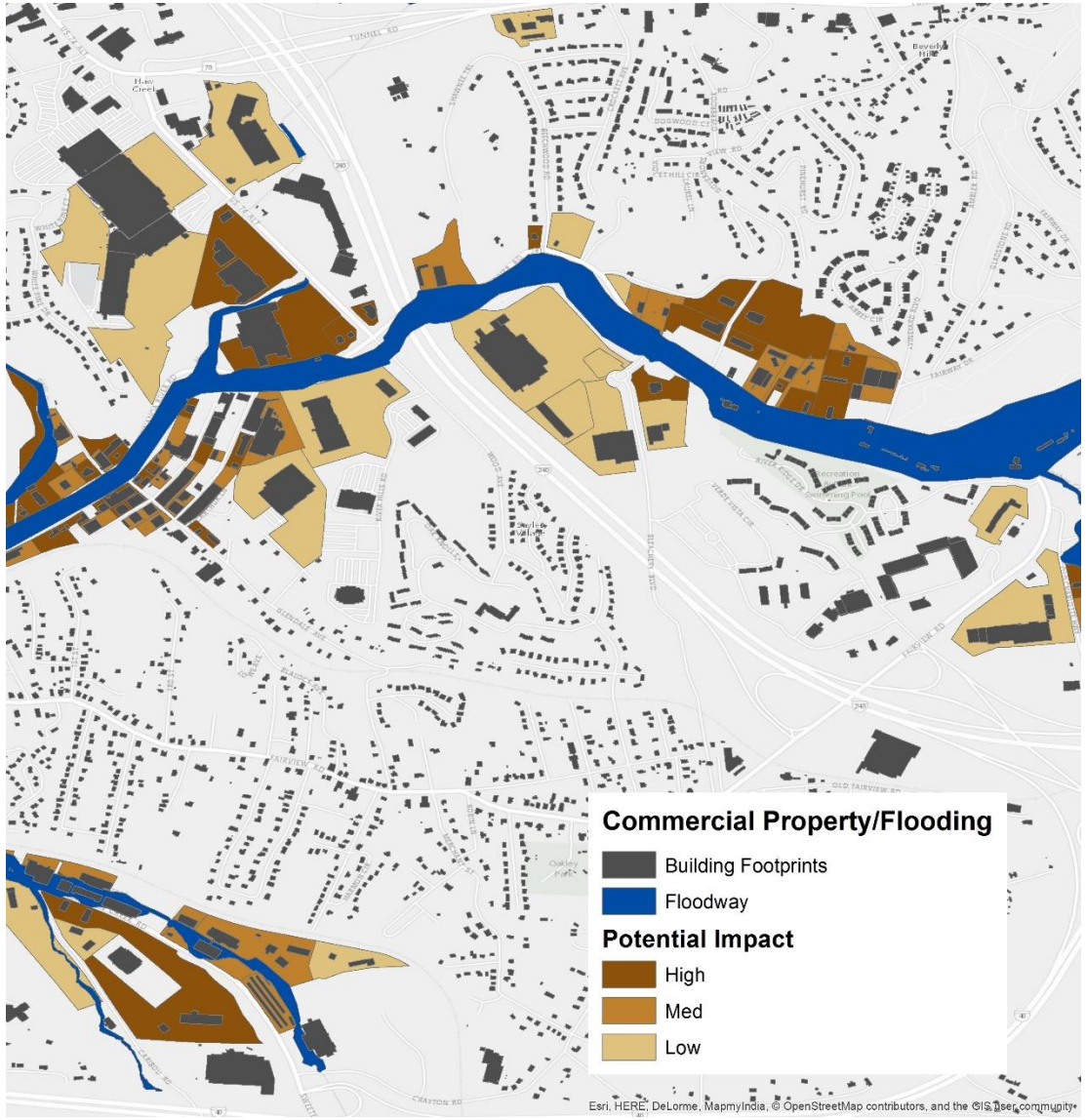
Potential Impact: Commercial Property/Flooding

Levels of Sensitivity - Parcels

High — Business-related structure in floodplain (retail stores, shopping centers, restaurants, hotels, offices)

Med — Other properties with structure in floodplain (parking lots, warehouses and storage)

Low — Surrounding property (only) in floodplain (no structure)



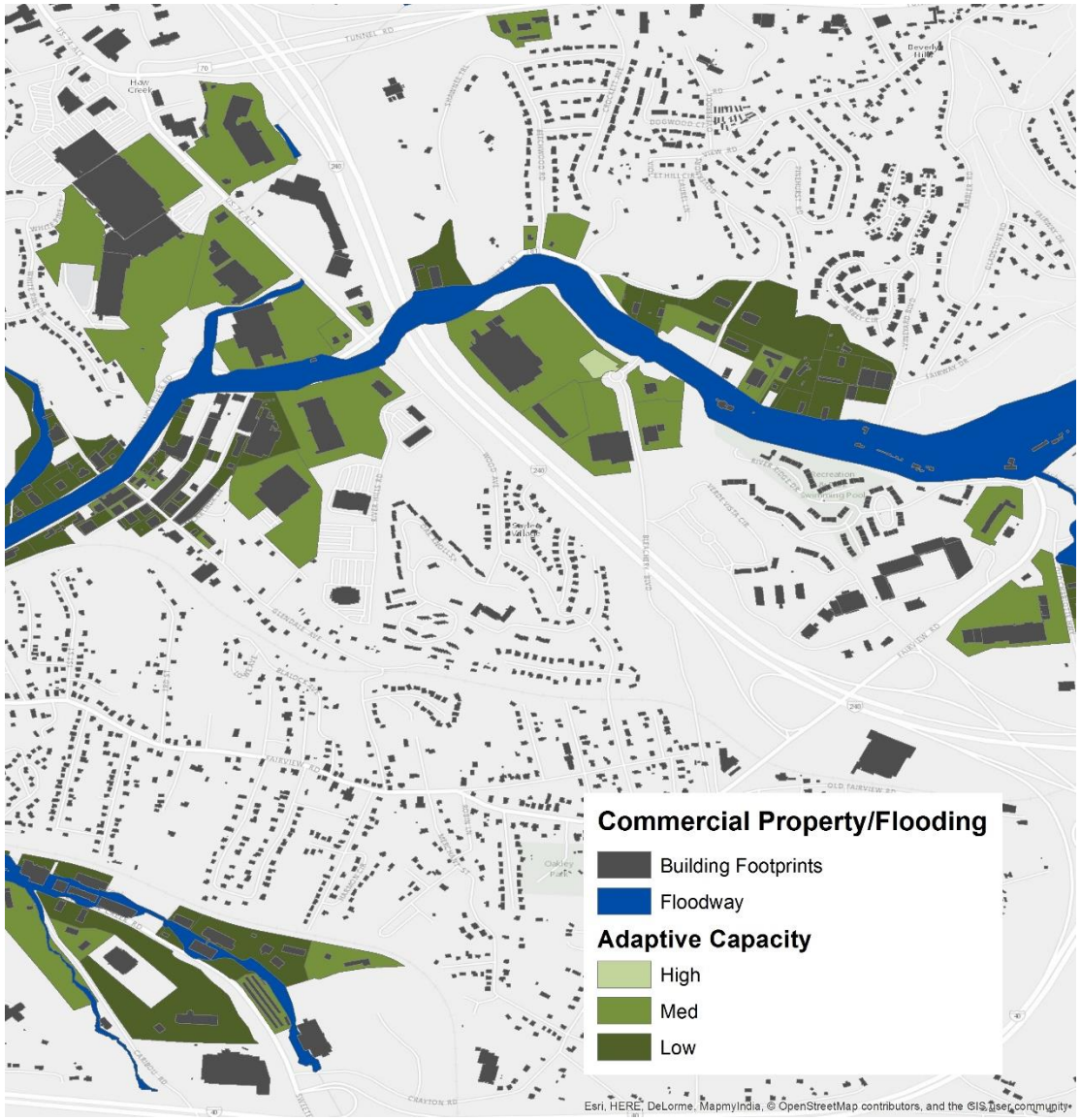
Adaptive Capacity: Commercial Property/Flooding

