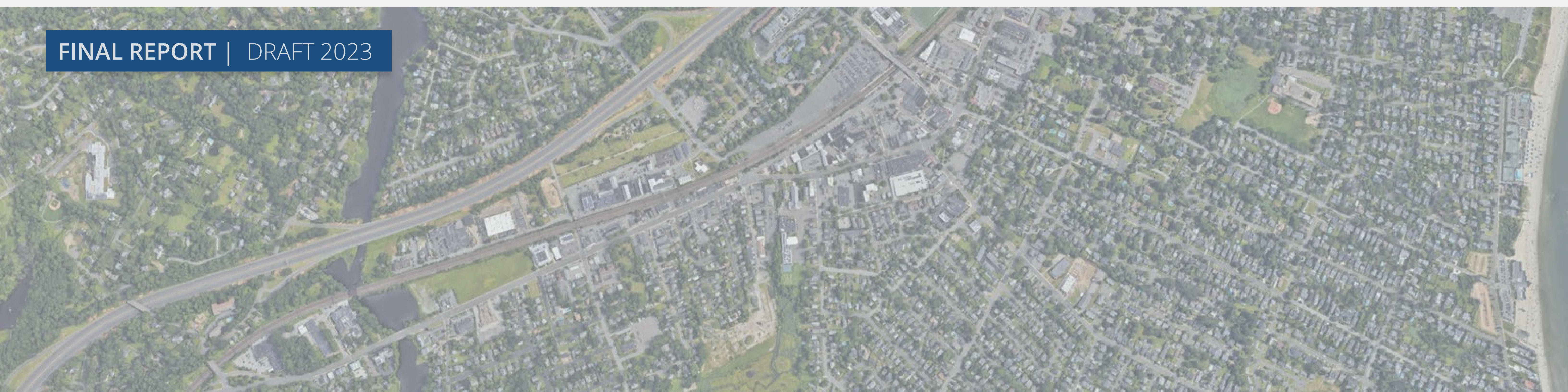
Resilient Fairfield

RESILIENT CORRIDOR ANALYSIS



FINAL REPORT | DRAFT 2023

Definitions and Acronyms:

CIRCA: The Connecticut Institute for Resilience and Climate Adaption

CT DEEP: The State of Connecticut Department of Energy and Environmental Protection

GC3: Governor's Council on Climate Change

CLEAR: The Center for Land Use Education and Research (CLEAR)

Resilient Fairfield Chapter I:

Project Introduction

CIRCA Phase III

The partnership between the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) and its pilot project communities is designed to address an array of climate-related vulnerabilities, provide the communities with actionable plans, and establish a roadmap for other Connecticut communities facing similar natural hazards. As a coastal town, Fairfield experiences storm-related coastal flooding; however, additional inland flooding occurs in the town at several low-lying underpasses and across several surface streets. The inland flooding occurs following intense rainfall and is more severe when occurring at the same time as high tides or storm surge events. This project will provide adaptive strategies to reduce the likelihood and impacts of flooding within the study area.

Role of CIRCA + Initial Project Phases

CIRCA is a multi-disciplinary research center based on collaboration between the University of Connecticut (UConn), and the State of Connecticut Department of Energy and Environmental Protection (CT DEEP) to address climate action and research within the state. Other partners involved in research and findings include the National Oceanic and Atmospheric Administration (NOAA), the Governor's Council on Climate Change (GC3), the Center for Land Use Education and Research (CLEAR), and the CT Department of Housing, among others.

CIRCA was founded in 2014 as a response to the impacts of severe storm damage caused by Superstorm Sandy, and the projected future storms exacerbated by climate change and rising sea levels. One of CIRCA's key goals is to not only produce high-quality research to better understand climate vulnerability at a fine-grained scale but to ensure that the best science would be used by local communities for infrastructure and resilience planning.

CIRCA's key project is Resilient Connecticut, which is multi-phase collaborative effort between CIRCA, state agencies, regional councils of governments (COGs), municipalities, and the public to better understand coastal flooding risk in Fairfield and New Haven Counties. Specifically, Resilient Connecticut has the following goals: 1) build capacity and promote coordination between the different levels of government that will be impacted by sea level rise and coastal flooding; 2) develop specific and implementable plans and projects; 3) use CIRCA and UConn's technical expertise to better predict flood and storm risk through modeling; and 4) Contribute to the inputs for a Connecticut Statewide Resilience Roadmap.

Resilient Connecticut has had three phases: Phase I began in 2018 and involved creating an assessment of resilience and adaptation efforts. This was combined with public outreach to guide the creation of a Resilience Planning Framework, released in January 2020.

In Phase II, CIRCA used the Resilience Planning Framework and coordinated with local governments and four regional COGs to 1) conduct public outreach among community members, and 2) assess regional risk and vulnerability for all 51 municipalities in two pilot areas of New Haven and Fairfield Counties. This project involved the creation of several interactive tools, further described below, as well as two comprehensive technical reports (Resilient Connecticut Phase II: From Regional Vulnerabilities to Resilience Opportunities, (December 2021), and the Phase II Technical Report (released in early 2022).

CIRCA created three interactive and map-based tools to better understand risk at different scales.

Social Vulnerability Index: The CIRCA team merged 30 community and social factors collected by the US Census Bureau—grouped into five main groups—into a composite Social Vulnerability Index (SVI). These factors include poverty levels, the percentage of the population without access to vehicles, and levels of the population with disabilities. Each of these may affect the adaptive capacity of .the communit

Climate Change Vulnerability Index: The CIRCA team created a Climate Change Vulnerability Index (CCVI), which involved the calculation and mapping of spatial risk scores created from flood and heat vulnerability inputs, normalized by "adaptive capacities" (the SVI score).

Zones of Shared Risk: The CIRCA team created a map showing "Zones of Shared Risk," which are geographical units that share some risk from rising sea levels and greater storms. ZSRs fall into the following categories: Access; Location; Natural Protection; Proximity; and Underpass. Descriptions of ZSRs are listed below:

Access ZSRs: Risk from the inability to enter/exit an area due to flooding from sea level rise/storm surges

Location ZSRs: Risk from the prevalence of being located within low-lying lands

Proximity ZSRs: Risk from being located adjacent to low-lying areas

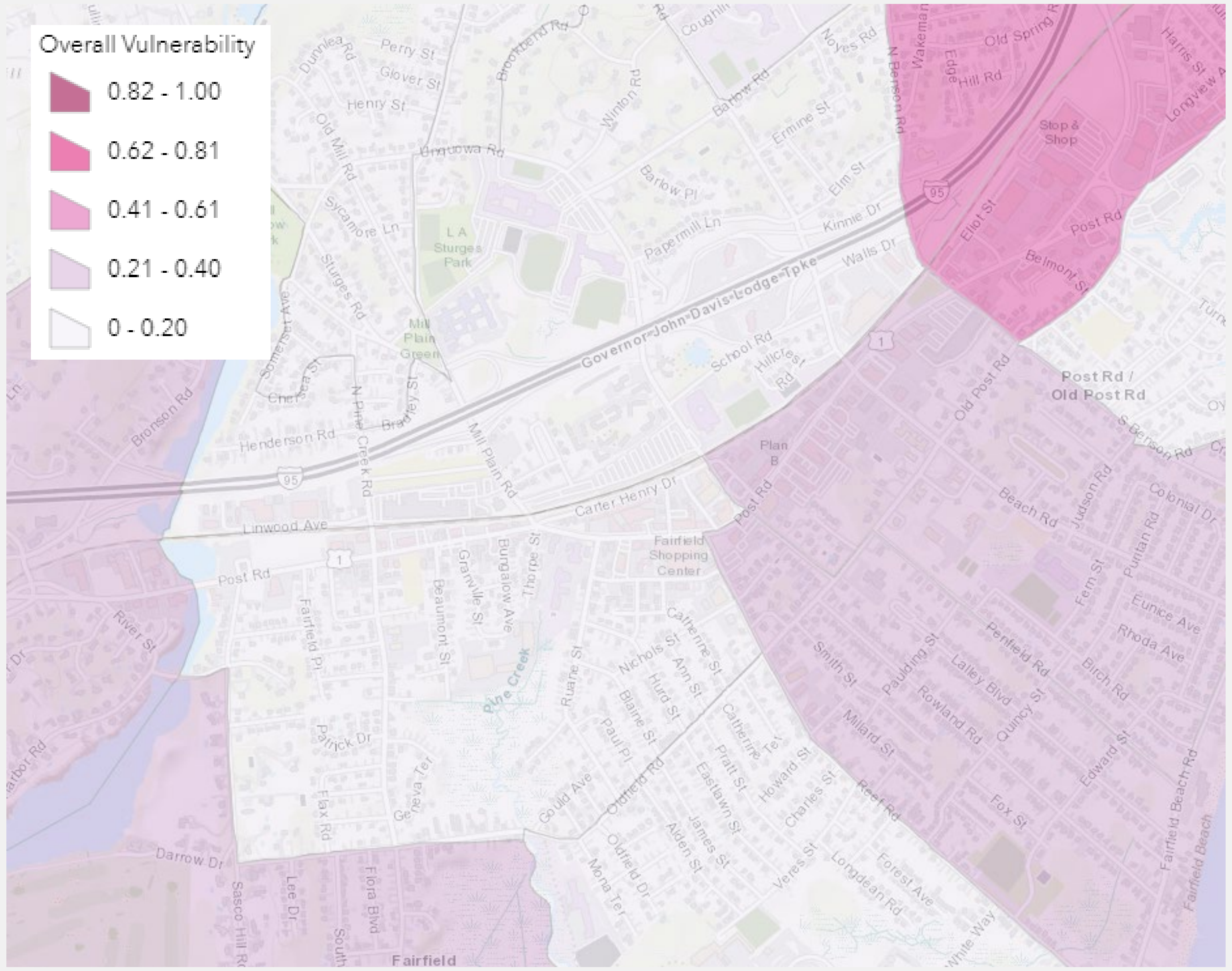
Natural Protection ZSRs: Risks to areas that provide natural flooding protection (to other areas)

Underpass ZSRs: Road underpass locations where roads often flood during heavy rainfall events

Identifying ZSRs can support the creation of "resilient corridors" by linking more vulnerable areas to less vulnerable areas and serving as evacuation pathways. Careful analysis and thoughtful planning can help implement successful adaptation strategies to reduce the impacts of climate change, as well as increases in economic development and social mobility.

