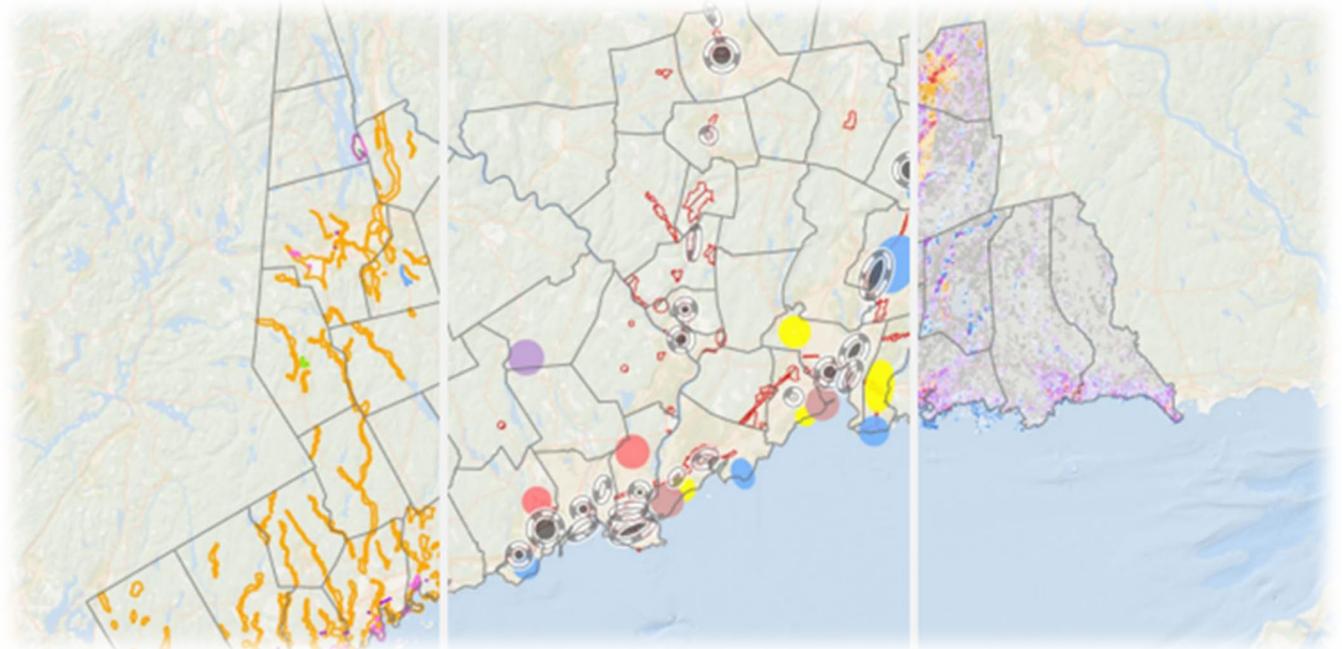


“Resilient Connecticut”

From Regional Vulnerabilities to Resilience Opportunities

Update for CWWA, CT Section
AWWA, and Water Utilities
December 16, 2021

David Murphy, PE, CFM
Director of Resilience Engineering
Connecticut Institute for Resilience and
Climate Adaptation (CIRCA)



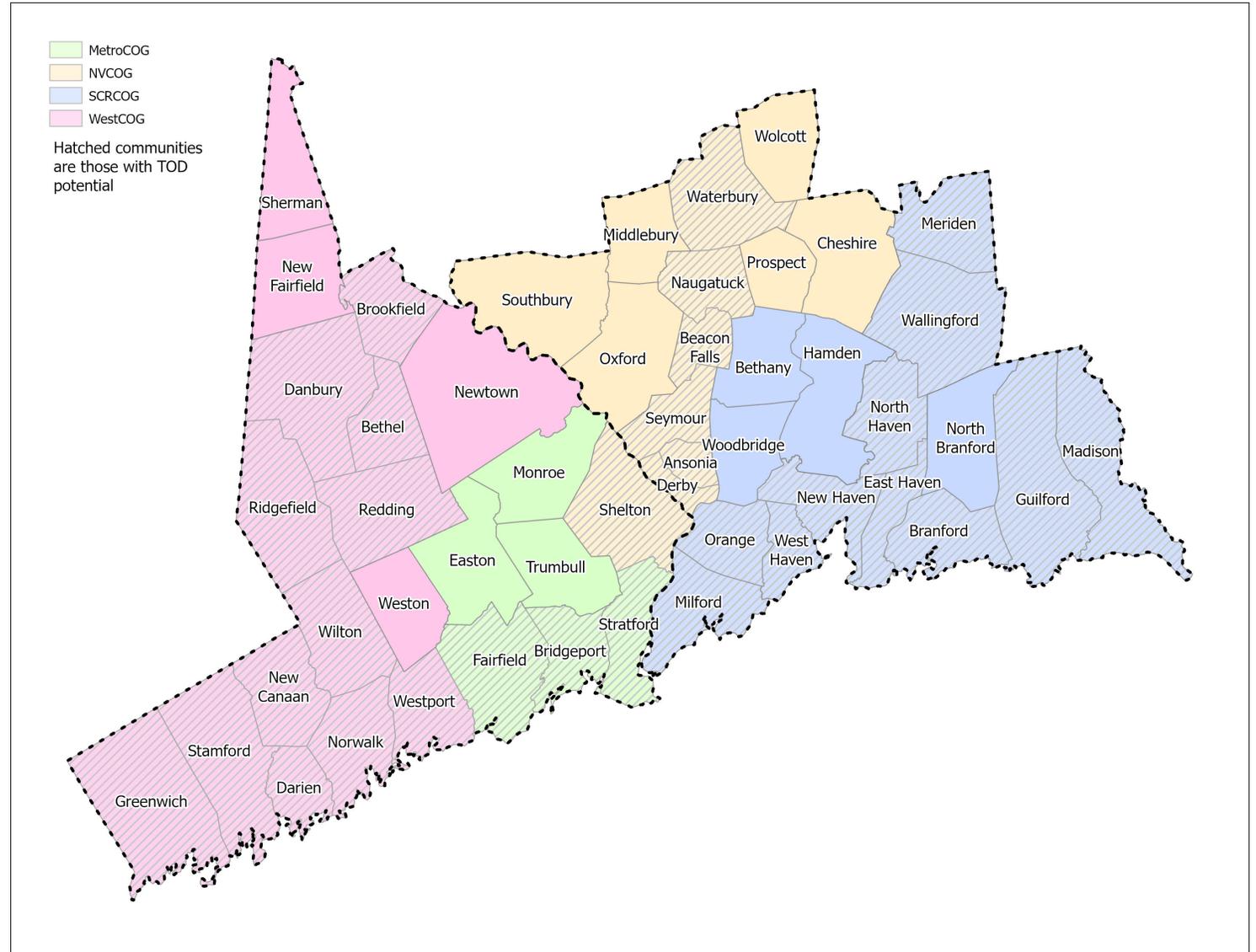
Resilient Connecticut

From Regional Vulnerabilities to Resilience Opportunities

Getting Oriented

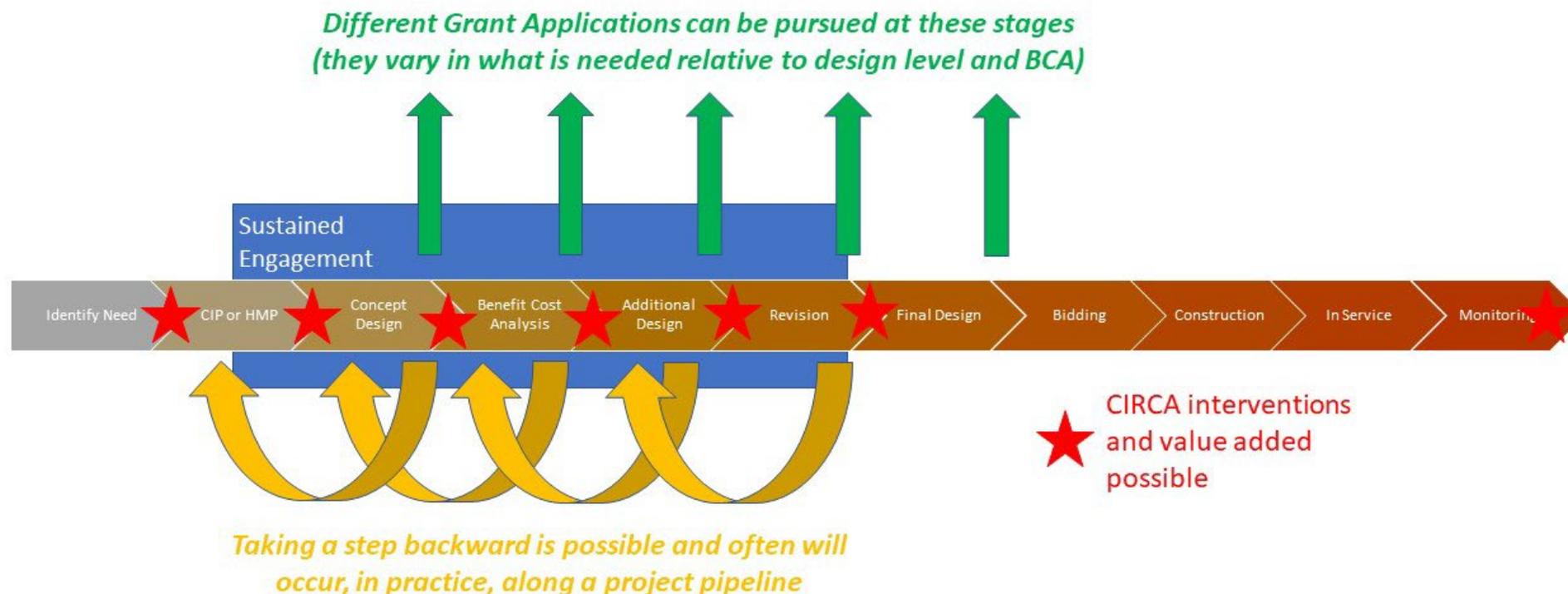
Area of Focus

- Fairfield and New Haven Counties
- Communities with Transit-Oriented Development (TOD) Potential
- Communities with “Resilience Corridor” Potential



What Can Resilient Connecticut do for GC3?

- Feed the Resilience Project Pipeline

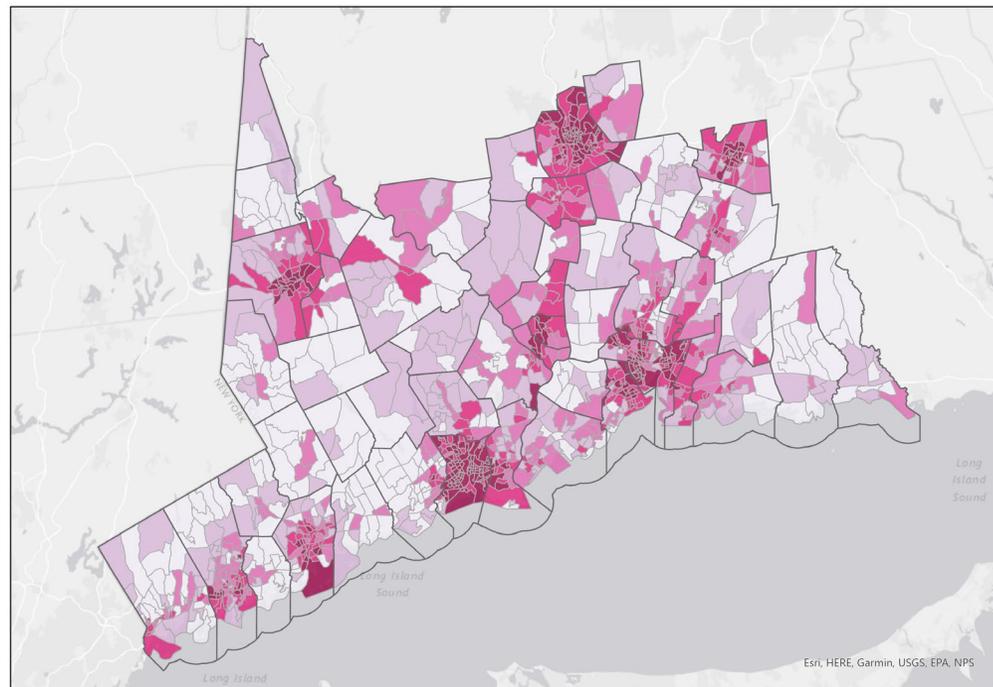


Social Vulnerability Index (SVI) Mapping

- Methodology & subgroups
- High-level regional findings

Climate Change Vulnerability Index (CCVI)