Levels of Adaptive Capacity - Parcels

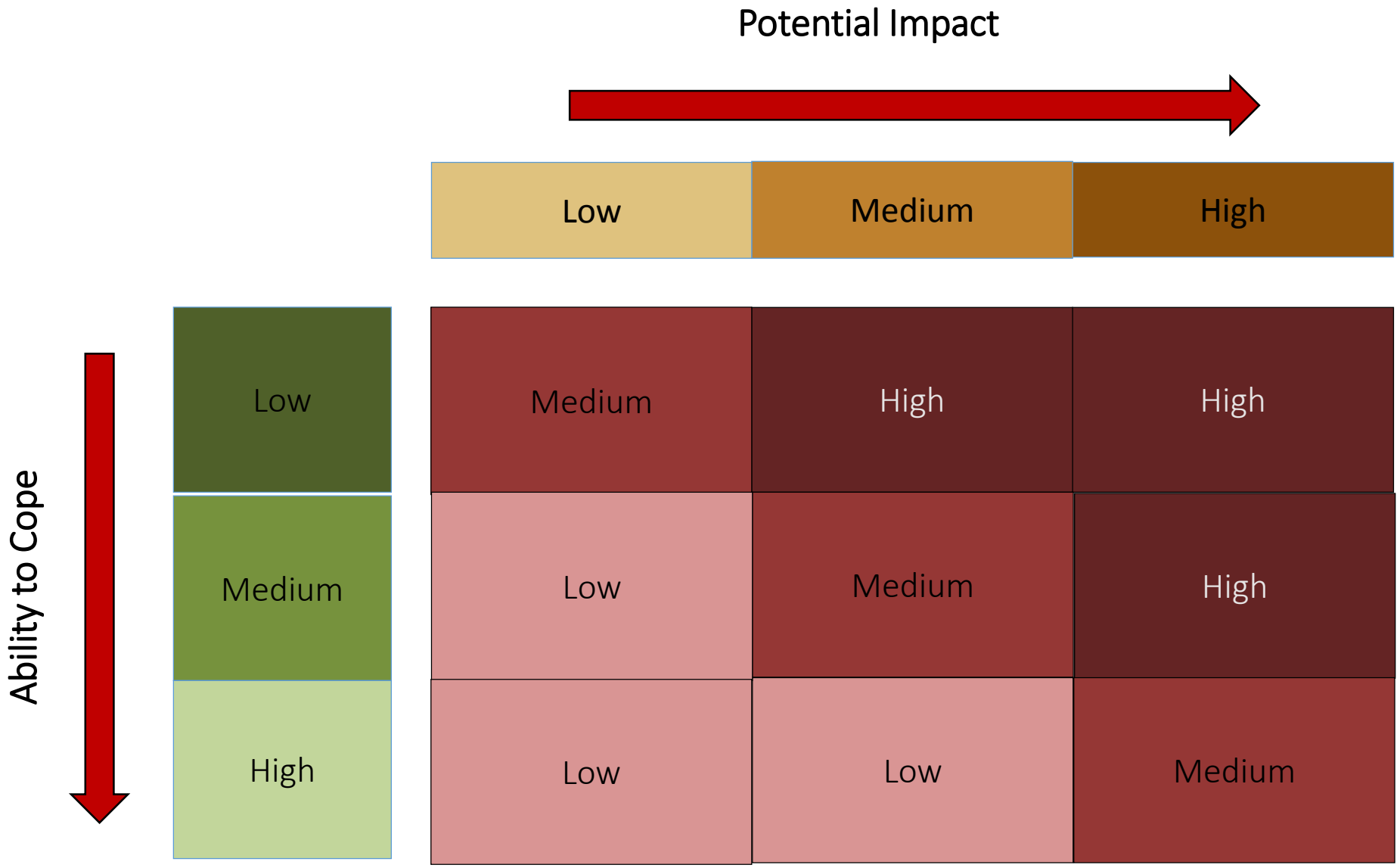
Low — No known building compliance to flood waters

Med — Structure built 1981-2010 (base height at level of 100yr flood and floodproofing requirements)

High — Structure built since 2010 (base height 2ft above 100yr flood and floodproofing requirements)

