Resilience Improvement Plan

Connecticut Department of Transportation

December 2025

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LIST OF ACRONYMS

BIL	Bipartisan Infrastructure Law
BMP	Best Management Practices
COG	Council of Governments
CIRCA	Connecticut Institute for Resilience and Climate Adaptation
CTDEEP	Connecticut Department of Energy and Environmental Protection
CTDOT	Connecticut Department of Transportation
DCIA	Directly Connected Impervious Area
DEMHS	Connecticut Division of Emergency Management and Homeland Security
EDA	United States Economic Development Administration
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FHWA	Federal Highway Administration
FY	Fiscal Year
HUD	United States Department of Housing and Urban Development
IIJA	Infrastructure Investment and Jobs Act
LID	Low Impact Development
LRTP	Long Range Transportation Plan
NCA5	Fifth National Climate Assessment
NBI	National Bridge Inventory
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHS	National Highway System
PROTECT	Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation
RIP	Resilience Improvement Plan
SFHA	Special Flood Hazard Area
STIP	Statewide Transportation Improvement Program
TAMP	Transportation Asset Management Plan
USDOT	United States Department of Transportation
VA	Vulnerability Assessment
VAST	Vulnerability Assessment Screening Tool

PLAN GLOSSARY

Adaptive Capacity	The ability of a system to adjust or respond to a natural hazard.
Asset	All physical transportation infrastructure located within the right-of-way. The term asset includes all components necessary for the operation of a transportation corridor including pavements, bridges, tunnels, signs, ancillary structures, and other physical components of a corridor.
Existing Conditions	Climate conditions observed in present day.
Exposure	The presence of assets in a location where they could be adversely affected by natural hazards.
Infrastructure	Public infrastructure projects in the United States, which include, at a minimum, the structures, facilities, and equipment for roads, highways and bridges; public transportation; dams, ports, harbors and other maritime facilities; intercity passenger and freight railroads; freight and intermodal facilities; airports; water systems, including drinking water and wastewater systems; electrical transmission facilities and systems; utilities; broadband infrastructure; and buildings and real property; and structures, facilities and equipment that generate, transport and distribute energy including electric vehicle (EV) charging.
Mid-Century Conditions	Climate conditions anticipated by 2050 from authoritative federal and state climate science sources.
Resilience	The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.
Sensitivity	How an asset or system fairs when exposed to a natural hazard based on characteristics of the asset such as the condition of an asset.
Vulnerability	The predisposition of assets to be adversely affected by natural hazards. There are three factors of vulnerability: Exposure, Sensitivity, and Adaptive Capacity.

EXECUTIVE SUMMARY

WHAT IS THE CTDOT RESILIENCE IMPROVEMENT PLAN?

The Connecticut Department of Transportation (CTDOT) has undertaken a voluntary risk-based assessment aimed at identifying and addressing vulnerabilities for the immediate and long-term planning needs of the state's surface transportation system. The Resilience Improvement Plan (RIP) is a strategic foundational assessment designed to ensure that the transportation system can withstand and recover from increasing extreme weather events. From culverts to bridges and roadways to rail lines, transportation infrastructure is susceptible to the disturbances and damage from natural hazards. Connecticut's RIP follows a process to identify natural hazards, assess vulnerabilities, and develop resilience strategies, to lessen the effects of natural hazards within the community and to transportation assets.

PURPOSE AND NEED

The Infrastructure Investment and Jobs Act (IIJA) established the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Program 23 U.S.C. 176(e). The purpose of the PROTECT program is to enhance the resilience of transportation infrastructure against natural hazards and climate variability including flooding, sea level rise, extreme precipitation, and other natural disasters through planning activities, resilience improvements, community resilience, and evaluating at-risk coastal infrastructure. The RIP contributes to the overall resilience of the state's transportation system by supporting efforts to identify vulnerabilities, propose resilience strategies, and provide a process for the prioritization of PROTECT eligible resilience improvement projects to meet the needs of the State's communities and travelers. The RIP will serve as the baseline for assessing the vulnerability of the surface transportation system in relation to the identified natural hazards that the state of Connecticut experiences.

RESILIENCE IMPROVEMENT DEFINITION

Under the USDOT's PROTECT program, resilience improvements are defined as measures that enable an asset or system to prepare for and adapt to changing conditions and disruptions; function during and after hazard exposure; experience fewer impacts from current and future hazards; and be able to absorb, adapt, and recover from hazard impacts.
[§ 11405; 23 U.S.C. 176(d)(4)(A)]

Developing a RIP enables CTDOT to remain proactive in the face of growing natural disaster risks. . The plan can improve transportation system reliability, further incorporate resilience measures into transportation planning and programming activities and continue to embed resilience into the decision-making process. Additionally, the development of this RIP allows CTDOT to maximize federal funds made available through the PROTECT Program Connecticut has access to $90 million in PROTECT formula funding (Fiscal Year (FY) 2022-2026) to make the state's surface transportation system more resilient to extreme weather events.[1] Projects included in the RIP qualify for a reduction in the non-federal cost share requirement by up to 10 percent and do not require a benefit-cost analysist (BCA) when granted discretionary PROTECT funds.

[1] Federal Highway Administration. "PROTECT 5-Year Funding by State." U.S. Department of Transportation. Retrieved from https://www.fhwa.dot.gov/bipartisan-infrastructure-law/protect_5year_funding_by_state.cfm.

Resilience Plan Federal Share Reduction

- 7% for creating a Resilience Improvement Plan and a list of priority projects.
- An additional 3% if a Resilience Improvement Plan is incorporated into the state's Long Range Transportation Plan (LRTP) or the metropolitan transportation plan, as specified under § 11405; 23 U.S.C. 176(e)(1)(B).[2]

Asset Data and Inventory

Data collection was essential when developing the RIP to help identify CTDOT-owned and managed assets as part of an ongoing assessment of system vulnerability. A foundational vulnerability assessment (VA) is in progress to identify the locations and conditions of assets at the greatest risk of experiencing disruption and damage from natural hazards. Using asset-level data, a quantitative assessment for primary assets is being performed for over 5,000 miles of roads, 4,000 bridges and culverts (National Bridge Inventory (NBI) and Non-NBI bridges and culverts), numerous drainage culverts[3] (NBI culverts and Non-NBI culverts), transit shelters, and multi-use trails. Additionally, a qualitative assessment for contributing assets with limited data availability will be performed using a descriptive narrative-based assessment. The culmination of the results may further assist in risk-based assessment, decision making, and PROTECT eligible project screening and project selection processes.

Resilience Strategies

As the ongoing vulnerability assessment is further refined, the RIP outlines strategies to enhance internal operations and to strengthen the physical resilience of CTDOT's assets to extreme weather disruptions. These strategies, tailored to specific hazards and asset groups, span various specialties including planning, design, construction, operations, and maintenance activities. Implementing resilience strategies within the organization can better prepare the surface transportation system to withstand and recover from natural hazards. Councils of Government (COGs) and municipalities can use the list of state and federal funding sources in Appendix D: Funding Overview to support the implementation of these resilience strategies. State agencies, including CTDOT, may be eligible to apply to some but not all of the listed programs.

Goal of the Resiliency Improvement Plan

The RIP provides a foundational understanding about present-day and Mid-Century transportation vulnerabilities within Connecticut. As the state is expected to experience more frequent flooding, rising sea levels, extreme precipitation events, and temperature fluctuations, recent events have highlighted where infrastructure improvements are most needed. The long-term goals of the RIP are to reduce risks to transportation infrastructure, guide cost-effective investments, improve safety, and enhance the ability of transportation assets to withstand and recover from extreme weather events while aligning with both federal and state standards. By investing in resilient planning and design, Connecticut can protect the state's transportation infrastructure assets, support economic vitality, and ensure safe, dependable transportation for all residents—now and into the future.

[2] Federal Highway Administration. (2025). Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program. Retrieved from https://www.fhwa.dot.gov/infrastructure-investment-and-jobs-act/protect_fact_sheet.cfm

[3] Within the RIP, the term "drainage culverts" refers to structures under six feet in diameter. Structures that convey a watercourse, stormwater and/or wastewater, as well as flow equalizers, are included within this asset group.

1. OVERVIEW OF CONNECTICUT'S TRANSPORTATION SYSTEM

The Connecticut Department of Transportation (CTDOT) oversees the planning, design, construction, operation, and maintenance of the state's transportation infrastructure. The state's diverse collection of assets includes more than 21,000 lane miles of highways and roadways, 37 rail stations along three major commuter rail lines, mass transit systems that produce more than 40 million bus trips annually, strategically located deep water ports, and a modernized international airport. While CTDOT does not manage the ports or airport assets, they remain part of the state's comprehensive transportation system.

This multimodal transportation system connects Connecticut's historic cities, towns, and villages to each other and the economic opportunities of the surrounding New England region and beyond. Nearly every resident, visitor, business, industry, and institution in the state is dependent upon this complex and interconnected system for daily needs, exemplifying why CTDOT's mission is to improve lives through transportation. The agency's vision is to create a consistently positive experience for the people of Connecticut that optimizes mobility, supports economic vitality, and recognizes the impact of infrastructure development on the public and the environment.

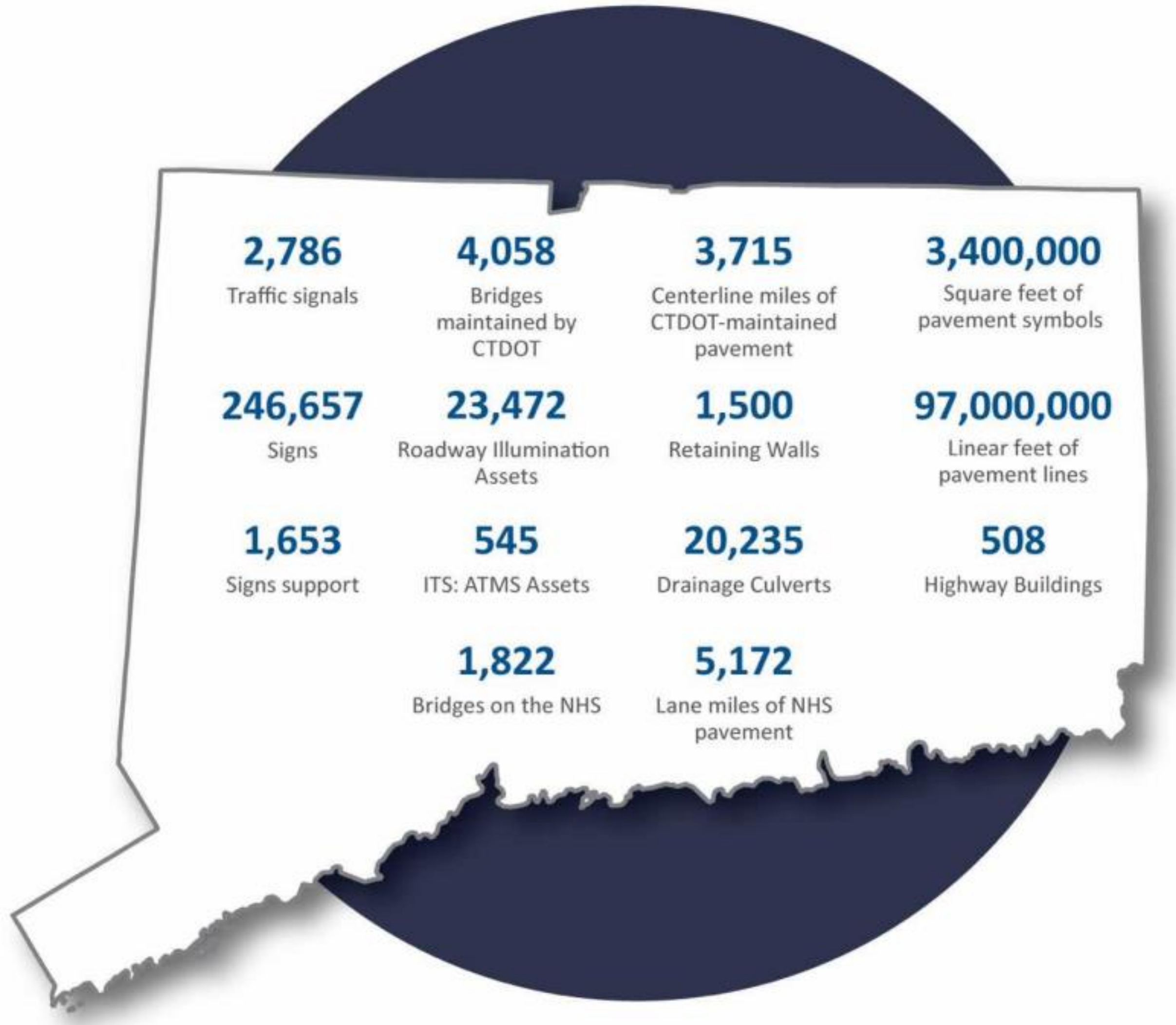


Figure 1: Connecticut Department of Transportation Highway Assets

CTDOT's Highway Transportation Assets

The RIP identifies opportunities for resilience improvements to CTDOT's transportation system that Connecticut residents and visitors use daily. Connecticut's transportation system comprises a diverse array of assets critical to daily mobility and economic activity across the state. CTDOT owns or operates over 5,000 miles of roads, both National Highway System (NHS) and non-NHS bridges and culverts, and a wide range of additional infrastructure, including drainage systems, bus routes, ferries, transit shelters, rail lines, and rail stations. These assets serve urban, suburban, and rural communities and form a multimodal system that supports commuter rail, intercity passenger rail, bus transit, freight movement, and non-motorized travel. The RIP focuses on transportation assets owned or operated by CTDOT. Connecticut's asset management system[4] is outlined below:

The National Highway System (NHS) in Connecticut currently consists of:

- 1,406 centerline miles of pavement
- 1,822 NBI bridges

The other CTDOT-maintained assets include:

- 3,715 centerline miles of non-NHS pavement
- 4,058 non-NHS bridges
- 2,786 traffic signals
- 246,657 signs
- 1,653 sign supports
- Pavement markings
    - 97,000,000 linear feet of pavement lines
    - 3,400,000 square feet of pavement symbols
- 508 highway buildings
- 23,472 light fixtures and 207 light systems
- 1,500 retaining walls (estimated)
- 20,235 drainage culverts (estimated)
- 545 intelligent transportation systems (ITS) devices

[4] CTDOT (2022). Connecticut Transportation Asset Management Plan. Retrieved from https://portal.ct.gov/dot/bureaus/engineering-and-construction/project-administration/asset-management?language=en_US.

Figure 2 displays the *Connecticut National Highway System*, as shown in the 2022 Transportation Asset Management Plan (TAMP). Connecticut's highway system is comprised of state owned and operated roadways. Monitoring and measuring transportation asset conditions allows CTDOT to assess the performance of the surface transportation system and analyze deficiencies that may help prepare for future transportation resiliency needs.

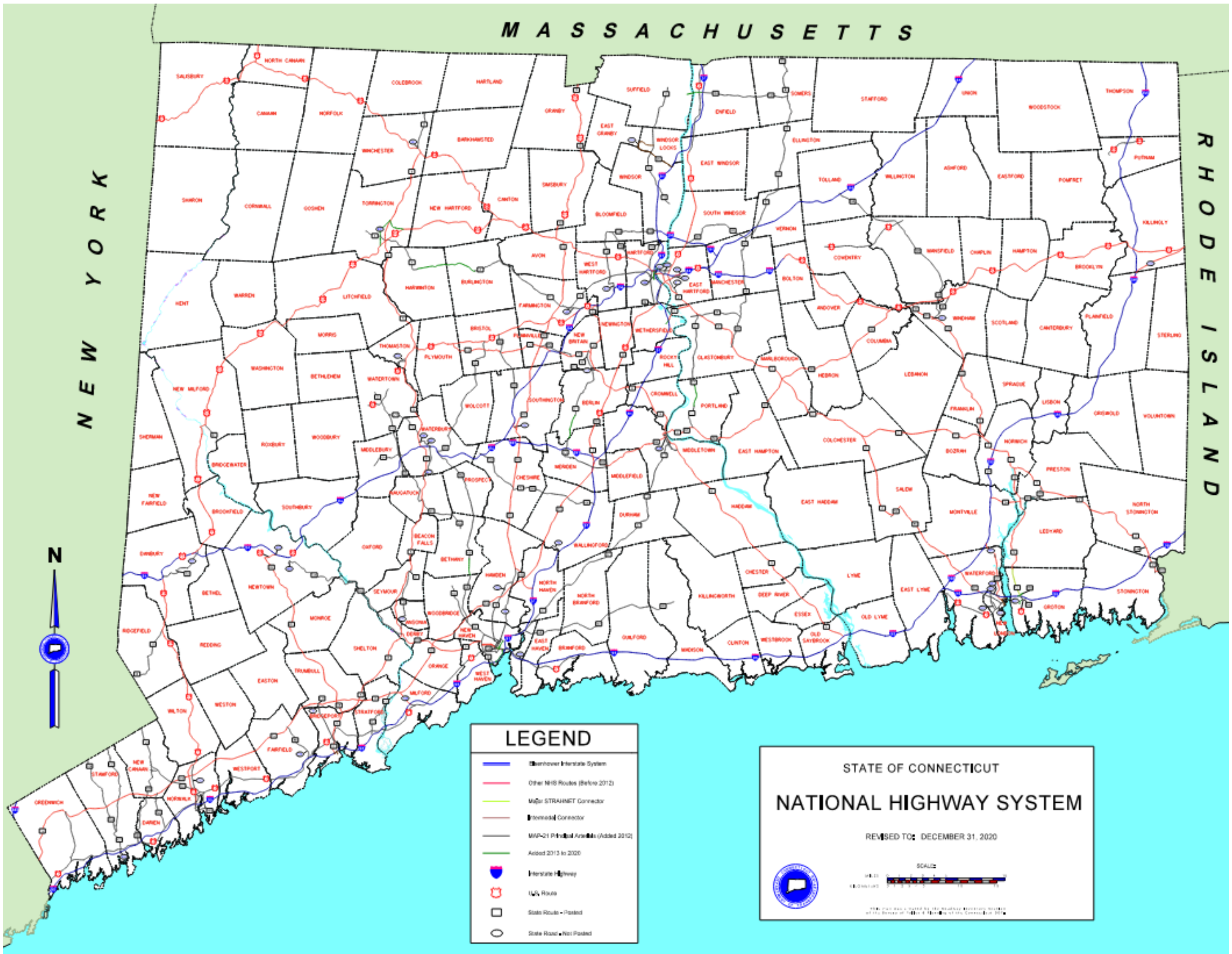


Figure 2: Connecticut's National Highway System[5]

[5] CTDOT (2022). Connecticut Transportation Asset Management Plan. Retrieved from https://portal.ct.gov/dot/bureaus/engineering-and-construction/project-administration/asset-management?language=en_US.

PUBLIC TRANSPORTATION

CTDOT is responsible for the development, operation, and maintenance of a safe and efficient multimodal transportation system to effectively move people and goods. CTDOT oversees a multi-billion-dollar, five-year capital program. In federal FY 2024 alone, CTDOT committed approximately $2.1 billion across all modes, including $800 million for bus and rail transportation assets. CTDOT is Connecticut's largest public transit owner-operator.

PUBLIC TRANSIT AND RAIL

Connecticut is home to over 300 local and express fixed bus routes (with supporting paratransit bus service), as well as intercity and commuter rail service on three main lines and three branch lines, and two seasonal ferry services. These multi-modal services carry over 66,000,000 passengers per year, keeping Connecticut moving to work, school, healthcare services, grocery stores, recreation, and more.

As detailed in the following sections, public transit assets are spread across several transit districts and include buses, garages, electric bus charging infrastructure, rail lines, rail stations, switch controls, and more. Because of the complexity of these assets, CTDOT will use the RIP and the Public Transportation Resilience Strategies that are currently being implemented and are outlined in Section 6 to further the resilience goals of CTDOT. Public Transportation Resilience Strategies serve to lay the groundwork for a future RIP update that is all inclusive. A detailed quantitative assessment of public transit asset types will be explored in the future as more data is available to aid in the vulnerability scoring process.

BUS

CTDOT owns the local bus divisions in Hartford, New Haven, Stamford, Waterbury, New Britain, Bristol, Meriden and Wallingford, and operates them under the CTtransit brand name. The state is fully responsible for the costs of operating these local bus systems. The state owns and holds title to all the buses that provide CTtransit services. CTtransit accounts for approximately 75% of the state's bus service, while the other 25% of service is operated by 13 Transit Districts, as shown in Figure 4.