- Methodology & index “pieces”
- Why flood and heat



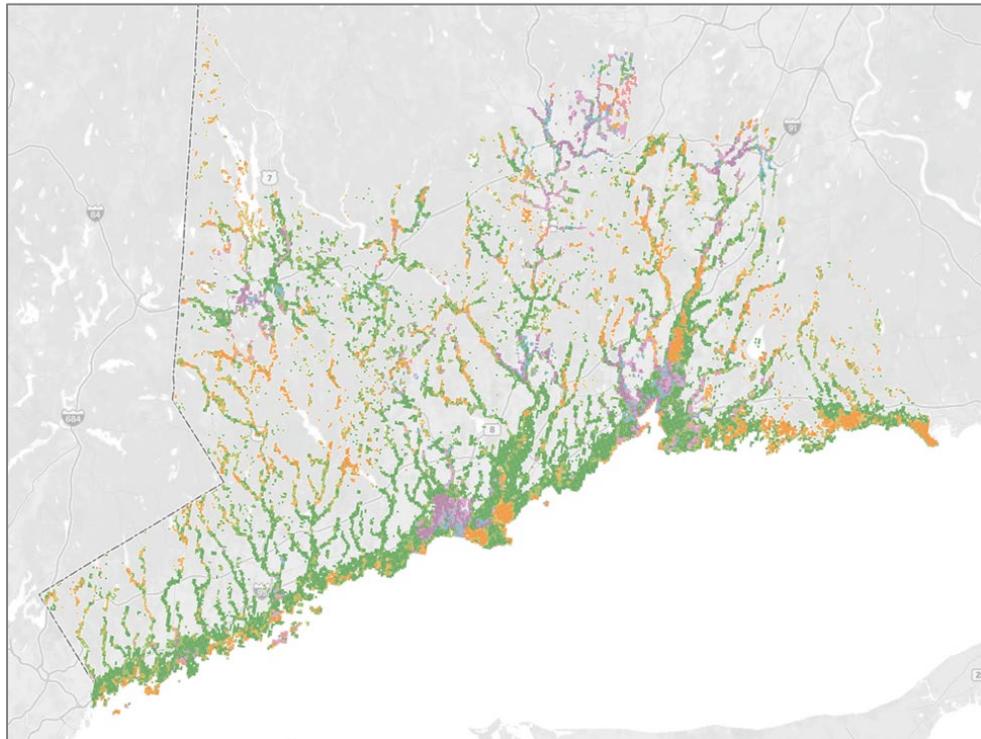
Social Vulnerability
Overall Vulnerability

0 - 0.20	0.41 - 0.61	0.82 - 1.00
0.21 - 0.40	0.62 - 0.81	



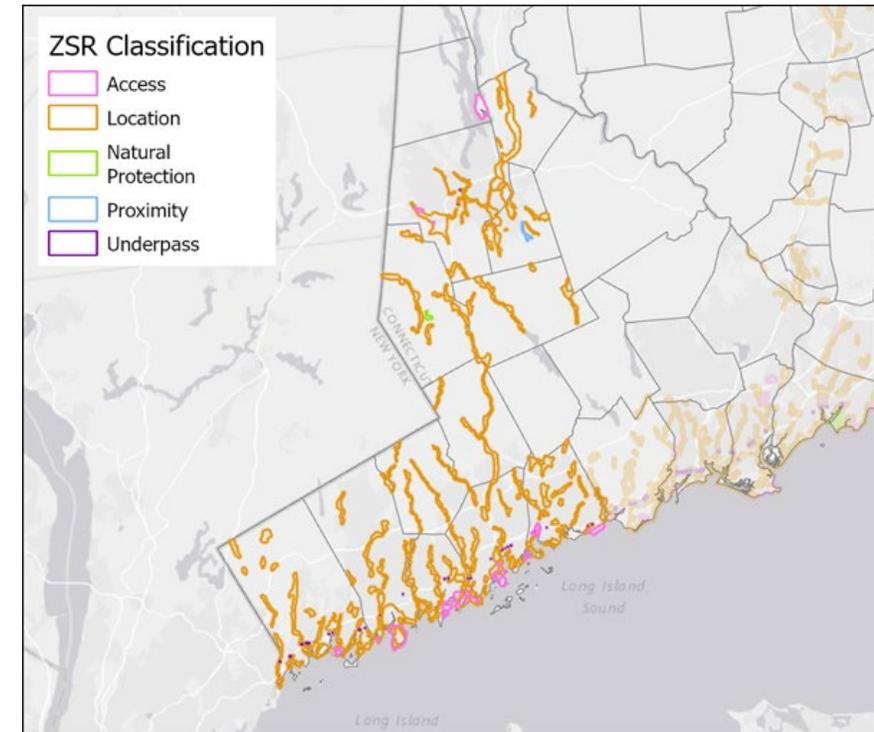
Flood and Heat Combined

- Combined vulnerabilities that can lead to cascading impacts



Zones of Shared Risk (ZSRs)

- Four types of ZSR
 - Access, location, proximity, natural protection

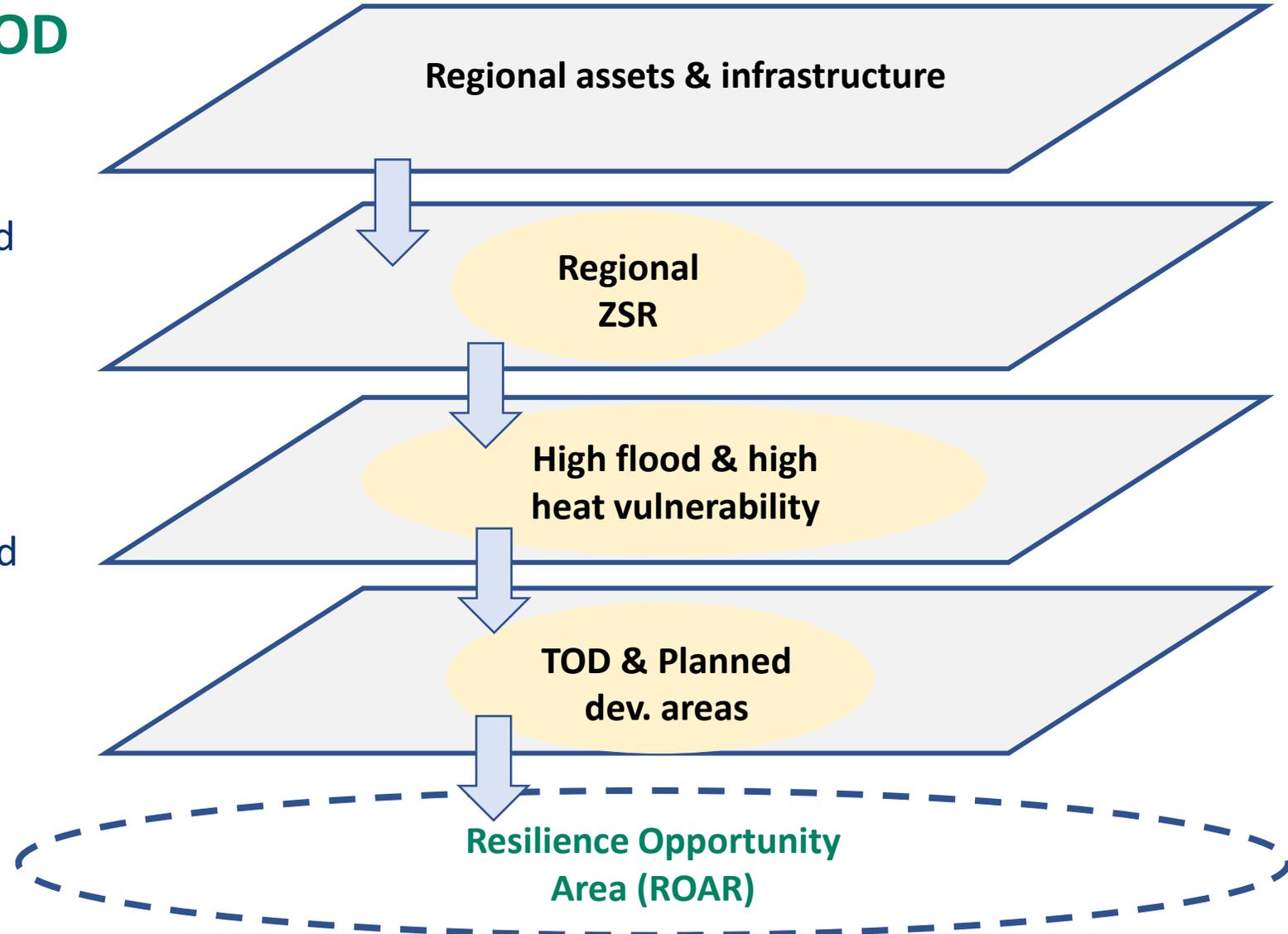


Overlay Process for Identifying Opportunities in TOD Communities

- The NDRC grant emphasizes identifying regional assets and infrastructure
 - ✓ Where are these regional assets and infrastructure densely located?
 - ✓ Where are they co-located with high flood and heat vulnerabilities?
 - ✓ Where are they located within “zones of shared risk”?
 - ✓ Where do all of these intersect with planned development areas and TOD opportunities?
- Can be applied to inland and coastal settings and communities

Overlay Process for TOD Communities

- Opportunity areas followed an overlay method beginning with regional assets and infrastructure
- Next were zones of shared risk, flood vulnerability, and heat vulnerability
- Planned development and TOD areas were used to refine area positions and boundaries



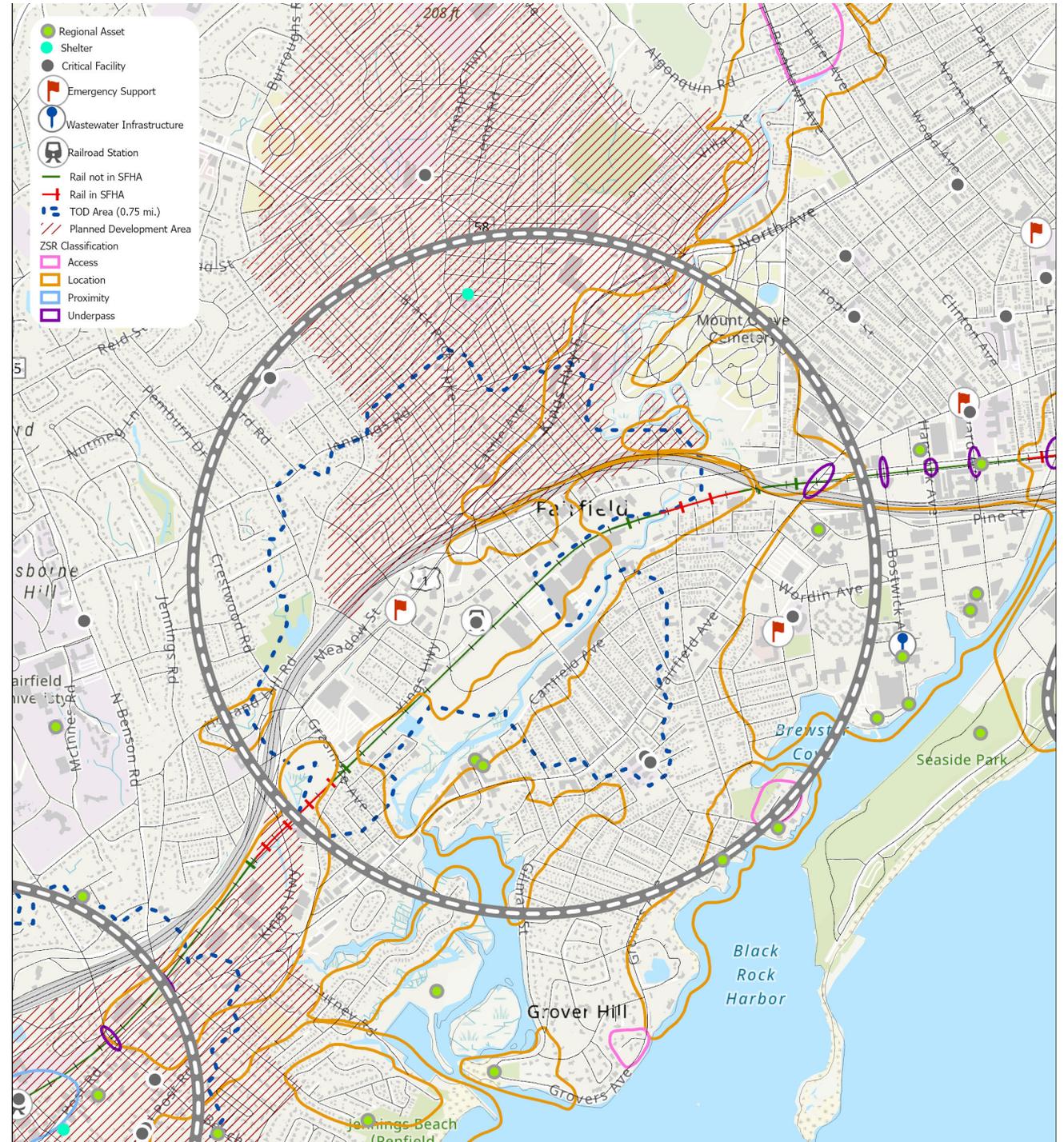
Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