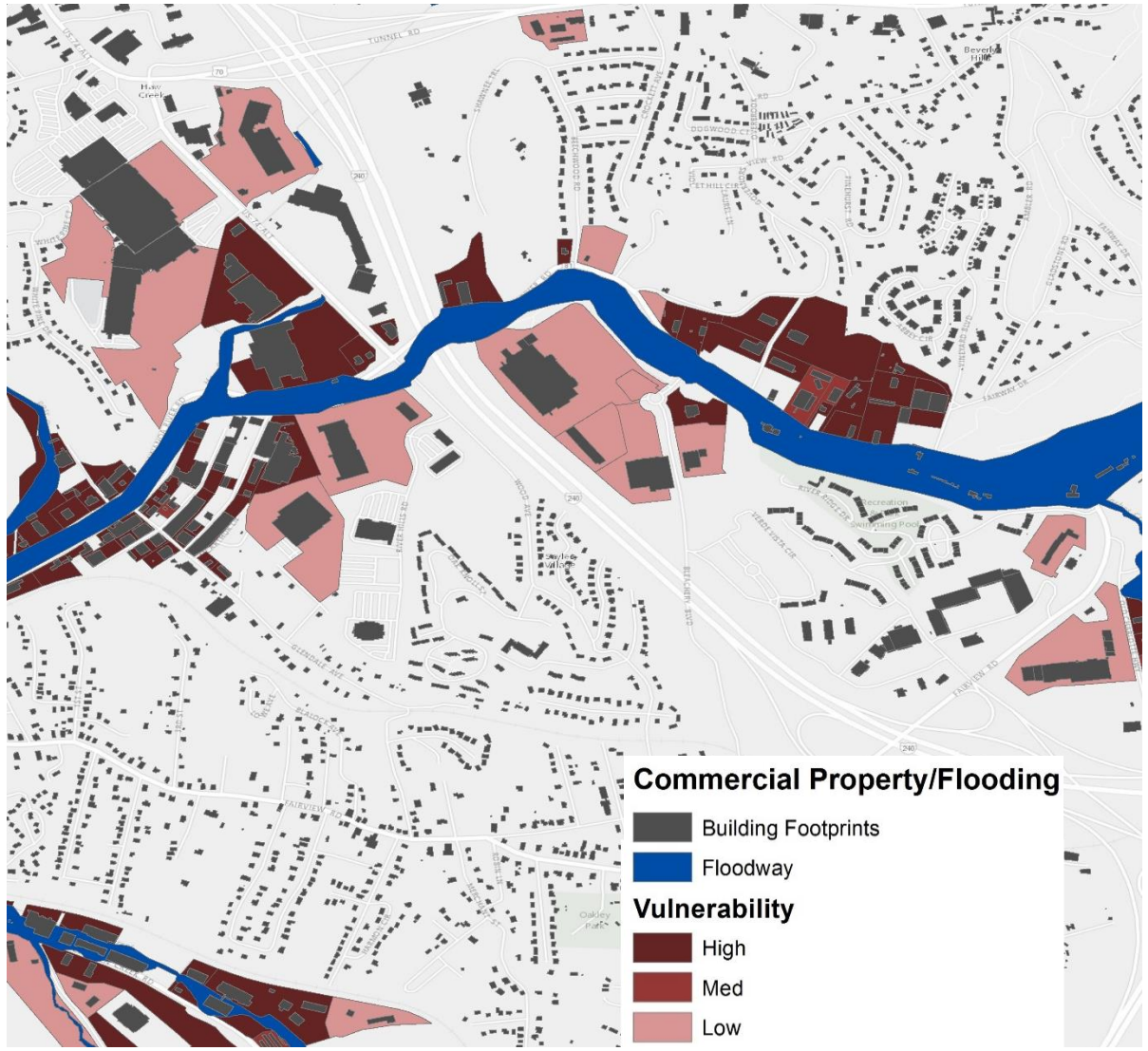


Vulnerability Matrix

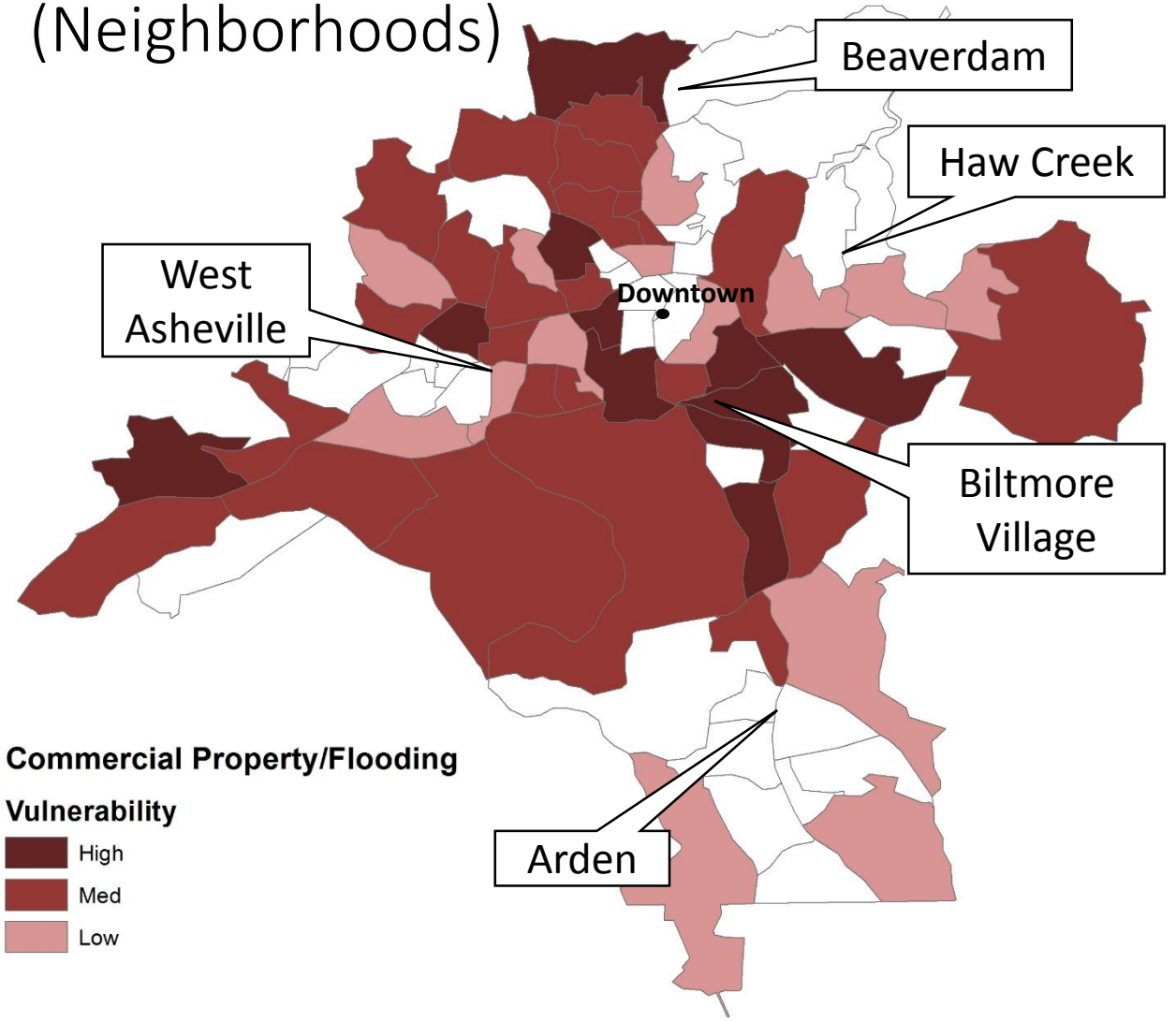


Areas of Vulnerability (Multiple scales)