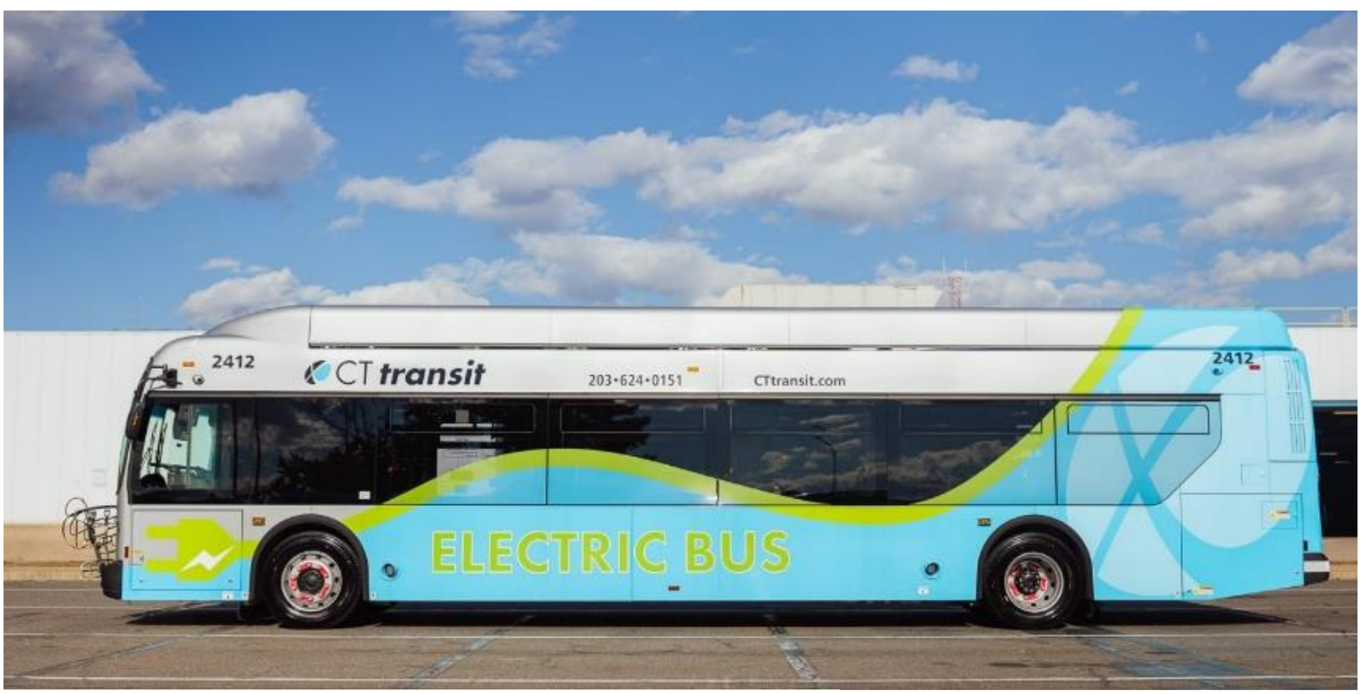


Figure 3: CTtransit Battery Electric Bus

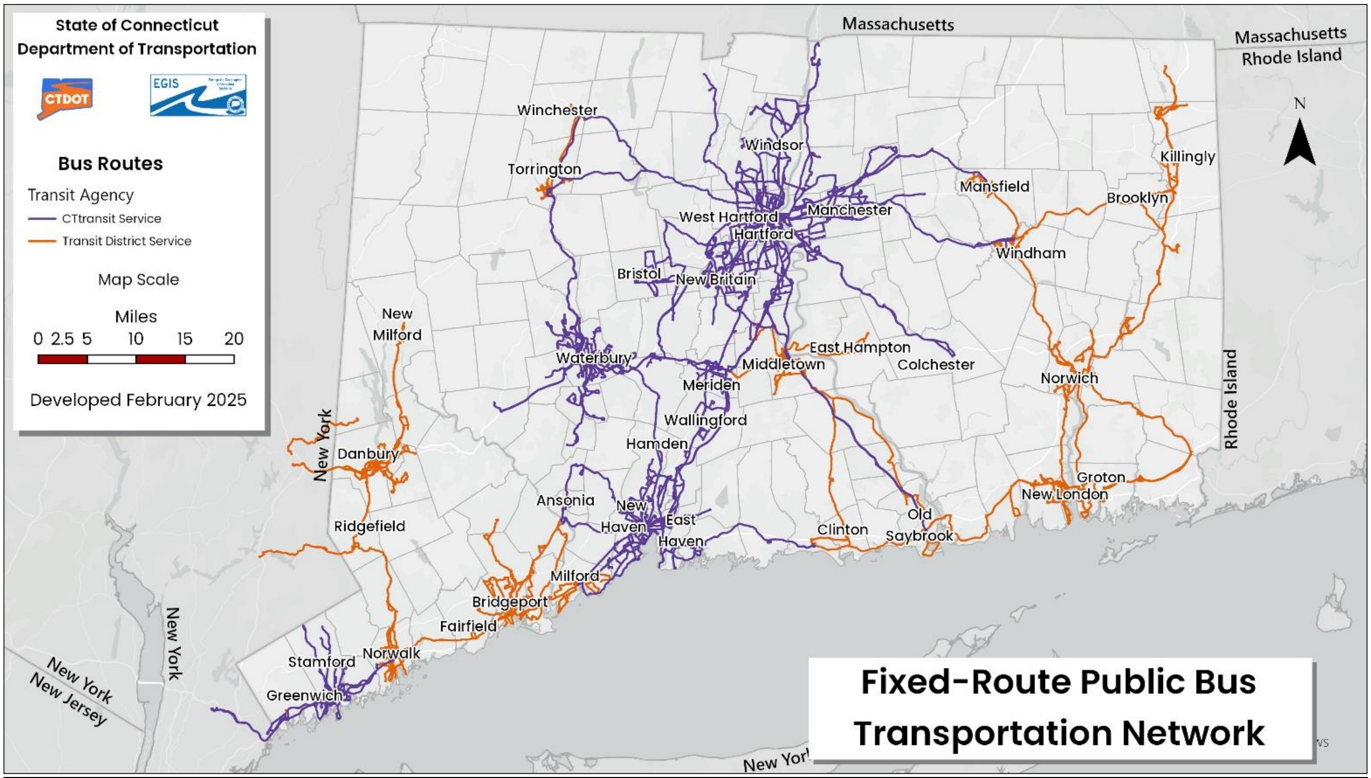


Figure 4: CTtransit-owned and Non-CTtransit Local District Bus Routes

CTDOT owns bus storage and maintenance facilities for the CTtransit Hartford Division, the CTtransit New Haven Division, the CTtransit Waterbury Division, and the CTtransit Stamford Division. In addition, the state owns bus storage and maintenance facilities for the Southeast Area Transit District and the Windham Region Transit District. The operators of the CTtransit New Britain and Bristol Divisions operate out of shared facilities with their private operators.

In the non-CTtransit service areas, local transit districts hold title to the buses used for their systems and are responsible for operation of bus services. The local districts provide bus transit services under the direction of local Boards of Directors representing the town members. CTDOT enters into transit operating assistance contracts with the transit districts to provide financial support to the transit districts.

PASSENGER RAIL

Connecticut's busiest commuter rail service is the New Haven Line (NHL), between New Haven, CT, and Grand Central Terminal in New York City. The line consists of the New Haven Main Line and three branch lines (New Canaan, Danbury, and Waterbury), illustrated by Gold lines in Figure 5. The State of Connecticut owns the NHL tracks within Connecticut and service is currently operated by Metro-North Railroad (MNR). CTDOT and MNR share capital and operating costs on the main line, while CTDOT is responsible for operating and capital costs on the branch lines. The NHL is a critical link along Amtrak's Northeast Corridor (NEC), allowing connections between Washington, D.C., Philadelphia, New York, Stamford, New Haven, and Boston.

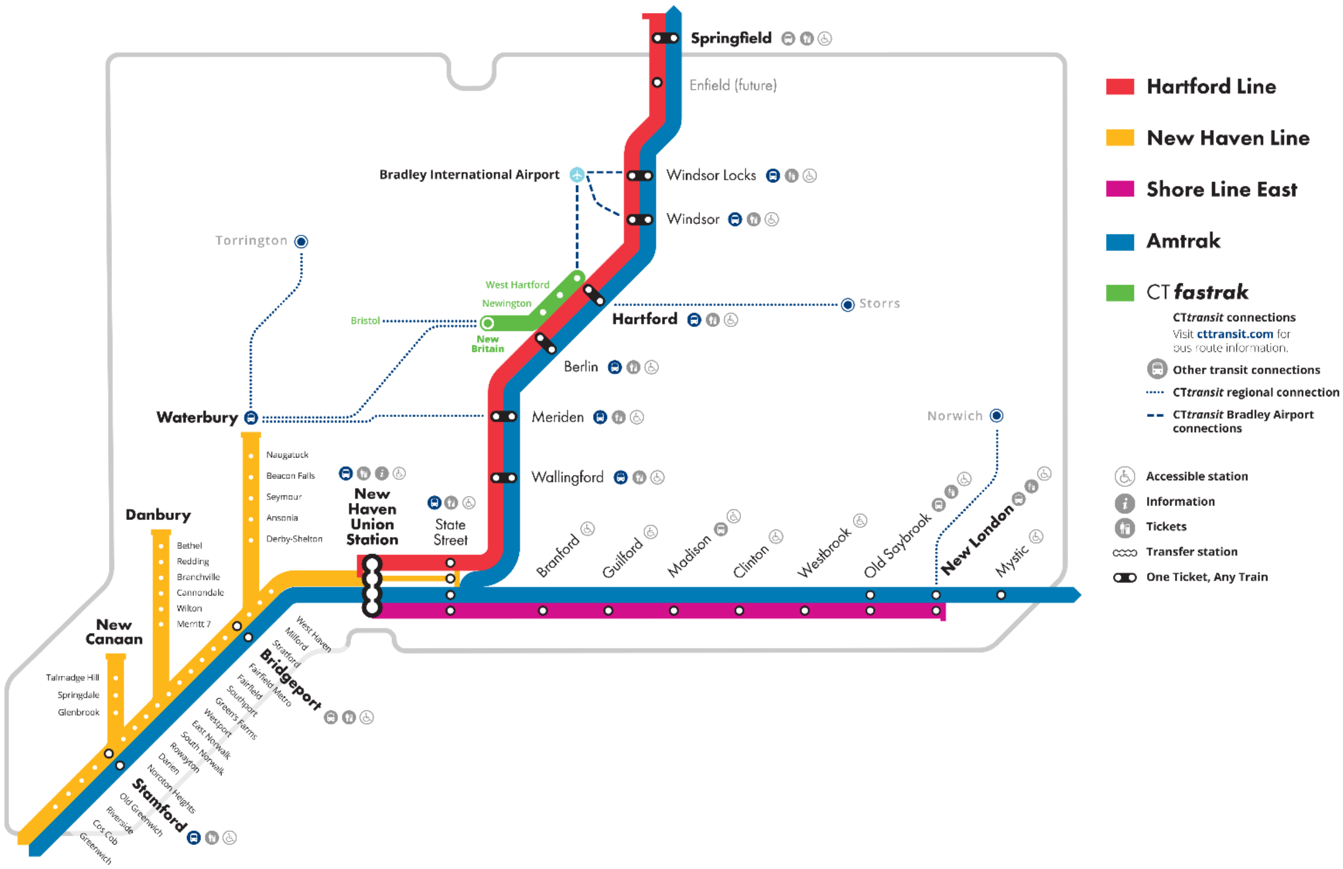


Figure 5: Breakdown of Passenger Rail Owned by Different Entities

The CTrail Hartford Line (HL) runs north-south from Springfield, MA to New Haven Union Station via Hartford Union Station, illustrated by Red lines in Figure 5. CTDOT owns all the stations along the Hartford Line, except for Hartford Union, which is owned by the Greater Hartford Transit District (GHTD). Amtrak owns all remaining fixed infrastructure along this route, while CTDOT owns the rolling stock.

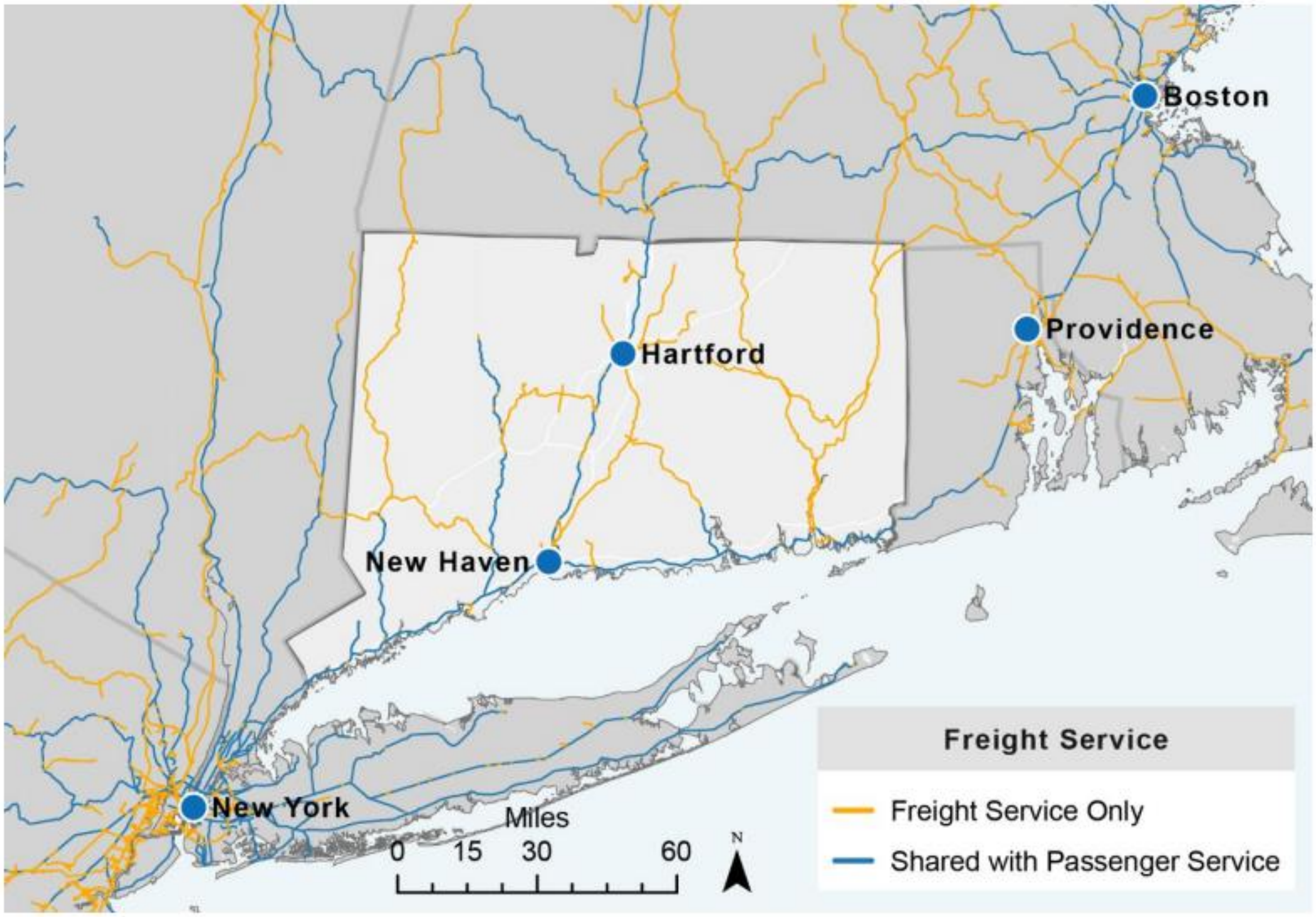
Finally, Amtrak operates intercity rail services throughout Connecticut including the Northeast Corridor connecting through New York City to Washington DC to the southwest and through Providence RI to Boston MA to the northeast. Additional Amtrak services connect north to Massachusetts and Vermont, illustrated by Blue lines in Figure 5.

Figure 6: CTrail Shore Line East

FREIGHT RAIL

Connecticut's rail freight industry is operated by the private sector as a for-profit and public benefit service. The State of Connecticut owns five freight rail routes, and its ten freight operators operate over 577 miles of right-of-way, shown in Figure 7.

There are over 628 miles of freight railroad right-of-way within the state consisting of public and privately owned property. Most of the freight rail operations in Connecticut involve shared-use agreements between owners of passenger rail operators (Amtrak, etc.) and freight rail companies. In 2019, an estimated 6.7 million tons of goods traveled on Connecticut rails. Most modern freight rail lines in the United States use the industry standard 286,000-pound rail, but many smaller railroads and branch lines have not been upgraded, effectively limiting freight capacity on such lines. Capacity and operations issues on key rail lines can lead to freight rail bottlenecks



Source: AECOM

Figure 7: Privately Owned Freight Service Shared with Passenger Service

MULTIMODAL FREIGHT SYSTEM

Millions of tons and billions of dollars in freight traverse across Connecticut's multimodal freight transportation system each year, representing a critical component of the economy from the local to the national level. Trucks carry the majority of freight in Connecticut; however, goods are also moved by rail, water, and air. Connecticut's multimodal freight transportation spans across 21,557 miles of public roadway[6], 628 miles of freight railroad right-of-way, three deep-water commercial ports, one major cargo airport, and 590 miles of gas and oil transmission pipelines.

The state utilizes three deep-water commercial ports located in New London, New Haven, and Bridgeport, as well as select ferry operations, to transport freight. In 2019, Connecticut's Bridgeport and New Haven ports combined to handle 11.1 million tons of goods. Freight transport via waterways requires maintenance dredging and nearby multimodal facilities to shift freight across vehicle modes, such as ship to rail. This mode shift is partially responsible for rail freight's projected growth of 30 percent by 2040.

Air cargo via the Bradley International Airport (BDL) represents the second largest contributor to freight movement by value in Connecticut. In 2020, BDL landed approximately 1.2 million pounds of air cargo ranking 30th in the nation.

[6] CTDOT (2022). Connecticut Statewide Freight Plan Update. Retrieved from https://portal.ct.gov/dot/-/media/dot/freight/2022-2026-connecticut-statewide-freight-plan.pdf?rev=f2261c61f8c8481383b8d2b1c38c9ab9&hash=D93579E65381C6A41F42DAC616D1C766.

FERRY

CTDOT owns and operates two seasonal ferries across the Connecticut River. The Rocky Hill - Glastonbury Ferry is the oldest operational ferry in the United States. The original ferry dates back to 1655, crossing the Connecticut River. The ferry consists of a barge that can transport three cars and a handful of pedestrians and bicyclists. The Chester-Hadlyme ferry has operated since 1769 serving local motorists, cyclists, and tourists between Chester and Hadlyme. Both ferries provide critical connections across the Connecticut River.

Additionally, there are three private interstate ferries that travel from Connecticut. The Cross Sound Ferry originates in New London, Connecticut and travels to Orient Point in Long Island, New York. The Bridgeport-Port Jefferson ferry offers year-round service departing the terminal in Bridgeport, CT traveling to Port Jefferson in Long Island, NY. The Block Island Ferry connects New London, Connecticut and Old Harbor, Block Island in Rhode Island.

Figure 8: Chester-Hadlyme Ferry on the Connecticut River

2. RESILIENCE IMPROVEMENT PLAN DEVELOPMENT PROCESS

Connecticut's transportation system faces growing challenges from increasingly severe weather events, including extreme precipitation, heatwaves, coastal and inland flooding, and other climate-driven hazards. These events have already led to substantial damage and service disruptions across the state's transportation system. These disruptions impact not only mobility, but also access to healthcare, jobs, education, and emergency services. CTDOT recognizes that responding to these challenges requires a proactive, strategic approach rooted in data, planning, and collaboration.

The RIP was developed between 2024 and 2025 and is a risk-based plan to strengthen the resilience of the surface transportation system against natural hazards. The RIP establishes a PROTECT eligible project screening process for integrating resilience into project planning and development phases. Integrating resilient measures into CTDOT's projects is vital for withstanding and recovering from hazards.

The RIP focuses on evaluating natural hazards that are consistent and complementary to the state and local hazard mitigation plans in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act). The Stafford Act, 42 U.S.C. 5165, was enacted under Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000), Public Law 106-390, to encourage and reward facilitated cooperation between state and local authorities in support of disaster planning to promote sustainable communities and services. In addition to state and local hazard mitigation plans, existing CTDOT plans including the 2018 Connecticut Statewide Long-Range Transportation Plan 2018-2050 (LRTP), 2022-2026 Statewide Freight Plan, Carbon Reduction Strategy (CRS), and Statewide Transportation Improvement Program (STIP) were reviewed for alignment with the RIP. Appendix A: Literature Review Memo details the existing state and local plans reviewed to identify synergies between the RIP and those relevant planning documents.