Name: Fairfield Metro

Location: Fairfield

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ●
Social Vulnerability	○ ● ● ● ● ○
<p>Fairfield and Bridgeport meet along the Ash Creek and Rooster River watershed. The Rooster River presents significant riverine flood risk to both communities, and Ash Creek is subject to storm surge flooding as occurred during SuperStorm Sandy. Fairfield supports TOD around the Fairfield Metro train station west of Ash Creek, and Bridgeport supports flood-resilient economic development in the Lower West End along Cedar Creek. Railroad underpasses have flooded many of the roads in the Lower West End. Although some distance is located between Fairfield Metro and the Lower West End, increasing pedestrian and transit connectivity across Ash Creek will join these areas, elevating their importance in the region. Large amounts of impervious surfaces from commercial development, dense residential development, with little green/open space contribute to increased heat vulnerability.</p>	
West End Fire Station Co. #7 & #11 American Medical Response Rail Station	Four Schools Biodiesel plant Substation Coastal access



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

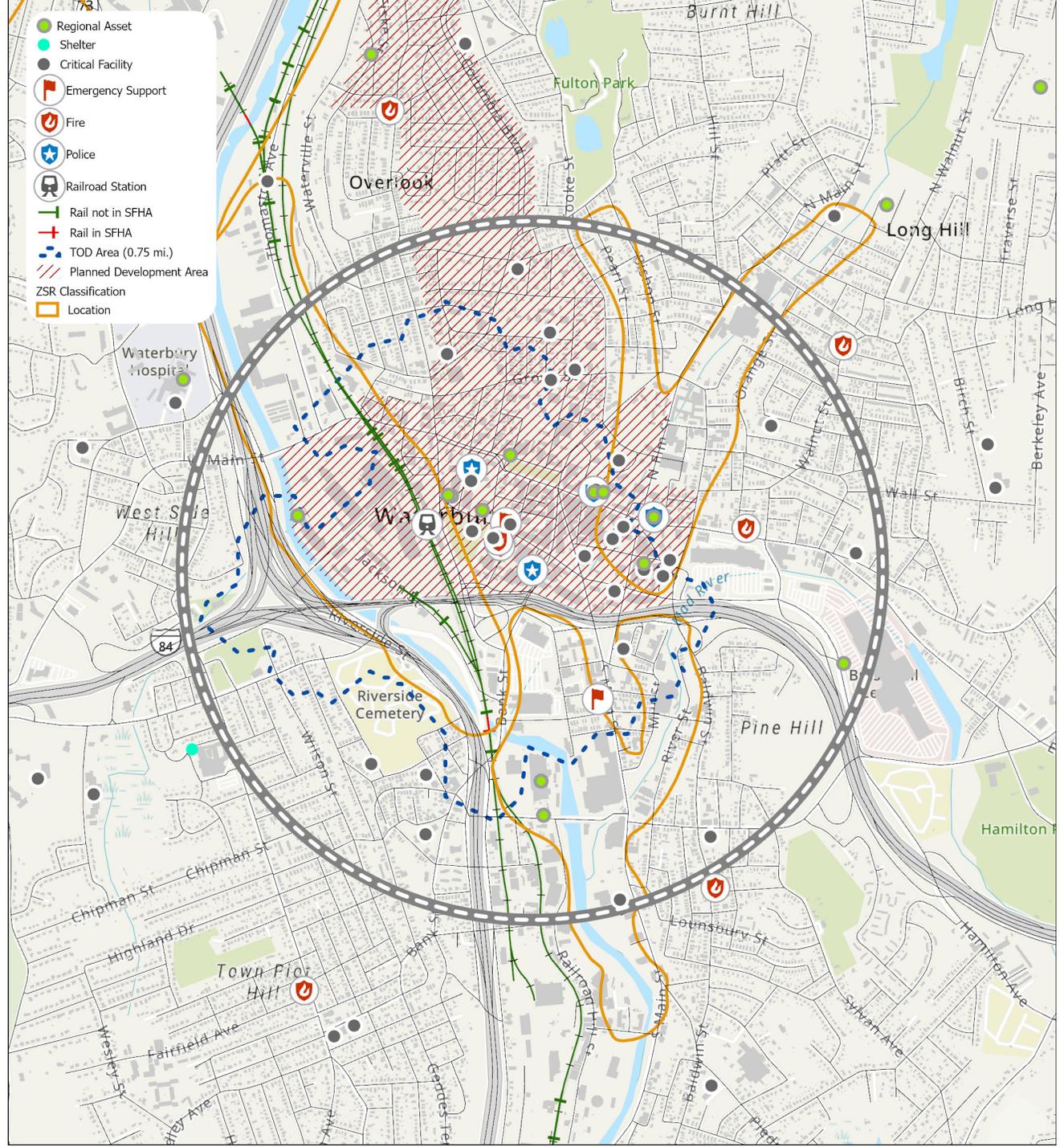
Name: Downtown Waterbury

Location: Waterbury

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ○
Social Vulnerability	○ ● ● ● ● ●

Several zones of shared risk merge in downtown Waterbury including the Naugatuck River corridor, Mad River watershed, Great Brook, and stream below the Fulton Park Ponds. Flood risks vary from riverine to the challenges associated with streams buried in culverts below buildings. TOD is desired in the Freight Street area, capitalizing on enhancements to the Waterbury line of MetroNorth. Numerous critical facilities and historic resources are located throughout the area. High heat vulnerable areas are concentrated along I-84 and Route 8. A high percentage of impervious surface with few green space and streets drives heat vulnerable in addition to a strong correlation with heat related social sensitivity.

Police dept., sub-station, annex New Haven County Marshal Campion Ambulance City Hall/EOC	Fire Dept. Station 10 & 2 St. Mary's Hospital Silas Bronson Library 14 schools City Offices	Assisted living facilities Electric substations Museums
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Resilient Connecticut

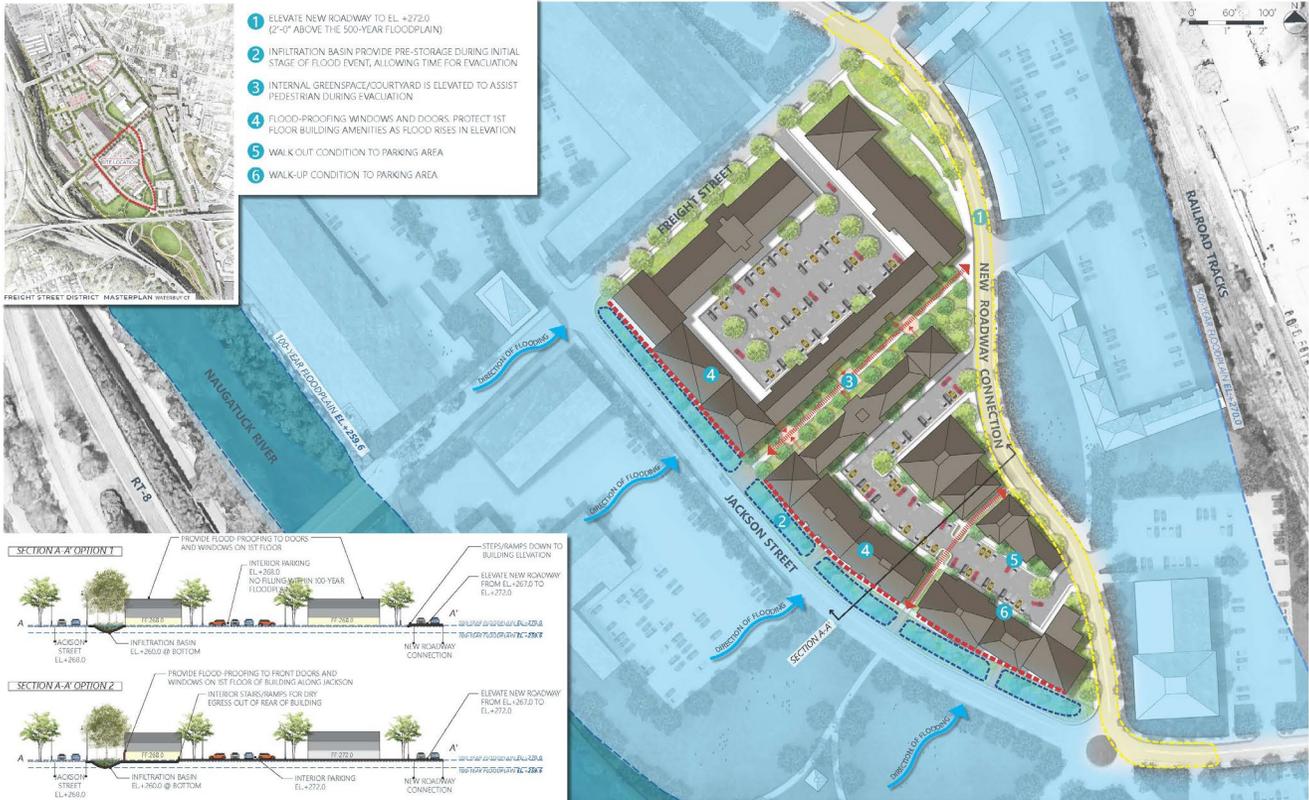
Next Steps for Resilient Connecticut



What Could a Concept Include?



FREIGHT STREET FLOOD ADAPTATION TRANSIT ORIENTED DEVELOPMENT - 100-YEAR



FREIGHT STREET FLOOD ADAPTATION TRANSIT ORIENTED DEVELOPMENT - 500-YEAR FLOOD

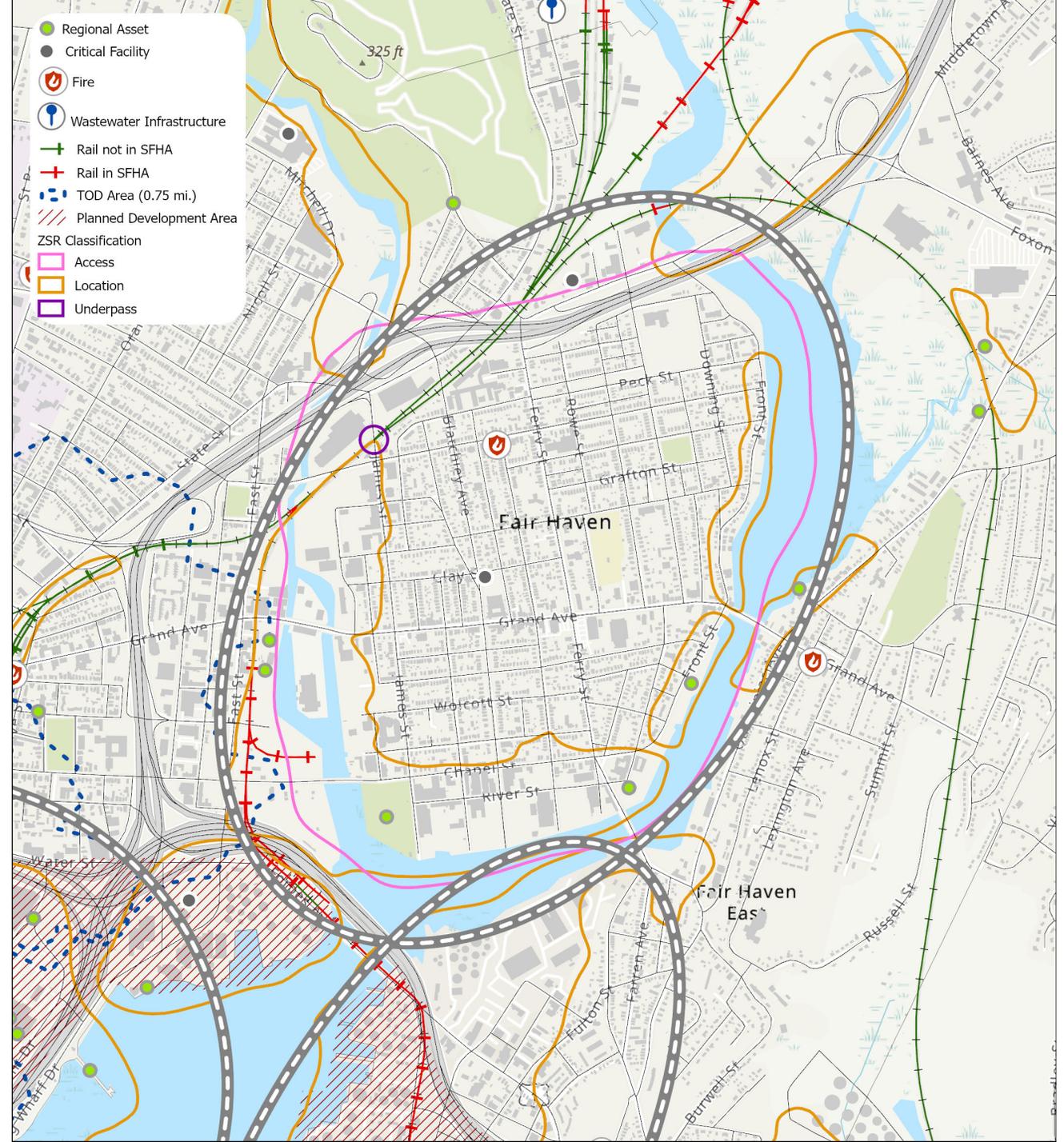
Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