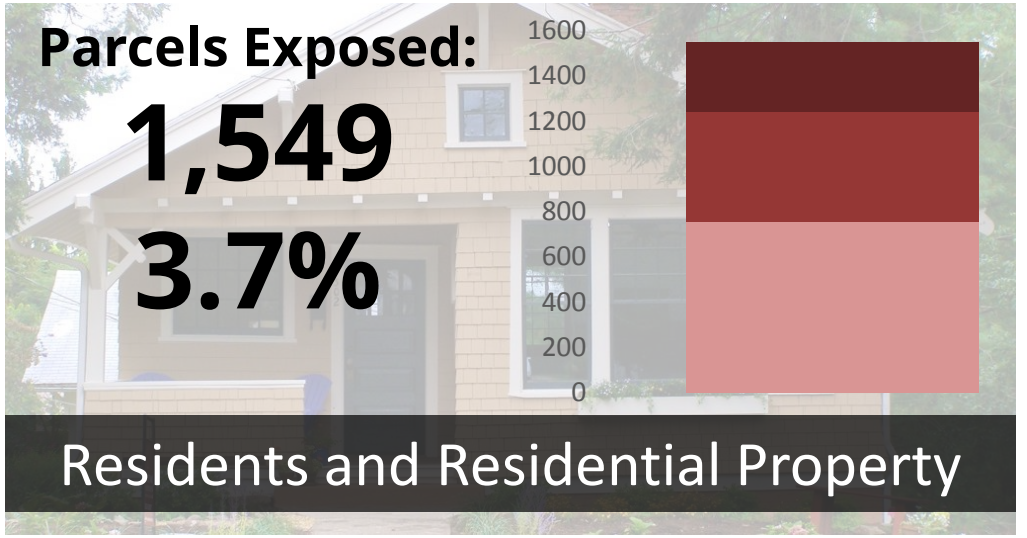
Individual Parcels

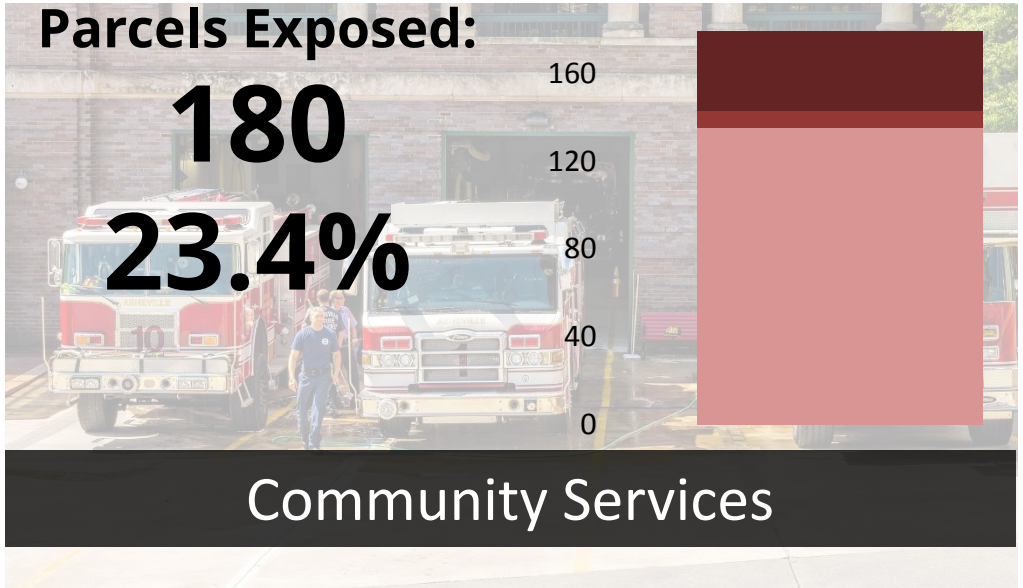


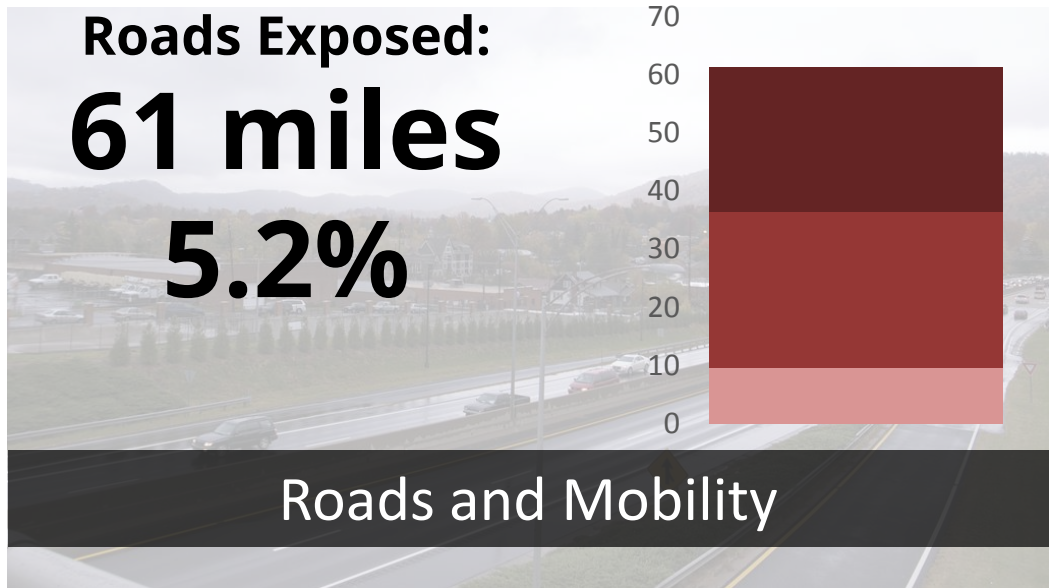
Census Block Groups (Neighborhoods)