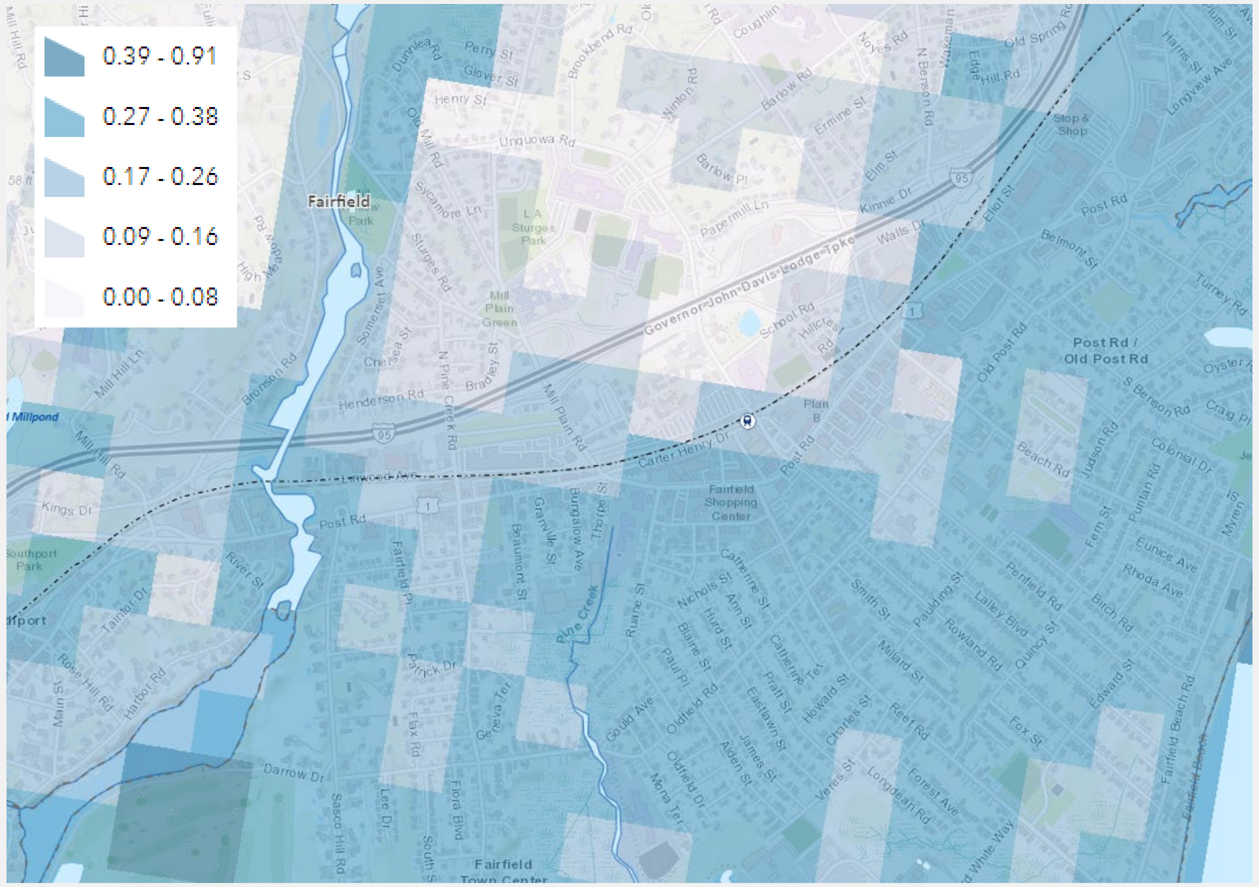
Flooding in downtown Fairfield. Source: Downtown Green Infrastructure Assessment (2018)

Social Vulnerability Index



Social vulnerability plays a key role in a community's ability to adapt to the threats of climate change. The social vulnerability within the study area is quite low and likely reflects the community's higher income levels and higher car ownership. The areas of greater vulnerability are generally concentrated towards the eastern edge of the study area.

Flood Vulnerability Index



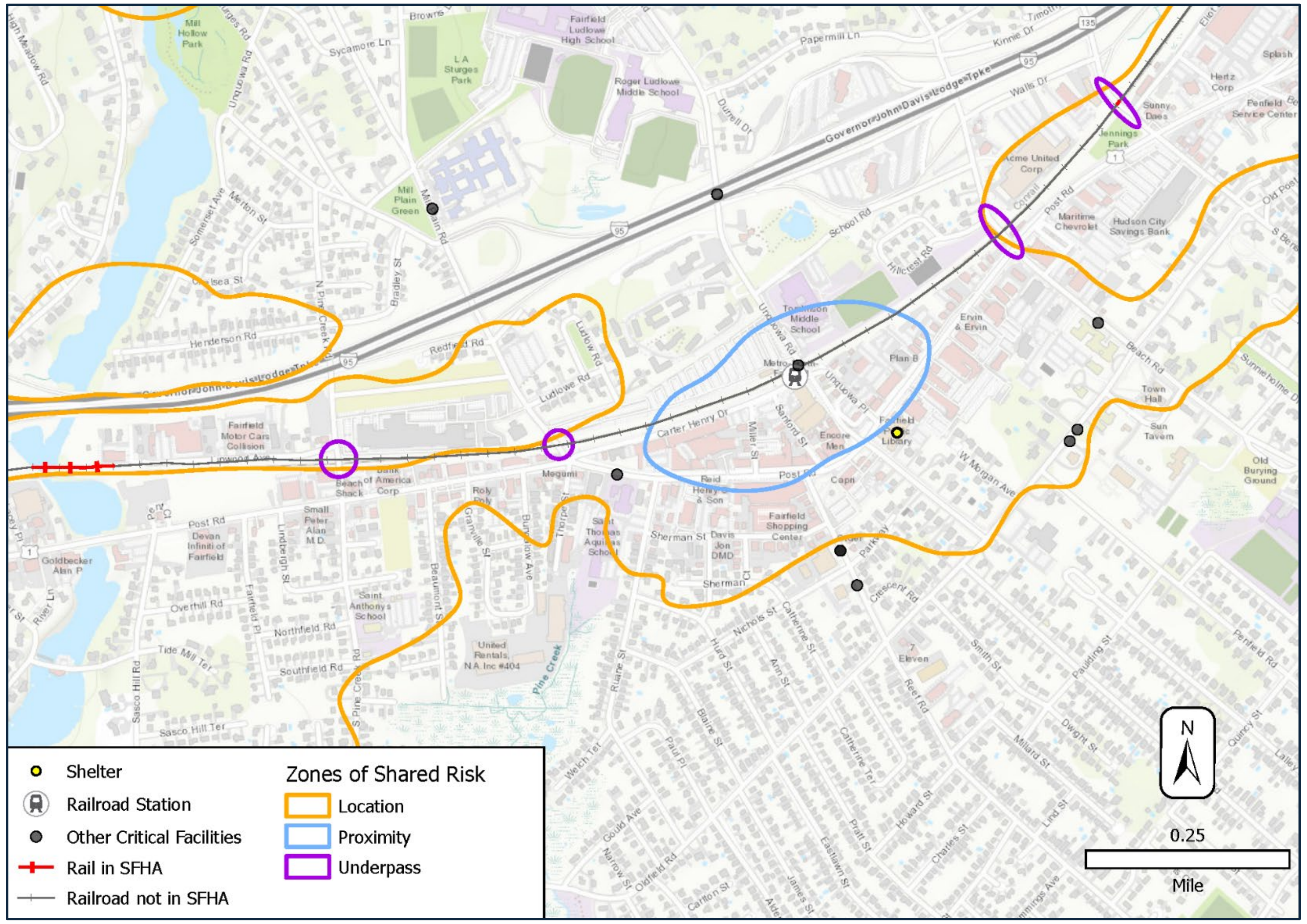
As a coastal community Fairfield experiences higher levels of flood vulnerability due to its proximity to Long Island Sound and low elevation. The flood vulnerability index indicates that flood vulnerability is generally highest south of the railroad and along Southport Harbor, Pine Creek and Ash Creek. Only the underpass at North Benson Rd. is generally considered vulnerable to flooding from storm surge associated inundation with a current 100yr storm event.

RIGHT: The Zones of Shared Risk assessment for downtown Fairfield indicated: 1) locational risk due to coastal flooding concerns, 2) proximity risk for the station area due to its adjacency to existing flood zones, and 3) underpass risk due to ongoing flooding and the four underpasses as key gateways between coastal and upland Fairfield. The underpass risk is the primary focus of this assessment due to their role as key connections to higher ground, particularly during flood evacuation scenarios.

Phase II of Resilient Connecticut identified zones of shared risk for the 33 municipalities in New Haven and Fairfield Counties. Through identifying zones of shared risk CIRCA developed 63 Resilience Opportunity Areas (ROARs), across the two counties. ROARs are areas in which climate change-related flooding and rising heat risk overlap with “key regional assets”—defined as affordable housing, transportation stations or corridors, critical infrastructure, and crucial ecological systems, among others. Of the 63, 20 ROARs were further analyzed in a portfolio and Story Map broken down by Council of Governments region.

Phase III selected from the identified ROARs to solicit planning level studies to further evaluate and develop strategies to address identified vulnerabilities. The Downtown Fairfield ROAR was selected as one of seven initial pilot projects due to the importance of the underpass connections as evacuation routes and because the type of ‘basined’ underpass present in this area of Fairfield is replicated across the Connecticut shoreline. It is the hope that not only will the Resilient Fairfield Pilot project develop actionable solutions to mitigate the flooding experienced in Fairfield but that the strategies proposed here will serve as a guide for other communities facing similar flooding concerns.

Zones of Shared Risk



Problem Overview and Study Area

As a coastal community Fairfield faces flooding risks from rising sea levels as well as more frequent and intense storms. This project will analyze and develop adaptation strategies in Fairfield to increase climate resilience in the community. The analysis will use the PERSIST framework in conjunction with a Benefit-Cost Analysis (BCA) to understand which strategies perform best from a holistic perspective.

This project will focus on adaptive strategies to address ongoing flooding in Fairfield's downtown along the Post Road. Flooding in Fairfield's downtown is particularly important because the Post Rd. serves a primary arterial for east/west and the four underpasses act as key connections across both the rail tracks and I-95. In this project, downtown is defined as the area roughly between Southport Harbor/Mill River in the west and Ash Creek in the east. Downtown Fairfield is located on slightly elevated land, surrounded by the coastal floodplain to the south, and marshlands along the Mill River and Ash Creek.