Name: Fair Haven/Mill River

Location: New Haven

Considerations	Characteristics of Area
Flood Vulnerability	● ● ● ● ●
Heat Vulnerability	● ● ● ● ●
Social Vulnerability	● ● ● ● ●
<p>Zones of shared risk along the Mill River and Quinnipiac River merge with a zone of shared risk drawn around Fair Haven (for isolation risks) to highlight an opportunity area centered on Fair Haven. While TOD does not overlap with Fair Haven, it is present just west of the Mill River. Numerous resilience opportunities may be available as the City promotes and supports redevelopment in the Mill River and Fair Haven areas. Care should be taken to enhance livability in Fair Haven and connectivity to surrounding areas.</p> <p>Fair Haven is entirely high heat vulnerable. This is attributed primarily to the high social sensitivity present here, combined with dense housing, high amounts of pavement, and disconnected green space for shade.</p>	
<p>Fire station</p> <p>Public works</p> <p>School</p>	<p>Substation</p> <p>Coastal access</p>



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

Name: Branchville/Georgetown

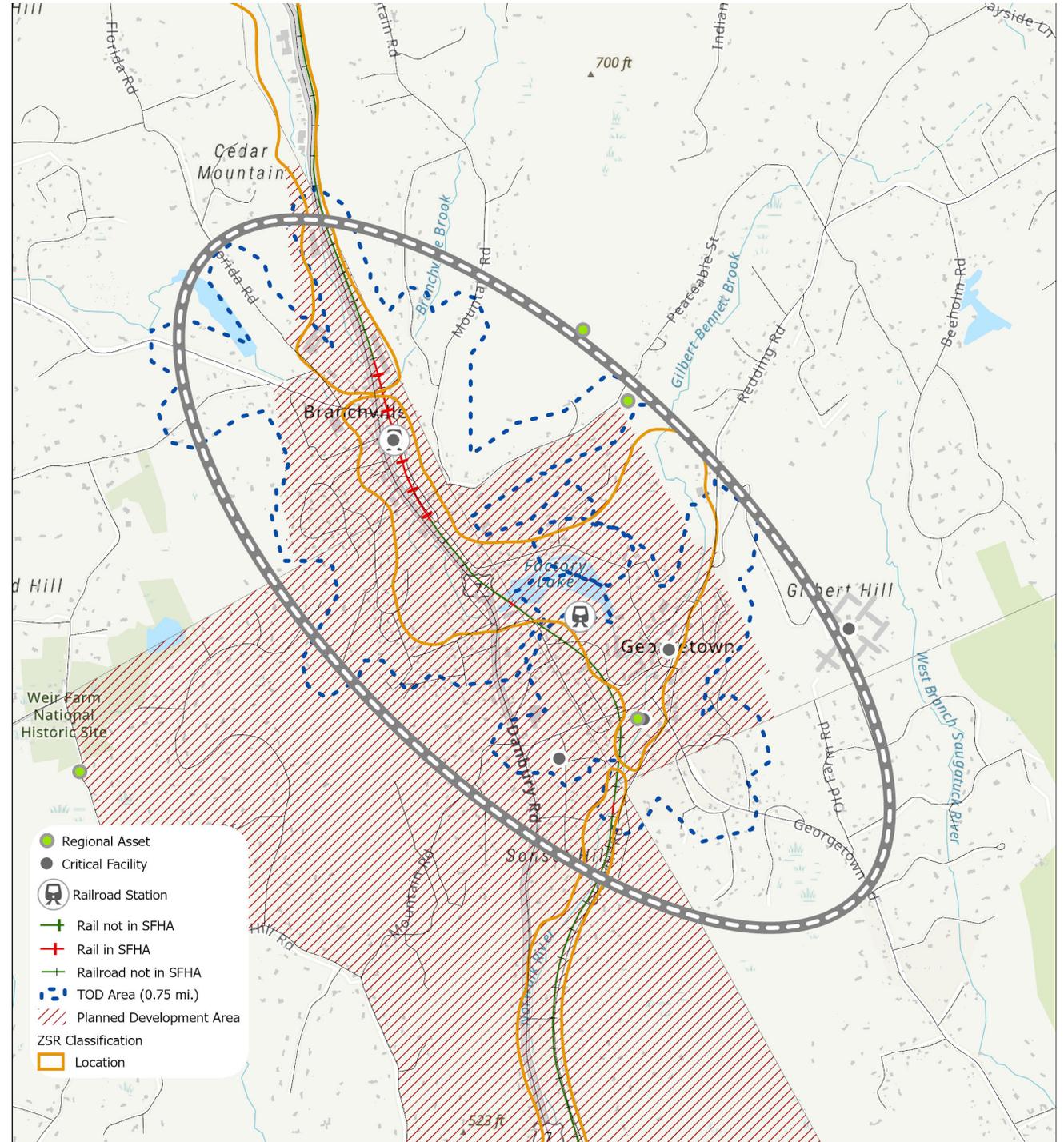
Location: Georgetown

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

Four municipalities come together in the Branchville/Georgetown region (Ridgefield, Wilton, Redding, and Weston). Separate TOD centered in Branchville (at the current train station) and in Georgetown (at a potential new train station) overlap along the Norwalk River zone of shared risk. New buildings and infrastructure associated with the two TOD areas must be resilient, while protecting existing buildings and historic resources.

Moderately high heat vulnerability is sporadic in the area, with increased vulnerability centered around commercial areas along Redding Road and Route 7.

Georgetown fire dept. Linden Hill School
 Sewage facility/WWTP Substation
 Rail station



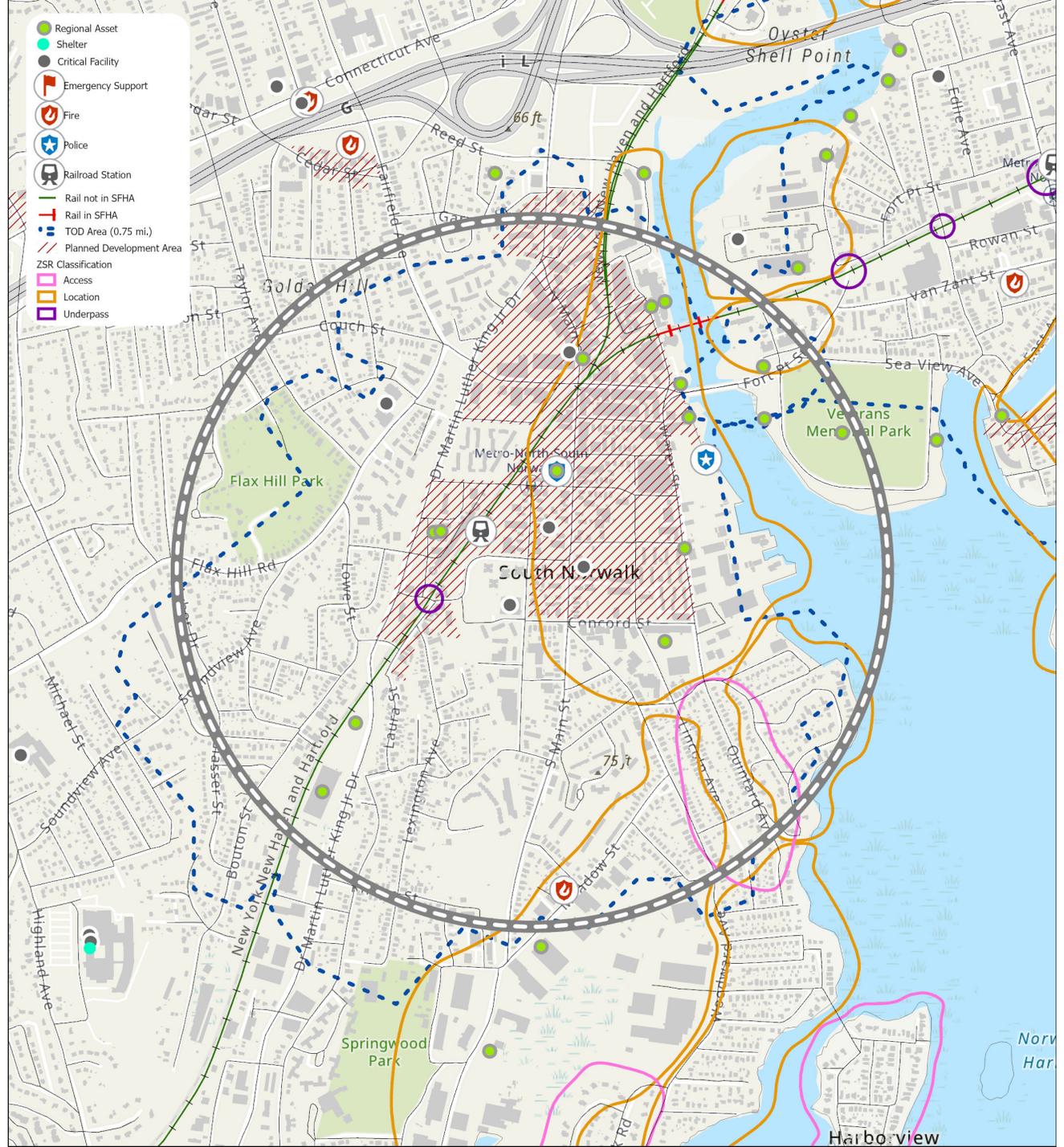
Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

Name: South Norwalk

Location: Norwalk

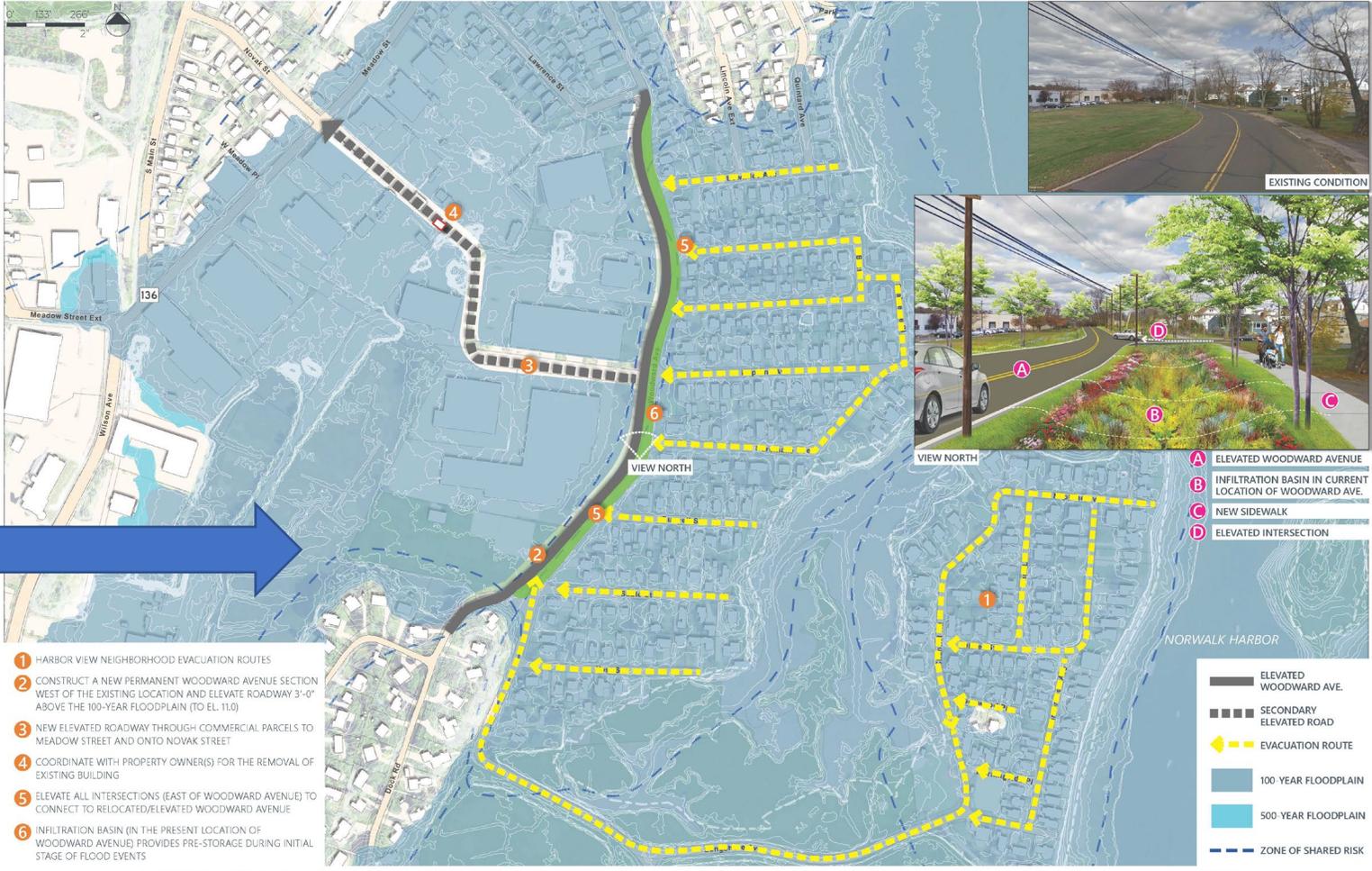
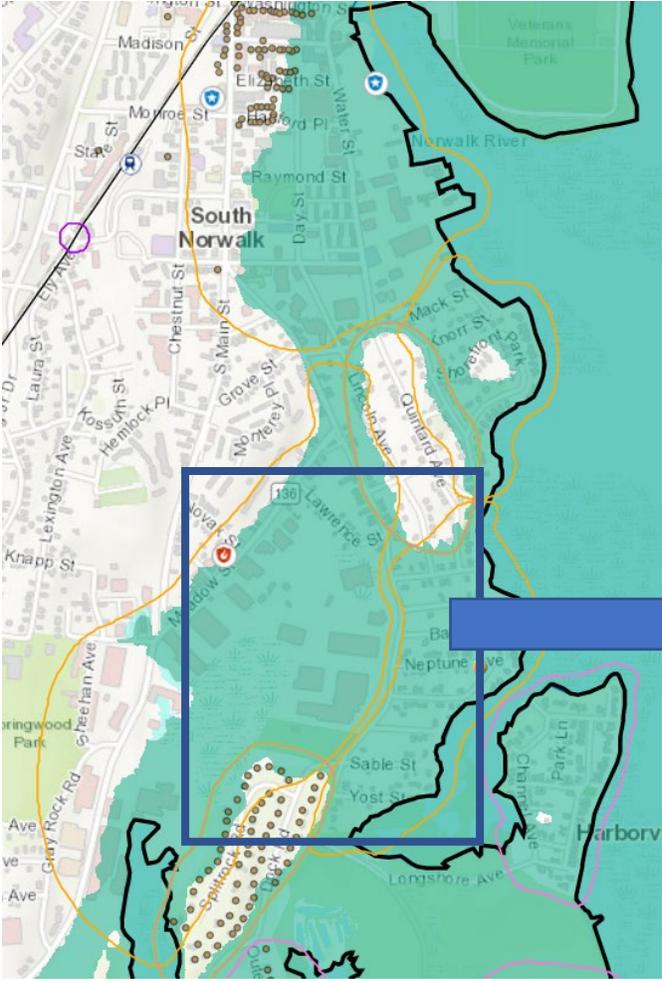
Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ○
Social Vulnerability	○ ● ● ● ● ○
<p>The South Norwalk area contains a major railroad station, numerous critical facilities and historic resources, regional tourist attractions, flood risk associated with the Norwalk River estuary and Norwalk Harbor, and key connections to areas to the south that can be isolated by coastal flooding. The City is evaluating challenges and opportunities associated with commercial and water-dependent properties along Water Street, all in the coastal flood zone.</p> <p>All of the SoNo area is high heat with dense commercial/industrial coverage along the waterfront with high impervious surfaces, and dense but green residential west of the railroad. This area is however high for social sensitivity contributing to the vulnerability.</p>	
<p>Fire station 5 Police dept. Marine patrol Two schools Medical care facilities</p>	<p>Coastal access Substation Commerce Shipping</p>