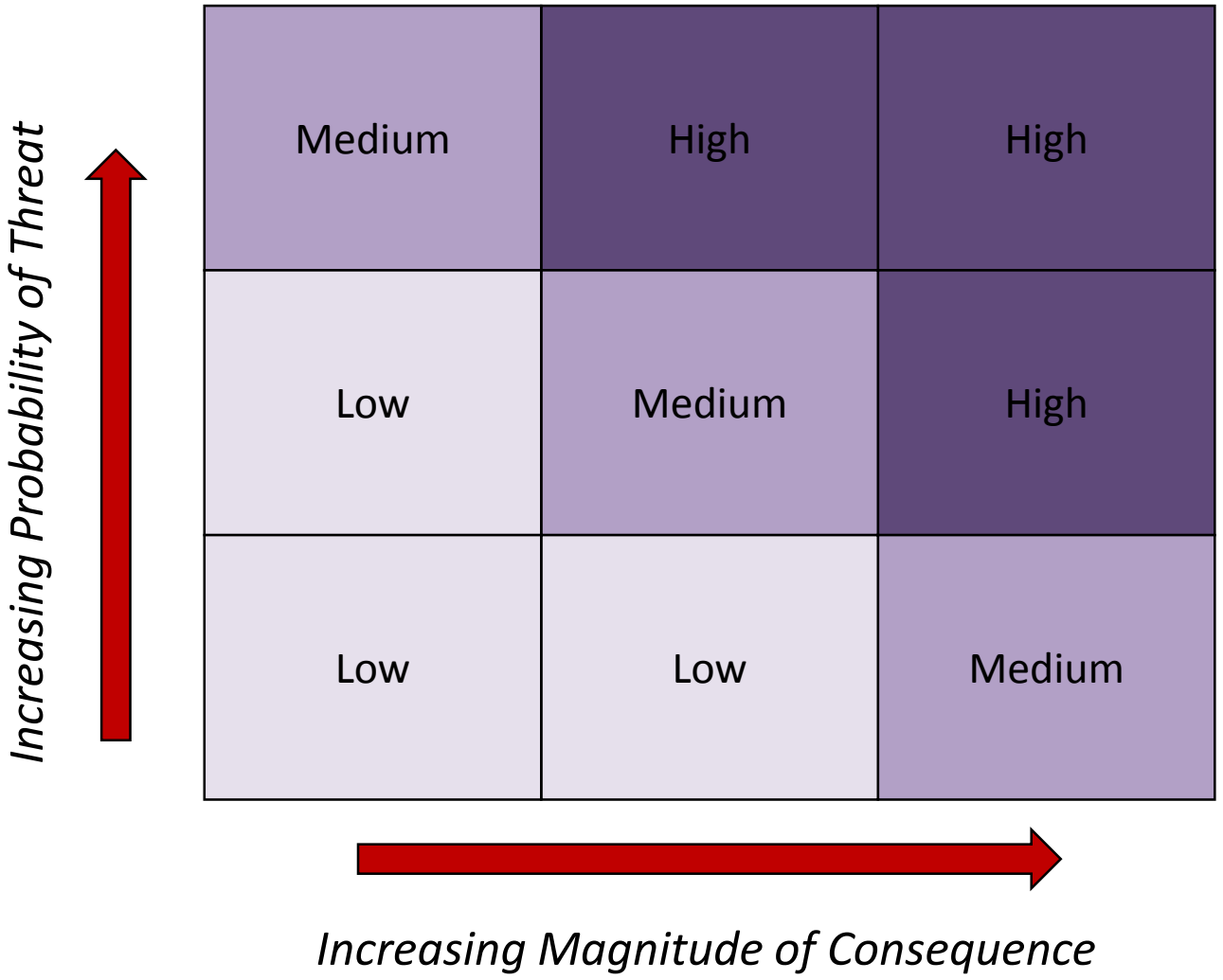
Summary at the City Scale: Flooding



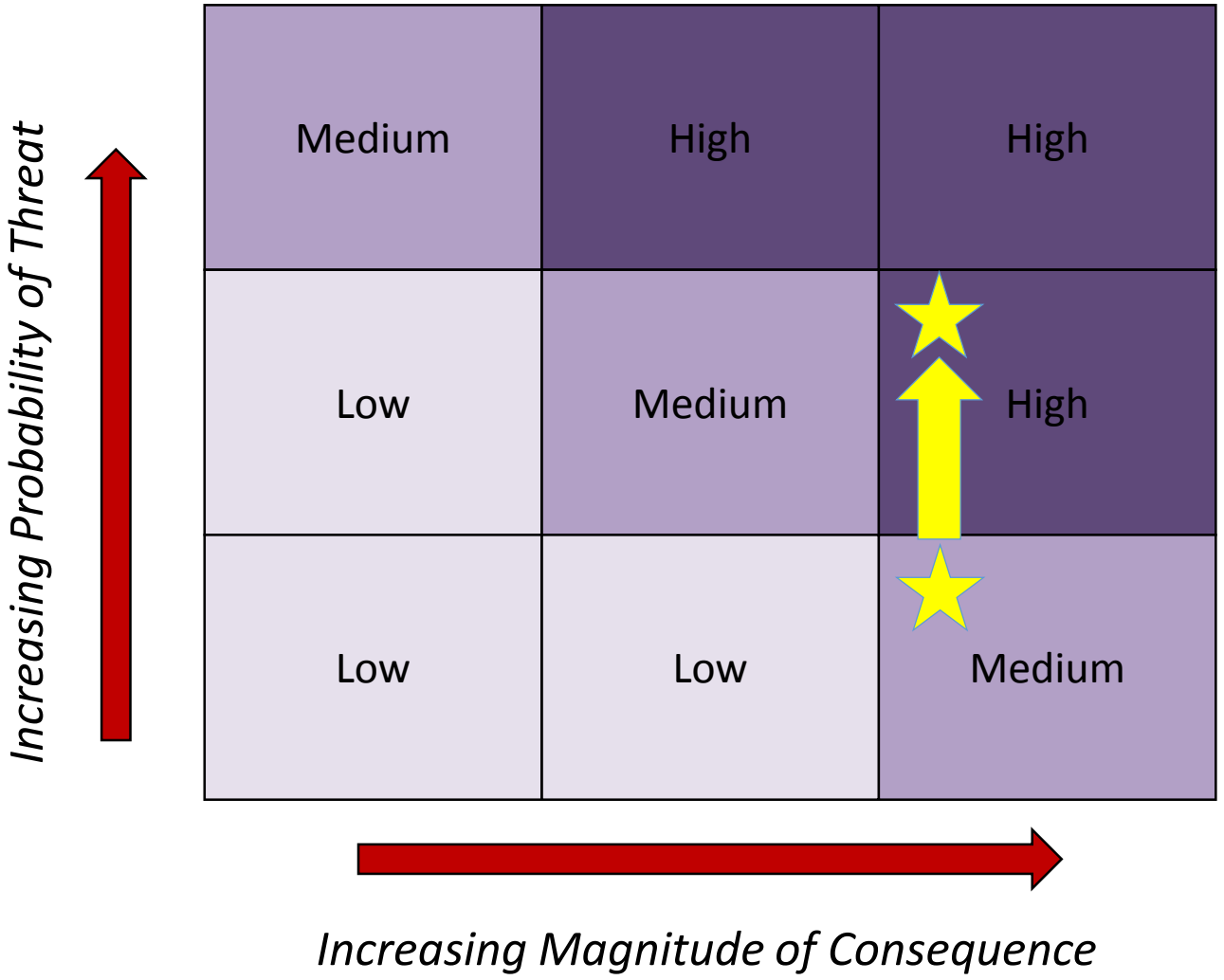




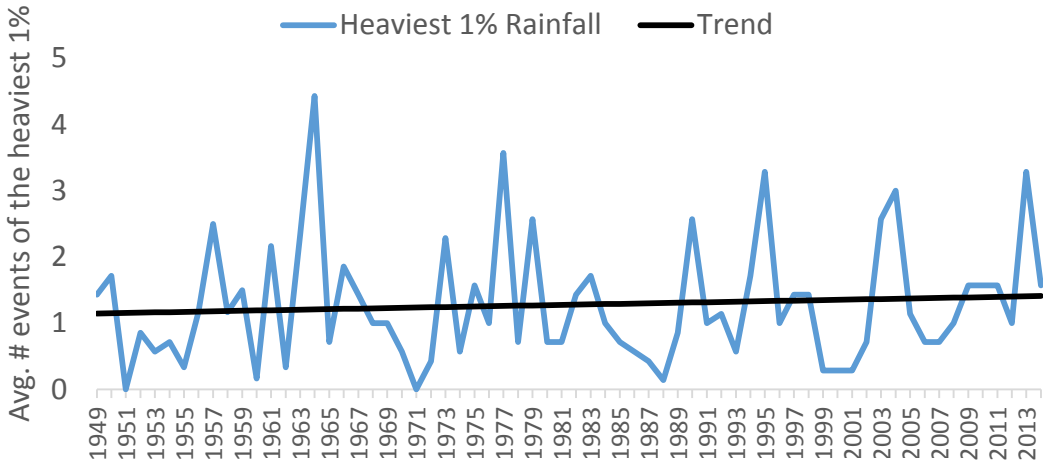