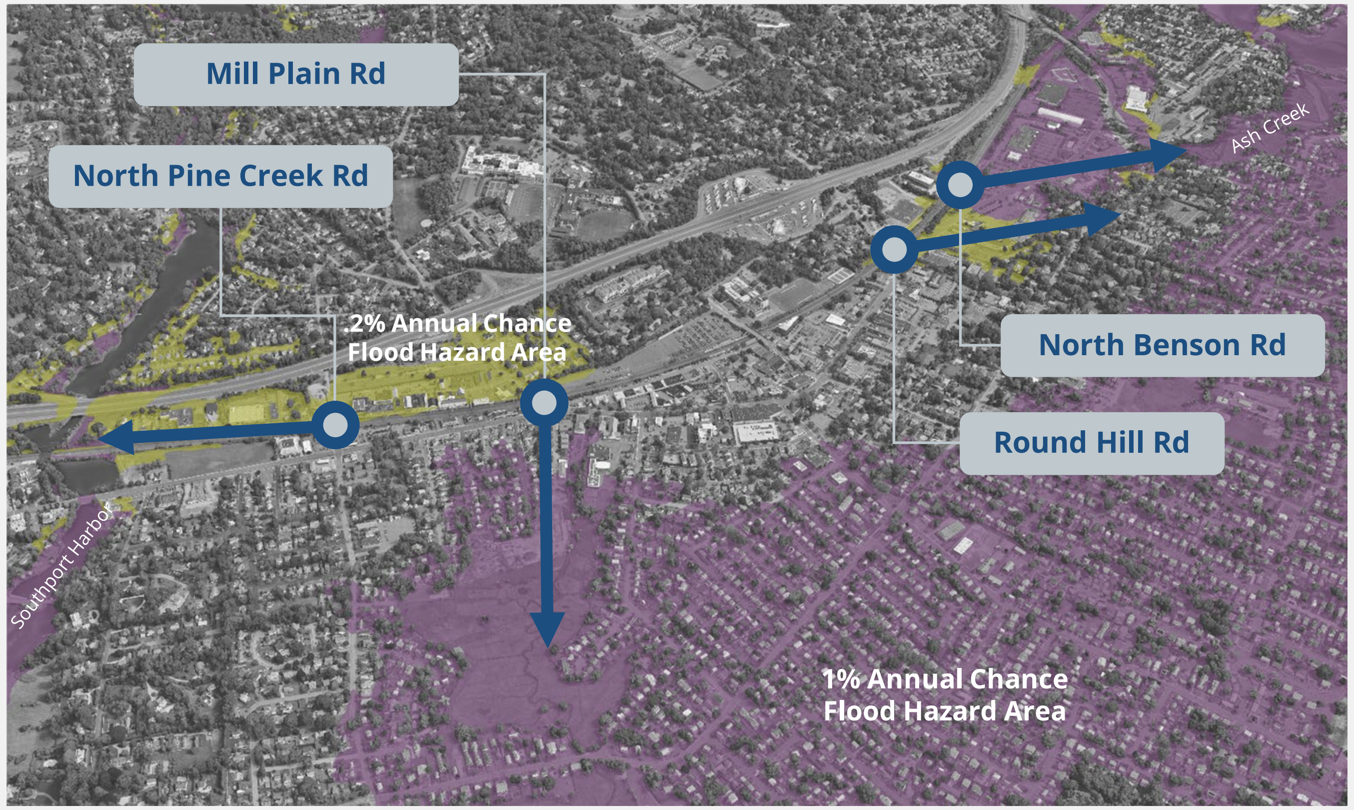
The specific project area includes the following roadways and underpasses: Boston Post Road (from North Pine Creek Road to South Benson Road); North Pine Creek Road; Mill Plain Road; Round Hill Road; and North Benson Road.

While the downtown area does not experience the same level of risk as the shoreline neighborhoods, it continues to experience flooding during heavy rain events. FEMA's National Risk Index highlights the immediate downtown area as being "Very Low Risk" and the area south of Carter Henry Dr. as "Relatively Low Risk," with coastal flooding being "Relatively Moderate." However, the ranking system does not score rainfall-induced flooding. Additionally, because the data is at the census tract level, exact vulnerabilities are difficult to determine.

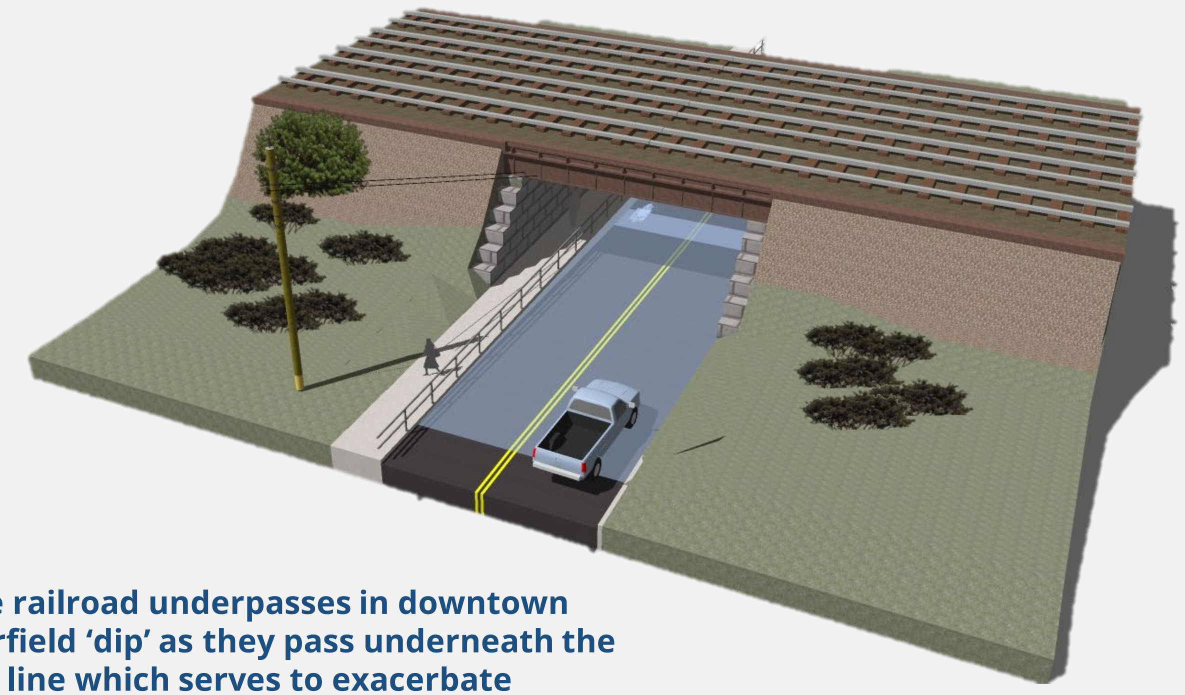
While the streets within the downtown area may or may not flood—depending on precipitation/storm surge severity—many roads leading to and from Downtown Fairfield are arterial or collector roads, and serve as important evacuation routes, or "resilient corridors." As a result, the entire downtown area may lose the ability to serve as a hub to which people could take shelter and/or organize other safety- or resilience-focused activities.

A transportation network is only as strong as its weakest link, and underpasses pose a significant weakness. Given the grade constraints for railroad operations and the dominant transport modes early in the 20th Century, underpasses were generally designed for ease of railroad use with low elevations for drivers. The limited grade separation that occurred means that roadways must 'dip' to cross under the tracks. In combination with the low elevations of Fairfield generally, and proximity to Long Island Sound and tributary watercourses, these railroad underpasses present challenges from a drainage perspective across the region. Additionally, such underpasses may stop evacuations from seaside areas northward, considering that of the five streets in the study area linking downtown areas to the north, only one (Unquowa Road) is an overpass less susceptible to flooding.

While multiple factors create current vulnerabilities, most of the current downtown area, along with immediately adjacent areas, are planned for increased transit oriented development, taking advantage of the ability to access jobs in Bridgeport and New Haven (to the east), and Stamford and New York City (to the west). These new developments offer the opportunity to include public benefits that promote resilience through the buffering of stormwater and the absorption of water.



The Resilient Fairfield study area encompasses four underpasses in the downtown area between Southport Harbor and Ash Creek.



The railroad underpasses in downtown Fairfield 'dip' as they pass underneath the rail line which serves to exacerbate drainage constraints and lead to accumulation of stormwater in the underpasses.

Previous and Ongoing Work

As a coastal town, Fairfield experiences storm-related flooding. Over the past decade multiple studies and reports have been commissioned to address flooding, resiliency concerns, and development in the community. These documents provide valuable insight into some of the issues being faced by the community particularly as the Resilient Fairfield pilot project works to address further flooding concerns.

Summary of Relevant Studies

***Fairfield Flood Mitigation Status and Plans: Report to the Board of Selectmen* (2015)**: A study commissioned by the Flood Erosion and Control Board (FECB) on inland and coastal flooding in Fairfield's "primary beach area," which was flooded during Superstorm Sandy. Specifically, the report looked at preventing and mitigating flooding in the beach area caused by the 1%/100-year storm. The report examines completed storm mitigation measures, those in progress, and key future projects that could increase the Town's resilience.