Resilient Connecticut

Next Steps for Resilient Connecticut

What Could a Concept Include?



NORWALK CT EVACUATION ROUTE DEVELOPMENT - RESILIENCY DESIGN

Resilient Connecticut

From Regional Vulnerabilities to Resilience Opportunities

Additional ROAR “recipes”

- Step beyond grant obligations
- Informed by state programs & policies
- Links Vulnerability to Local Planning
- Addresses stakeholder comments from RCC, regional workshops, SAFR
- Can be applied inland & coast
- GIS analysis + technical review
- *Limited by available data (e.g. no widely available evacuation routes of affordable housing) at this moment*
- Can add on additional priorities to sort



Example Concept - Housing



What Were the Results?

- Affordable housing in vulnerable areas
- Affordable housing without transit to areas of respite
- Wastewater treatment plants
- Public water supply watersheds with increasing climate risk due to land uses
- Public water supply wells that serve critical facilities
- Public water supply wells exceeding density thresholds in areas of increasing climate risk

Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

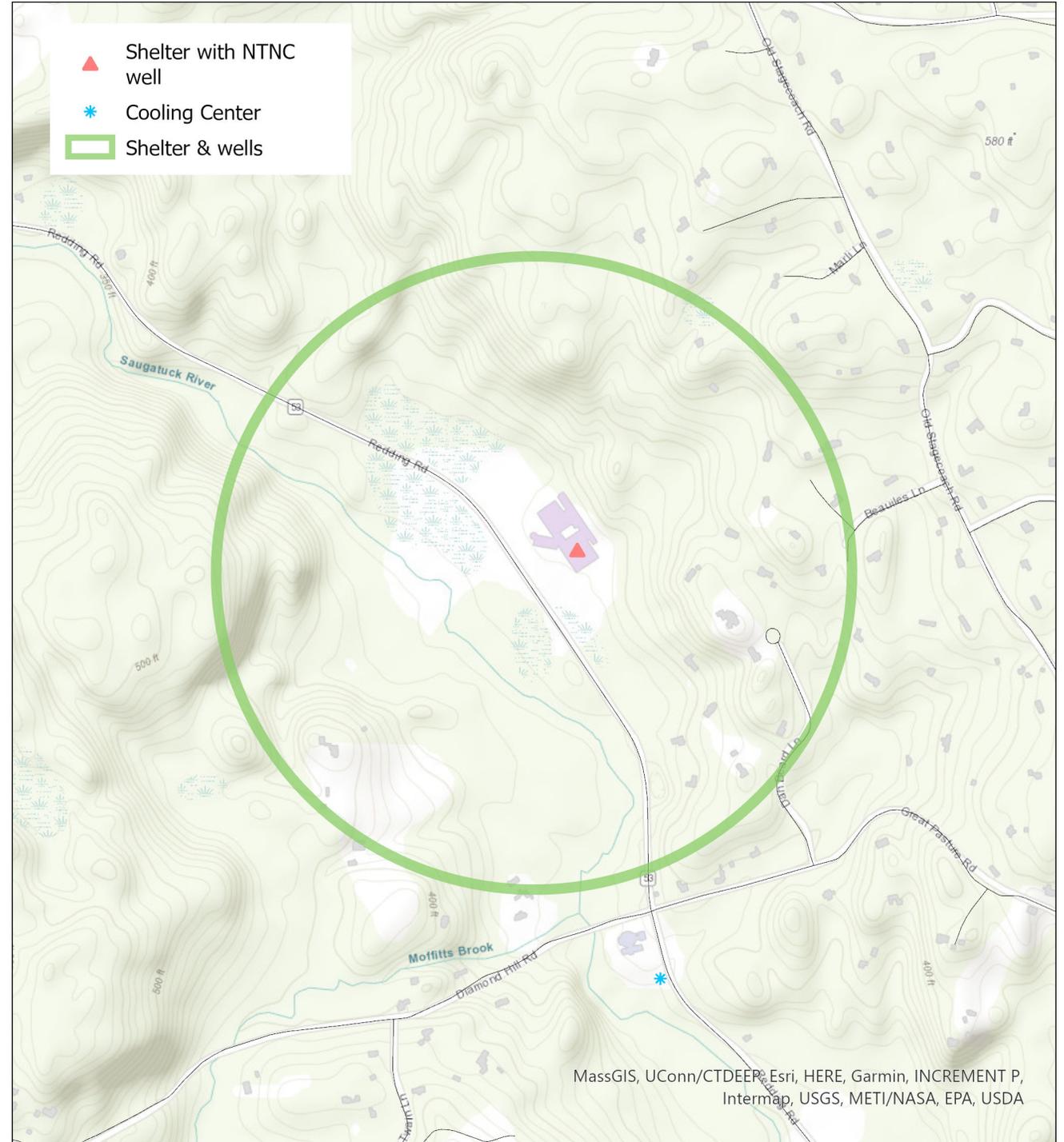
Name: John Reade Middle School

Location: Redding

Considerations	Characteristics of Area
Flood Vulnerability	<input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Heat Vulnerability	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Social Vulnerability	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>

The John Read Middle School serves a shelter for the Town of Redding. This shelter is in a high flood vulnerable area. In addition, a non-transient non-community water supply well is the primary water source. The well is located in the Saugatuck River floodplain and the wellhead has been elevated somewhat. Given that this location is slated for use as a shelter during a flood (or other emergency) event, an opportunity may exist to mitigate future flood risk to the water supply, the shelter, and the surrounding area simultaneously. While the overall opportunity area has relatively low to moderate flood vulnerability, the school has moderate to high flood vulnerability.

A municipal shelter with a flood vulnerable well as primary drinking water source.



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

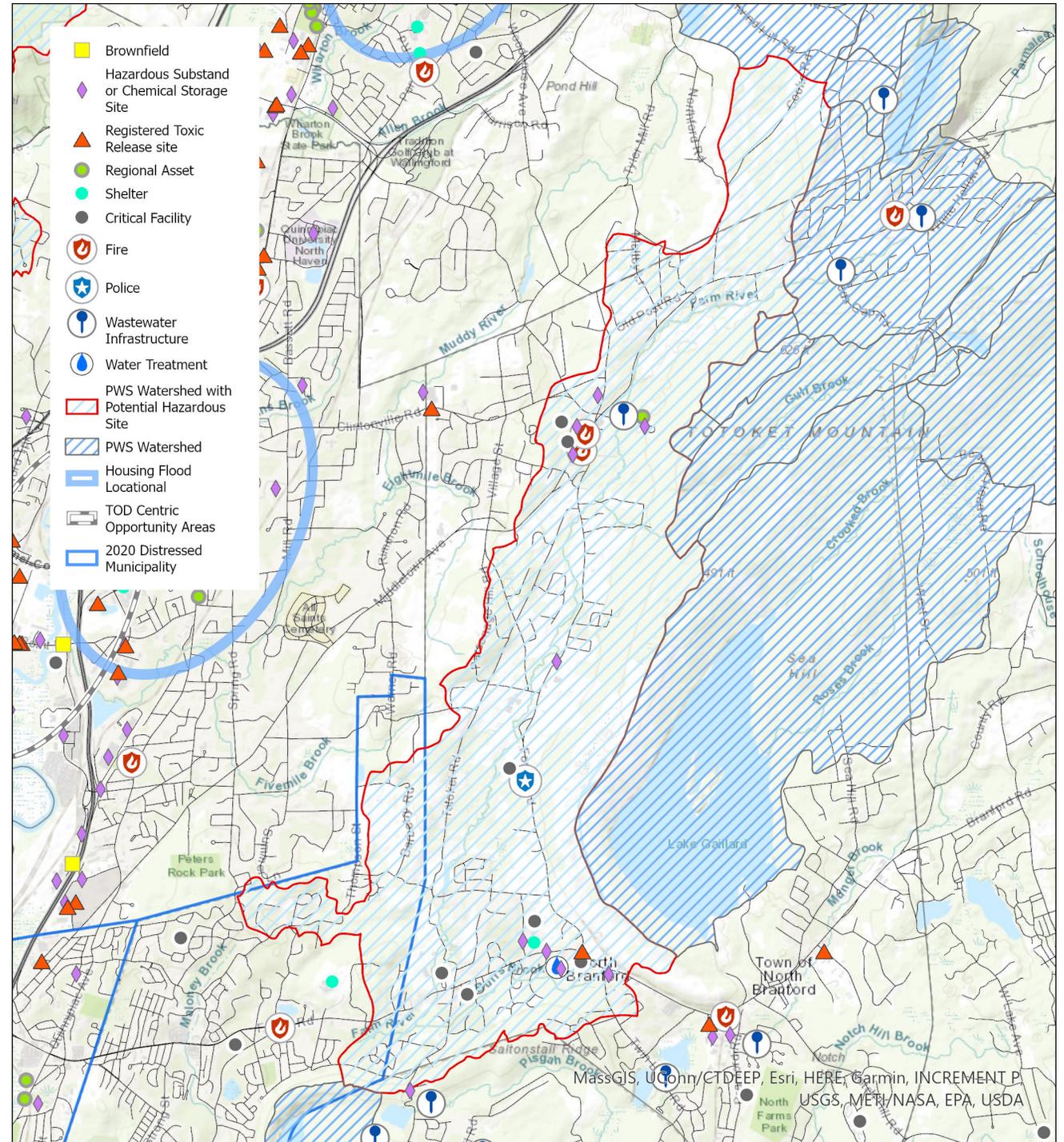
Name: Lake Saltonstall Watershed

Location: East Haven/North Branford

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

Several hazardous sites are located in this 7,100 acre watershed along the Farm River and Burrs Brook. Flood-related impacts at these sites could present challenges to the Lake Saltonstall drinking water supply, which is fed through a diversion from the Farm River. Notwithstanding the source protection programs in place at the State and local levels, the presence of the potential releases in the watershed suggest an opportunity for advancing resilience to climate impacts such as more intense or frequent floods.

Public water supply watershed with potential risk of toxic releases from land uses that have flood vulnerability.