While preparing the RIP, CTDOT applied a systemic approach to further understand transportation infrastructure's resilience against natural hazards. As demonstrated in Figure 9 below, the RIP development process consists of multiple steps. CTDOT has completed Steps 1, 2 and 3 while Step 4, Assessing Vulnerability, is ongoing. Steps 5 and 6 have been developed. The RIP is a working document that will be updated as vulnerable assets are addressed or newly identified.

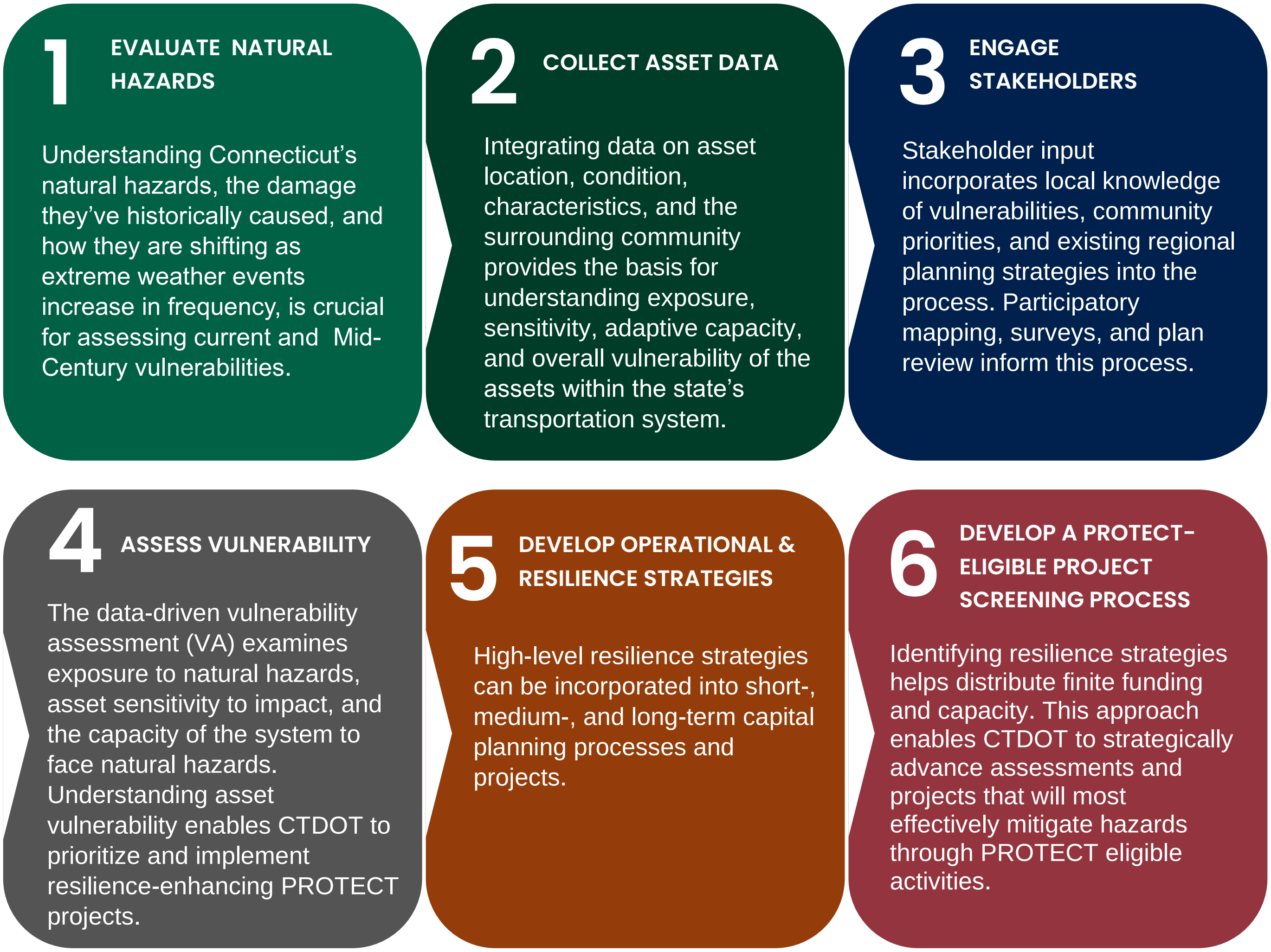


Figure 9: RIP Development Process

Step 1 Evaluate Natural Hazards: The plan development process begins with an understanding and evaluation of the natural hazards that may affect Connecticut. The 2023 State Hazard Mitigation Plan included an assessment of natural hazards that can impact the State of Connecticut. The hazards with the most negative impact on the state of Connecticut have included flooding, hurricane / tropical cyclone (storm surge), extreme heat, and extreme cold / winter weather. Understanding Connecticut's natural hazards is critical for assessing current and mid-century vulnerabilities.

Step 2 Asset Data: This involved data collection of over 30,000 assets. Data integration included asset location, condition, characteristics, and surrounding communities. To assess the overall surface transportation system's vulnerability based on the Federal Highway Administration's (FHWA) Vulnerability Assessment Scoring Tool (VAST), asset condition data was based on the three vulnerability indicator types used in the tool: exposure, sensitivity, and adaptive capacity. Data collection also included the review of existing statewide and local plans such as multi-hazard plans, climate resiliency plans, Connecticut's Statewide Transportation Plan, and Connecticut Institute for Resilience and Climate Adaptation (CIRCA) reports. This step furthered CTDOT's understanding of the existing resilience work and climate projections completed to date across Connecticut.

Step 3 Stakeholder Coordination: Stakeholders were engaged to ensure that the knowledge, lived experiences, and priorities of Connecticut's stakeholders were incorporated in the RIP. Councils of Governments (COGs) have a wealth of knowledge around localized extreme weather impacts, concerns, and needs. Engagement efforts with these groups sought to capture the local personal experiences of community members.

Step 4 Assess Vulnerability: Vulnerability is the predisposition or tendency of an asset to be adversely affected by a hazard. Vulnerability of assets can be assessed both quantitatively and qualitatively. CTDOT is currently refining the vulnerability assessment to ensure that the planning tool accurately reflects areas susceptible to natural hazard disruptions.

Step 5 Operational & Resilience Strategies: This involved the development of operational and resilience strategies. Recommendations of current resilience practices, proposed resilience strategies, internal operational strategies, and external partnership collaboration ensures that the systemic approach of the RIP enhances CTDOT's ability to withstand, respond to, and restore affected areas that have experienced disruptions from natural hazards.

Step 6 Project Screening Process: The purpose for developing a project screening process is to integrate resilience into the criteria for PROTECT eligible project selection with a risk-informed approach to promote Connecticut's economic resilience from natural hazards; while streamlining project delivery and making strategic investments that save lives, secure livelihood, and reduce taxpayer burden in conformance with Executive Order 14239 - Achieving Efficiency Through State and Local Preparedness. The Executive Order aims to enhance national resilience and preparedness by empowering state, local and individual governments to make informed decisions and investments.

3. PHYSICAL AND SOCIAL CONTEXT

Geographic Overview

Connecticut's geography and topography have shaped development patterns within the state. Spanning 5,543 square miles and located in the northeastern coast of the United States, Connecticut is part of the New England region bordered by Massachusetts to the North, Rhode Island to the East, Long Island Sound to the South, and New York to the West. The Connecticut River is the longest waterbody in New England and is tidally influenced (subjected to the ebb and flow of Long Island Sound). The Connecticut River is approximately 407 miles long flowing southward from New Hampshire / Vermont, through Massachusetts, and bisects the state of Connecticut ultimately discharging into Long Island Sound. Inland hilly regions of the state, while removed from coastal flooding, face exposure to stream and riverine flooding concerns associated with deep river valleys. Removed from the temperature-regulating forces of the sea, inland communities of the state encounter relatively greater temperature extremes. Inland population centers include the cities of Hartford and Waterbury. Notably, Connecticut is the third smallest state by area and is densely populated. Approximately 61% of the state's 3.6 million people are concentrated in coastal communities such as New Haven, Bridgeport, Norwalk, and Stamford.[7] Connecticut's temperate climate is geographically dependent and experiences all four seasons. Communities across the state experience varying degrees of exposure to increasingly severe natural hazards. These hazards are geographically dependent and include sea level rise, storm surge, tidal flooding along the coast, flash flooding, extreme heat, and freeze-thaw cycles in inland areas.

Population

State planning projections,[8] as shown in Figure 10, demonstrate the projected population change from 2015 - 2040 with the highest rates of population growth in the Capitol region (CRCOG), Metropolitan region (MetroCOG), Southeastern region (SECCOG), and South Central region (SCRCOG). As the population grows in these regions, the demand for transportation infrastructure and other public services will intensify, placing additional strain on aging assets. Growth in flood-prone areas can also increase the number of people and critical facilities at risk during extreme weather events, compounding both direct physical impacts and long-term recovery costs. The impact of population growth on the transportation system is complex and continues to be shaped by the demands of the community to accommodate for a more resilient and sustainable infrastructure system.

[7] EPA. (2024). Climate Change Connections: Connecticut (The Coastline). Retrieved from https://www.epa.gov/climateimpacts/climate-change-connections-connecticut-coastline

[8] CT Data. (2018). Connecticut Population Projections – State, County, and Regional Councils of Governments Level, 2015--2040. Retrieved from https://data.ct.gov/Government/Connecticut-Population-Projections-State-County-an/pv2w-k7qu/about_data

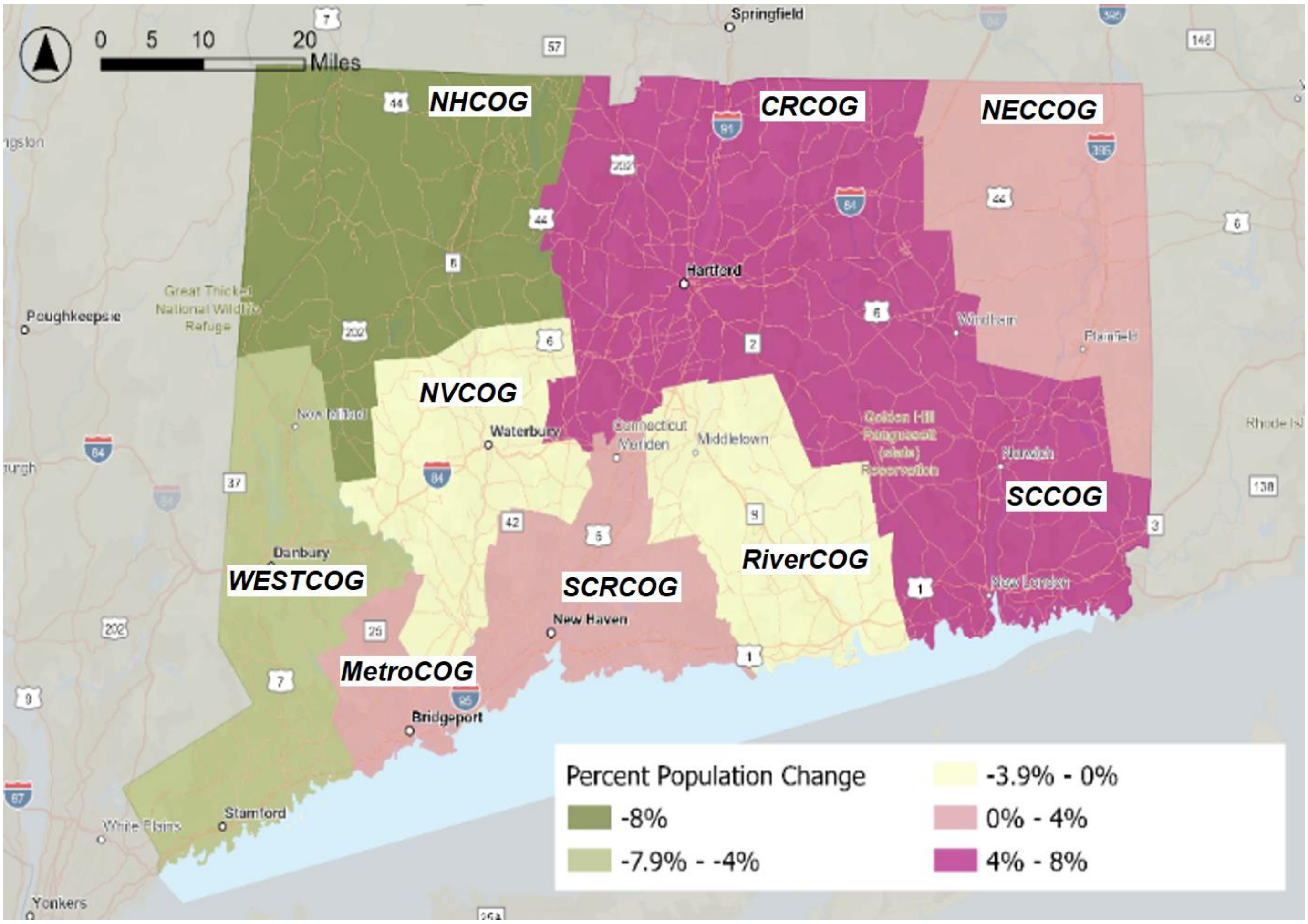


Figure 10: Projected Population Change, 2015 – 2040

LAND USE

Connecticut's land use varies from a mix of urban, suburban, and rural areas. Land use regulations are adopted by the city or town that regulate the permissible uses for residential, commercial and industrial areas, the use of buildings and structures, and even green space within the community. Connecticut's landscape has been influenced by and has evolved to accommodate the various environmental and economic needs of the state. The state is experiencing ongoing development, which results in an increasing amount of impervious surface coverage. This increase in impervious surface coverage has led to an increase in stormwater runoff, the transport of sediment, and has increased localized flooding concerns that can impact transportation infrastructure.[9] There are 169 municipalities in which "home rule" governs the local decision-making process. Home rule allows municipalities to establish their own form of localized governance through a town charter while also abiding to state and federal laws. The complexities of land use policies can influence the need for infrastructure investments made by CTDOT within the given municipality.

[9] University of Connecticut's Center for Land Use Education and Research (2022). 1985-2015 Incremental Land Cover Change. Retrieved from https://clear.uconn.edu/projects/landscape/ct-stats/change7dates/

4. NATURAL HAZARDS

Natural Hazards are defined by FEMA as an environmental phenomenon that has the potential to impact societies and the human environment.[10] Connecticut faces natural hazards, such as extreme temperatures, snow and ice events, flooding, and hurricanes. Extreme weather events can have damaging impacts across Connecticut's communities, businesses, and infrastructure. The surface transportation system is vulnerable to performance impacts, as complexities of the system and various lifecycles of assets can dictate how infrastructure fairs under the pressure of natural hazards.

IDENTIFIED NATURAL HAZARDS

The 2023 Connecticut Natural Hazard Mitigation Plan (HMP) identified twelve (12) natural hazards, of which four (4) natural hazard types were selected for the inclusion into the CTDOT RIP. According to the state HMP, hazards with the most impact include flooding (which encompasses thunderstorms, dam failure, storm surge, sea level rise, hurricanes and tropical cyclones that make landfall), and extreme heat and cold. Natural hazard risks are expected to continue increasing in frequency, severity, and duration.[11] As the state's climate becomes warmer, wetter, and less predictable, repairing and replacing the state's transportation infrastructure becomes more costly and challenging. The Fifth National Climate Assessment (NCA5) indicates that these kinds of transportation disruptions will be exacerbated by increasingly severe weather events.

Understanding the risks associated with natural hazards requires CTDOT to take a systemic approach to evaluating the resilience of the surface transportation system while being consistent and complementary to state and local mitigation plans. Four natural hazard types from the HMP were selected for evaluation and further refinement of CTDOT's asset vulnerability. The natural hazards selected for the vulnerability assessment were based on prior natural hazard disruption frequencies and the potential to impact CTDOT's surface transportation system. Figure 11 illustrates theses hazard types.

Figure 11: Natural Hazard Types Included in the RIP

[10] FEMA (2025) Natural Hazards | National Risk Index. Retrieved from https://hazards.fema.gov/nri/natural-hazards
[11] CIRCA. (2019). Connecticut Physical Climate Science Assessment Report (PCSAR): Observed trends and projections of temperature and precipitation. Retrieved from https://circa.media.uconn.edu/wp-content/uploads/sites/1618/2019/11/CTPCSAR-Aug2019.pdf

EXTREME PRECIPITATION, FLOOD, AND DAM FAILURE

Extreme precipitation, flooding, and dam failure were grouped as one hazard type for their effect on inland flooding. Extreme precipitation, riverine flooding, backwater flooding, and dam failure can all contribute to varying potential flood hazard conditions, as explained in the following sections.

EXTREME PRECIPITATION

When an area receives too much rain in a short period of time, water levels rise rapidly, and localized flooding occurs. Extreme precipitation is likely to result in frequent flooding events, with increased intensity, that could potentially disrupt and damage the statewide transportation system. Flooding is the most frequent and costly natural hazard in the United States, responsible for approximately 90% of Presidential Disaster Declarations.[12] As seen in Figure 12, the 50 Year Storm is a 24-hour duration precipitation event that has a 2% chance of occurring annually. By Mid-Century, precipitation depths from 50-Year storm events are expected to nearly double from current conditions.

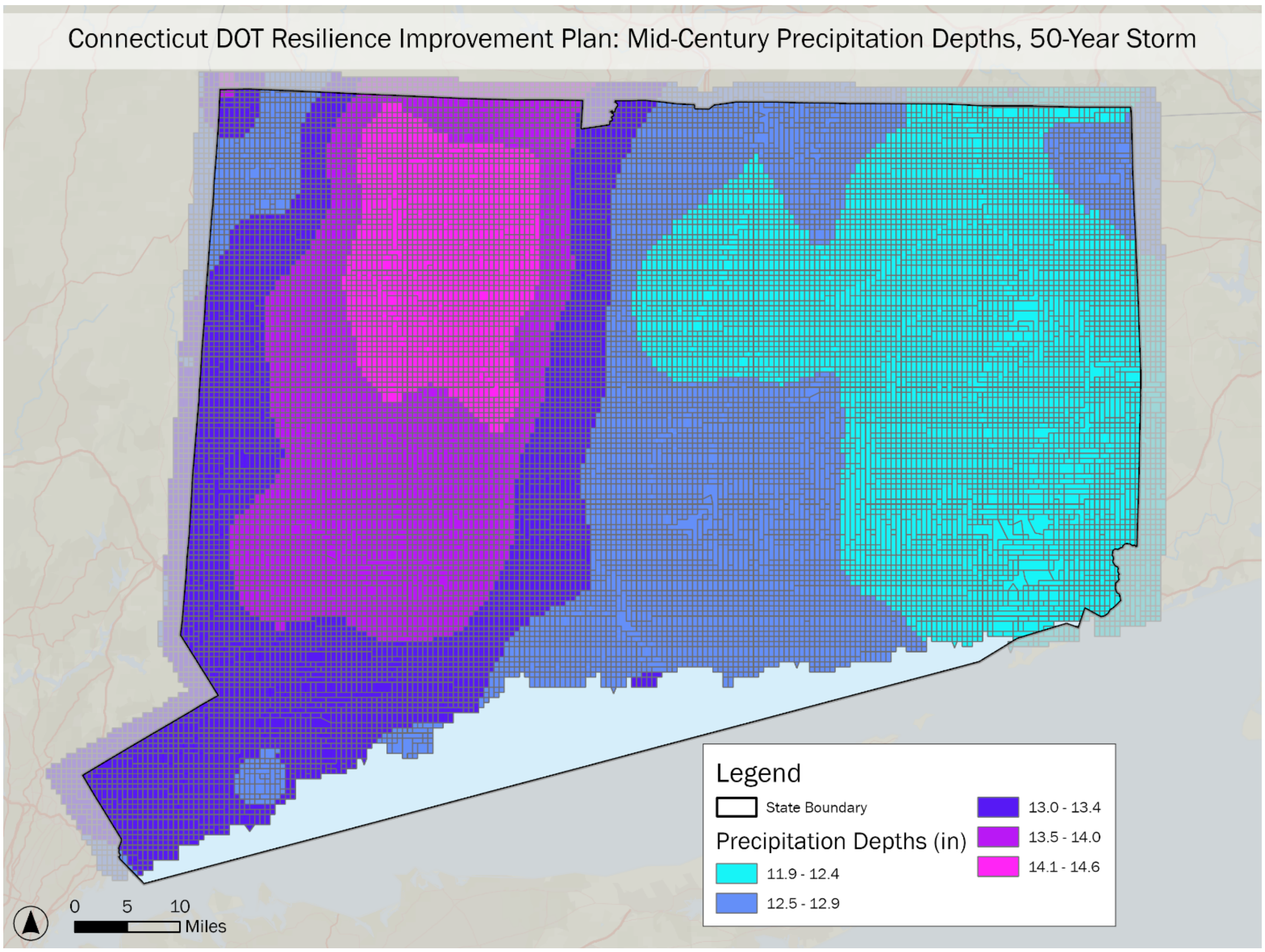


Figure 12: Mid-Century Precipitation Depths of 50-Year Storm

[12] Connecticut Department of Emergency Services and Public Protection. (2023). Connecticut Natural Hazard Mitigation Plan Update. Retrieved from https://portal.ct.gov/demhs/-/media/demhs/_docs/plans-and-publications/ehsp0024---2023-natural-hazard-mitigation-plan---final.pdf?rev=01aae6d47e8e4bf8a0e24f4ca71581ee&hash=D7467FC0C0E730B61AD407EC3487AD9B

FLOOD HAZARD AREAS

The Mid-Century map in Figure 13 shows areas that are at risk of flooding statewide when heavy precipitation occurs. The 100-Year Storm Flood Hazard Areas, also referred to as the Base Flood or 1% Annual Chance Flood, have a 1% annual chance probability of flooding. The Base Flood Elevation (BFE) represents the computed elevation to which floodwater is anticipated to rise during this event. The 500-Year Storm Flood Hazard Areas have a 0.2% annual chance probability of flooding each year.