***Resilience for Downtown Fairfield using Green Infrastructure* (2018):** This plan focused on the extent to which green infrastructure (GI) reduces runoff and flooding, with the goal of developing a resilience strategy for Downtown Fairfield based on GI development. Besides identifying problem areas and offering possible locations for GI, the study found the following:

- Stormwater pipes running north-south may be undersized
- Soil/groundwater conditions are favorable for GI
- GI will reduce peak flows and flooding volumes but will not solve the problem
- Gi implementation would require retrofits and reconstruction

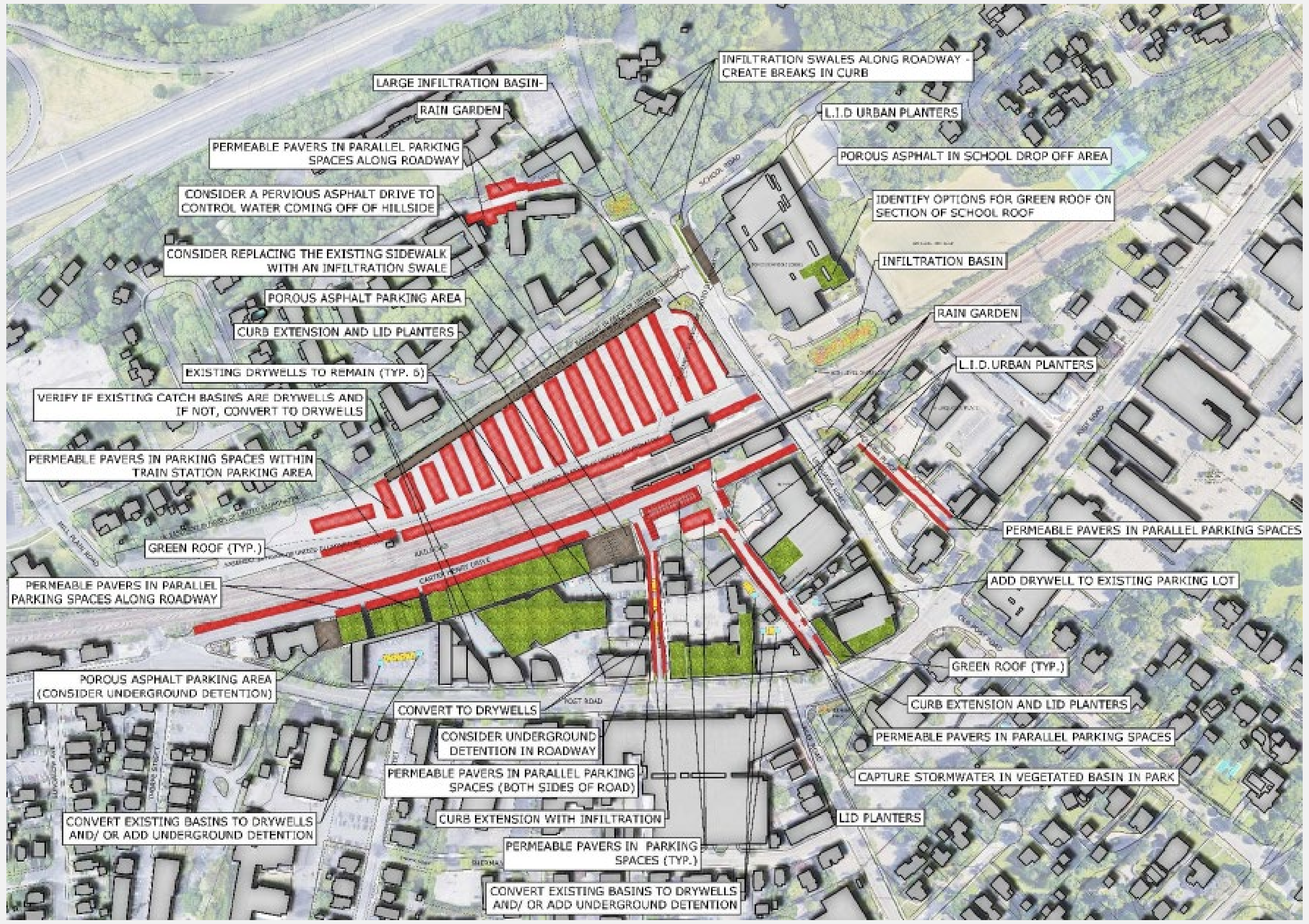
***Fairfield Plan of Conservation and Development* (2016):** This document, prepared by the Town, is the latest POCD, although it is currently being updated. This plan includes the following recommendations of relevance to this project:

- Discourage expansion of railroad parking
- Minimum development intensity (height-to-ROW width ratios)
- Review and revise evacuation and shelter plans and increase coordination among various agencies.
- Protect wetlands, shorelines and marshes from further degradation, promote ecological restoration, and pursue, whenever possible, non-structural beach erosion and flood control strategies. Establish a priority list for land acquisition to retain parcels that could aid in such preservation efforts and improve flood control in the area.

2019 Natural Hazard Mitigation Plan Update (2019): This plan, prepared for the MetroCOG region, focused on flooding risk and mitigation locations and strategies in the Greater Bridgeport Area. While having less detail than plans limited to the Town of Fairfield, the document will be helpful in ensuring that all recommendations are consistent with regional objectives.

Fairfield Storm Surge Modeling Report (2022): This document, performed by CIRCA in May 2022, described sea level rise, storm, precipitation, and wave height predictions based on the latest model inputs for the 100-year storm. The Resilient Connecticut Downtown Fairfield project will use these outputs to ensure that recommendations are responding to the latest data.

US Army Corps of Engineers Coastal Flood Risk Management Study: Fairfield and New Haven Counties, CT (2019) This study, conducted by the US Army Corps of Engineers (ACOE), created a plan that updated an early USACE effort called the Coastal Engineering Report – Fairfield Beach (2016). This plan was an effort to protect the town flood plain for a fifty + year period from anticipated flooding. ACOE evaluated multiple strategies and selected Alternate #3 as the preferred option. Alternate #3 included pump stations, tide gates, flood control easements, a pile-supported T-Wall, and a WWTP hardening project. The selected project reported similar benefits to the other alternatives but was less expensive. However, even this alternative was estimated at $547 million, with non-federal funding requirements of 35%of the total costs.



Excerpt from 2018 Downtown Green Infrastructure Assessment of potential green infrastructure solutions in and around the Fairfield Train Station.

Resilient Fairfield Chapter II:

Current & Future Conditions Assessment

Existing and Future Conditions

The New Haven Line travels east-west through Fairfield. Located on a raised berm, the rail line separates coastal neighborhoods along the shoreline from the more inland community. All but one of the north/south connections (within the study area) pass underneath the railroad tracks through steel girder bridges that provide for 9' 11" to 11' 6" of clearance. These underpasses serve as critical routes to higher ground for residents south of the tracks. Stormwater is collected by a series of separated drainage systems which outlet to nearby waterways, with only Round Hill Rd. and North Benson Rd. being drained by the same network.

Community Characteristics

The town of Fairfield is located along the northern shore of the Long Island Sound. Fairfield is a community of 61,000 people with 72% of households earning more than $75,000 annually and a median income over $150,000. South of the New Haven Line and within the study area, there are approximately 8,500 residents who reflect similar demographic characteristics (income/ race/ gender) to the broader community. The community is positioned to respond well to its climate vulnerability and flooding concerns because of its community resources and active participation in climate and natural hazard planning.

The study area encompasses significant portions of Fairfield's downtown area along the Post Road which serves as a major commercial hub and local east/west corridor for the community. The Fairfield Rail Station is centered in the study area with access points on the north side of the tracks from Mill Plain Road and Unquowa Road.

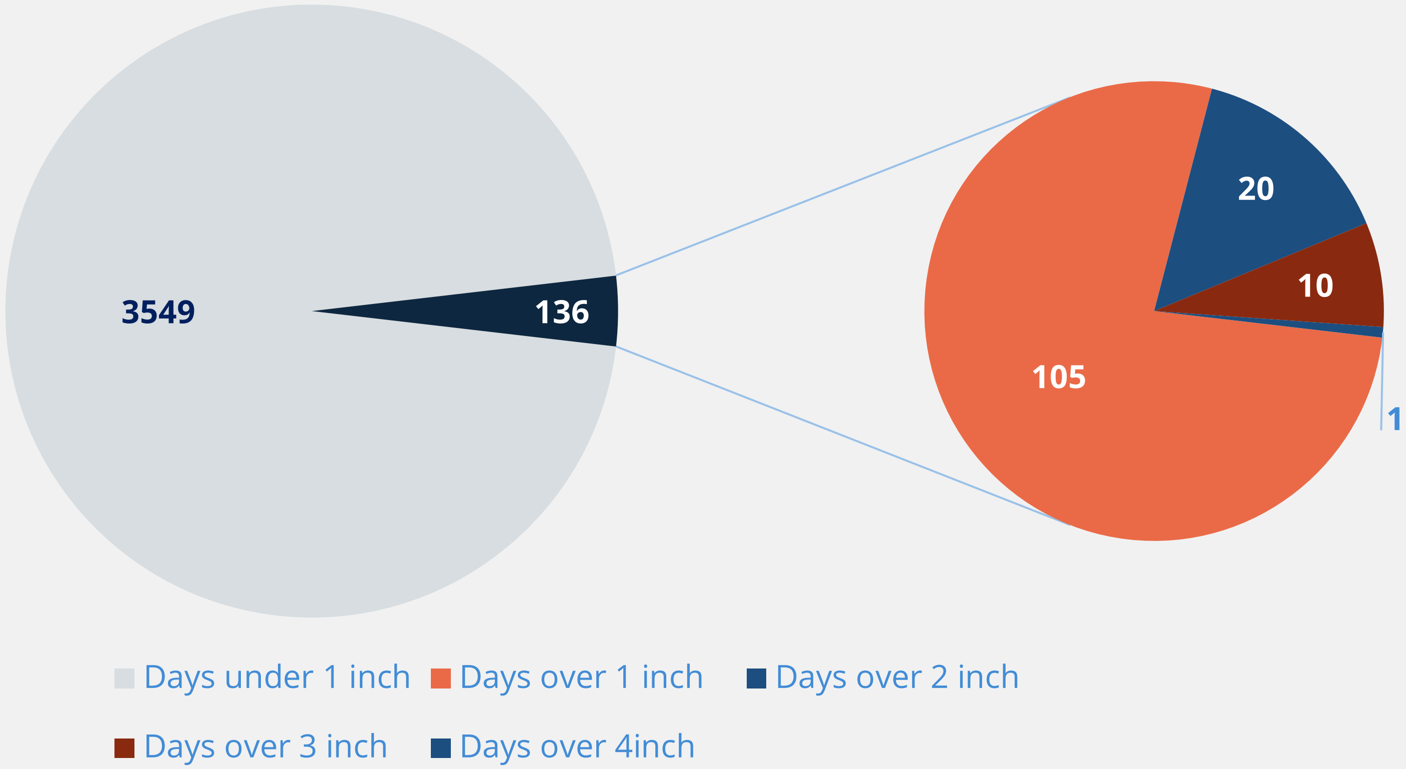
The downtown area is flanked by several bodies of water to the east, south, and west. Ash Creek travels to the sound from the eastern side of the town, Pine Creek from the south (in the central study area), and Southport Harbor/Mill River is located on the western edge of the study area. These three waterways drain runoff from a significant portion of the community including the study area.

The four focus points in this study are located at the railroad underpasses. They are important means of transportation in the town and serve as the evacuation routes from areas of flood risk. Presently, only one of the critical points, North Benson Road, lies within the FEMA 100-year floodplain, but flooding at these underpasses is still a prevalent issue within the community.

The flooding at these critical points is due to a combination of factors. Inland overflow from tidal waters and storm surge, extreme rainfall intensity and frequency, and existing stormwater infrastructure issues all contribute to the frequent flooding of downtown Fairfield.