Risk depends upon both **probability** and **consequence**
Risk scoping involves the initial broad quantification of risk



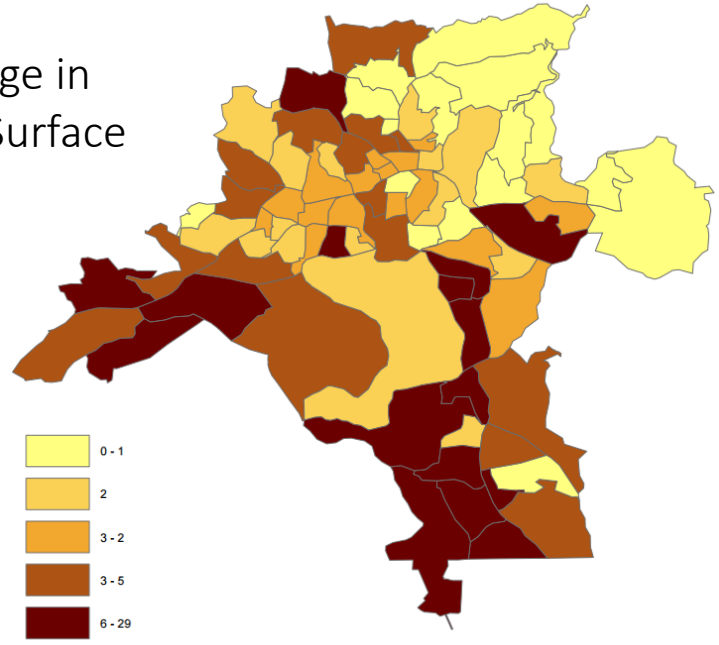
Future Change of Climate-Related Threats