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

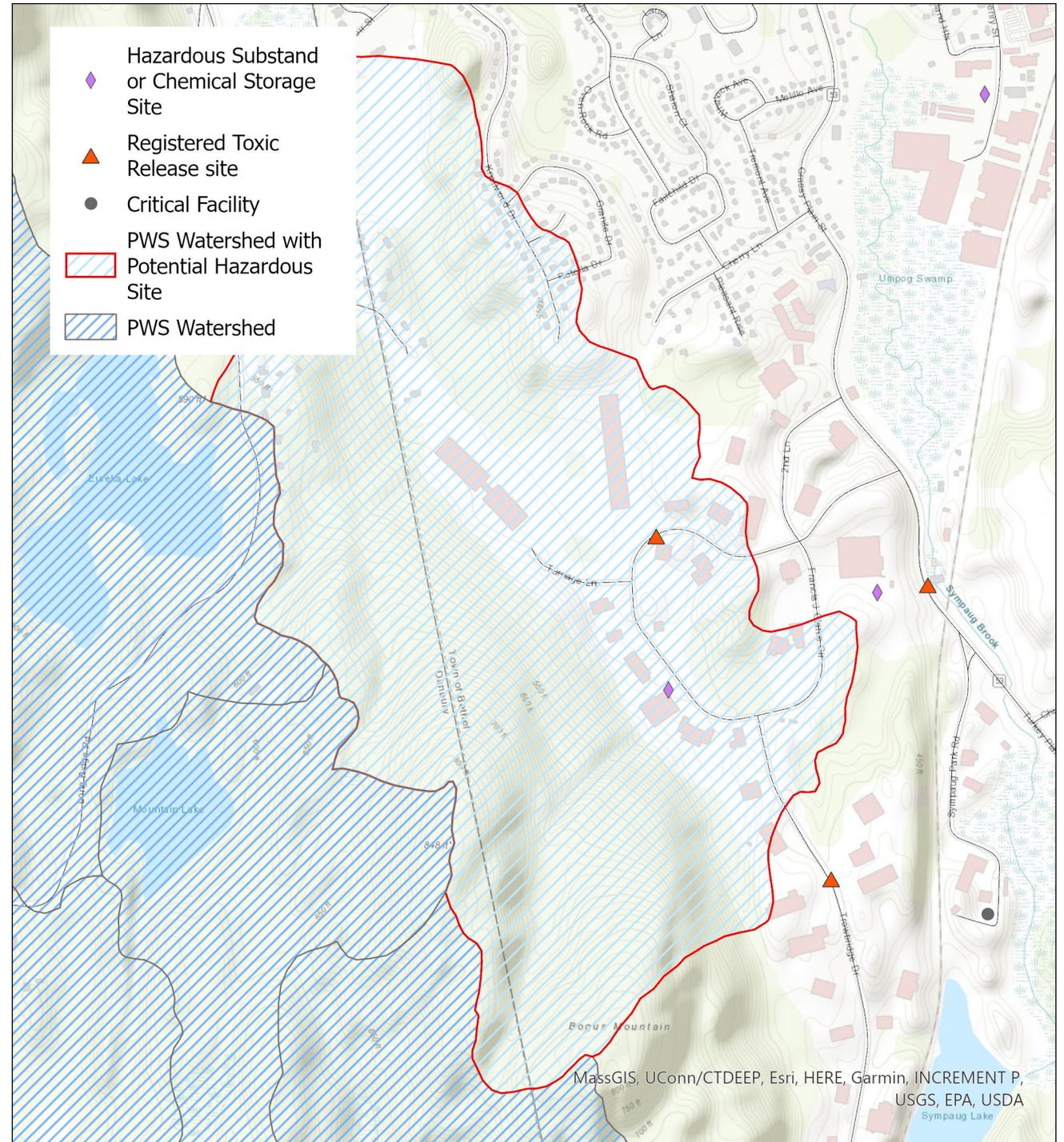
Name: Eureka Lake Watershed

Location: Bethel/Danbury

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ○ ○ ○
Heat Vulnerability	○ ● ● ○ ○
Social Vulnerability	○ ● ● ● ○

This small 353-acre public drinking water supply watershed encompasses one toxic release site and one hazardous substance storage facility. Bethel Water Department operates a diversion downstream of these facilities, presenting potential concerns in the event of a flood that causes a release or spill. Notwithstanding the source protection programs in place at the State and local levels, the presence of the potential releases in the watershed suggest an opportunity for advancing resilience to climate impacts such as more intense or frequent floods.

Public water supply watershed with potential risk of toxic releases from land uses that have flood vulnerability.



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

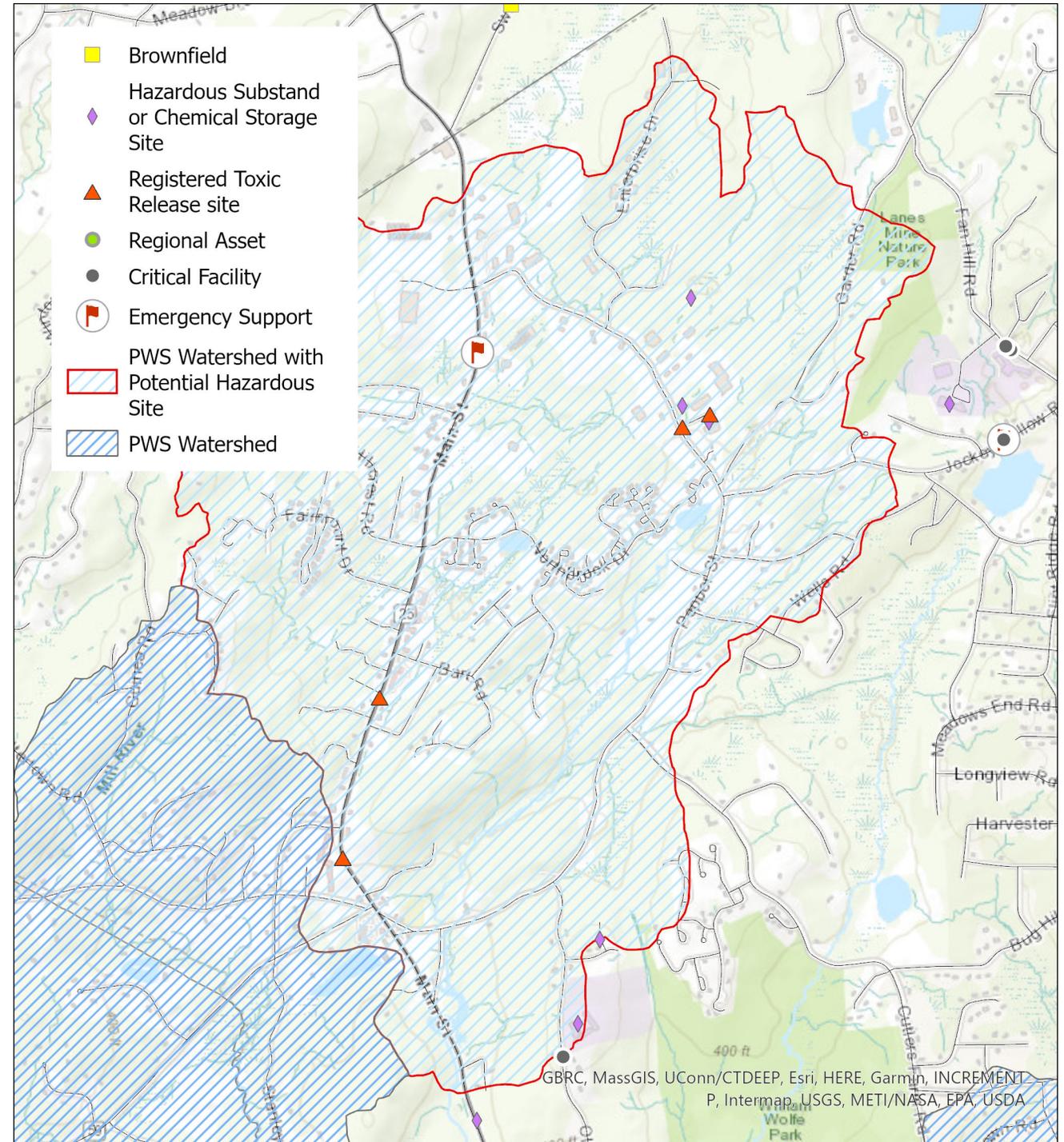
Name: Easton Reservoir Watershed

Location: Monroe

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

This 2,500-acre watershed of Aquarion Water Company includes several toxic release sites and storage facilities located along the West Branch Pequonnock River and other tributary streams. The Easton Reservoir is located downstream of these sites, presenting potential concerns in the event of a flood that causes a release or spill. Notwithstanding the source protection programs in place at the State and local levels, the presence of the potential releases in the watershed suggest an opportunity for advancing resilience to climate impacts such as more intense or frequent floods.

Public water supply watershed with potential risk of toxic releases from land uses that have flood vulnerability.



GBRC, MassGIS, UConn/CTDEEP, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

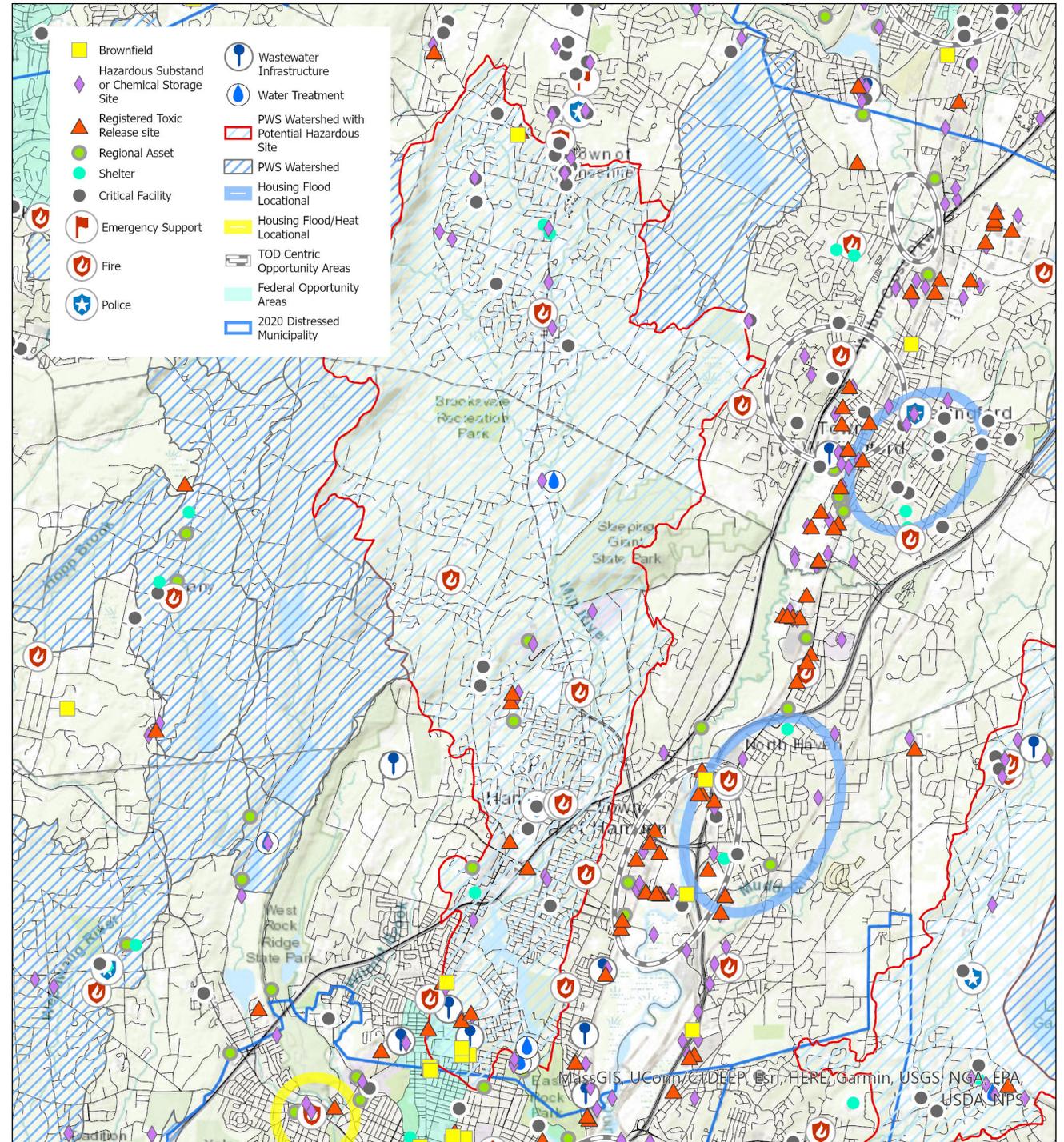
Name: Lake Whitney Watershed

Location: Cheshire/Hamden/North Haven

Considerations	Characteristics of Area
Flood Vulnerability	● ● ○ ○ ○
Heat Vulnerability	● ● ○ ○ ○
Social Vulnerability	● ● ○ ○ ○

The Lake Whitney watershed has several sites of potential concern throughout its 23,000 acres. While overall flood vulnerability is low to moderate throughout the watershed, some potential toxic substance sites are situated along the Mill River, Willow Brook, and within direct proximity to Lake Whitney, presenting potential concerns in the event of a flood that causes a release or spill. Notwithstanding the source protection programs in place at the State and local levels, the presence of the potential releases in the watershed suggest an opportunity for advancing resilience to climate impacts such as more intense or frequent floods.

Public water supply watershed with potential risk of toxic releases from land uses that have flood vulnerability.