The 100-year floodplain defines the level of risk. The 100-year flood plain means there is a 1% chance of the area being flooded in any given year. Each storm event is an individual probability event, meaning that if a 100-year event happens one day, it is still possible another 100-year event can happen the next day.

Extent of flooding and flood depth for a current 100yr storm event. Under current conditions only the North Benson Rd underpass experiences inundation from a 100yr storm event.



Historic Pattern of Storm Surge Events

The four critical underpasses are generally located within the storm surge inundation area of a category 3 hurricane (or equivalent storm events). However, North Benson Road is closer to sea level and the Ash Creek tidal marsh is considered vulnerable to Category 1 and 2 hurricanes (or equivalent storm events). Flood risk for inundation varies significantly and is impacted by many factors, including wind speed, temperature, and location.

When a storm hits Fairfield, the surge will travel inland via the Southport Harbor, Pine Creek, and Ash Creek. Over the preceding 10-15-years, Connecticut has faced several storms (during both winter and summer) that have been accompanied by storm surges or storm surge-like conditions. Notably, this includes Hurricane Irene and Super Storm Sandy.

Historic Pattern of Rain Events

Currently, a significant portion Fairfield south of the Post Rd. is already within the 10-year floodplain. This means without proper capacity within the stormwater infrastructure system or the means to retain the stormwater, many areas in the economic hub of the community are prone to flooding. None of the critical points in this study are located within the 10-year floodplain, but they still see flooding on a regular basis. Because of this, it can be assumed that the flood problems are not necessarily caused by rainfall events alone, but a combination of rain events, storm surge, and stormwater management infrastructure concerns.

Each of the critical points are connected to the floodplain via their stormwater drainage systems, as they outfall within these areas.

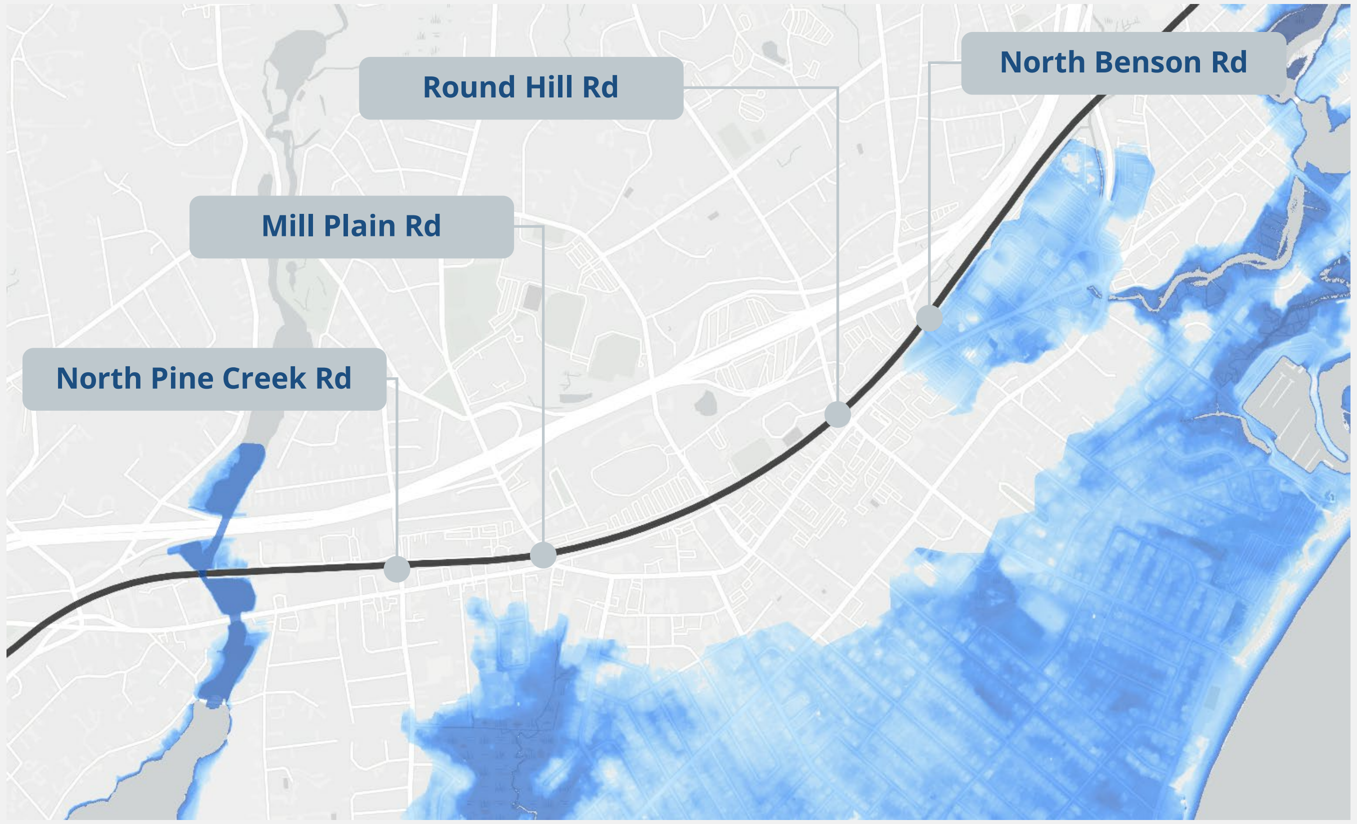
According the available data from the University of Oregon PRISM Climate Group, the town has experienced approximately 105 days over the past 10 years where they received an excess of 1-inch of rain and 20 days with more than 2 inches of rain.

Existing Flooding

Flooding at the underpasses and in downtown occurs intermittently throughout the year and typically occurs during severe rainfalls. The flooding leads to road closures at the underpasses and the flood depths disable cars that attempt to drive through the flood waters. Typically, the flooding only persists for short durations, during and immediately following high intensity rainfall events which overwhelm the existing drainage systems.

The severity of the flood and duration can be exacerbated by coincidence with high-tides and storm surge events. According to the Fairfield Department of Public Works (DPW), the underpasses collectively flood around 4-6 times per year, with Round Hill Road and North Benson Road being the most frequently flooded. Residents also have voiced agreement in these findings for return intervals.

LEFT: Graph of 'Precipitation Days' over the preceding 10-year period (2012 to 2022) derived from the University of Oregon's PRISM Climate Group. Modeling indicated that over this time period the study area likely experienced +/- 100 days with greater than 1 inch of rain and 11 days with greater than 3-inches of rain. Based on anecdotal evidence of return frequency it would suggest that precipitation between 1 and 2 inches is likely needed to begin causing underpass flooding.



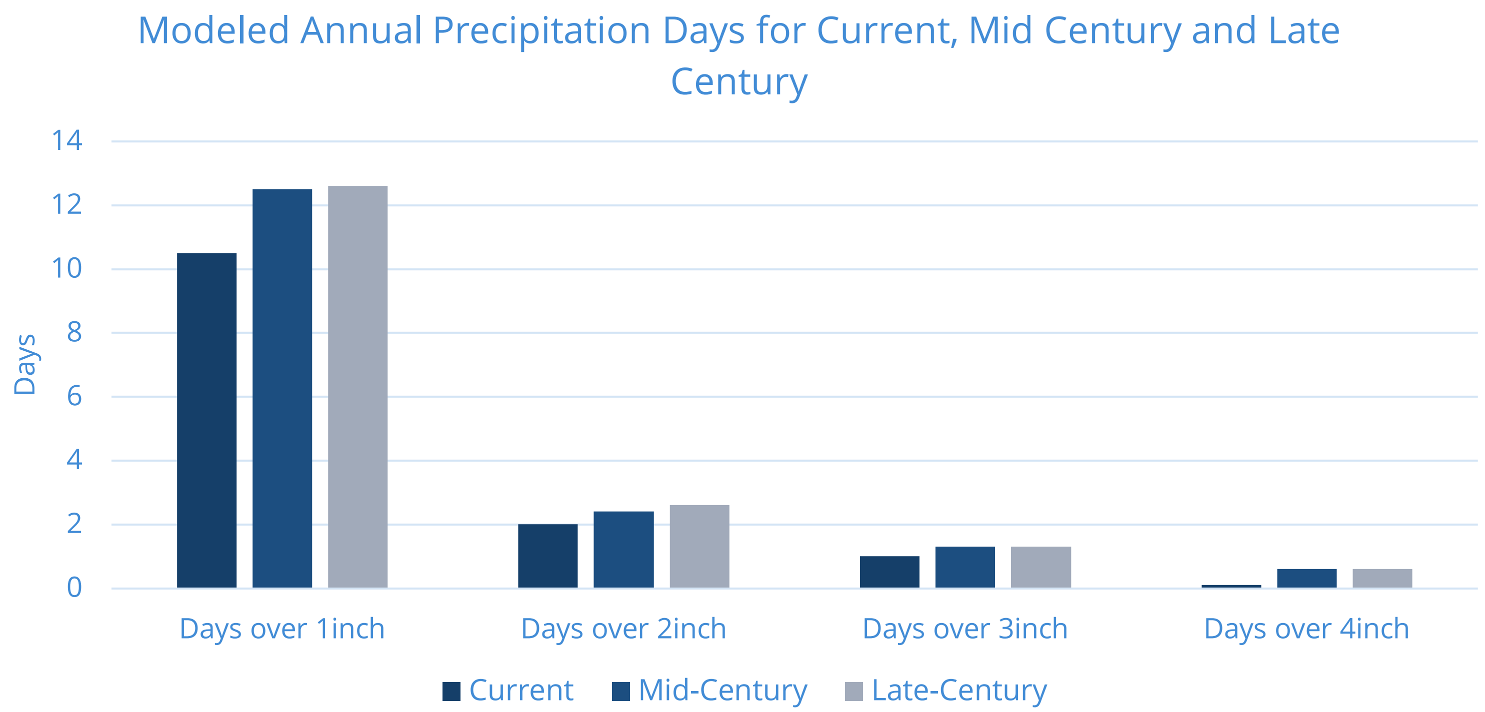
Extent of flooding and flood depth for a future 100yr storm assuming 20 inches of sea level rise. Under this scenario, the extent of the flooding extends further inland towards the underpasses and projected flood depths have increased. This future coastal flood scenario will likely further impact the ability of the existing drainage system to handle stormwater and will induce underpass flooding at lower precipitation levels.