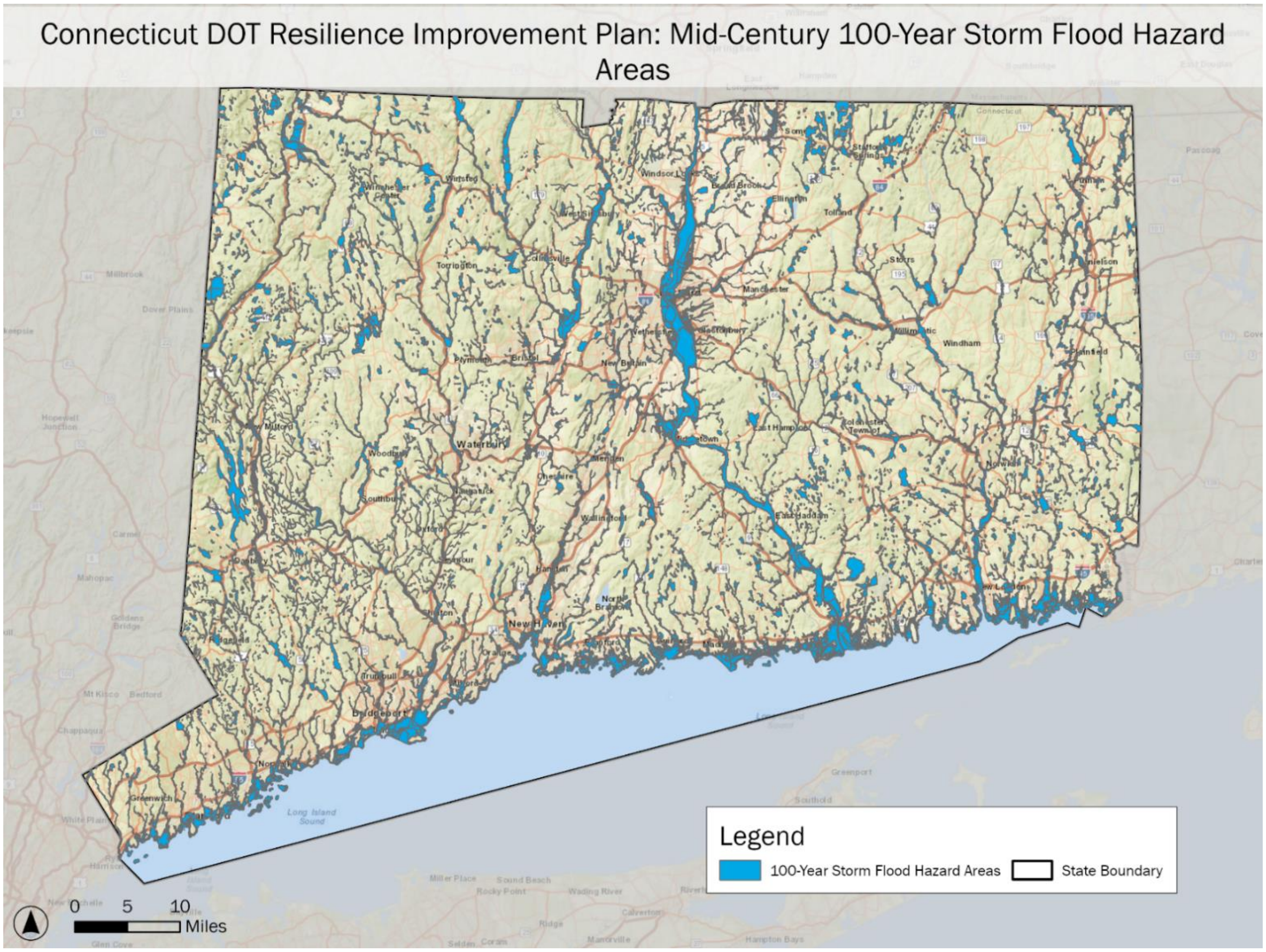


Figure 13: Mid-Century 100-Year Flood Hazard Areas

RIVERINE FLOODING

When rivers, streams, or other waterbodies receive more rain or snowmelt than their total capacity, their banks overflow, which can contribute to flooding.

BACKWATER FLOODING

Sea level rise can elevate river stages in tidally influenced waterways slowing the discharge rate to the ocean, causing water to back up further upstream. The Connecticut River's tidal influence is as far north as Windsor Locks and the Housatonic River, and the Thames River are also tidally influenced. These tidally influenced waterways may experience the effects of backwater flooding (upstream flooding caused by downstream conditions or restrictions) which can have both direct and indirect impacts to the resilience capacity of the surface transportation system.[13]

[13] Ramsar Convention Secretariat. 1994. Connecticut River Estuary and Tidal River Wetlands Complex. Retrieved from https://rsis.ramsar.org/RISapp/files/RISrep/US710RIS.pdf

DAM FAILURE

There are over 4,800 registered dams in Connecticut.[14] When a dam breaks or experiences a structural failure, the subsequent release of water behind the dam can overwhelm rivers and streams, leading to flooding in downstream areas. Higher water volumes can increase the hydraulic pressure on aging or undersized dams. Additionally, the current design of the dams may prohibit the ability of spillways and outlets to handle high flow events, heightening the risk of dam overtopping or structural failure. Dam failure can pose a harm to downstream transportation infrastructure and can result in widespread roadway washouts, bridge scour, and culvert damage.

Although dams themselves were not directly assessed in the RIP, the vulnerability of transportation assets to dam failure was evaluated as part of the continued efforts to refine the hazard analysis. Dam ownership in Connecticut is distributed among state agencies, municipalities, and private entities. The Connecticut Department of Energy and Environmental Protection (CTDEEP) is the responsible agency for recording and documenting conditions of dams across the state of Connecticut.

FEMA FLOOD INSURANCE RATE MAPS (FIRMS)

FEMA's Flood Insurance Rate Maps (FIRMs) identify Special Flood Hazard Areas (SFHAs), with greater risk of experiencing flooding events. All Connecticut municipalities participate in the National Flood Insurance Program (NFIP). Structures within SFHAs must comply with NFIP regulations and flood insurance requirements. Traditional design standards often consider the 1% Annual Chance Flood. Updated guidance is increasingly encouraging the incorporation of more conservative design criteria. For instance, the 2024 update of the Flood Resistant Design and Construction standard (ASCE 24) recommends expanding the scope for flood resistant design to include the 500-Year Floodplain within the flood hazard area, acknowledging the increasing frequency and severity of flooding events.[15] FIRM maps and specific hydraulic models serve as the foundational data source for project planning within CTDOT, informing preliminary scoping and permitting.

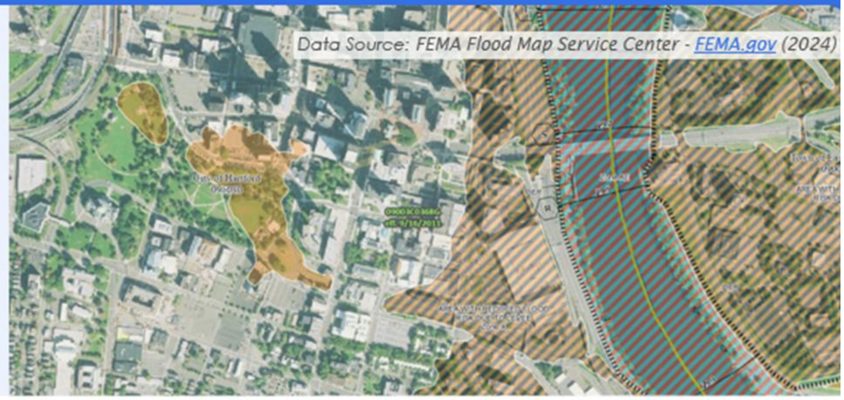
[14] CTDEEP. (2025). Dam Registration and Dam Recordation. Retrieved from https://portal.ct.gov/deep/water/dams/dam-registration-and-dam-recordation

[15] ASCE. (2024). Advancing Flood-resistant Design: The ASCE/SEI Flood Resistant Design and Construction Standards Committee. Retrieved from https://www.asce.org/communities/institutes-and-technical-groups/structural-engineering-institute/news/advancing-flood-resistant-design-the-asce-sei-flood-resistant-design-and-construction-standards-committee#:~:text=The%20newly%20released%20ASCE%2FSEI,ASCE%207%2D22%20Supplement%202.

FEMA Flood Insurance Rate Maps (FIRMS)

FEMA's Flood Insurance Rate Maps (FIRMs) identify Special Flood Hazard Areas (SFHAs), with greater risks of experiencing flooding. Structures in these areas must comply with National Flood Insurance Program (NFIP) regulations and flood insurance requirements.

However, existing FEMA maps are based on historic events rather than future climate projections, and are known to under-represent floodplain extents, neglect the impacts of extreme precipitation events, and fail to account for the impact of development on drainage.



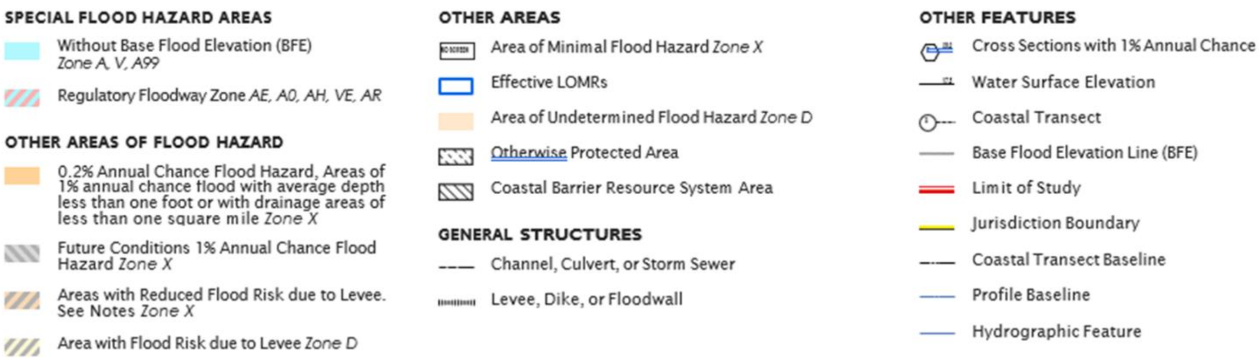


Figure 14: FEMA FIRMette, Hartford, Connecticut

While FIRM maps provide a valuable baseline for flood risk assessment, they are primarily based on historical data and do not reflect future weather projections. In certain locations, the FIRMs maps may underestimate, or some may overestimate floodplain extents, the effects of extreme precipitation events, and the influence of ongoing development on local drainage patterns.

Recognizing these limitations, CTDOT integrates additional hydrologic and hydraulic design measures to supplement FEMA studies during the preliminary engineering and design phase of projects. The objectives of the CTDOT Drainage Manual is to provide thorough investigation and planning, adequate design, construction and durability of CTDOT facilities; address the safety of the travelling public and adjacent property owners; minimize any undesirable effects which might be caused by the construction and maintenance of the facility; and achieve an optimum balance between risk of damage to the facility and the cost of construction.[16] Establishing design criteria for resilient, future-ready infrastructure is essential to account for projected increases in intensity and frequency of precipitation events based on the best available climate projection data.

CTDOT adheres to design standards and specifications to address 100-year and 500-year storm events. There are bridges in the state that were hydraulically adequate when built; however, adjacent development has dramatically increased the impervious surface area, consequently changing the hydraulic capacity resulting in the need for further armoring at the outfall location. Modern hydrologic and hydraulic design processes account for impacts concerning precipitation and flood risks. Additionally, the 100-year and 500-year storm event flood levels are expected to increase in frequency and intensity, placing many older transportation assets at risk of flooding and physical damage.

[16] CTDOT (2000). CTDOT Drainage Manual. Retrieved from https://portal.ct.gov/dot/-/media/dot/drainage/ctdot-drainage-full-pdf.pdf.

AUGUST 2024 RAINFALL EVENT

On August 18, 2024, Connecticut experienced an extreme rainstorm resulting in severe flooding and extensive damage. The National Weather Service (NWS) issued flash flood warnings for Fairfield and New Haven counties, estimating the rainfall between one to two inches per hour. Peak rainfall amounts exceeded 3 inches of water per hour, and 7 inches in three hours in a band from the Town of Monroe to the Town of Oxford.[17] Additional towns that were impacted by this rain event include Ansonia, Bethel, Danbury, Middlebury, Newtown, Redding, Roxbury Seymour, Southbury, Washington, Watertown, Weston, and Woodbury. It was determined that the rainfall was significant enough to qualify as a 1,000-year flood event in some locations. A 1,000-year flood event equates to an event with a 0.01% Annual Chance Probability of Occurrence, meaning it is an extremely rare and severe event. This intense rainfall led to major river flooding of Eightmile Brook and the Housatonic, Little, and Naugatuck Rivers.

Figure 15: Washout in Oxford, CT. August 2024.

[17] CTDOT Department of Emergency Services & Public Protection (2025). August 18th, 2024: Severe Flooding Disaster. Retrieved from https://portal.ct.gov/demhs/emergency-management/resources-for-officials/disaster-recovery/august-18-2024-severe-flooding-disaster?language=en_US.

Figure 15 shows the impacts to a roadway following the August 2024 rain event. During this extreme weather event, mudslides washed out roads, streets were inundated with flood waters, and evacuations were necessary particularly in southwestern Connecticut and Long Island, New York. The extreme rainfall resulted in the closure of over 27 state roads, closure or delays along rail lines, and more than 100 emergency water evacuations were performed. Of the three deaths that occurred in Connecticut, two resulted from separate incidents of cars entering flooded waters. In addition, a rail washout near the Kinneytown Dam in Seymour closed the Metro-North Waterbury Branch for two months. CTDOT's immediate recovery efforts included clearing approximately 125 catch basins, repairing 50 roadway shoulders and washouts, clearing 31 culverts and pipes, and removing 1.2 million pounds of debris. Damage amounted to over $206 million.[18]

Drainage, including culverts, are critical components of transportation infrastructure. As storms become more extreme, culverts may be strained beyond their intended hydraulic design. CTDOT is investing in drainage infrastructure to further enhance the resilience of the surface transportation system. The RIP and PROTECT eligible projects serve as investments for immediate and long-range planning activities for CTDOT's aging infrastructure.

Extreme precipitation, flood and dam failure can have physical and operational impacts on all transportation infrastructure. Increased rainfall and flooding significantly disrupt road, rail, and transit operations. Flooding can damage infrastructure and lead to service interruptions, affecting both public transit and freight systems. In addition to inundation and road closures, extreme precipitation and flooding can lead to significant sediment deposition and erosion, including landslides and mudslides. Sediment deposition can contribute to bridge and culvert failure, impact navigation channels, and cause embankment failures on critical highway connections.

Storm Surge and Sea Level Rise

Coastal flooding occurs along the coastline, which in Connecticut is the interface with Long Island Sound. Coastal flooding also affects coastal rivers and tributaries. Types of coastal flooding include both storm surge and sea level rise. Sea level rise, coupled with regional land subsidence, is likely to result in more frequent tidal flooding, also known as sunny day flooding or nuisance flooding.

Coastal transportation assets are more vulnerable to storm surge and wave action during hazards like hurricanes and nor'easters. Coastal communities can be isolated as roads experience severe and repetitive coastal flooding. The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) predicts that Connecticut needs to plan for 20 inches of sea level rise to occur by 2050. This recommendation became a state planning requirement with passage of Public Act 18-82 - *An Act Concerning Climate Change Planning and Resiliency*, which integrated CIRCA's sea level projections into a range of planning, coastal management, and flood management requirements. Under the act, local municipalities are required to adopt this sea level change scenario in their new evacuation plans or hazard mitigation plans.

In order to assess the current and anticipated level of storm surge and future sea level rise throughout Connecticut, storm surge inundation extents from CIRCA coastal modeling were used for the Existing and Mid-Century conditions exposure indicators. Sea level rise from warming oceans and melting glaciers can cause the permanent flooding of low-lying coastal areas. Storm surge is the abnormal rise of seawater above the predicted tides, primarily caused by storms, waves, and winds pushing a column of water towards the land.

[18] Connecticut Office of the Governor. (2024). Request for major disaster declaration. https://portal.ct.gov/-/media/office-of-the-governor/news/2024/20240909-request-for-major-disaster-declaration.pdf.

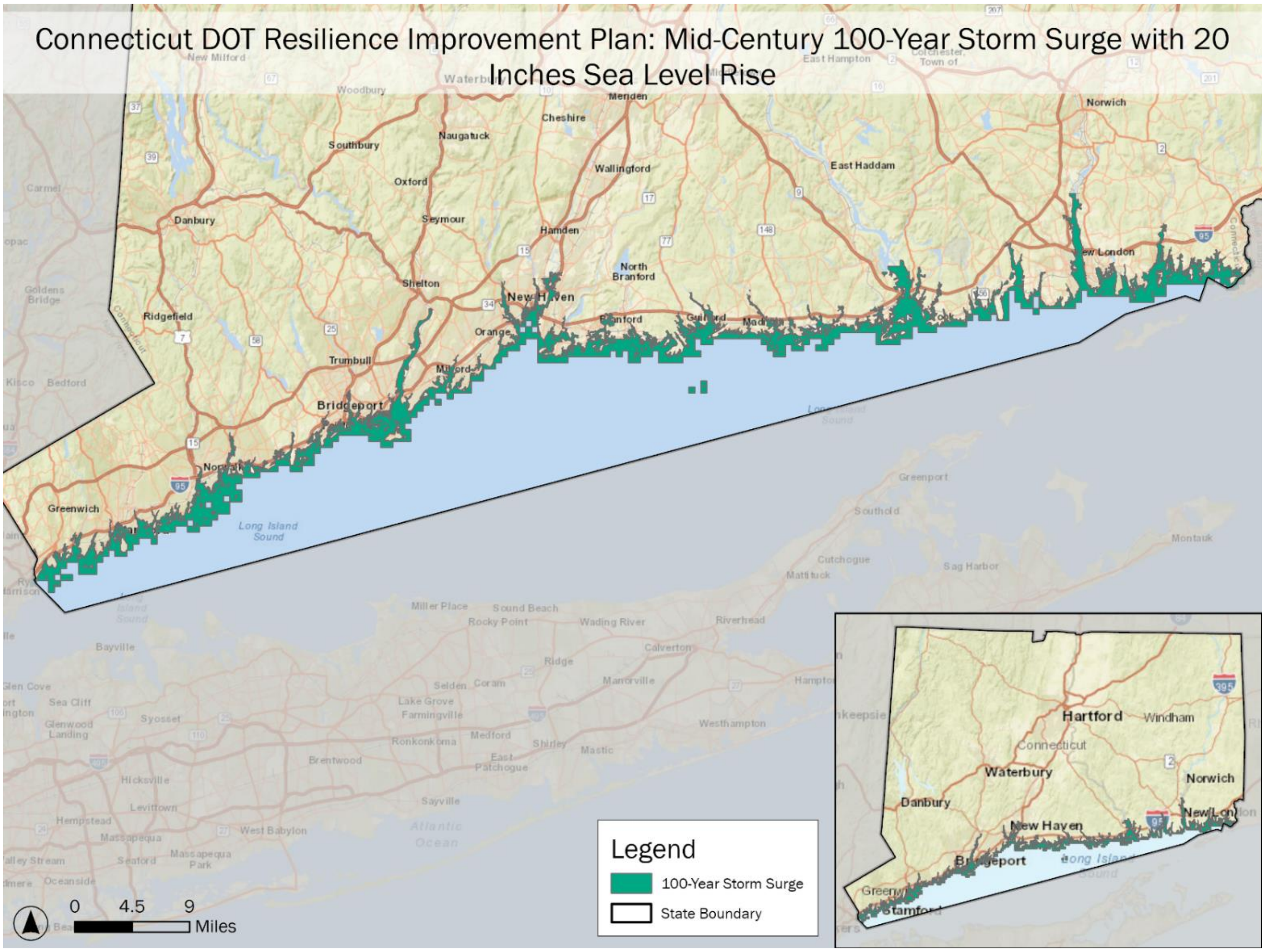


Figure 16: Connecticut Mid-Century Storm Surge and Sea Level Rise

Sea levels have been rising in Connecticut since the mid-1800s. Predicted sea rise will result in land loss, shift areas prone to damage from moderate wave action inland and deepen storm surge**.** The intensity of hurricanes is potentially expected to also increase, leading to more severe storm surge.[19] While major flooding is often considered a coastal risk produced by hurricanes, intense rainfall also can contribute to disastrous coastal flooding. Hurricanes produce more rainfall as they move inland and dissipate. In addition to base sea level rise and coastal surges, impacts from riverine flooding, increases in precipitation, wave runup, and seasonal and tidal variations can affect overall coastal water level. Figure 16 and Figure 17 illustrate coastal land areas that are projected to be inundated from storm surge and tides due to rising sea levels by the year 2050.