Extreme Precipitation Index for the Asheville Area



Recent Change in Impervious Surface

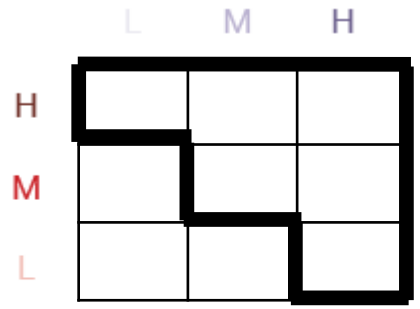


Most Vulnerable and at Risk

Example: Commercial Property/Flooding

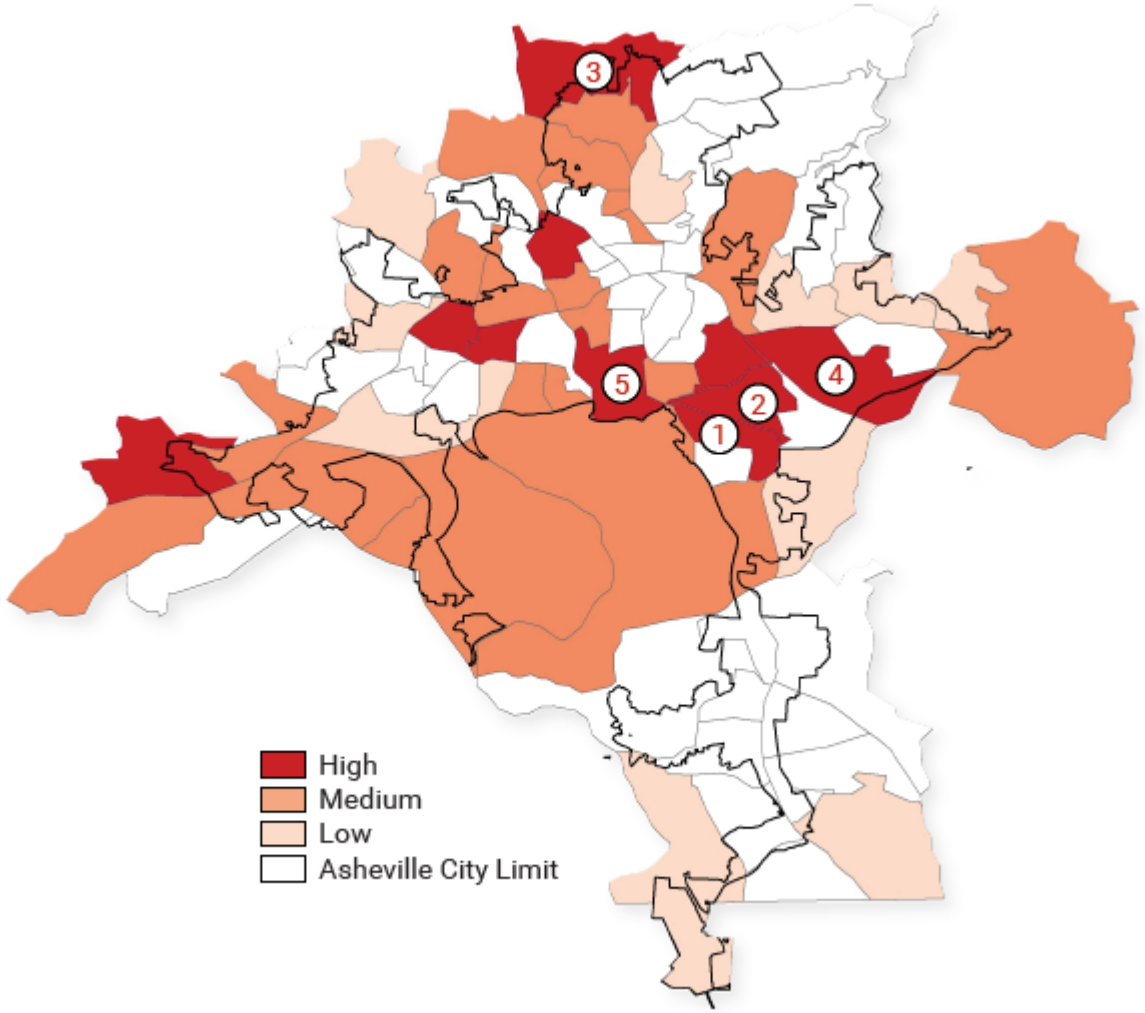
Risk

Vulnerability

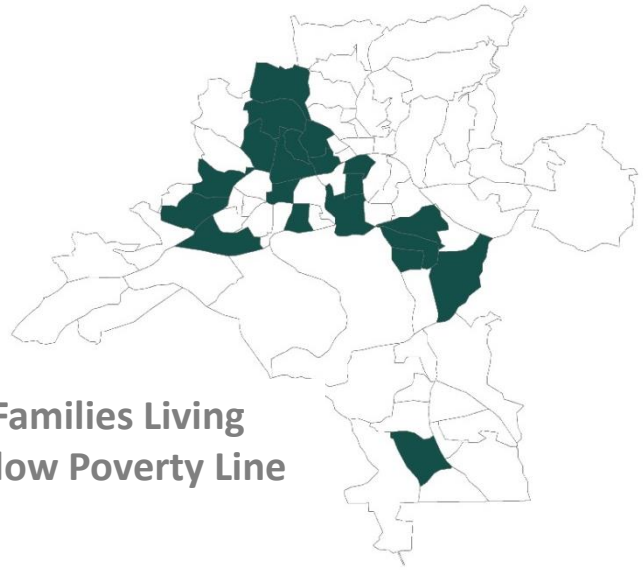


415 parcels

with medium and high vulnerability and risk

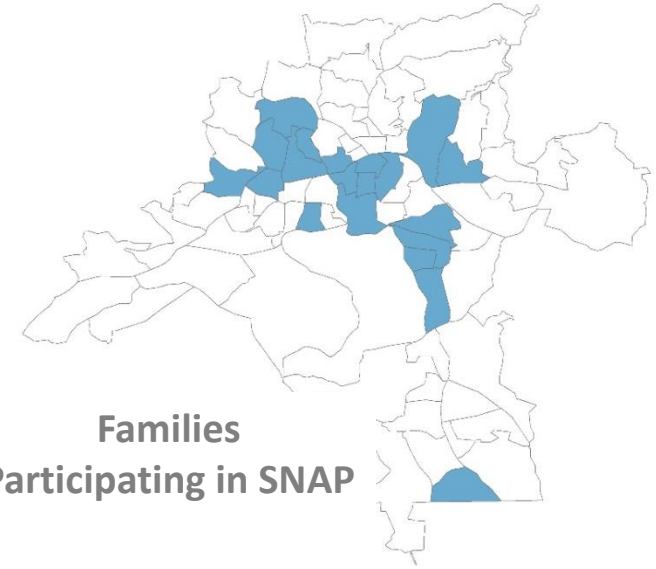


Socioeconomic Vulnerability

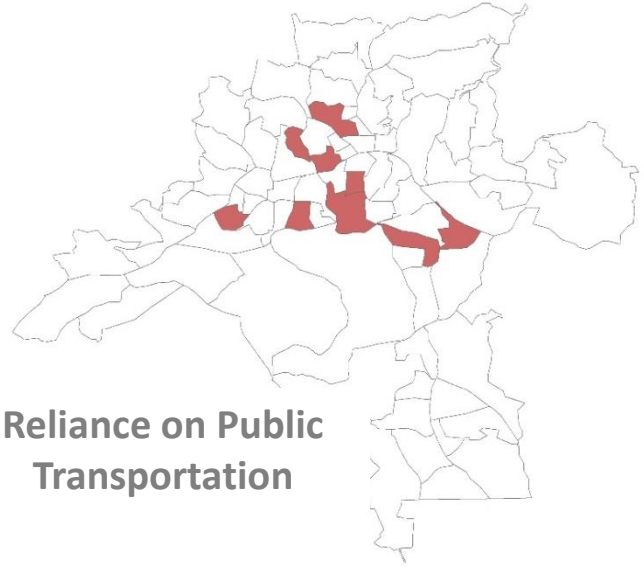


Families Living
Below Poverty Line

Unemployment



Families
Participating in SNAP



Reliance on Public
Transportation

Step 3: Investigate Options

- Focus on the assets that have the highest vulnerability and risk
- Identify feasible options that
  - Reduce Vulnerability or Risk
  - Support Response and Recovery
- 75 options identified so far

Option	Location	Source	Estimated Time Frame	Focus
Build Adaptive Capacity into any new asset put in the RAD	River Arts District (RAD)	RAD plan?	Long term	Increasing Adaptive Capacity: We are focusing on adaptive capacity because we cannot reduce exposure
Increase stream buffer	Vuln areas	UDO	Med	Both reduces exposure by distancing structures and increases adaptive capacity by having storage
Increase/Require use of LID	Vuln areas	UDO	Short	Increases adaptive capacity by providing filtration and storage