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

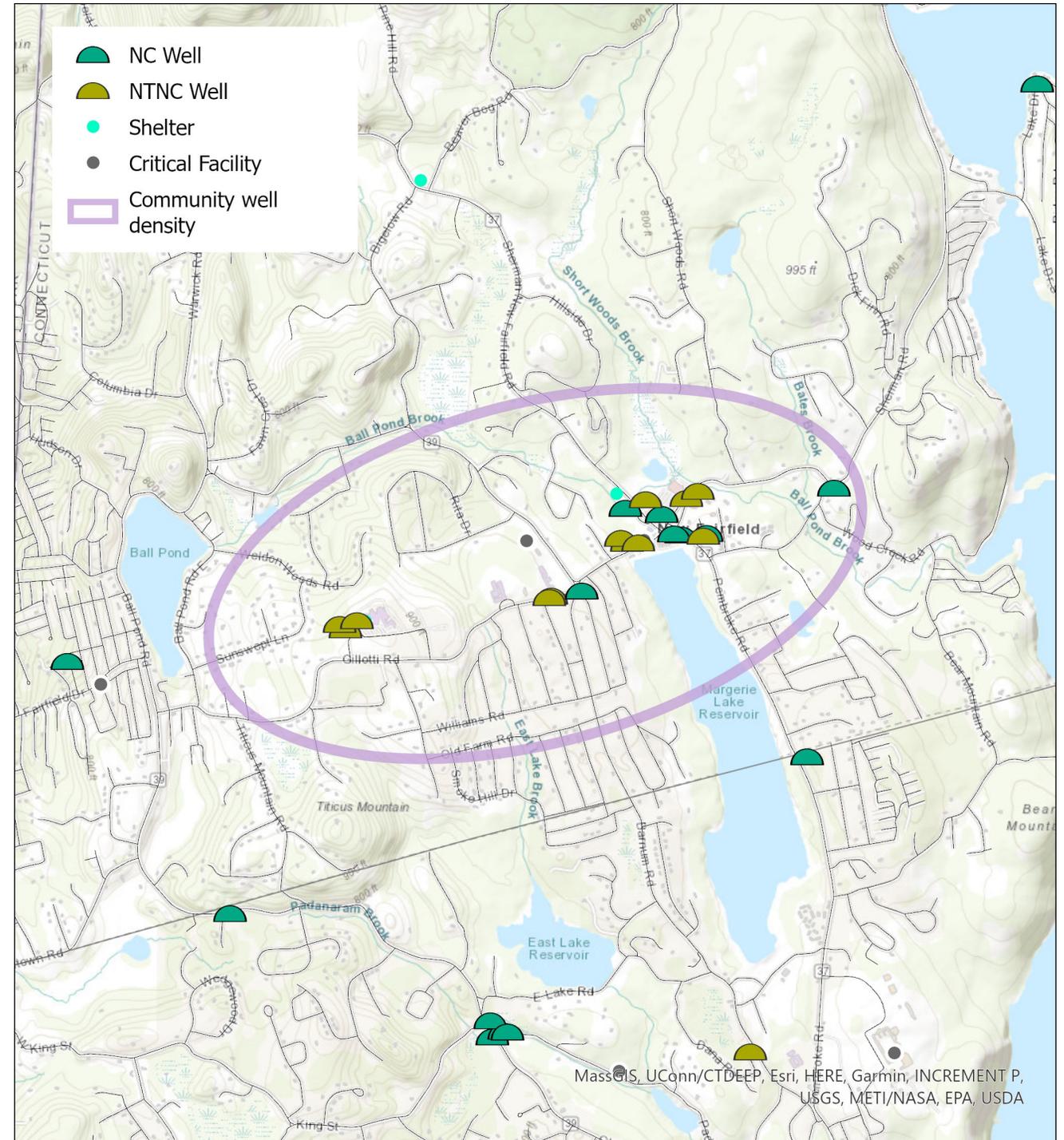
Name: New Fairfield Center

Location: New Fairfield

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

The Town of New Fairfield has taken steps to expand its municipal water system and connect individual properties with non-transient non-community and transient non-community wells, but numerous wells and small water systems remain present. Some of the wells in the town center are affected by a history of groundwater pollution and not all are fitted with treatment systems. With increasing flood and heat risks possible due to variable flood and heat vulnerabilities in the town center, individual wells and water systems could be adversely impacted over time. The opportunity area includes the non-transient non-community and transient non-community wells in the town center and serving the public schools.

High density of public water supply wells in areas of flood and heat vulnerability.



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

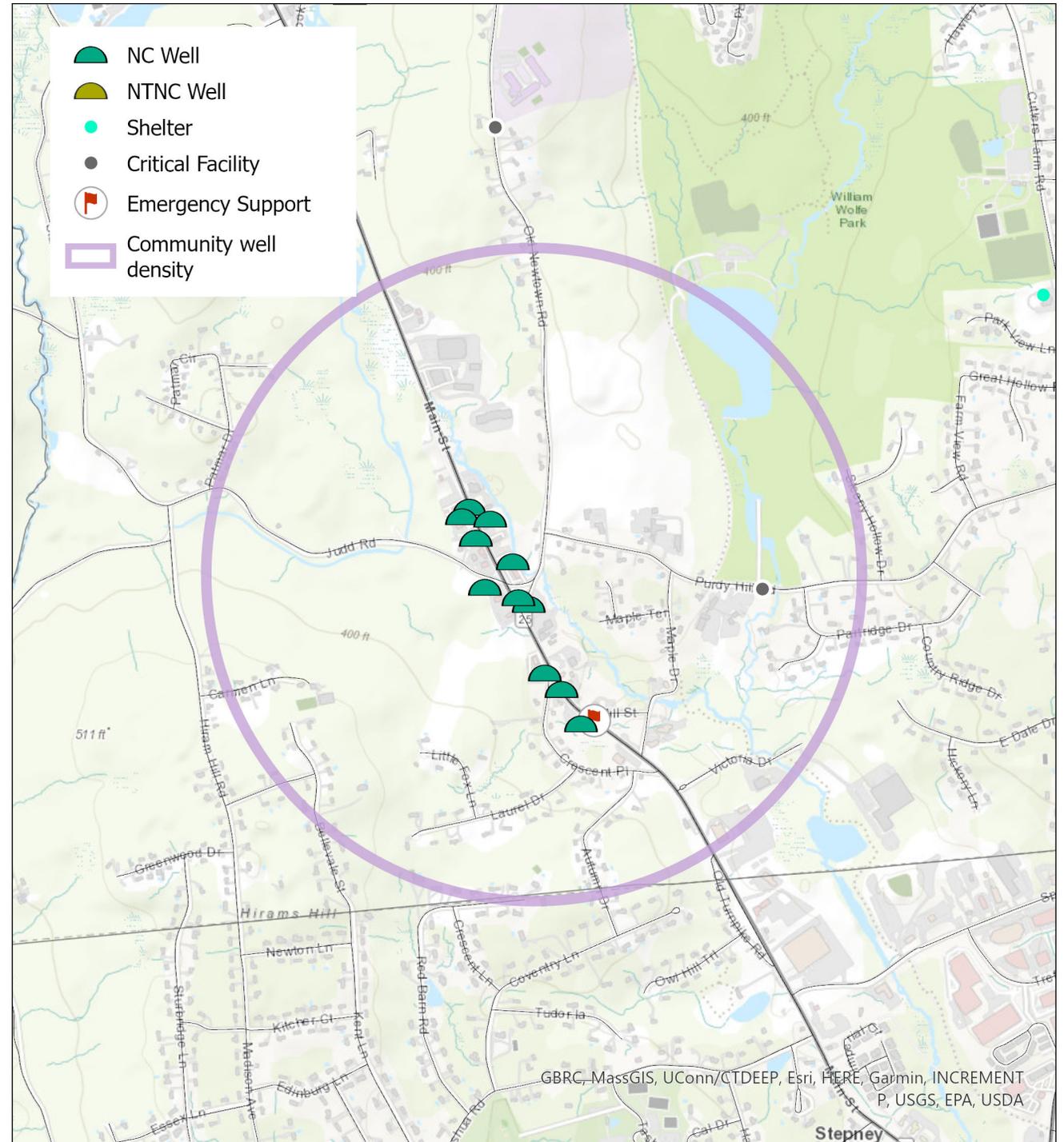
Name: Stepney

Location: Monroe

Considerations	Characteristics of Area
Flood Vulnerability	<input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Heat Vulnerability	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Social Vulnerability	<input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>

Numerous transient non-community wells and their corresponding small water systems are present along Main Street in Monroe. With increasing flood and heat risks possible due to variable flood and heat vulnerabilities along Main Street in Stepney, individual wells and water systems could be adversely impacted over time. The opportunity area includes most of the transient non-community wells.

High density of public water supply wells in areas of flood and heat vulnerability.



Resilient Connecticut

Regional Adaptation/Resilience Opportunity Areas

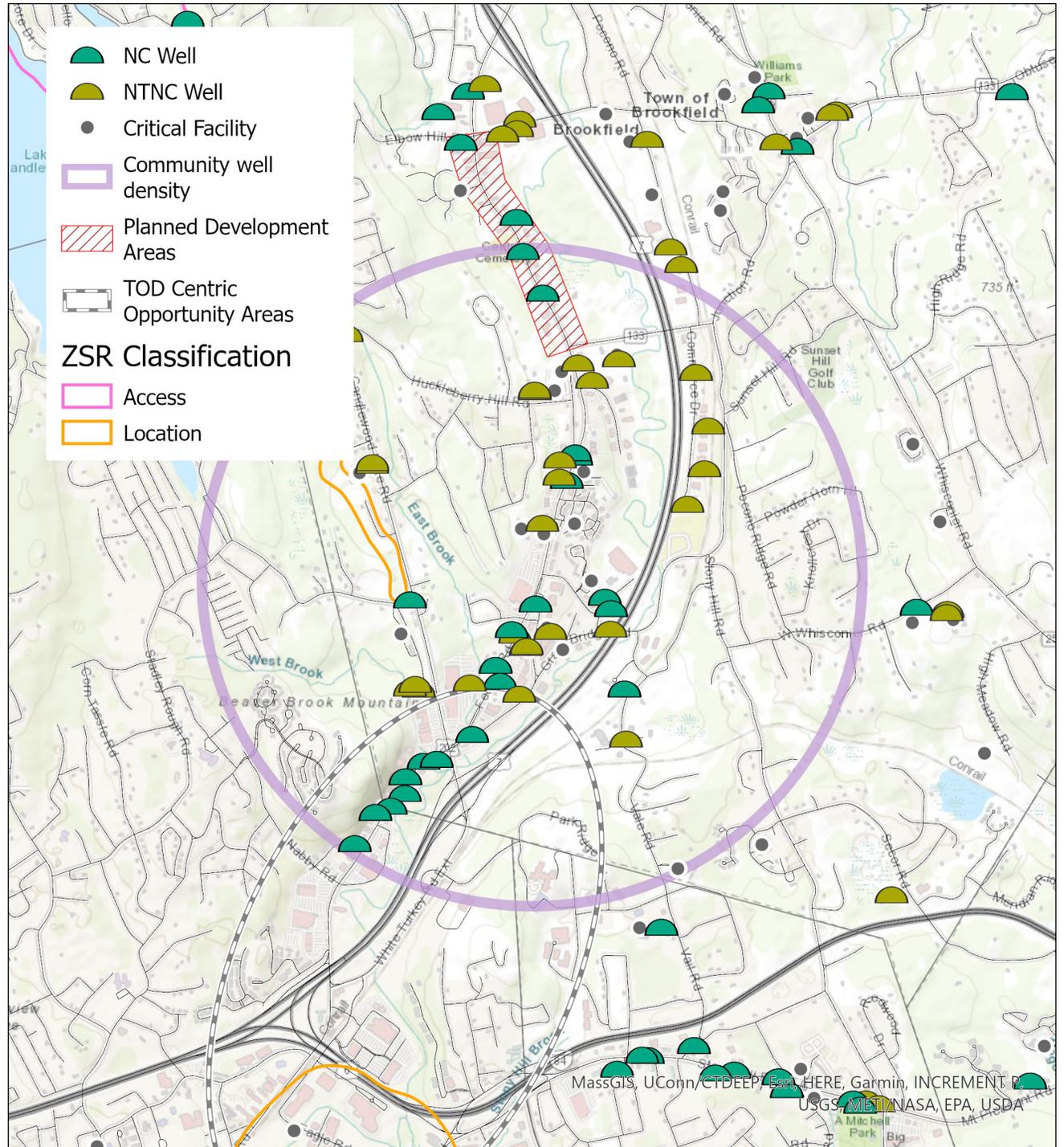
Name: Federal Road

Location: Brookfield

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

The Town of Brookfield and Aquarion Water Company have taken steps to expand Aquarion’s water system and connect individual properties with non-transient non-community and transient non-community wells, but numerous wells and small water systems remain present. With increasing flood and heat risks possible due to variable flood and heat vulnerabilities along the heavily developed Route 7 corridor, individual wells and water systems could be adversely impacted over time. The opportunity area includes many of the non-transient non-community and transient non-community wells.