[19] Department of Emergency Services and Public Protection. (2023). Connecticut Natural Hazard Mitigation Plan Update. https://portal.ct.gov/demhs/emergency-management/resources-for-officials/hazard-mitigation-and-resiliency/hazard-mitigation-and-resiliency/2023-state-natural-hazard-mitigation-plan-update.

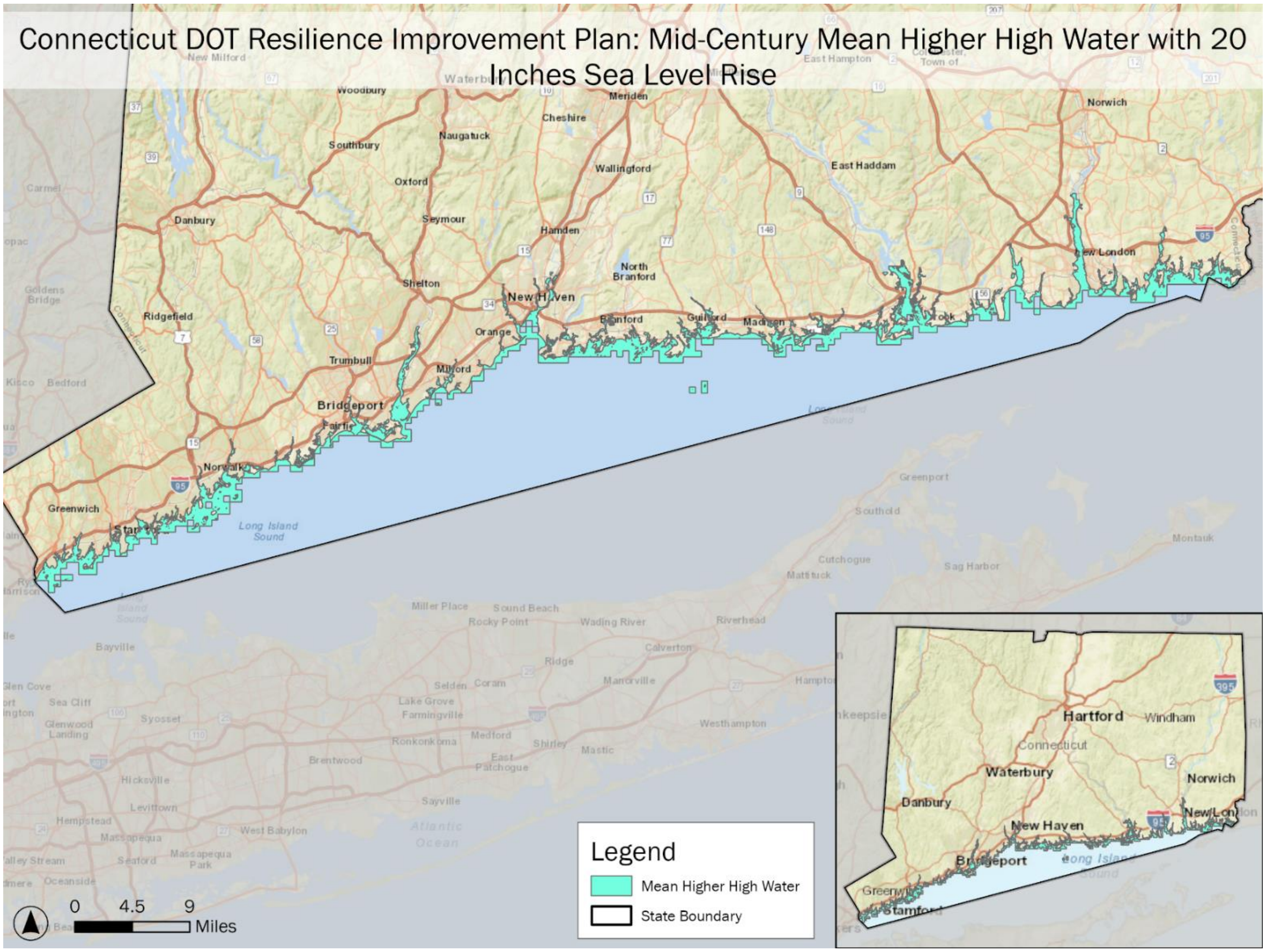


Figure 17: Mid-Century Mean Higher High Water (MHHW)

With global and regional ocean surface temperatures increasing, it is expected that hurricane intensity and frequency will also increase. Climate models indicate that the intensity, frequency, and duration of North Atlantic Hurricanes, as well as the frequency of Category 4 and 5 hurricanes have all increased since the early 1980s and will continue to cause heavier rainfall and higher storm surges.[20] Atlantic hurricanes are becoming larger and stronger as a result of warming ocean temperatures. Increased numbers and magnitude of storm surges may potentially shorten transportation infrastructure life.

Storm surge and sea level rise can have physical and operational impacts on transportation infrastructure. Rising sea levels can lead to more frequent and severe flooding, even during regular high tides. Routine inundation, floodwater exposure, erosion, and heightened storm surge can lead to road closures, sea wall damage, scour at bridges and disruptions to passenger and freight transportation. Increased local flooding can impede access to schools, workplaces, and other essential activities. Projections indicate that the amount of state and local roads in Connecticut experiencing tidal flooding at least once every 30 days will rise by four times by Mid-Century.

[20] USGCRP (2023) Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://toolkit.climate.gov/NCA5.

Extreme Heat

Extreme heat is defined as a prolonged period of unusually high temperatures and can lead to heat waves, which are periods of abnormally hot weather lasting more than two days. While warming temperatures are expected across the United States, the severity of warming in a given location depends on geographic factors such as latitude, elevation, and proximity to the ocean. Extreme heat can be exacerbated in cities by the urban heat island (UHI) effect. The heat island effect occurs when the built environment absorbs and radiates heat greater than their surrounding natural environment. This UHI effect can cause urban temperatures to increase by as much as 7°F higher than surrounding areas.

Temperatures have been rising throughout Connecticut since the early 1900s and are expected to continue increasing, further straining infrastructure systems and public health services. Extended exposure to heightened temperatures can damage transportation assets and pose health risks to construction, maintenance and field and operations staff, as well as to pedestrians, cyclists, and public transit users. Extreme heat is the leading cause of weather-related deaths in the United States.[21] Figure 18 highlights areas of the state that are expected to experience high average maximum temperatures in the future.

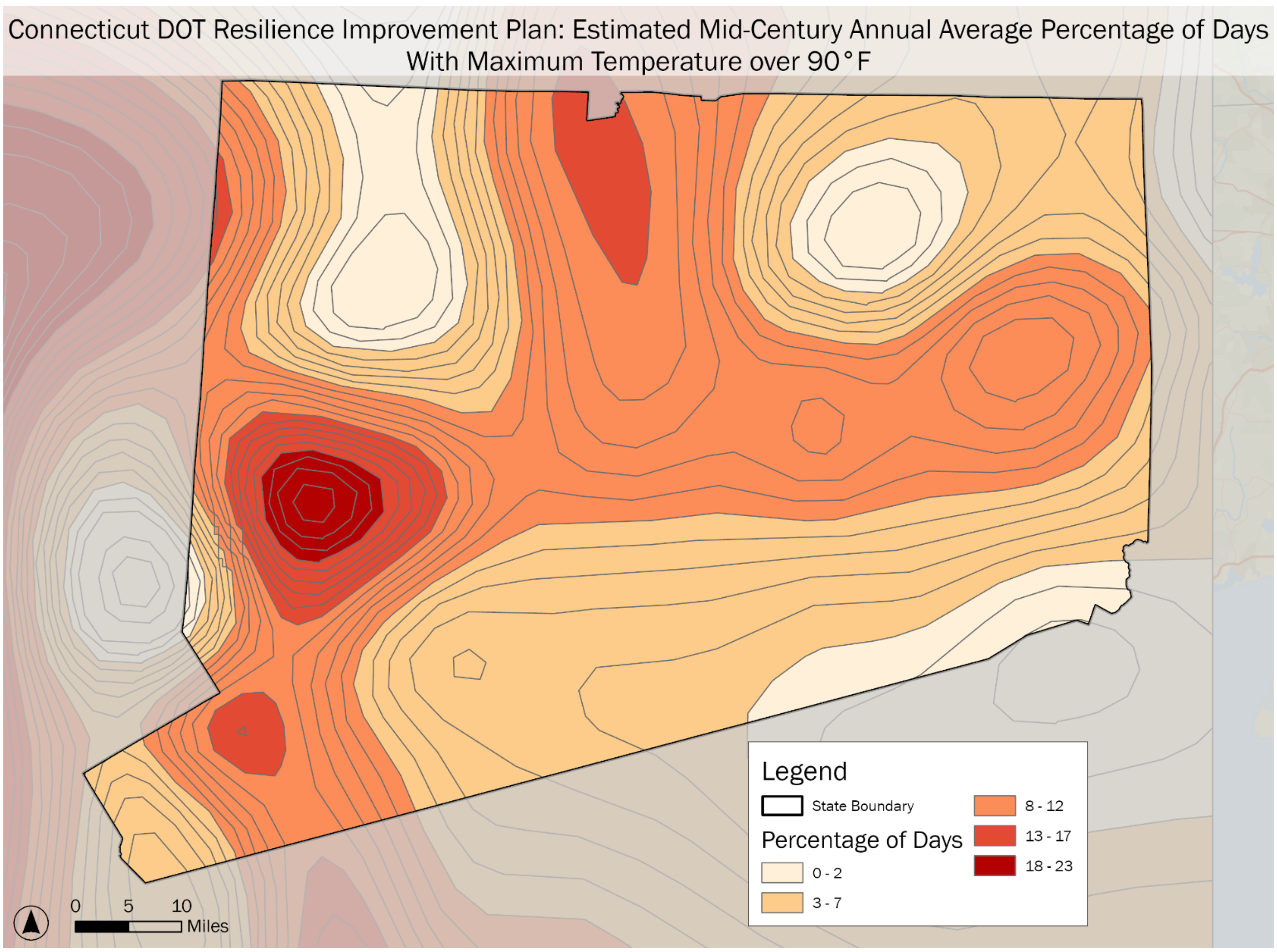


Figure 18: Connecticut Mid-Century Extreme Heat

[21] US EPA. (2022). Climate Change Indicators: Heat-Related Deaths. https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths

Extreme heat poses potential impacts to transportation infrastructure and operations, contributing to delays and disruptions across Connecticut. Longer and hotter heatwaves are likely to result in increased risk to transportation users, road infrastructure, and rail line operations. Consequently, heat-related delays affect the way people and goods move throughout the state.

In the Northeast, delays have been experienced during the summer months as heat waves place pressure on electrical systems, tracks, and trains, resulting in disruptions to service along the Northeast Corridor. . High temperatures can cause steel rails to expand, leading to "sun kinks" or buckling. Excessive heat can also cause sagging of overheard catenary lines which are essential for powering trains. High temperatures can cause lines to sag resulting in potential failure, service delays or even suspension of service. The effects of heat-related delays on transportation systems include rail operating at slower speeds due to catenary wire and track expansion, increase in travel time from heat-related speed restrictions, and potential cancellations caused by equipment failure.

In addition to direct physical impacts, power outages caused by excessive demand on the electrical grid for cooling can contribute to rail operational disruptions. Higher temperatures strain not only electric grids but also infrastructure. For example, in June 2025 commuters in Connecticut and New York experienced delays or cancellation due to a power outage on Metro-North's New Haven Line and Amtrak's Northeast Corridor. The overhead catenary power lines failed, causing more than 800 passengers to be evacuated and disrupting transit service.

Extreme heat can cause disruptions to movable bridge functionality due to component expansion which can delay rail, road, and waterway transit for vehicles reliant on bridge positioning. An example from 2014 involved the Norwalk River("Walk") Bridge in Norwalk, which became stuck after its metal and the swing bridge could not return to the closed position. The failure of the bridge on one of the busiest stretches of the Northeast Corridor caused disruptions to train traffic, freight movement and impacted hundreds of morning commuters over a five-hour period. The train delays caused by the bridge malfunction required Metro-North passengers heading east to be bussed from South Norwalk Station to the East Norwalk Station, while commuters traveling west were forced to rely on sporadic trains from Stamford and Grand Central Station.

Steel, asphalt, and sealant materials used on roads and bridges can also deteriorate under extreme heat conditions. Roadways are primarily made of either asphalt or concrete. In concrete infrastructure, joints open and close with temperature changes to ensure roadways maintain their integrity during weather fluctuations. However, these design elements do not account for all temperatures or prolonged exposure to extreme heatwaves, which are becoming increasingly more common and intense. As concrete expands in temperatures the joints were not designed to handle, it expands beyond the joints' limits and causes the roadway to buckle.

The process is similar with asphalt roadways; expansion due to intense heat creates ridges that can eventually lead to deterioration such as potholes. Connecticut was one of many states to experience this phenomenon during the summer of 2025. While temperatures in the 90s are not uncommon in the state, the extended periods of exposure to intense heat, as well as the drastic swings in temperatures within a short amount of time caused pavement buckling. In June 2025, Connecticut experienced the first recorded case of pavement buckling where the asphalt meets the concrete. This occurred in Fairfield on I-95 Southbound between Exits 25-24 resulting in a pavement heave within the roadway causing traffic slowdowns and the need to temporarily and permanently address the roadway segment.

Extreme Cold

While average temperatures are expected to increase, cold events also pose a risk to infrastructure. Connecticut frequently experiences storms and cold temperatures during winters. Extreme cold events are characterized by prolonged periods of unusually low temperatures, typically accompanied by high winds. Ambient air temperatures that drop to 0°F or below are classified as extreme cold. Figure 19 highlights areas that are expected by Mid-Century to continue experiencing multiple days below freezing annually.

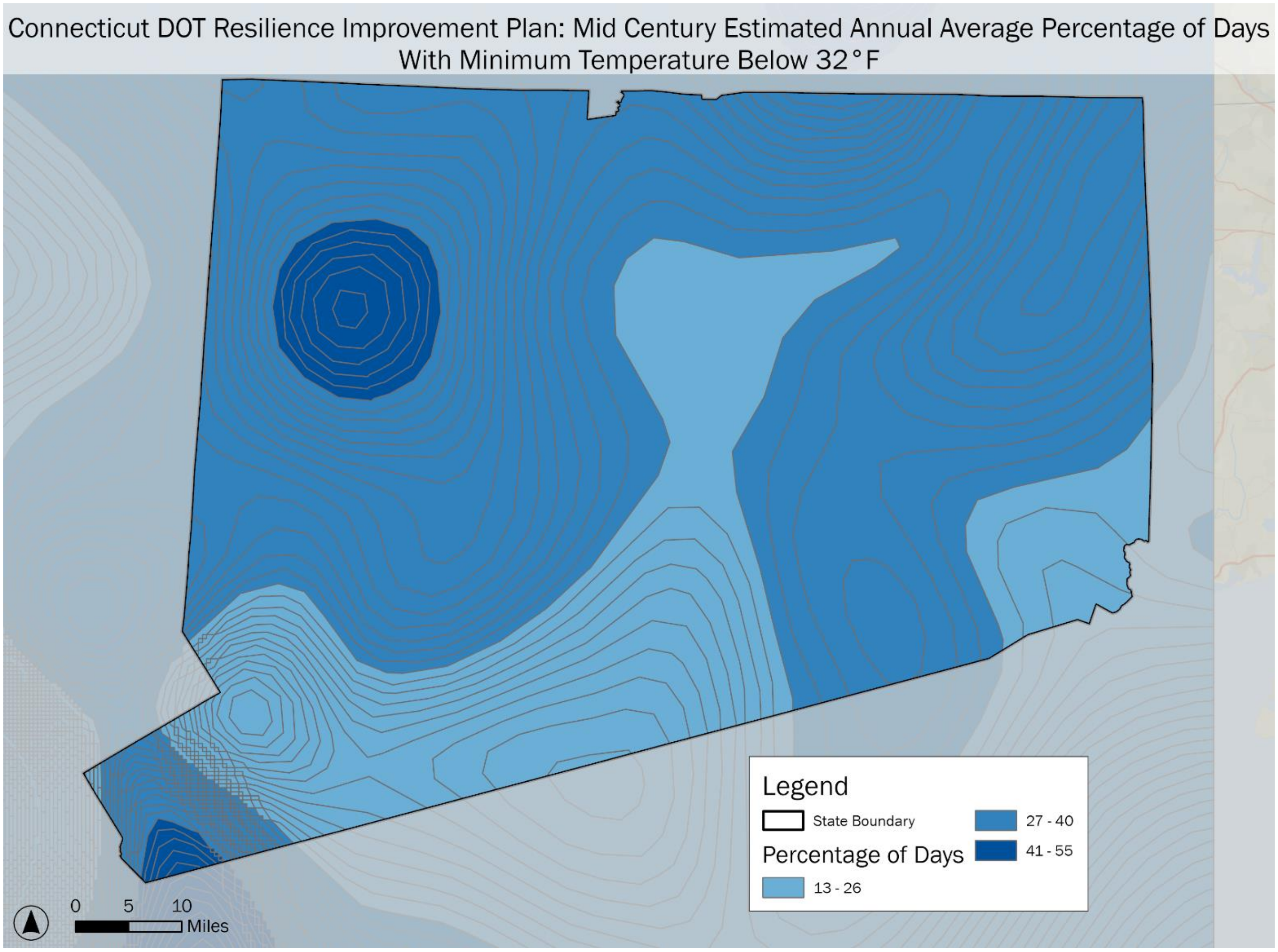


Figure 19: Connecticut Mid-Century Extreme Cold

Polar Vortex

One major factor contributing to extreme cold conditions is the polar vortex. The polar vortex refers to the large area of low pressure and cold air surrounding both of the Earth's poles. The clockwise flow of air that helps keep the colder air close to the North and South Poles is the "vortex." Polar vortex events occur when a mass of low-pressure cold air from the Arctic shifts southward to areas of the US, including Connecticut, bringing colder than average temperatures to the state. Winter storm conditions are often associated with polar vortex events, including snow, sleet, freezing rain, and frigid temperatures.

Connecticut, along with most of central and eastern United States, experienced record-breaking cold temperatures between December 2017 and January 2018.[22] Strong winds combined with temperatures around 10 degrees below average made for wind chills between -10°F and -20°F. Extreme cold can cause ice to form more easily and quickly on road surfaces and make it harder for maintenance and operations to effectively de-ice the roadways. Extreme cold events, such as this polar vortex, can make other types of winter weather more severe, such as blizzards or ice jams.