Step 4: Prioritize to Reduce Vulnerability and Risk

Example: Consolidate and prioritize selected options

	Ability to increase resilience	Economic feasibility	Low environmental impact	Ability to implement
LSE-2	🟢	🟢🟡	🟢🟡	🔴
MD-1	🟢	🟢	🟢🟡	🟡🔴
MD-7	🟢	🟢	🟡	🟡
MD-4	🟡	🟡	🟢	🟢
MD-4 / MD-7	🟢	🟢	🟢	🟢

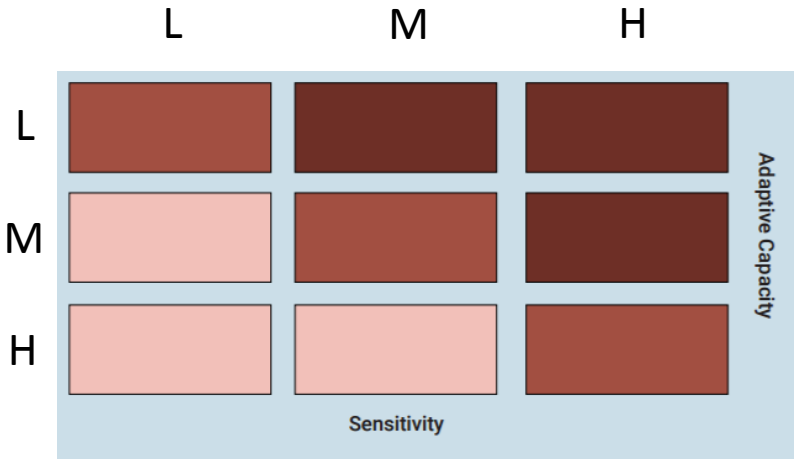
Example prioritization from a group in Michigan

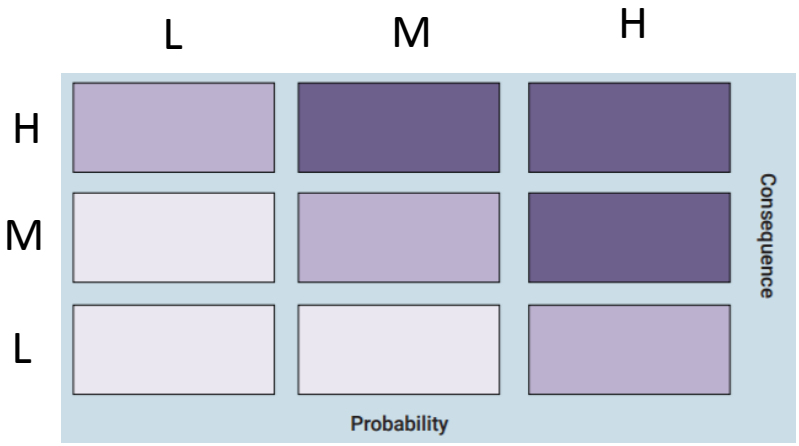
Summary

- Supports planning at multiple scales
- Assessment provides foundation for options (action) to build resilience
- Importance of reiteration
- Importance of defining assets (in a measureable way)
- Next steps
  - Options are still being identified and prioritized
  - Options will be integrated with Comprehensive Plan
  - Final report

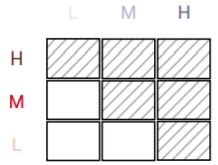
Open House: Preliminary summary sheets

Page 1: Assessment Criteria



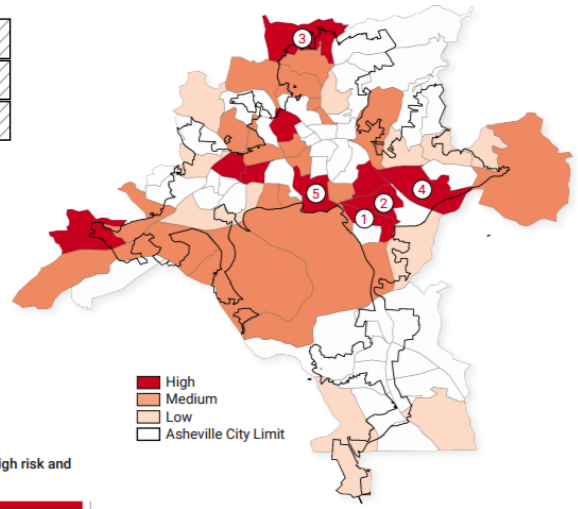


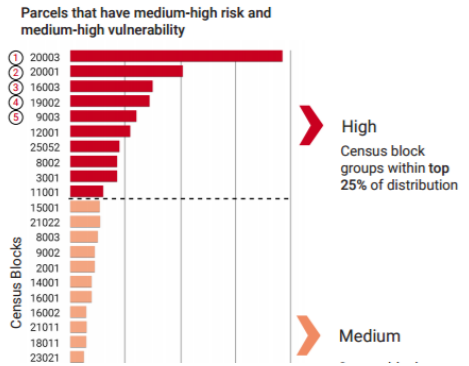
Page 2: Med-High Vulnerability and Risk



600 parcels

with medium and high vulnerability and risk





Commercial properties that are most at risk are found in some expected places (Biltmore Village and the Rivers Arts District), but also in North Asheville.

① 20003 – Biltmore Village
② 20001 – Oakley (Biltmore Village and Tunnel Road)
③ 16003 – Reynolds Mountain
④ 19002 – River Ridge
⑤ 9003 – Livingston (River Arts District)

Pages 3-4: Options and Data Sources

Options

Option	Location	Source	Estimated Time Frame	Focus
Build Adaptive Capacity into any new asset put in the RAD	River Arts District (RAD)	RAD plan?	Long term	Increasing Adaptive Capacity: We are focusing on adaptive capacity because we cannot reduce exposure
Increase stream buffer	Vuln areas	UDO	Med	Both reduces exposure by distancing structures and increases adaptive capacity by having storage
Increase/Require use of LID	Vuln areas	UDO	Short	Increases adaptive capacity by providing filtration and storage
More restrictive ordinance to help implement suggestions in the CRS Repetitive Loss Report	Repetitive Loss Area	CRS Community Rating System	Short-Mid term	Increases Adaptive Capacity

Data Source

Bus routes: City of Asheville http://data.ashevillenc.gov/datasets/71c2756c24834b0ba241d54c12762422_11 (Accessed October 2016)

Reliance on public transportation: US Census, American Community Survey 2014 5-year estimates
Floodplain mapping: North Carolina Floodplain Mapping Program (2010)

Thanks!

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