It is important to note that under this future scenario evacuation to the east may be impossible due to flooding from Ash Creek cutting off the Post Rd. and Old Post Rd. Additionally, it is possible that the both Post Rd and Harbor Rd. along the western edge of the study area may also be impacted by flooding, making the crossroads (excluding North Benson) the only possible evacuation routes.

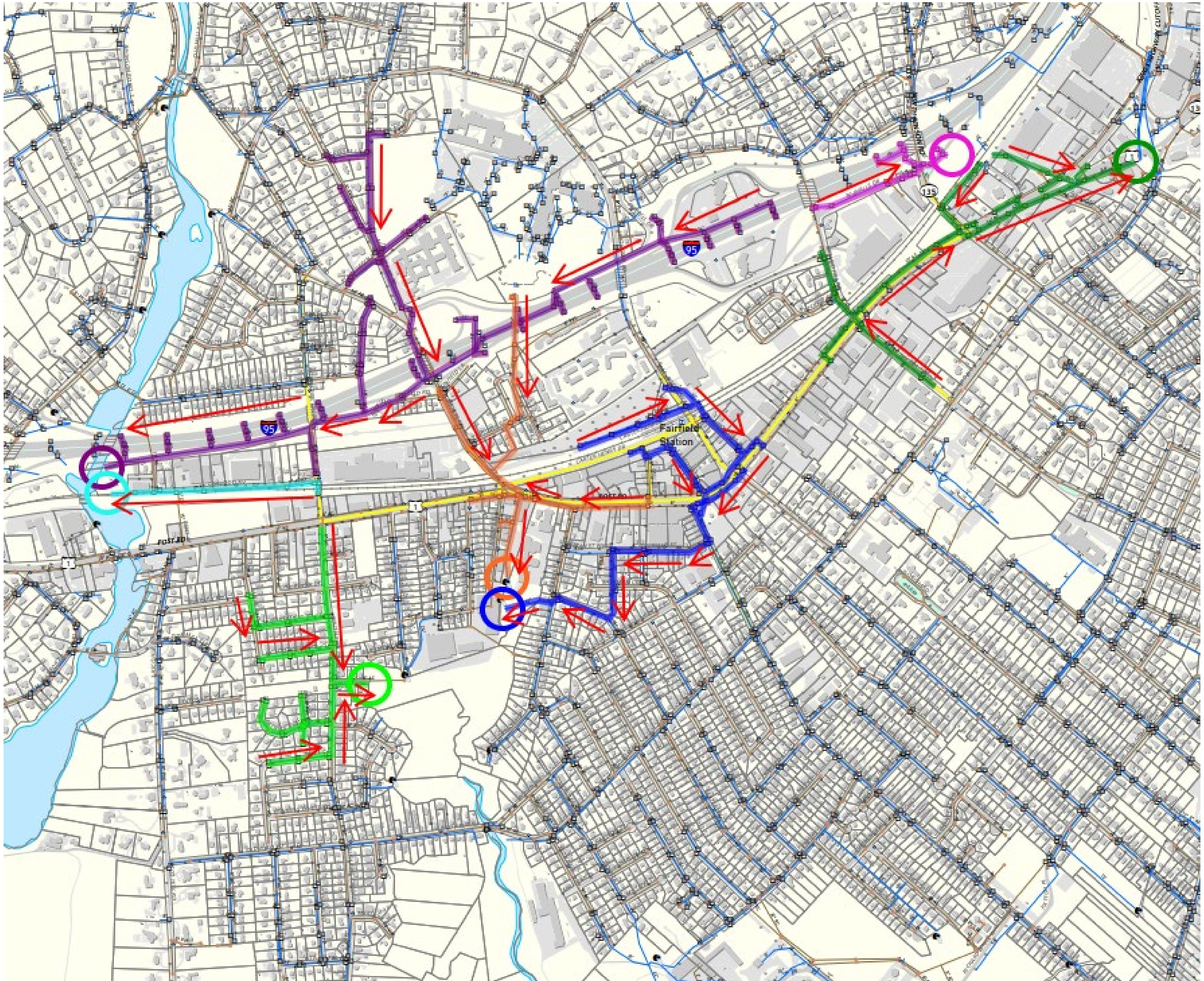
Future Flooding and Inundation

Climate change will exacerbate the natural hazards currently faced by the town of Fairfield, leading to warmer and wetter winters, and hotter and drier summers that will increase storm severity and the likelihood of storm surges and intense rainfall.

The Connecticut Physical Climate Assessment report, published in 2019, indicates that by midcentury, average annual precipitation will increase by 8.5 percent and by 9.5 percent by late century. Moreover, this precipitation increase will be concentrated during the winter months which could cause a 10-13.4 percent increase by mid-century and a 16.3-16.5 percent increase by late century.



An analysis of the University of Oregon PRISM data and the Connecticut Physical Climate Assessment Report allowed for the extrapolation of increased precipitation days by mid-century and late century. The greatest increase occurred for days over 4 inches. Over the preceding decade the study area only recorded a single day with over 4 inches of rain fall, in that same decade with a 'mid-century' precipitation increase the study area would have received 6 days with over 4 inches of rain fall. Additionally, due to sea level rise and increased inundation, the required rainfall amount to induce underpass flooding will likely decline as high rainfall days increase.



Drainage Network

Downtown Fairfield is served by a series of underground drainage systems which utilize catch basins to capture stormwater and pipe networks to collect and move water out towards large water sources where it will eventually reach the Long Island Sound. The four underpasses within the study area are covered by three independent drainage networks:

Underpass Drainage Network and Outfall Location:

- **N Pine Creek Road:** Represented by the cyan linework, this segment only drains the underpass itself and outfalls to the west into Southport Harbor.
- **Mill Plain Road:** Represented by the orange network, this segment drains from north of the underpass and includes portions of the Post Road. The network outfalls into Pine Creek.
- **Round Hill Road and N. Benson Road:** Both underpasses are drained by the same network represented in dark green. This network drains about half a mile of Post Road in addition to the underpasses and eventually outfalls to Ash Creek.

Other drainage networks service additional portions of downtown. Broadly speaking, Southport Harbor, Pine Creek, and Ash Creek drain a significant portion of Fairfield as the land slopes downwards towards the coast. Each of the four underpasses in the study area have outfalls to the surrounding waterbodies south of the rail line.

Drainage Standards: The Connecticut Stormwater Manual uses multiple criteria across multiple protection classifications to define design standards for stormwater conveyance and level of impacts to adjacent areas. The most relevant standard to the assessment is Conveyance Protection, which is intended to prevent erosive flows within internal and external drainage networks. For this classification the system should be able to handle a 10-year event within a 24hr period. For Fairfield County this is five inches of rain. Based on PRISM precipitation data and flooding return intervals from the town it is clear that the drainage networks associated with the underpasses do not meet this standard and do not meet a 2-year event (defined as 3.3 inches in a 24-hour period). Additionally, the design standards usually do not consider other factors, such as storm surge or future sea-level rise which will inhibit the ability of the system to operate efficiently.

Insufficient capacity is often a major issue when investigating drainage system failures. In this case, the stormwater drainage system in unable to handle the water being added to it during intense storm events. During an event, the drainage systems do not have enough storage area (referring to the in-network pipe volume) to transport the water to the outlet. A modern drainage system is designed to have increasing pipe diameters as water flows downstream to account of the aggregation of stormwater along the length of the network.

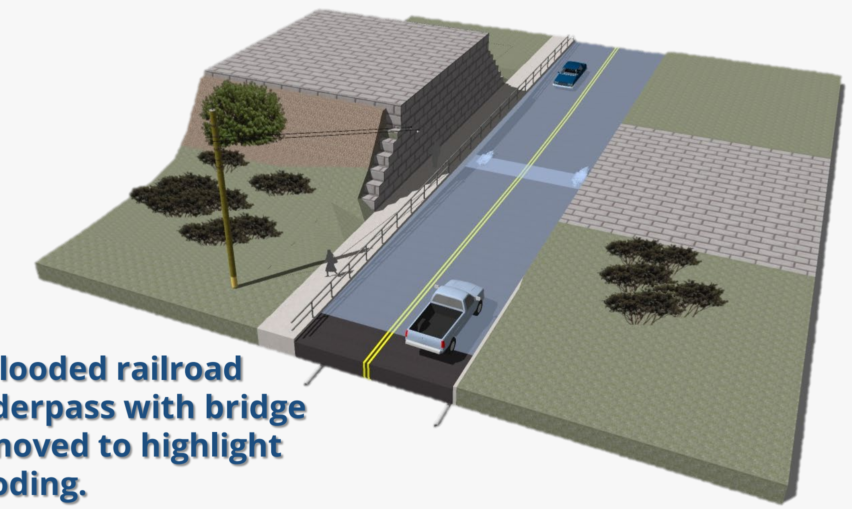
When pipes do not have enough capacity due to the downsizing of consecutive pipes, backwater may occur. Backwater is when water builds up within a system due to it not being able to flow freely to the outlet. This is akin to a three-lane highway merging into one lane. Traffic may start to back up, and drivers will significantly slow their speed when passing through the area, or even stop completely. And as more cars approach the merge the area of congestion moves further from the merge point. Prior reports have noted the prevalence of downsizing concerns within Fairfield, and it likely plays a role in the flooding experienced at the underpasses.

The concave nature of the underpasses due to the limited vertical clearance from the railroad operating above provides a perfect vessel for containing the excess stormwater not handled by the existing drainage networks. As stormwater flows downhill towards the underpasses, both on surface and within the drainage network, the accumulation overwhelms the network capacity and water either back flows into the concavity or accumulates there. Storm surges or covered outfall locations can further hinder the drainage system's ability to efficiently transport stormwater.