ICE JAMS

Figure 20: Ice Jam at the East Haddam Swing Bridge, Connecticut River (2018)[23]

An ice jam is a blockage of a river caused by chunks of ice clumping together (referred to as ice floes), which can lead to flooding in nearby areas. Conditions such as rapidly melting snow and ice and heavy rain can contribute to the formation of ice jams. Warm temperatures and spring rains cause snow and ice to melt rapidly, resulting in the excess water causing frozen rivers and streams to expand as the layer of ice breaks up and the ice floes float downstream. The ice floes can become lodged in the narrower sections or at bends in the river, blocking the flow of water and potentially leading to flooding. A series of freeze-thaw cycles led to massive ice jams along the Housatonic and

[22] National Weather Service. (2018). December 26, 2017 - January 8, 2018 Record Cold. Retrieved from https://www.weather.gov/okx/RecordCold_Dec17Jan18

[23] Cassandra Day, Ice jams causing Connecticut River flooding in upper Middlesex County, Jan. 17, 2018, Hearst Media via The Middletown Press. Retrieved from https://www.middletownpress.com/news/article/PHOTOS-Ice-jam-Connecticut-River-flooding-in-12504685.php.

Connecticut Rivers in 2018 (Figure 20). In Kent, a milelong, 12-foot-thick ice jam formed causing flooding that blocked roadways and prompted a local emergency, requiring hundreds of evacuations.[24, 25] The U.S. Coast Guard deployed ships to break up the ice. The ice jams were large enough to be seen from space.[26]

TEMPERATURE VARIATIONS

As a New England state, Connecticut is equipped to handle extreme cold events. Facing new climatic challenges from temperature variations, the surface transportation system may experience damage as a result of the freeze-thaw cycle. Freeze-thaw cycles may lead to pavement cracking, crumbling, and potholes. These cycles can also exacerbate structural damage, putting increased stress on bridges, roads, and railways. Underground infrastructure is also susceptible to freezing temperatures; an example of which includes burst water mains or pipes that can subsequently impact the surface transportation system. Cold events with temperature variations can also affect maintenance operations resulting in reduced efficiency and an increase in operational costs.

TEMPERATURE VARIATION IMPACTS

ROADWAYS AND RAILROADS

Travel under extreme cold conditions creates a hazard for the commuting public, as icy conditions, blowing snow, and high winds can create white-out conditions that lead to road closures and delays along state roadways.

From a railroad perspective, railway tracks are vulnerable to the track damage, heavy snow accumulation, and icing of train components. Ice accumulation on tracks decreases friction, reducing braking efficiency and increasing stopping distances. The effects of which may lead to disruptions in train movements, performance functionality, and service. On February 22, 2025, a train derailment in Plainville was caused by ice at a rail crossing on West Main Street, leading to road closure for over three hours.[27]

BRIDGE PAINT (LEAD-BASED)

In the February 2023, Connecticut and other New England states experienced lead-based paint chips falling from steel bridge structures due to sudden temperature changes. Fluctuating temperatures from an intense cold snap followed by a quick warmup caused the sudden and unexpected release of lead-based paint chips from bridge structures across the state. A costly remediation effort was required by CTDOT and municipalities to address the cleanup of the lead-based paint debris. The newly encountered challenges of fluctuating temperatures require the surface transportation system to mitigate and respond to the adverse effects of extreme temperature change events on infrastructure assets. This issue has prompted CTDOT to assess and remediate the situation with plans to recoat over 200 of its approximately 500 steel bridges over the next eight years.

[24] FloodList. (2018). USA and Canada – 100s Evacuated as Ice Jams Cause Flooding. Retrieved from https://floodlist.com/america/evacuations-ice-jams-flooding-north-east-january-2018
[25] New York Daily News. (2019). Stories that shaped the decade: Extreme weather in Connecticut is linked to climate change. Retrieved from https://www.nydailynews.com/2019/12/22/stories-that-shaped-the-decade-extreme-weather-in-connecticut-is-linked-to-climate-change/.
[26] NASA Earth Observatory. (2018). *Ice James on the* Connecticut River. Retrieved from https://earthobservatory.nasa.gov/images/91620/ice-jams-on-the-connecticut-river.
[27] Brown, B (2025). Ice causes train derailment and road closures in Plainville. Retrieved from https://www.wtnh.com/news/connecticut/hartford/ice-causes-train-derailment-in-plainville/

Compounded Natural Hazard Events

These natural hazards do not happen in isolation, and their impacts are compounded as years of extreme weather increase the need for repair and replacement of transportation assets. Multiple natural hazard events can occur concurrently or in close sequence, with interactions exacerbating impacts. These compound events and their impacts are expected to increase as severe weather events grow in frequency.[28] For instance, extreme precipitation combined with storm surge, tidal maximums, and wave action can produce major flooding in coastal regions in the Northeast, as occurred in major coastal storms Hurricane Irene (2011) and Superstorm Sandy (2012). Such compound flood events, in which heavy rain and storm surge coincide, are increasing in frequency.[29] Therefore, there may be a prolonged exposure to flooding duration and damage to infrastructure resulting in a longer response and operational recovery efforts.

Significant portions of the state are at risk of experiencing compound flood events due to Connecticut's substantial coastline and numerous rivers. Between 1985 and 2015, urban and suburban development in the state increased from 14% to 18% in areas adjacent to rivers and in areas where rivers intersect with the coast, while development near the coast increased by only 1% to 8% over this same time period.[30]

Bridges, roads, and critical evacuation routes face mounting risks from erosion, structural degradation, and flooding. Continued commercial and residential land development in overlapping river and coastal flood zones contribute to the increase in flood risks. This type of land use development is at the cost of natural storm defense systems such as tidal and non-tidal marshes.[31] These natural defense measures can include wetland areas and riparian zones that increase stormwater retention and help attenuate flows to reduce flood risks and provide our watercourses with vegetated channel banks to reduce scour and erosion. Inland forested areas also serve as a protective barrier from the elements, as the vegetative woodland area can reduce wind speeds, increase groundwater infiltration, and tree roots can increase slope stability. Along the coastal flood zones of Connecticut, sandy dunes and breakwaters protect coastal communities from storms and high winds, as the dunes act as a protective barrier from the elements by dissipating wave energy along the shoreline to minimize wave action erosion.

[28] Singh, D., A.R. Crimmins, J.M. Pflug, P.L. Barnard, J.F. Helgeson, A. Hoell, F.H. Jacobs, M.G. Jacox, A. Jerolleman, and M.F. Wehner, 2023: Focus on compound events. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. Retrieved from https://toolkit.climate.gov/sites/default/files/2025-07/NCA5_F1_Compound-Events.pdf

[29] Khanam, Mariam, Giulia Sofia, Marika Koukoula, Rehenuma Lazin, Efthymios I. Nikolopoulos, Xinyi Shen, and Emmanouil N. Anagnostou. 2021. "Impact of Compound Flood Event on Coastal Critical Infrastructures Considering Current and Future Climate." Natural Hazards and Earth System Sciences 21 (2): 587–605. https://doi.org/10.5194/nhess-21-587-2021.

[30] Mitu, Mahjabeen Fatema, Giulia Sofia, Xinyi Shen, and Emmanouil N. Anagnostou. "Assessing the Compound Flood Risk in Coastal Areas: Framework Formulation and Demonstration." Journal of Hydrology 626, Part B (2023): 130278. https://doi.org/10.1016/j.jhydrol.2023.130278.

[31] University of Connecticut. (2014). Connecticut's Coast: Then and Now. Retrieved from https://clear3.uconn.edu/viewers/Coast1934/

HISTORICAL NATURAL HAZARD EVENTS

Natural hazards have significantly impacted Connecticut throughout its history. Natural hazards are defined by the Federal Emergency Management Agency (FEMA) as an environmental phenomenon that has the potential to impact societies and the human environment.[35] Since 1954, Connecticut has experienced 26 major natural disaster declarations.[32] A governor's declaration of a natural disaster indicates that the government is in a state of emergency due to a situation requiring immediate action. Such a declaration represents a formal request for federal assistance in recovery efforts and allows the governor to mobilize resources to coordinate an immediate, emergency response.

Connecticut has endured numerous extreme weather events that has seen the destructive force of the Earth's natural environment and disrupted the state's transportation system. Table 1 describes historical natural hazard events in Connecticut under the four natural hazard categories outlined in the RIP. This table is a comprehensive list of significant weather-related events that had a direct impact on the state. The experiences from past events can provide insights as to how the surface transportation system can be supported to be more resilient for an effective disaster response, rebuild, and recovery. The impacts of natural hazards on the state's infrastructure may include road closures or delays along rail lines, repairing of roadway shoulders and washouts, clearing of culverts and pipes, debris removal and additional restoration efforts resulting in millions of dollars spent in disaster recovery actions. While weather events are identified by the major hazard category in Table 1, individual storms may exhibit characteristics of multiple categories.

[32] FEMA. (2024). Disasters and Other Declarations. Retrieved from https://www.fema.gov/disaster/declarations

Table 1: Connecticut's Natural Hazard Historical Events[33]

Date of Occurrence	Event	Affected CT Areas	Severity	Damage to CT Transportation Infrastructure
Flood, Extreme Precipitation, & Dam Failure				
August 25, 1635	1635 Great Colonial Hurricane	Statewide	Category 4 / Category 3	Coastal flooding
October 4-11, 1804	1804 Snow Hurricane (aka Storm of October 1804)	Statewide	N/A	Flooding and snowfall blocked roads.
September 23-24, 1825	Great September Gale of 1815	Shoreline	Category 3	Ships and docks were smashed and destroyed. Downed trees blocked roadways.
January 31, 1869	Danbury Reservoir Dam Burst	Danbury, CT	N/A	Three (3) bridges were destroyed and numerous railroad tracks.
March 11, 1936	1936 Flood	Hartford, Lowell, Laurence (extensive flooding)	N/A	Heavy rainfall, snowmelt, and ice jams caused rivers to rise and flood streets in surrounding communities around the state. Downtown Hartford was only navigable by boat. Bridges in Ansonia, Woodville, and other communities were damaged, many others closed. New Haven Railroad and Central Vermont Railway reported numerous track washouts.
September 21, 1938	The Great New England Hurricane (1938 flood)	New London, Hartford, CT River Valley, Middletown, Groton, Mystic	Category 3	Severe flooding in Hartford, Middletown, and other river towns preventing any use of streets. Falling trees also blocked streets. Boats were destroyed in ports. Bridges around the state were damaged and rail tracks were washed out.
September 9-16, 1944	1944 Great Atlantic Hurricane	Hartford and the Coastline	Category 3	Roadways were blocked, railroad damage reported in Mystic.
August 25, 1954	Hurricane Carol	Old Saybrook and the Coastline	Category 3	Boats smashed into docks. Downed trees and water prevented roadway use. Portion of New Haven rail line flooded. Entire communities along the coast were nearly wiped out. FHWA provided $3 million in Emergency Relief funds to CTDOT for road and bridge repairs.
August 1955	Hurricanes Connie & Diane (1955 Floods)	Norwalk River Valley, Waterbury, Winsted, Naugatuck, Derby, Ansonia, Farmington, New Hartford and Putnam	Category 4 and 2	At least 17 bridges were destroyed. The Norwalk River Valley dam failed and 90% of roads were washed out in the area. Rail line damage across the state.

[33] CT State Library (2025). Dates of Disaster in Connecticut. Retrieved from https://libguides.ctstatelibrary.org/hg/disasters.

March 1963	Spaulding Pond Dam Failure	Norwich, CT	Dam Failure	Flooded city streets including Lake, Pond, and Brook Streets
August 1976	Hurricane Belle	Fairfield and New Haven Counties	Category 3	Power failure on the New Canaan Commuter line canceled service. Portion of the Merritt Parkway closed due to downed trees.
June 4-7,1982	1982 Flood	Southern and Central CT, Naugatuck Valley	Intense Rainfall	Yantic, Farmington, and Shetucket rivers overflowed causing various bridge closures and road collapses in Clinton, Haddam, and Higganum.
May 1984	Middletown Flood of 1984	Hartford County	Severe Rainfall	Cut off 75% of access routes
September 15, 1985	Hurricane Gloria	Coastline from Stonington to Milford	Category 1	More than 100 state roads, including Route 1, were either partially or completely shut down due to fallen trees, downed power lines, and flooding. Boat and pier damage as well.
August 19, 1991	Hurricane Bob	Hartford and New London Counties	Category 2	Fallen trees blocked major roadways, ferry services were suspended, and many traffic signals were inoperable. Sailboat wreckage along CT River as well.
September 17-18, 1999	Hurricane Floyd	New Haven Fairfield Counties, Danbury, throughout State	Category 4	The storm caused extensive damage to roads, with many roads being closed for several days, particularly in Hartford and Fairfield counties. The Still River in Danbury and its tributaries overflowed triggering severe flooding. Major flooding at the Danbury Municipal Airport impacted runways and taxi areas, which disrupted airport operations during the storm and required recovery efforts after the water receded.
August 28, 2011	Hurricane / Tropical Storm Irene	Bridgeport, New Haven,	Category 3	The Connecticut, Housatonic, Farmington, Pomperaug, and Pequabuck Rivers experienced major flooding, which damaged hundreds of structures, roads, and bridges.
October 2012	Superstorm Sandy	Coastline	Category 3	All roads to non-emergency vehicles closed on the shoreline. All state highways were ordered to be closed. Roads all along the coast experienced flooding and downed trees. Sikorsky Airport, located in Stratford, CT was severely flooded.
May 15, 2018	Macroburst, 4 tornadoes, microburst	Brookfield, Bethany, Sleeping Giant State Park in Hamden, Newtown, Cheshire, New Haven County	Extreme Weather Event, Category EF1 tornadoes	Intense floods were reported, downed trees and fallen debris blocked roadways and bridges, and power outages.
August 4, 2020	Tropical Storm Isaias	Statewide	Category 1	Downed trees along Merritt Parkway blocked traffic and damaging road surfaces. MTA reported more than 2,000 trees fell on its train and bus system. $21 million in public infrastructure damage, $50 million in FHWA aid, $13 million in Metro-North Railroad in Seymour repairs.
August 18, 2024	Extreme rainfall event	Statewide	1,000-year flood event	Dam/culvert failure in Southbury. A rail washout near the Kinneytown Dam in Seymour closed the Metro-North Waterbury Branch for two months. FHWA provided $3 million in Emergency Relief funds to CTDOT for road and bridge repairs.

Storm Surge & Sea Level Rise				
September 21, 1938	Great New England Hurricane (storm surge)	New London, Hartford, CT River Valley, Middletown, Groton, Mystic	Category 3	Made landfall during hightide, creating surges of 14-18 feet along the coast from New Haven to Bridgeport. Severe flooding in Hartford, Middletown, and other river towns preventing any use of streets. Falling trees also blocked streets. Boats were destroyed in ports. Bridges around the state were damaged and rail tracks were washed out.
August 25, 1954	Hurricane Carol (storm surge)	Statewide, Old Saybrook	Category 3	Caused storm surges up to 14.4 feet in Narragansett Bay and produced flooding in towns such as Norwalk and Lyme. FHWA provided $3 million in Emergency Relief funds to CTDOT for road and bridge repairs. Boats smashed into docks. Downed trees and water prevented roadway use. Portion of New Haven rail line flooded. Entire communities along the coast were nearly wiped out.
September 12, 1960	Hurricane Donna (storm surge)	New Haven	Category 1	Created storm surges up to 10 feet along the CT coastline and caused major floods, wrecked boats and inundated homes. Storm surge and strong winds lead to the New York-New Haven Railroad ceasing service for the first time in its history.
September 15, 1985	Hurricane Gloria (storm surge)	Coastline from Stonington to Milford	Category 1	More than 100 state roads, including Route 1, were either partially or completely shut down due to fallen trees, downed power lines, and flooding. Boat and pier damage as well. Hit at low tide but generated significant wave action causing heavy coastal damage especially between Westport and Milford.
August 28, 2011	Hurricane / Tropical Storm Irene	Bridgeport, New Haven	Category 3	Caused a 3–5-foot storm surge during a high tide cycle. The Connecticut, Housatonic, Farmington, Pomperaug, and Pequabuck Rivers experienced major flooding, which damaged hundreds of structures, roads, and bridges.
October 2012	Superstorm Sandy	Norwalk-Danbury Corridor	Category 3	Brought a storm surge of up to 10 feet into the Long Island Sound with Bridgeport, New Haven, and Fairfield hit especially hard. All roads to non-emergency vehicles closed on the shoreline. All state highways were ordered to be closed. Roads all along the coast experienced flooding and downed trees.
Extreme Heat				
August 23, 1916	Heatwave	Torrington	106°F	Extreme heat events can significantly impact the transportation system, particularly rail and traditional surface transportation. These events create increased demand of the electrical grid and strain construction materials, leading to delays in service and necessary repairs. Rail infrastructure is often impacted by heatwaves as catenary systems sag and cause power outages on trains, electrical grid strain forces delayed/restricted service, and tracks warp in elevated temperatures with prolonged use.
July 15, 1995	1 Heatwave	Statewide, Danbury	106°F	
Summer 1999	2 Heatwaves	Statewide	Up to 99°F	
Summer 2000	1 Heatwave	Statewide	Up to 94°F	
Summer 2006	1 Heatwave	Statewide	Up to 100°F	
Summer 2011	1 Heatwave	Statewide, Bridgeport, Hartford	Up to 103°F	

Summer 2012	1 Heatwave	Statewide	Up to 106°F	Extreme fluctuations in temperature can cause roadway buckling in both concrete and asphalt surfaces. Drought conditions during heatwaves force municipalities to implement water conservation measures which can lead to soil shrinkage and increased risk for ground/roadway cracks and sinkholes. Moveable bridges can become inoperable if their joints expand in the extreme heat.
Summer 2016	3 Heatwaves, Drought	Statewide	Up to 103°F	
Summer 2017	4 Heatwaves	Statewide	Up to 103°F	
Summer 2019	4 Heatwaves	Statewide	95-100°F	
Summer 2020	3 Heatwaves, Drought	Statewide	Up to 99°F	
Summer 2021	4 Heatwaves	Statewide	Up to 99°F	
Summer 2022	4 Heatwaves, Drought	Statewide, especially Eastern Connecticut	Up to 103°F	
Summer 2023	2 Heatwaves	Statewide	95-105°F	
Summer 2024	4 Heatwaves	Statewide	98-100°F, Stage 2 Drought Advisory	
Summer 2025	4 Heatwaves	Statewide	90-110°F	
Extreme Cold				
February 16, 1943	Extreme Cold	Norfolk, Falls Village	-32°F	Stressed heating systems and pipe infrastructure, water risked freezing, icy highway surfaces.
January 22, 1961	Extreme Cold, Nor'easter	Coventry	-32°F Coventry, -26°F Hartford	Major highways (including the Wilbur Cross Highway) were blocked and vehicles were stranded. Bus services were interrupted or cancelled. Heavy snow and ice from the Nor'easter led to power line collapses, compounding transportation challenges by disabling traffic signals and public services.
December 16-17, 1973	Ice Storm Felix	Statewide		Freezing rain and sleet covered roadway surfaces with ice. Damaged trees and power lines also impacted roadways.
February 2016	Extreme Cold	Danbury	-10°F	Frozen pipes risk, hikes in heating demand, road maintenance complications due to ice prevalence
December 27, 2017 -January 8, 2018	Extreme Cold	Statewide	-13°F	Accumulation of black ice on roads made for dangerous driving conditions.
January 13 – 23, 2018	Extreme Cold	Connecticut and Housatonic Rivers	Ice Jam	The cold snap created a mile-long ice dam on the Housatonic River in Kent, CT, flooding Route 7 and forcing evacuations of homes. The ice jams reached a mile in length and a thickness of 12 feet.

5. STAKEHOLDER ENGAGEMENT

STAKEHOLDER ENGAGEMENT – DATA COLLECTION

CTDOT is committed to involving stakeholders during the development of the RIP and project planning process. The intention of stakeholder engagement is to ensure that the knowledge, lived experiences, and priorities of Connecticut's stakeholders are incorporated into the RIP. Engaging stakeholders was critical in the development of the RIP in order to incorporate diverse perspectives, integrate local place-based knowledge around specific challenges and needs, and build essential consensus for successful strategy implementation. The findings from stakeholder input strengthened the alignment of the RIP with local needs and on-the-ground natural hazard challenges.

The Stakeholder Engagement Memo, attached in Appendix B, details the outreach process that integrated local insights into the RIP. Stakeholder engagement with the Connecticut Councils of Government (COGs) included gathering data from three working sessions, an online participatory mapping tool to locate transportation hazard concerns (Figure 21), as well as an online survey. Flooding—both coastal and inland—emerged as the primary concern, alongside drought, storms, and extreme heat. COGs highlighted the need for better dissemination of climate impact information and funding opportunities. Key findings included aging culverts and increasing flood-related disruptions.

Participatory mapping input was received from seven of the nine COGs. Additionally, COGs recommended prioritizing projects that would enhance road redundancy, support small towns with limited capacity, and address transportation resilience in vulnerable communities.