High density of public water supply wells in areas of flood and heat vulnerability.



Do State Water Plan Recommendations fit?

- “Identify risks of climate change as they relate to integrated water quality and quantity management”
- “The Climate Change Preparedness Plan includes numerous strategies and recommendations related to water which should be considered in the State Water Plan” [this action is being superseded by the work of the GC3, which has superseded the Climate Change Preparedness Plan]
- “Study climate change further and with more specificity”
- “Continue to discuss climate change, specifically inland flooding potential (not covered by coastal studies), and impacts on future drought risks”

Do WUCC Recommendations fit?

- Regionalization and Interconnections - Ensure redundant and environmentally responsible supplies.
- Water Conservation and Water Efficiency - Reduce future demands and unnecessary water use.
- Reduction in Clustering of Small Water Systems - Encourage system consolidations and ensure responsible planning to prevent proliferation of adjacent (but independent) small systems.
- Assistance to Small Public Water Systems - Ensure proper technical, managerial, and financial capacity of small public water systems.
- Investment in Infrastructure - Replace aging infrastructure, including century-old pipes.
- Funding - Provide grants and loans for planning, projects, and small systems in line with the above needs.
- Drought Management and Resilience - Increase awareness of drought impacts and standardize responses to the extent practicable.
- Resiliency to Storms and Climate Change - Reduce recovery time and adapt to future conditions.
- Protection of Watersheds and Supplies - Continue to ensure adequate water supplies with high water quality.
- Planning for Water Demand & Drinking Water Quality Risks - Ensure that public water systems continue to maintain supply to meet projected demands and maintain the highest quality drinking water

Do WUCC Recommendations fit?

- Consolidations or interconnections of small CWSs near larger utilities
 - Brookfield, Bethel, Newtown, New Fairfield
- Development of regional interconnections (dual directional)
 - Waterbury, Aquarion, CWC, Meriden, Wallingford
- Development of other projects to address supply needs
 - Bethel, Aquarion

Do the DWVARP Recommendations fit?

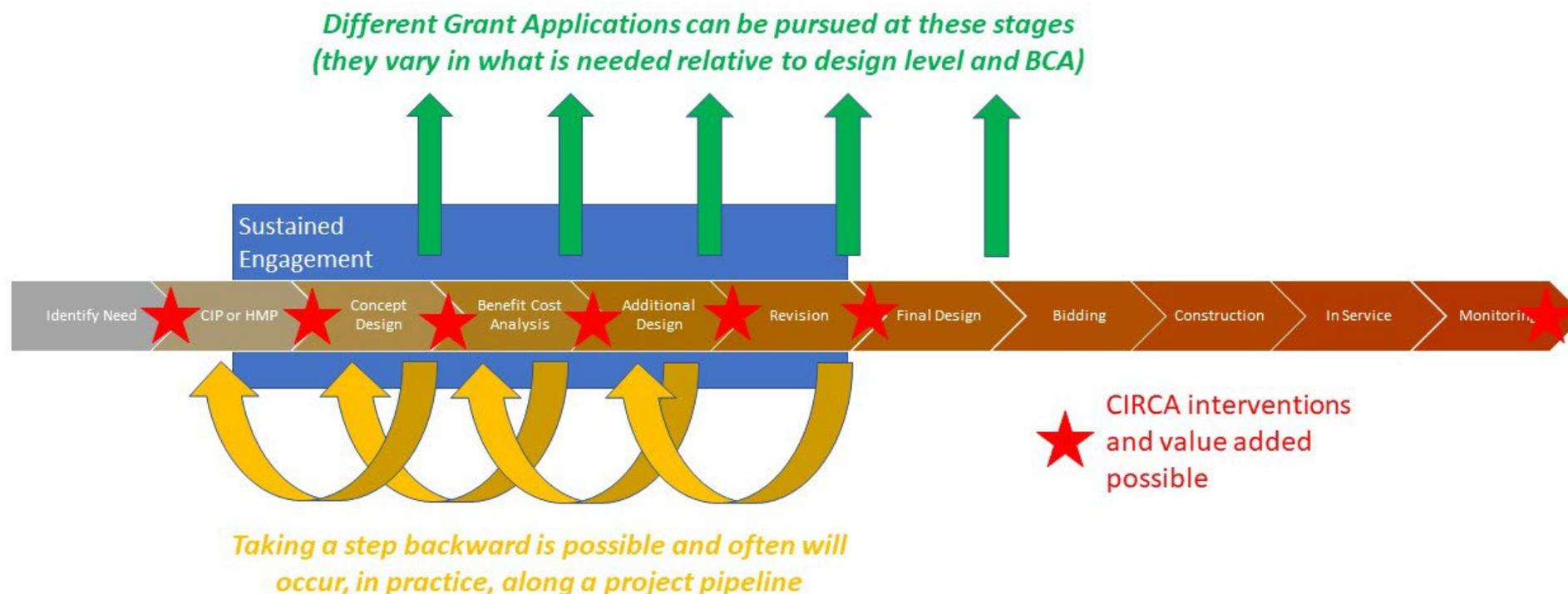
- Directly Supports the WUCC Recommendations on prior slide
- Two additional:
 - Identify property acquisitions to eliminate private well damage from flooding (e.g. River Trail and Flood Bridge Road in Southbury)
 - Extend public water systems to coastal areas that are at risk of coastal flooding, sea level rise, and saltwater intrusion (e.g. Indian Cove in Guilford)

Next Steps for “Resilient Connecticut 1.0”

- Phase II summary report January 2022
- Phase II will transition to Phase III
- Five or six of the opportunity areas will be selected and advanced to public engagement, study, and concept design. This could include:
 - Hydrologic and hydraulic analysis of river and stream systems
 - Coastal flood analysis
 - Transportation and traffic studies; corridor studies
 - Analysis of existing affordable housing
 - Some combination of the above
 - Followed by concept designs

Next Steps for “Resilient Connecticut 1.0”

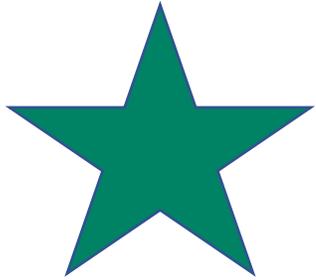
- Feed the Resilience Project Pipeline



Resilient Connecticut

From Regional Vulnerabilities to Resilience Opportunities

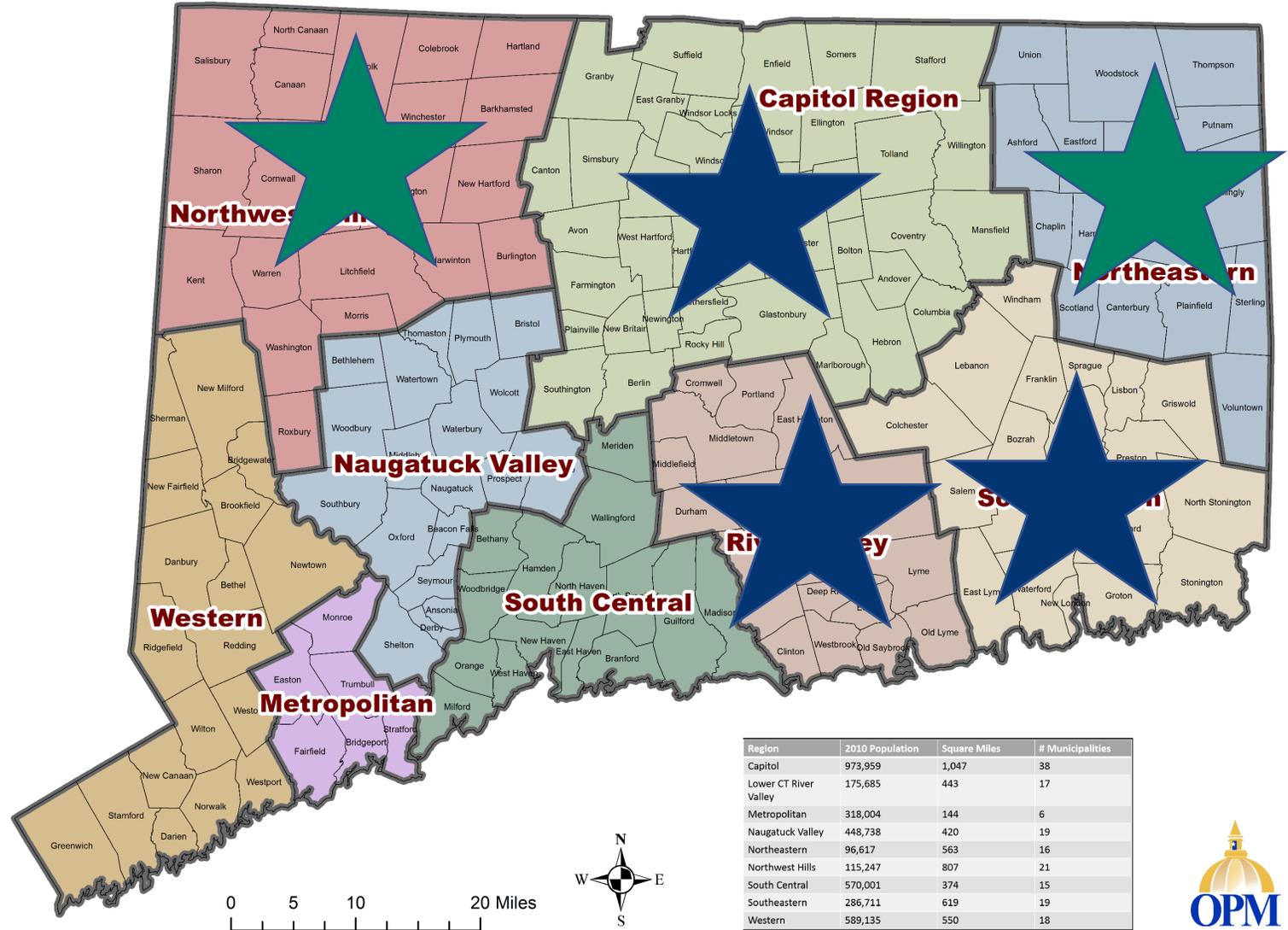
Introducing “Resilient CT 2.0”



Expansion of CCVI
vulnerability
assessment tool



Expansion of CCVI
and intensive
municipal
engagement to
identify resilience
opportunity areas
and future projects



“Resilient Connecticut 2.0”

- The planning process will be expanded in 2022
 - SVI mapping and CCVI expanded to the remainder of Connecticut
 - Intensive planning (meetings with municipalities and identification of opportunity areas) expanded to Hartford, Middlesex, and New London Counties
- The concept design phase will then proceed in 2023
 - Selection of opportunity areas in Hartford, Middlesex, and New London Counties
 - Engagement, study, and concept designs completed by the end of 2023
 - **The TOD focus will need to shift to a more expansive approach; let us know if you have ideas – I have one idea already!**

“Resilient Connecticut 2.0”

- Potential Use of the **State Water Plan** for Identifying Opportunities
 - State Water Plan included a technical analysis to identify drainage basins that have relatively higher instream and out-of-stream needs as compared to available water (i.e., “high risk” and “tipping point” basins).
 - This analysis could be used to help identify high climate vulnerability areas.
 - High risk and tipping point basins may possess a lower level of resilience associated with water resources because the uses are greater; or because water users may have a higher dependency on water or lower capacity to use less water abruptly during droughts.
 - The high risk and tipping point basins may also have lower capacity to infiltrate and store water due to higher development or imperviousness.

“Resilient Connecticut 2.0”

- The high risk and tipping point basins could be used to:
 - ✓ Identify adaptation and resilience opportunity areas
 - ✓ Prioritize adaptation and resilience opportunity areas
 - ✓ Identify adaptation and resilience projects in selected opportunity areas (i.e., design of buildings and landscaping to use less water because of the location in a basin of risk)

2022 Municipal Resilience Grant Program: Resilience Financing and Project Development

- Two tracks:
 - Stormwater authority (stormwater utility) support
 - Project development for FEMA and other grant programs



The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) is requesting grant proposals from municipal governments, non-governmental organizations (NGOs) in partnership with municipalities, and councils of governments (COGs) for initiatives that advance two specific climate priorities for the state of Connecticut: 1) implementation of stormwater authorities, and 2) development of a resilience “project pipeline.” This funding supports the state’s recent legislation, [An Act Concerning Climate Change Adaptation](#) (PA 21-115), and recommendations of the [Governor’s Council on Climate Change](#) (GC3). Importantly, this funding expands the capacity of municipalities to address local resilience financing and project development needs.

Project proposals in either track described below should develop knowledge or concepts that are transferable to other communities and have well-defined and measurable goals. Applicants can submit proposals for both tracks, but only one proposal for each track. Projects should be completed in 12-months.

Eligible Applicants

Connecticut municipalities, NGOs in partnership with municipalities, and COGs.

Proposal Deadline

An original and complete application must be received no later than 5:00 pm on **February 1, 2022**.

A webinar to learn more about this grant funding will be held on **January 7, 2022** from 12:00 – 1:00 pm. [REGISTER HERE](#)

Resilient Connecticut 2.0 and the Grant Program

- Keep Feeding the Resilience Project Pipeline!