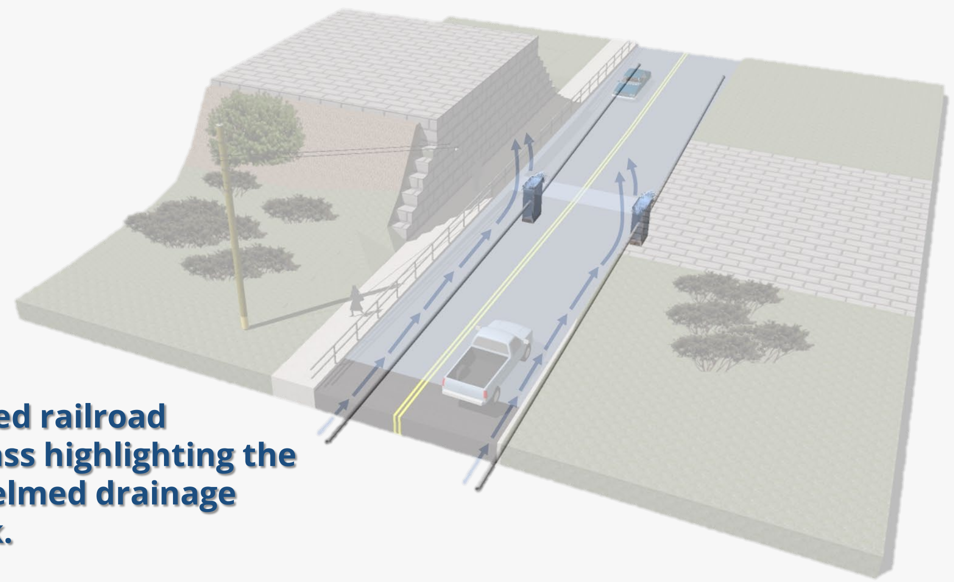
BELOW: Figure highlighting the drainage capacity concern present at the four underpasses within the Fairfield study area.

a. Typical railroad underpass in Fairfield.

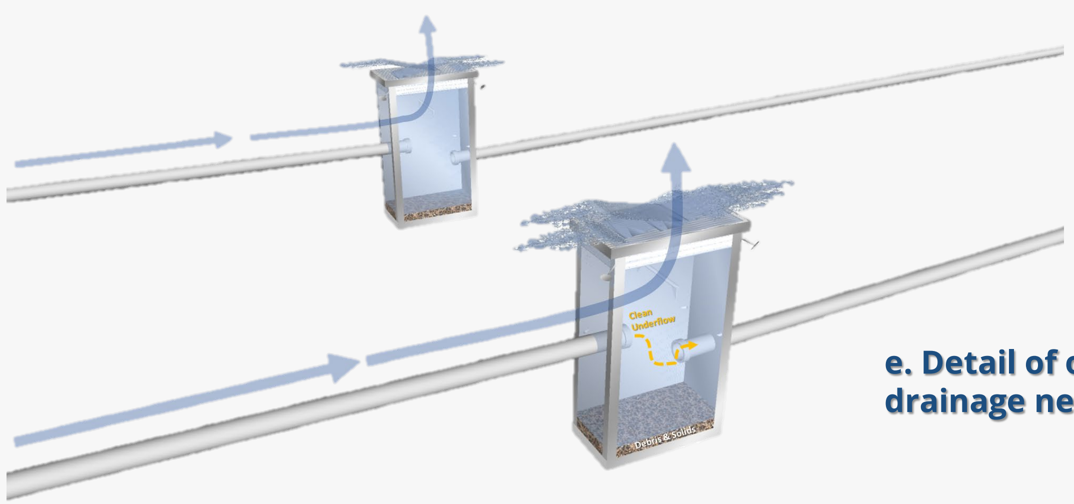
b. Flooded railroad underpass.



c. Flooded railroad underpass with bridge removed to highlight flooding.



d. Flooded railroad underpass highlighting the overwhelmed drainage network.



e. Detail of overwhelmed drainage network.

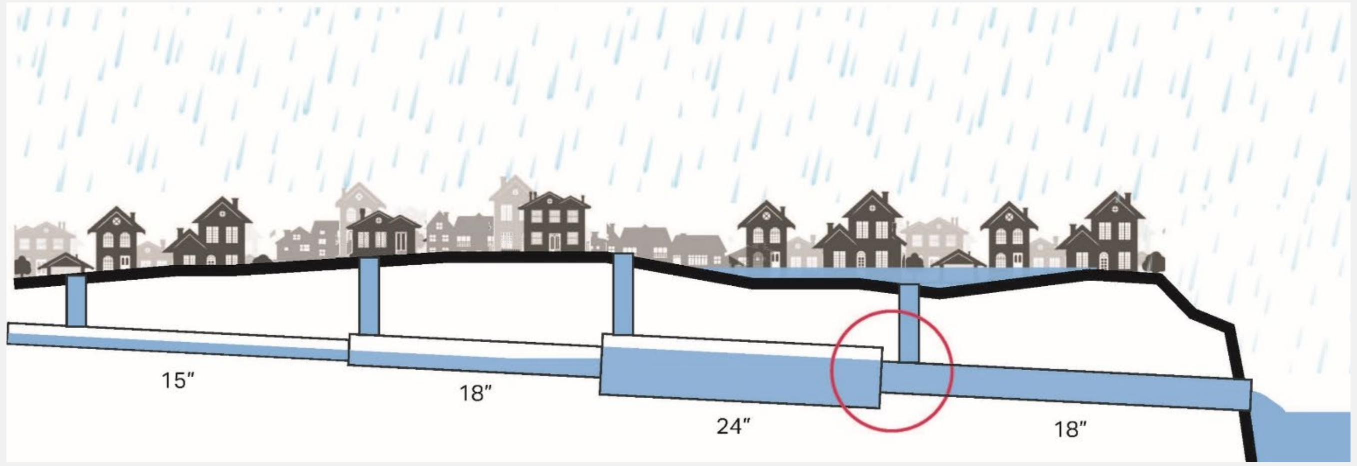
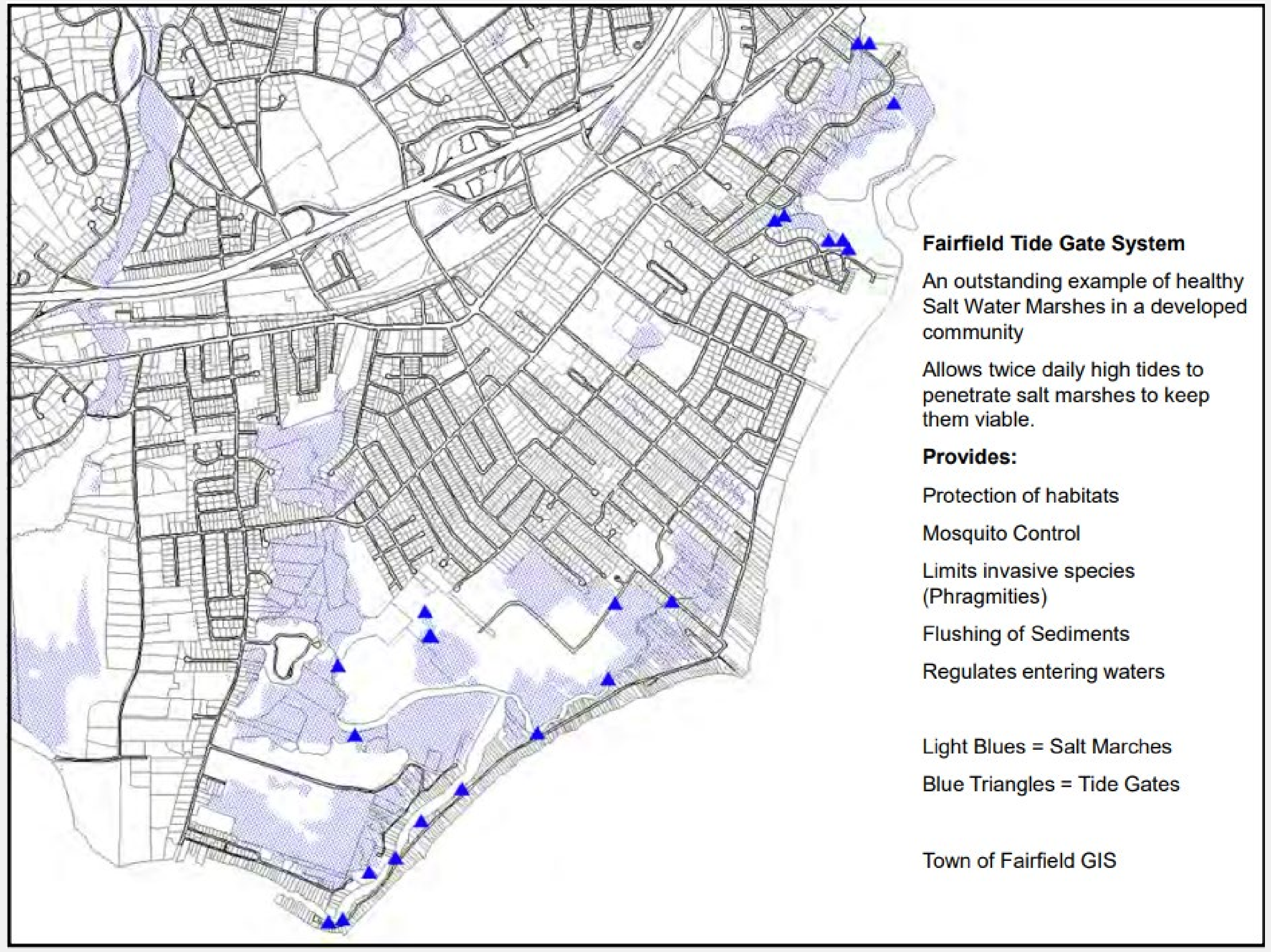


Figure highlighting the drainage network downsizing concern. In a modern drainage system, the pipe diameter is designed to incrementally increase as you get closer to the outfall location to accommodate the continually increasing stormwater volumes.



Excerpt from the Fairfield Flood and Erosion Board Flood Mitigation Plan highlighting the location of existing tide gates within the Fairfield coastal plain.

Fairfield Tide Gate System

In addition to the drainage networks described, the town has a system of tide gates to help mitigate the inundation from storm surges. The system is primarily located along Pine Creek and Ash Creek.

Tide gates are structures that are commonly used to prevent flooding caused by high tides or storm surges. They are typically installed at the entrances of coastal waterways, such as estuaries, inlets, or rivers, where the water level can rise above the surrounding land during high tide events.

The function of a tide gate is to regulate the flow of water into and out of the coastal waterway. During normal tidal conditions, the tide gate remains open, allowing water to flow freely between the coastal waterway and the surrounding ocean. However, when the water level rises above a certain threshold, such as during a storm surge or a king tide event, the tide gate can be closed to prevent the inland flooding of adjacent areas.

In the context of the inland flooding in Fairfield the tide gate network which is designed to reduce impacts from coastal may be exacerbating flooding at the underpasses by inhibiting the flow of stormwater at the equipped outfall locations. This is most likely to occur when severe rain coincides with high-tides or storm-surge-producing events which push more water up into Ash Creek and Pine Creek.

The model type and age/condition of the tide gates play a role in their functionality. Fairfield employs a combination of 'flap-only' and self-regulating tide gates. The self-regulating tidegates use a system to detect water levels and will close when the water levels reach the designated height to prevent flooding, or too much water coming inland.