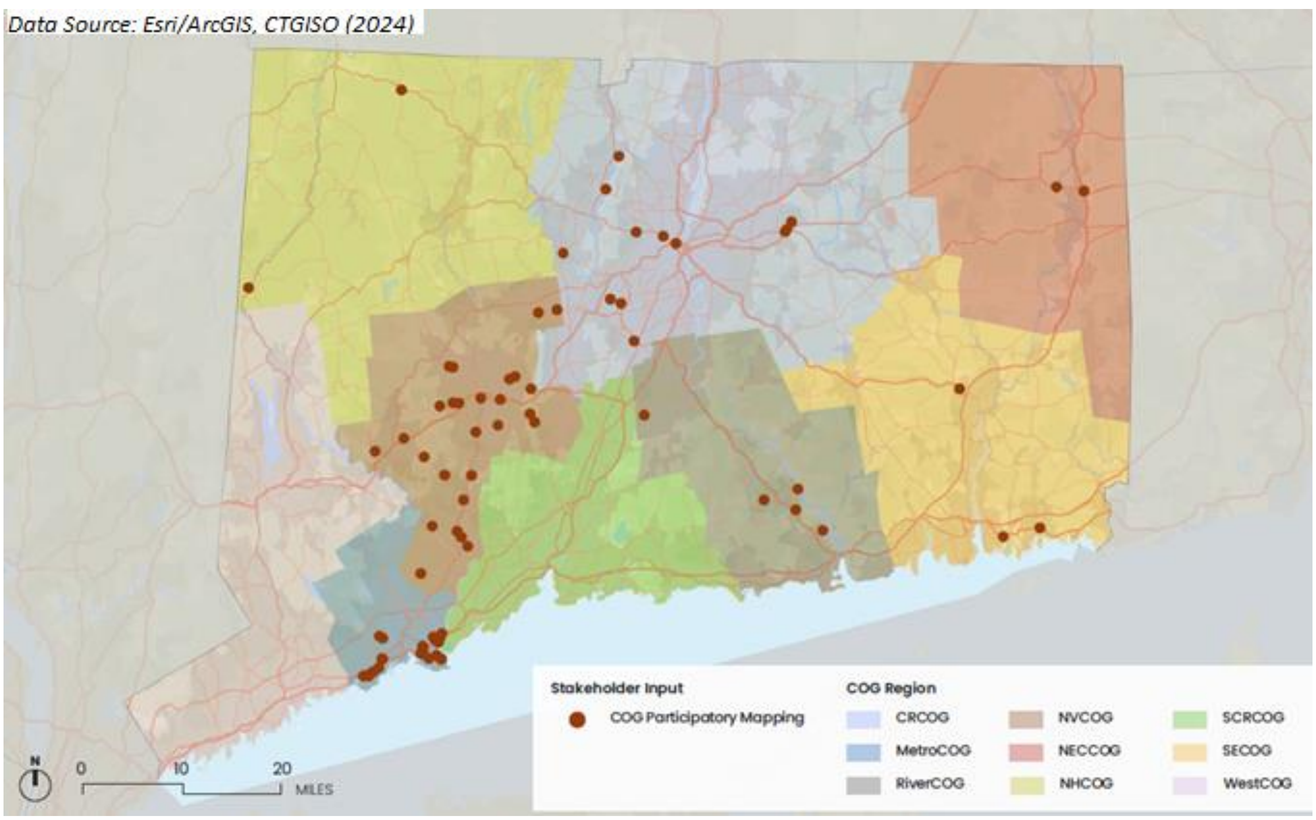


Figure 21: Stakeholder Engagement Map

COG ENGAGEMENT

Connecticut's Councils of Government (COG) are regional planning organizations that collaborate with local government to address regional issues and promote coordinated development across the state. Connecticut is divided into nine Councils of Government, as seen in Figure 22.

- Capital Region (CRCOG)
- Connecticut Metropolitan (MetroCOG)
- Northeastern Connecticut (NECCOG)
- Northwest Hills (NHCOG)
- Naugatuck Valley (NVCOG)
- Lower Connecticut River Valley (RiverCOG)
- Southeastern Connecticut (SECOG)
- South Central Regional (SCRCOG)
- Western Connecticut (WestCOG)

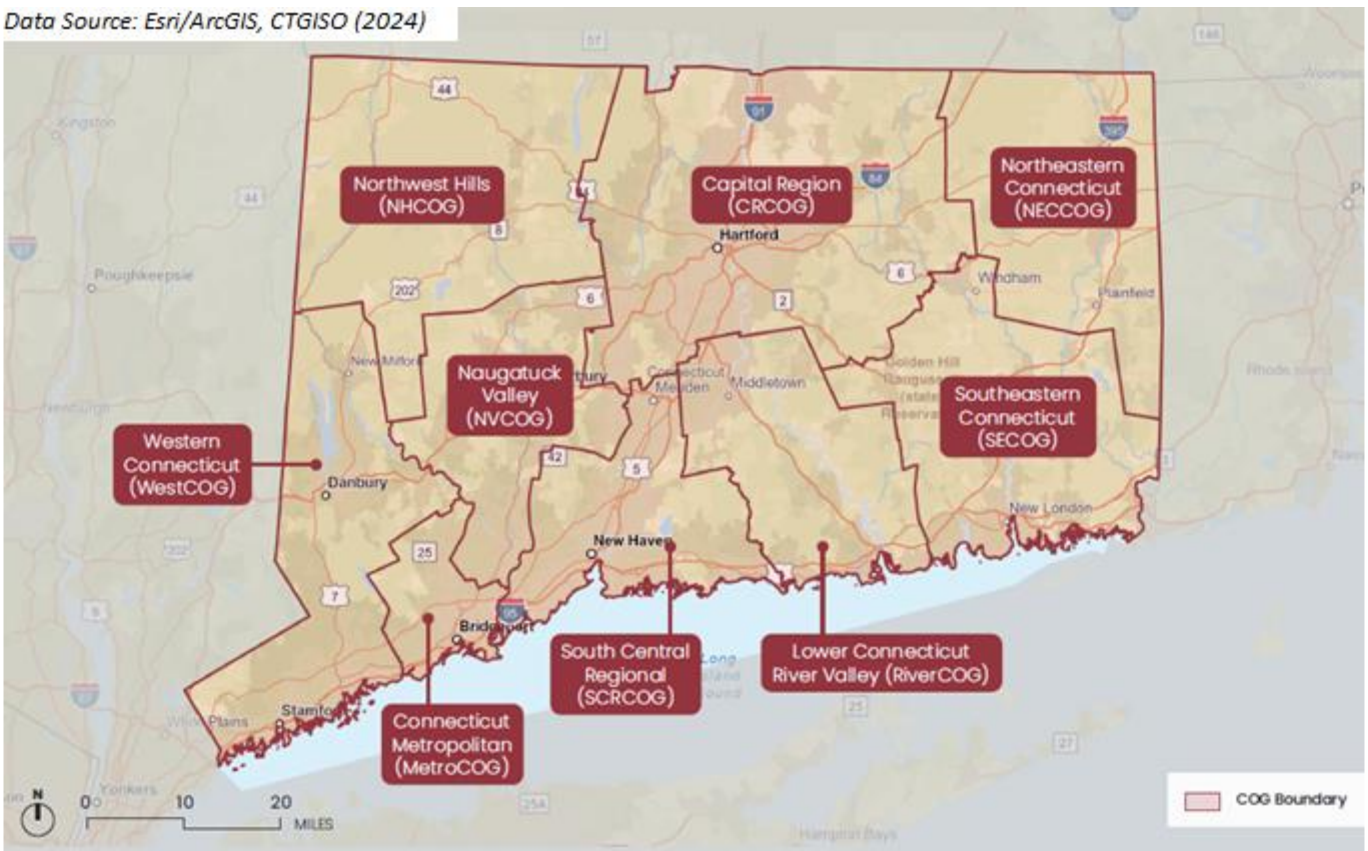


Figure 22: Map of Connecticut Council of Governments

Natural hazards are experienced in ways that are unique to each region, community, and asset. Understanding the specific vulnerabilities at different geographic scales can help inform future transportation planning, design opportunities, and assist COGs with funding opportunity justifications. Additional details on natural hazard incident locations and PROTECT eligible projects can be found within Appendix B: Stakeholder Engagement Memo.

Capital Region (CRCOG)

- **Population (2020 Census)**: 976,248
- **Land Area**: 1,027.46 square miles
- **Number of Municipalities:** 38

Stakeholder Feedback

CRCOG stakeholders identified several concerns related to Extreme Precipitation, Flood, and Dam Failure. One stakeholder noted that "… Route 315 is one of the first places we need to close as the Farmington River floods as early as the Action Stage of stream gauge heights. This closure can isolate Tariffville from emergency services from the center of Simsbury." The Farmington River was also noted to pose a risk to NBI Bridge 01487 in Farmington, which carries State Route 177. The CRCOG stakeholder noted, **"**Floodwaters will get dangerously close to flooding this bridge. Have not had to close yet, but it is anticipated that could happen."

These concerns were echoed in Weatogue where flooding from the Farmington River occurs on State Route 185 (Hartford Road), which leads to road closures. Similar concerns were present in Berlin along Route 9, where ***"****flooding impacts [NBI] Culvert 01095 and Town Physical Services Complex and surrounding area."* Along US-44 (Albany Avenue) in West Hartford, it was stated, *"Storms lead to road closures, emergency vehicle response time increases, and residents (are) stuck in their houses."*

Connecticut Metropolitan (MetroCOG)

- **Population (2020 Census)**: 325,778
- **Land Area**: 196 square miles
- **Number of Municipalities:** 6

Stakeholder Feedback

MetroCOG stakeholders reported extensive flood and sea level rise events throughout their region. Noted concerns include flooding on US-1 (Post Road) at approximately six intersections in Fairfield, impeding access to the train stations. The MetroCOG Hazard Mitigation Plan, as well as MetroCOG staff, notes the need for redesign and replacement of multiple culverts and channels on Surf Avenue at the I-95 overpass in Stratford due to frequent flooding, as well as the exploration of a flood wall to reduce coastal flooding in Bridgeport. Flood concerns are also noted at I-95, Exit 24. Recurrent high tide flooding and weekly blue-sky high tide flooding are reported at numerous locations along State Route 113, around Sikorsky Airport. It is important to note that in 2025, Route 113 in Stratford near Sikorsky Airport, became the site of an emergency declaration (ED) to replace a series of three culverts; additionally, another portion was replaced in 2024.

Northeastern Connecticut (NECCOG)

- **Population (2020 Census)**: 95,348
- **Land Area**: 562 square miles
- **Number of Municipalities:** 16

Stakeholder Feedback

NECCOG stakeholder input in Windham County was comparatively limited, primarily describing stakeholder perception of undersized or inundated culverts. An incident with **"**over the road flooding**"** was noted on State Route 12 north of Dayville Brook, near State Route 101 in Killingly. Additional input included a previously failed corrugated metal pipe culvert and maintenance action items along State Route 89 near Westford Hill Road in Ashford, roadway flooding along State Route 200 (Thompson Hill Road) in Thompson, and one culvert (now an active project) along State Route 12 between Killingly and Putnam.

Northwest Hills (NHCOG)

- **Population (2020 Census):** 112,503
- **Land Area**: 515 square miles
- **Number of Municipalities:** 21

Stakeholder Feedback

This region of the state is notable for its hilly terrain and frequent thunderstorms. Extreme precipitation, riverine flooding and extreme cold are the primary concerns voiced in the NHCOG region.

One stakeholder noted recurrent flooding along US-7 (Kent Road), which loosely follows the Housatonic River. **"**This flooding happens at different times of year…One of the worst flooding events happened in February of 2018, when the flooding resulted in a multi-day ice jam**."** These flood events have resulted in temporary roadway closures.

Naugatuck Valley (NVCOG)

- **Population (2020 Census)**: 450,376
- **Land Area**: 422 square miles
- **Number of Municipalities:** 19

Stakeholder Feedback

NVCOG stakeholders expressed flooding concerns with NBI Bridge 04123 in Bristol, which carries Central Street over the Pequabuck River, and NBI Bridge 01475 in Southbury, which carries State Route 172 (S. Britain Road) over the Pomperaug River. Small flooding issues were also noted along State Routes 63 and 73 in Watertown, which serve as the town's Main Street.

Lower Connecticut River Valley (RiverCOG)

- **Population (2020 Census):** 174,225
- **Land Area**: 444 square miles
- **Number of Municipalities:** 17

Stakeholder Feedback

RiverCOG stakeholders noted several concerns with riverine flooding. A stakeholder voiced concern about future flooding near non-NBI culvert 05620 in Deep River, which carries State Route 80. Springtime flooding concerns were noted for State Route 17 in Portland, which is adjacent to the Connecticut River. Across the region, State Route 148 received the majority of flooding comments, with additional flooding concerns present in Lyme, Chester, and Killingworth.

Southeastern Connecticut (SECOG)

- **Population (2020 Census):** 280,430
- **Land Area**: 616 square miles
- **Number of Municipalities:** 19

Stakeholder Feedback

SECOG stakeholders identified various flooding-related challenges across the region, including the Yantic River flooding in January 2024 (Figure 23), which was associated with a breach at the Fitchville dam and affected the nearby towns of Norwich, Franklin and Bozrah. On State Route 138 in Sprague, stakeholders noted concerns at Drainage Culvert 170-CV-4129, which is currently being replaced. Flooding during heavy rain events was also noted under NBI Bridge 01352 in Lisbon, which carries Providence and Worcester Railroad Company tracks over State Route 138.

The underpass of NBI Bridge 01641 in Groton, which carries Amtrak over State Route 649, is frequently inaccessible due to flooding. Storm surge and sea level rise concerns were expressed for US-1 (Main Street) in downtown Mystic. Stakeholders note "ponding during high tide" at US-1 and Jackson Avenue, and "not much damage, but major flooding to downtown Mystic district."

Figure 23: Yantic River Flooding and Evacuations in Norwich, January 2024. [34]

SOUTH CENTRAL REGIONAL (SCRCOG)

- **Population (2020 Census):** 570.487
- **Land Area**: 570 square miles
- **Municipalities:** 15

STAKEHOLDER FEEDBACK

Amtrak underpass flooding was noted on US-1 in Madison. Numerous flood issues were noted at various points along US-5 (South Broad Street) in Meriden, posing physical and operational challenges for transportation assets along this route. Overtopping or "water over road" occurrences were reported frequently along State Route 146, including at Non-NBI Culvert 02675 in Branford by Linden Avenue, as well as at Non-NBI Culverts 01371 and 05421, which both carry Amtrak lines over State Route 146 in Guilford. CTDOT completed a Corridor Management Plan for State Route 146 in Guilford and Branford in March 2025, and challenges related to sunny day flooding and extreme weather are further discussed in that study.[35]

WESTERN CONNECTICUT (WESTCOG)

- **Population (2020 Census):** 320,549
- **Land Area**: 522 square miles
- **Number of Municipalities:** 18

STAKEHOLDER FEEDBACK

WestCOG stakeholders reported experience with flooding from both extreme precipitation and sea level rise, causing impassable roadways and hazardous driving conditions. US-1 was a recurrent concern, with flooding and infrastructure failures reported in Greenwich and Darien. Recurrent flooding is present where US-1 crosses Greenwich Creek.

[34] Dana Jensen, Yantic Fire Department rescue during flooding in Norwich, Conn., Jan. 10, 2024, The Day via AP. Retrieved from https://apnews.com/article/us-winter-weather-storms-snow-tornadoes-flooding-b537b2e4b7903effbdbffbd98fc562ca.
[35] Connecticut Department of Transportation. (2025) *Route 146 Corridor Management Plan*. Retrieved from https://route146cmp.com/documents.html

QUICK WIN PROJECTS

The RIP prepares CTDOT for changing conditions related to natural hazards by documenting the known lived experiences of stakeholders. The RIP provides resilience strategies to address immediate and long-term vulnerabilities to better prepare for and respond to these natural hazards. To address identified vulnerabilities found throughout the literature review and stakeholder engagement process, Appendix C: Quick Win Projects Memo was developed. The memo evaluates potential resilience projects against criteria that ensures projects are feasible, eligible for PROTECT funding, and align with community immediate and long-term resilience goals. The Quick Win Projects Memo includes PROTECT eligible projects for the COGs to consider. In addition, Appendix D Funding Overview lists potential funding sources for the COGs.

6. RESILIENCE STRATEGIES

The following section suggests high-level strategies for increasing systemwide resilience to the identified natural hazards, through interventions directly on assets themselves, as well as on surrounding land contained within CTDOT's right-of-way. These strategies can be incorporated into CTDOT's planning, design, operations, and maintenance activities. Strategic actions are outlined below using the following categories:

- Resilience Strategies (Current and Proposed)
- Internal Operational Recommendations
- External Collaboration and Partnership Recommendations

CTDOT implements resilience strategies to enhance the ability of the surface transportation system to adapt to natural hazard disruptions and to recover efficiently. Resilience strategies can be nature-based to enhance natural systems or engineered, both of which can provide environmental co-benefits and greater efficiencies on the surface transportation system. Resilience strategies are embedded within CTDOT, as Table 2 provides an overview of current resilience practices. Table 3 describes resilience strategies implemented for public transportation. Table 4 lists proposed strategies that can strengthen the transportation system, protect infrastructure users (travelers, riders and maintenance crews), and offer data driven results to further support actionable decision making. Recognizing that resilience extends beyond CTDOT's direct control, this section also outlines opportunities for external collaboration with Councils of Governments, other state agencies, municipalities, quasi-governmental and private infrastructure owners. These partnerships will be vital in standardizing risk metrics, supporting local planning, and promoting systemwide resilience.

Figure 24: Hazard Types in Resilience Strategies

CURRENT RESILIENCE STRATEGIES

Table 2: Current Resilience Practices

ASSET TYPE	CURRENT RESILIENCE PRACTICES	HAZARD ADDRESSED
All	Consider the benefits of combining hard surface transportation assets and natural infrastructure.	All Hazard Types
All	When project conditions allow, disconnection of impervious areas or provide primary stormwater treatment.	Extreme Precipitation, Flood, Dam Failure
Bridges	Utilize existing USGS stream gage sensors to collect data to assist in maintenance, monitoring, and design phase activities for all State-owned bridges and Municipally owned NBI Bridges.	Extreme Precipitation, Flood, Dam Failure
All	Where practicable, structures built to previously accepted design standards are upgraded to the current design standard.	All Hazard Types
Bridges and Drainage Systems	On a case-by-case basis, consider projected rainfall estimates in addition to current rainfall estimates when determining design flood elevations (DFEs), following guidance outlined in HEC-17 and various NCHRP Reports including NCHRP 15-61 (completed), NHRP 15-61A (in progress), and NCHRP 15-80 (in progress). Additionally, once NOAA Atlas 15 is released it will become the basis for current rainfall estimates, superseding NOAA Atlas 14.	Extreme Precipitation, Flood, Dam Failure
Buildings and Facilities	For existing transportation facilities designed under previously accepted design standards, continue to employ protective features for critical equipment as needed. These can include elevating equipment, installing backup power, and stocking emergency supplies in buildings housing critical staff and systems.	All Hazard Types
Roadway, Seawalls Bridges and Culverts	On a case by case basis continue to incorporate state, (CT DEEP/CIRCA) or federal (NOAA/USACE) sea level rise projections in the planning and design phase for coastal infrastructure projects, following the guidance outlined in HEC-25.	Storm Surge and Sea Level Rise
Roadways, Retaining Walls, Bridges and Culverts	Stabilize embankments as needed to protect roadway and structures.	All Hazard Types
Bridges and Culverts	Install protective coatings systems to structures exposed to chloride-based products.	Extreme Cold
Roadways	Utilize chloride-based products like sodium, magnesium, and calcium chlorides to prevent snow and ice from bonding to pavement.	Extreme Cold
Dams	Identify CTDOT-owned dams that are obsolete and at-risk that could be removed.	Extreme Precipitation, Flood, Dam Failure

Top 5 Resilience Improvement Strategies For Public Transportation

Table 3: Implemented Resilience Strategies for Public Transportation

Strategy	Coordination
Prioritize and implement strategies identified in the April 2024 MTA Climate Resilience Roadmap.	Metro-North Railroad and CTDOT
Develop climate resilience measures and implementation plan for passenger and freight rail, bus, and ferry capital projects to ensure public transportation infrastructure is built to withstand current and future extreme weather events and climate changes.	CTDOT
Evaluate progress on 2022 Amtrak Climate Resilience Plan and identify future work to mitigate extreme weather impacts to Amtrak, CTDOT, and freight services along the Northeast Corridor.	Amtrak and CTDOT
Develop operating plan for battery electric bus fleet in the event of power outages.	CTDOT
Advance Statewide Bus Stop Enhancement Program, in coordination with Complete Streets directive, to increase number of bus shelters at transit stops, thereby providing safe, protected areas to wait for a bus in extreme heat, cold and precipitation events.	CTDOT

Proposed Resilience Strategies

Table 4: Proposed Resilience Strategies

Asset Type	Strategy	Hazard Addressed
All	In locations where a transportation facility improvement is required, investigate weather related risks to assets (beyond bridges) and incorporate into design where feasible and prudent.	Extreme Precipitation, Flood, Dam Failure
All	Consider development of CT-Specific guidance for CTDOT's use in evaluating inland precipitation increases and sea level rise along the coast given the multiple data sources available and various guidance documents providing instruction for implementation of these resilience measures.	Extreme Precipitation, Flood, Dam Failure Storm Surge and Sea Level Rise
Culverts	Continue to identify locations and conditions of all culverts statewide through a culvert inspection program.	Extreme Precipitation, Flood, Dam Failure
Roadways	Create internal geospatial data inventory to capture geotechnical assets such as rock slopes and steep embankments (cut slopes with roadway below) and steep embankments adjacent to watercourses.	All Hazard Types
All	Validating and refining the Vulnerability Assessment scores and further examining the relationship between vulnerability, natural hazard-related disruptions, and maintenance costs with a goal to have this data as a GIS layer available to planners and designers.	All Hazard Types
All	Further refine the tracking of natural hazard-related disruptions for identification purposes.	All Hazard Types
All	Refine methods to validate the efficacy of implemented interventions.	All Hazard Types
All	Identify emerging hazard concerns such as precipitation patterns, sea levels, and temperatures change.	All Hazard Types
All	Assess MetroNorth and Amtrak's Resilience plans to work towards a multi-modal Resilience Improvement Plan.	All Hazard Types
All	Working with the CT Port Authority and the CT Airport Authority on resilience initiatives.	All Hazard Types

Internal Operational Recommendations

Increasing surface transportation system resilience involves investing in both infrastructure assets and organizational processes that collectively support a more resilient system. Table 5 contains recommendations that aim to enhance CTDOT's resilience programming, metrics, evaluation processes, and organizational knowledge of weather-related risks and vulnerabilities.

Table 5: Internal Operational Recommendations

Focus	Objective	Recommendation
Vulnerability Development	Validation / Ground Truthing	As the VA is developed, the results should be shared with maintenance field staff to "ground truth" the outputs to ensure the project priorities are in line with needs seen in the field.
Plan Roll-Out And Adoption	Provide VA Web Viewer Training	Once the VA is completed, identify the units within CTDOT who would benefit from training on the VA web viewer. Train staff on what the VA is, why it is important, and how to interpret the results.
Operations	Capture Events that Occur at Structures, Culverts, Roadway Embankments, etc.	Continue to report activities around natural hazard-related infrastructure disruptions to develop a baseline against which progress can be evaluated.
		Verify accuracy of lists containing transportation assets that have been damaged repeatedly by natural hazards. Investigate concepts to address these areas.
Planning	Additional Resilience Project Identification	Evaluate opportunities for incorporating sustainable best management practices into PROTECT project selection.
Policy	Incorporate state and federal policy guidance within the Project Selection process	Integrate resilience policy strategies into the project development and project selection process.
Funding	Leverage Federal Funding	Track Notices of Funding Opportunities (NOFOs) for applicable federal discretionary grant funding programs. Secure additional federal funds for resilience projects, as available, for resilience projects that are ready to advance.
Capacity Building	Interdepartmental Coordination	Encourage open conversations across CTDOT bureaus to periodically discuss extreme weather hazards and adaptation approaches.
		Update information through regular reporting / data gathering from District Offices.
Validation	Validate Vulnerability Assessment	Cross-check whether new extreme weather disruption metrics align with VA results.
Programming	Pilot Projects Current Practice	Develop and implement pilot projects to test new technologies or approaches to improve resilience.
	Enhance Communication with Transportation Users	Consider ways to continue enhancing emergency notifications and standard communication between operators and users. This could include developing applications with real-time updates and delay notifications or installing bus arrival displays. Provide information on alternative transportation methods when transit operations are suspended or delayed. Expanding system notification of Variable Message Signs and CT roads.

External Collaboration and Partnership Recommendations

CTDOT recognizes the importance of collaboration to address statewide resilience, which is strengthened through cross-jurisdictional and inter-agency action. Collaboration with internal and external stakeholders will help disseminate resilience data, standardize measurement and evaluation metrics across organizations, and align broader planning efforts. Strategies to improve transportation system resilience include engagement with various resiliency planning efforts within CTDOT and among federal, state, and local partners. As part of the resilience integration process, CTDOT will foster and promote collaboration to leverage expertise and resources, align priorities, and implement resilient measures. Table 6 outlines a variety of opportunities for future coordination.

Table 6: External Collaboration and Partnership Recommendations

State Agencies	
Cross-Agency and Private Utility Collaborations	Streamline resilience improvement efforts across transportation, water, energy, and communication sectors. Support consistent risk identification and mitigation strategies across disciplines for public safety.
Councils of Government	
Integrate Resilience Interventions Locally	Inform Councils of Government about the RIP to support their regional transportation improvement and hazard mitigation plans, understand risks to local roads that connect to critical transportation corridors and enhance system redundancy. Gathering stakeholder input on assets prone to natural hazard-related disruptions and recurrent maintenance needs can be an efficient and minimal effort activity to assess emerging vulnerabilities. In partnership with CTDOT, identified concerns may be screened for the appropriate resolution to address potential systemwide vulnerabilities.
Municipalities	
Proactively Coordinate with Municipalities and Community Resilience Initiatives	Encourage municipalities to develop and disseminate evacuation routes, identify vulnerable infrastructure, develop projects that further resilience goals, and share data. This recommendation aligns with the passage of Connecticut House Bill (H.B.) No. 5004, “An Act Concerning the Protection of the Environment and the Development of Renewable Energy Sources and Associated Job Sectors,” formally known as Public Act 25-125. The Public Act passed on July 1, 2025 tasks the state’s Department of Administrative Services (DAS), in consultation with other state agencies including CTDOT, to establish a process for consideration when any decision is made to remodel, alter, repair, construct, or enlarge any state asset, by January 1, 2026.

7. PROTECT PROJECT SCREENING PROCESS

The following process provides a structured approach for prioritizing PROTECT eligible transportation projects that incorporate resilience strategies to address known vulnerabilities. The PROTECT eligible project screening process uses an evaluation criterion to ensure that selected projects deliver meaningful benefits and are feasible to implement. To maximize impact and resource efficiency, the process focuses on identifying and addressing the most urgent needs—those where investment will significantly enhance the resilience of the surface transportation system.

The process should evaluate each project based on the vulnerability of the assets involved, the potential impact on surrounding communities, and the project's alignment with broader regional priorities. Additional criteria for consideration include asset interdependencies, feasibility, constructability, and funding eligibility. These factors with stakeholder support can support the immediate and long-term resiliency goals of CTDOT.

It should be noted that the screening process was created to determine eligibility of projects that align with the PROTECT Program under 23 USC 176 and does not apply to CTDOT's capital project selection process.

CRITERIA

SYSTEM FUNCTIONALITY

The following criteria are intended to identify and prioritize projects focused on the most critical components of the surface transportation system outlining an approach to identify locations with the highest vulnerability and providing essential access to community lifelines:

- **Resilience Benefits:** Prioritize projects based on quantifiable resilience benefits. Consider the vulnerability of transportation assets in relation to critical infrastructure.
- **Criticality:** Prioritize projects that preserve access to critical community lifelines necessary for public safety such as hospitals and fire stations, which can significantly improve a community's emergency response and recovery capacity during natural disasters and emergency events.
- **Detour Route Availability and Access:** Consider the importance of maintaining access to areas that lack alternate routes, especially in situations where emergency services may be needed.

EFFICIENCY

The following criteria aim to advance the efficient use of funding, administrative effort, and project management resources:

- **Multiple Assets:** Prioritize projects addressing multiple vulnerable assets simultaneously, in effort to provide greater overall impact.
- **Cost:** Prioritize projects with expenses substantial enough to justify the administrative effort of securing funds, yet not so high as to limit the funding of other projects, in effort to optimize resource allocation.
- **Implementation Feasibility:** Prioritize projects with a high likelihood of successful and prompt execution, in effort to avoid delays and complications that can hinder the efficient disbursement of PROTECT and other funding programs.

COMMUNITY IMPACT

To ensure that selected projects have a greater impact on the public, they must address vulnerabilities from extreme weather while also providing broader benefits. Together, these criteria identify projects that are not only effective and efficient but also beneficial to the community and environment:

- **Co-Benefits:** Prioritize projects that enhance community well-being through improvements in multimodal infrastructure.
- **Environment:** Prioritize projects that help the state prepare for, and respond to, weather-related events. Connecticut has established various laws and executive orders to advance these efforts, which are outlined in Table 7.

Figure 25: CTDOT Multimodal Infrastructure – Charter Oak Greenway

Table 7: Connecticut Executive Orders and Public Acts

State of Connecticut Executive Order / Public Act	Date Issued/Signed	Purpose
Public Act 12-148, An *Act Enhancing Emergency Preparedness and Response*	June 15, 2012	To improve the ability of the state, municipalities, and utility companies to better prepare for natural disasters and other emergencies.
Executive Order No. 46	April 22, 2015	Establishes a new Governor's Council on Climate Change to examine the efficacy of existing policies and regulations designed to reduce GHG emissions and identify new strategies to meet the established emission reduction targets.
Executive Order No. 50	October 26, 2015	Establishes the State Agencies Fostering Resilience Council, which is responsible for strengthening the state's resiliency from extreme weather events.
Public Act 18-82, *An Act Concerning Climate Change Planning and Resiliency*	June 6, 2018	Integrates new sea level change projections into various municipal and state planning documents, including plans of conservation and development, and municipal evacuation or hazard mitigation plans; and applies the new sea level change projections to the state's coastal management and flood management laws.
Executive Order No. 1	April 24, 2019	Directs executive branch state office buildings and vehicle fleets to become greener and more energy efficient through an expanded "Lead by Example" sustainability initiative aimed at reducing the state's carbon footprint and reducing the cost of government operations.
Executive Order No. 3	September 3, 2019	Reconstitutes and expands the scope of the Governor's Council on Climate Change (GC3) to address climate change adaptation in addition to mitigation.
Public Act 21-115, *An Act Concerning Climate Change Adaptation*	July 6, 2021	To increase local resilience planning options, legal authorities, and financing for adaptation and resilience projects.
Public Act 25-15, *An Act Concerning the Protection of the Environment and Development of Renewable Energy Sources and Associated Job Sectors*	June 3, 2025	Focuses on the protection of the environment and the development of renewable energy sources in Connecticut.
Public Act 25-33, *An Act Concerning the Environment, Climate and Sustainable Municipal State Planning, and the use of Neonicotinoids and Second-Generation Anticoagulant Rodenticides*	June 10, 2025	Works towards a safer and healthier Connecticut by protecting people and vulnerable infrastructure from climate impacts like flooding, extreme weather, and heat waves by improving transparency, strengthening infrastructure, and establishing Resiliency Improvement Districts.

Project Categories

The resilience strategies from Tables 2 through 4 and the PROTECT eligible project screening process described above were referenced to establish several project categories that could align resiliency with CTDOT goals. CTDOT incorporates resilience into project design through the use of specified standards found in various design manuals. The following table will be a useful guide to streamline the PROTECT eligible project planning process.

Note: This table is to provide examples and does not represent all types of projects being considered.

Table 8: Project Categories for Resilience Improvements

CTDOT Project Categories for Resilience Improvements		
PROJECT TYPE	**DESCRIPTION**	**PROJECT SIGNIFICANCE**
Scour protection and/or scour monitors at existing bridges and other structure types	Monitor scour and/or mitigate erosion/scour to enhance the stability of a structure.	Scour is the erosion of soil or sediment that occurs when water erodes the base of support structure for bridges and their foundation. Scour holes can weaken the structure integrity for certain structure types. Ensuring proper scour protection is added to a structure, if deemed necessary, will reduce risk of impacts due to scour.
Stabilization Measures	Mitigate instabilities and implement stabilization measures.	Provide for protection of slopes, channels, and streambanks along roadway embankments, bridge and culvert structures and other assets to prevent undermining.
Stormwater drainage capacity improvements	Incorporate low impact development measures, reduce directly connected impervious area, increase stormwater retention / storage.	These measures reduce flooding, flow, and velocities within pipes to minimize scour and erosion, decrease conveyance flows and promote infiltration.
Analyze vulnerable bridges for current and future natural hazard condition	Lengthen and / or raise bridges to increase the hydraulic openings. Raise height of bridges to reduce severe overtopping. Reduce mid-span piers and culverts with multiple openings which can accumulate debris and lead to channel blockages.	Increase of hydraulic openings and raising vulnerable bridges and culverts can reduce severe overtopping in response to extreme weather events. The lengthening and raising low chord of vulnerable bridges or increasing culverts size may be needed in areas that are susceptible to flooding to enhance safety of roadway users and increase the structure lifespan. Increasing hydraulic openings (wider spans, raised low chords, reducing/eliminating mid-span piers) can reduce debris buildup and minimize damage to bridge structure.
Development of Vulnerability Assessments planning tools	The development of vulnerability disruption scenario models overlayed with GIS technology to aid in the project planning process.	Planning is an important first step of the project screening process. Harnessing GIS/modeling technologies to overlay data with projected storm models could provide insights into asset vulnerability and promote meaningful project selection.

8. NEXT STEPS

CTDOT can strengthen internal processes by continuing to incorporate resilience into asset management systems, inspection protocols, and project planning framework. Next steps include updating the RIP to ensure its resilience strategies align with those already established within other CTDOT statewide transportation plans. Further actions include developing and refining the vulnerability assessment to gain greater insight into the performance of CTDOT's assets when exposed to natural hazards during current and Mid-Century conditions. This involves expanding the collection of asset data to include a comprehensive overview of CTDOT owned and managed public transportation infrastructure. Together, these next steps advance CTDOT's vision of providing a safe, reliable, and sustainable transportation system that supports Connecticut's economic vitality and safeguards communities in the face of changing future conditions.

RIP UPDATES

CTDOT may amend the RIP, as needed, to ensure the information is as up to date as possible. Revisions may include adding information related to new local or regional natural hazard resilience policies and programs. Additional updates to the RIP may include improving methods of data collection, expanding asset vulnerability tracking, and refining natural hazard dataset projections. Staying apprised of the most current data can effectively support CTDOT's capacity to adapt to changing conditions.

DEVELOPMENT OF A VULNERABILITY ASSESSMENT

Understanding vulnerability requires evaluating how natural hazards can damage infrastructure; it requires assessing how transportation disruptions can affect system users and communities. These insights are critical for increasing transportation system resilience, ensuring continuity during disruptions, and supporting adaptation to changing conditions.

CTDOT is currently assessing the vulnerability of the surface transportation system to natural hazards. Through a data-driven approach using the FHWA VAST tool, the Vulnerability Assessment (VA) is currently being developed to identify possible risks associated with natural hazards. Conducting a risked-based vulnerability assessment of transportation assets on current and Mid-Century conditions requires data validation to ground truth the system model. It is essential to compare geospatial analyses to the data that has been gathered, including the lived experiences of stakeholders, in order to confirm the validity of the analysis and to ensure trusted risk-based decisions can be achieved. This systemic approach of validating both quantitative and qualitive transportation assets to the model will improve the systems resilience and further investments throughout the state. Once completed, the VA will aid in identifying vulnerabilities related to extreme weather and natural hazards.

ASSET IDENTIFICATION

CTDOT is in the process of refining and further validating outputs from the FHWA Vulnerability Assessment Screening Tool (VAST). VAST provides a score for each asset's level of exposure, sensitivity, and adaptive capacity to natural hazards, which ultimately produces a final vulnerability score. Each asset receives a score for existing and mid-century conditions. The following tables list the assets that are being used in CTDOT's Vulnerability Assessment which is currently under development.

Table 9: Quantitative Primary Assets

ASSET TYPE	DEFINITION
Roads	CTDOT owned roads. Sidewalks, bike lanes, bus routes, bus stops, and freight routes are included as attributes in this analysis
NBI Bridges	CTDOT owned bridges with a span greater than 20 feet
Non-NBI Bridges	CTDOT owned bridges with a span equal to or less than 20 feet
NBI Culverts	CTDOT owned culverts with a span of over 20 feet
Non-NBI Culverts	CTDOT owned culverts with a span between 6 and 20 feet
Drainage Culverts	CTDOT owned culverts under 6 feet
Transit Shelters	CT*transit* bus shelters
Trails	CTDOT owned trails of regional significance

Table 10: Qualitative Contributing Assets

ASSET TYPE	DEFINITION
Rail	CTDOT owned rail tracks
	CTDOT owned rail power and communication utilities
Transit	CT*transit* bus stops
Tunnels	CTDOT owned or operated tunnels: Heroes Tunnel – Owned/operated by CTDOT. Hartford Platform – roadways owned by CTDOT, overtopping park owned by Hartford, operations controlled by CTDOT but funded by Hartford. Hartford Library – Roadway owned by CTDOT; library owned by Hartford.[2]
Buildings/Facilities	CTDOT owned rail maintenance facilities
	CTDOT owned intermodal facilities
	CTDOT owned truck weigh stations
	CTDOT owned truck parking locations
	CTDOT owned bus parking
	CT*transit* bus maintenance facilities

9. CONCLUSION

Through this collaborative planning process, CTDOT has identified natural hazard risks, developed strategies, and positioned itself to continue enhancing the resilience of Connecticut's statewide surface transportation system as extreme weather intensifies. The RIP serves as foundational documentation of known lived experiences and resilience strategies for CTDOT and the COGs to better prepare for and respond to these natural hazards. With PROTECT funding and technical guidance from FHWA, Connecticut will have a better understanding of system-wide vulnerabilities to natural hazards under existing and Mid-Century conditions. To meet these challenges, CTDOT will have an enhanced perception of the relative vulnerability of its asset holdings and internal organizational action items for continuous learning and improvement, ranging from enhanced data gathering to capacity building. This comprehensive approach will help Connecticut build a more resilient transportation system that is capable of withstanding future extreme weather challenges while supporting the safety and prosperity of its communities. Moving forward, CTDOT can continue to use this PROTECT eligible screening process to guide resilience programming and project development in order to ensure that resilience improvements are realized efficiently and effectively.

APPENDICES

The RIP relies on numerous technical processes, which are detailed in the following appendices.

APPENDIX A – LITERATURE REVIEW MEMO

The literature review covered pertinent planning documents developed by other entities across the state and are included in RIP for reference. The literature review examines over 12 plans in Connecticut including the 2023 Connecticut State Hazard Mitigation plan, and each of the nine COG's hazard mitigation. Localized extreme weather projections were also reviewed. The review identified common weather-related challenges, resilience challenges COGs and CTDOT face, and identified opportunities for potential action. The Memo was utilized to identify synergies between the Resilience Improvement Plan and previous efforts, and to understand previously identified resilience challenges.

APPENDIX B – STAKEHOLDER ENGAGEMENT MEMO

Stakeholders such as CTDOT's district maintenance engineers and Council of Governments staff were engaged during the planning process to document known hazard concerns, locations of experienced hazards, and priorities for projects. This feedback was collected through conversation at engagement meetings, participatory mapping exercises, and surveys to help focus area selection. The Stakeholder Engagement Memo summarizes the feedback received throughout the stakeholder engagement process. Key components include an overview of the engagement process, identified stakeholder areas of concern, and a summary of previous flood impacts. It is important to note that stakeholder engagement data is a snapshot in time and may not reflect every issue COG and CTDOT District staff experience.

APPENDIX C – QUICK WIN PROJECTS MEMO

CTDOT began making strides to improve transportation system resilience prior to the development of the Resilience Improvement Plan. The Quick Wins Projects Memo establishes a process to review existing early-stage CTDOT projects, as well as concerns identified by CTDOT Districts and COGs that meet the criteria of the PROTECT program. The Memo summarized a shortlist of likely PROTECT eligible projects to allow CTDOT to utilize PROTECT funds while the Resilience Improvement Plan was being finalized. Key components of the Memo include a summary of the selection process, overview of project sources, and the identified quick wins project list.

APPENDIX D – FUNDING OVERVIEW

The Funding Overview memo outlines federal and state programs that support resilience-improvement projects, with an emphasis on opportunities available to COGs and municipalities as CTDOT may not be an eligible applicant for each identified funding program.