Pump Stations

Pump stations play a crucial role in mitigating flood damage by removing excess water from low-lying areas or urban areas prone to flooding. The pump station functions by receiving and storing excess water during a flood event and then pumping the water out of the flood-prone area.

The pump station typically includes pumps, pipes, and an associated control system to regulate the water flow. In many cases, the control system is a tide gate. The pumps draw water from the flooded area into the pump station where it is stored in a reservoir, sump or wet well. From there, the water is pumped through pipes or channels and released into a nearby waterway or drainage system.

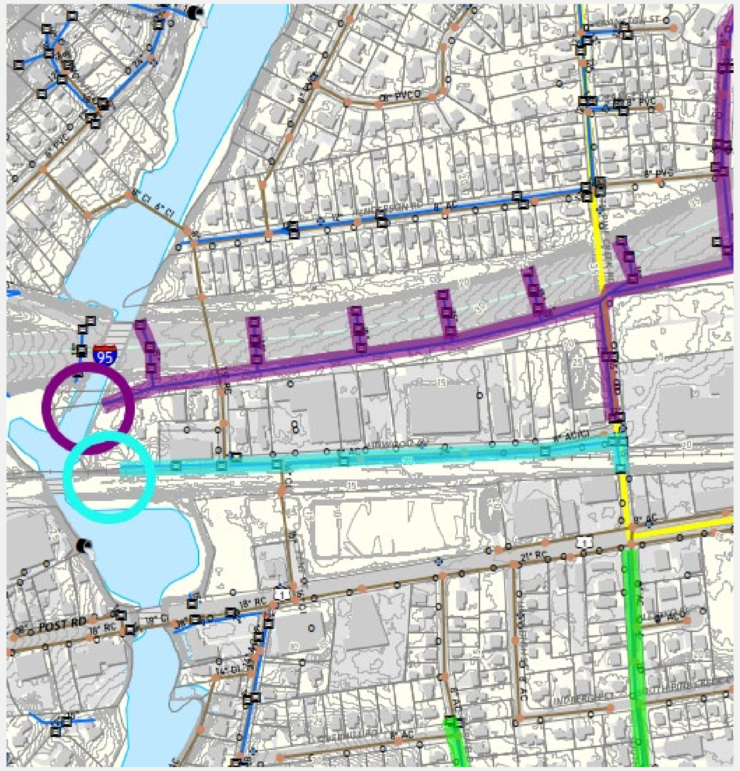
Pump stations are designed to be reliable and operate continuously, even during heavy rainfall or flooding events. They are often designed with backup power sources to ensure they can function in the event of a power outage.

Similar to how drainage networks have a maximum stormwater capacity, pump stations also reach a threshold of water it can handle and pump out of an area. Depending on the storm intensity, pump stations may not always be able to keep up with the potential flooding.

Several pump stations currently exist in Fairfield, but the existing network likely does little to mitigate the unique drivers for flooding at the four underpasses. The currently operating pumps stations are located at the WPCA plant and drain inside of the hardening of Richard White Way.

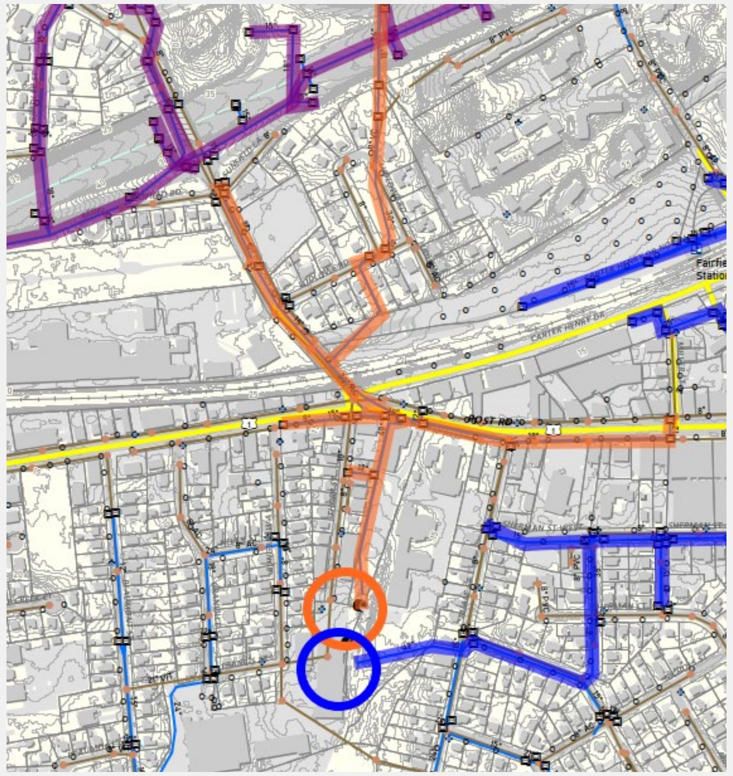
Underpass and Drainage Network Summaries

North Pine Creek Road



The catch basins that drain the underpass on North Pine Creek Road discharge to Southport Harbor. This system is unique in the downtown area in that the underpass is the most upstream part of the network with the system only draining the underpass and Linwood Ave. Through anecdotal evidence, this underpass experiences the least severe flooding of the four and likely results from the underpass being located at the top of the network. Additionally, South Pine Creek Road, north and south of the underpass is drained by additional separate systems, which removes additional flow from the entering the drainage network.

Mill Plain Road

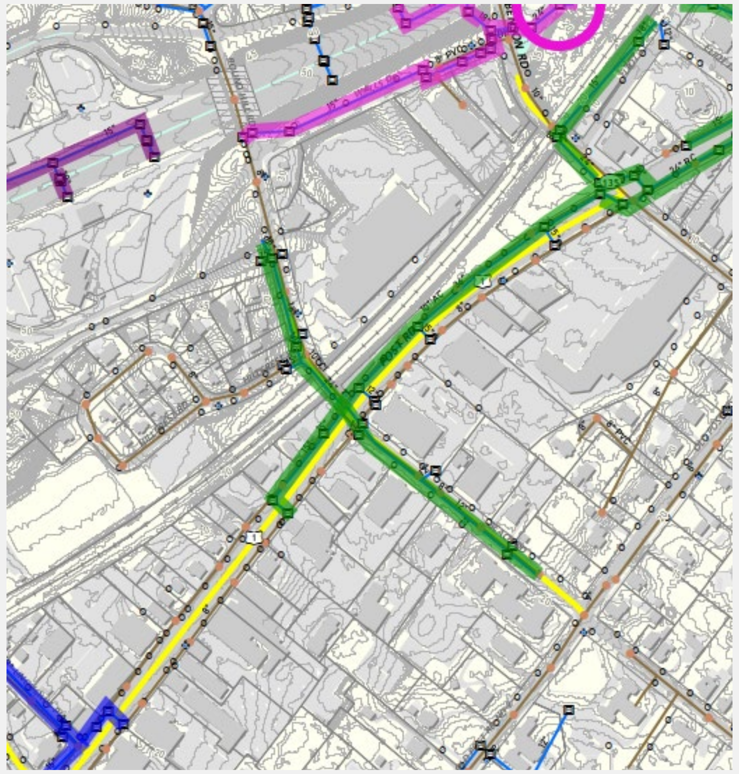


The underpass at Mill Plain Road receives a significant amount of runoff from the area north of the underpass.

This includes: 1) a portion of the Fairfield Train Station parking lot which slopes towards Mill Plain Road, 2) Mill Plain Road from the I-95 overpass down to the underpass, and 3) Ludlow Road/Ct neighborhood and the back fields of Fairfield Ludlowe High School.

This underpass area contains a significant amount of impervious surface and drains a larger catchment area when compared with Pine Creek Road. These factors likely place a greater strain on the system leading to the underpass flooding and the flooding at the intersection of Mill Plain Road and the Post Rd.

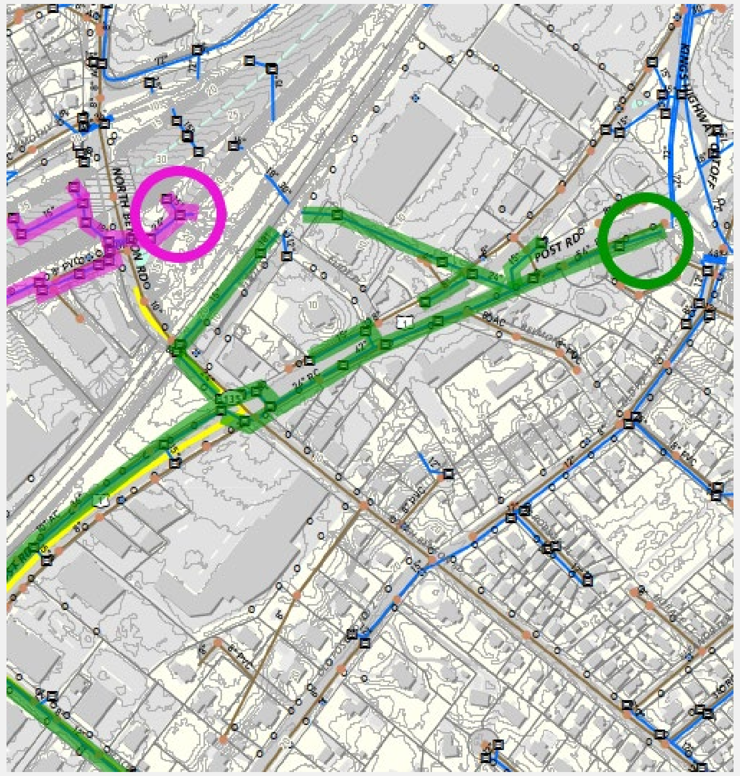
Round Hill Road



The drainage area around Round Hill Road is directed towards Ash Creek. The underpass at Round Hill Road shares a drainage network with the North Benson Road underpass as well as several additional side streets.

Its important to note that this underpass is within the 500-year flood zone. Proximity to a flood zone likely exacerbates the flooding at this location.

North Benson Road



The underpass at North Benson Road is downstream of Round Hill Road within the same drainage system. The water collected from this area is eventually discharged into Ash Creek.

The accumulation of water from the upstream drainage network likely contributes to the severity of flooding at this location. It is also important to note that this critical point is within the 100-year floodplain.

Underpass Summary Table

Underpass	Elevation of Bottom	Main Source of Flooding	Secondary Source of Flooding	Third Source of Flooding
North Pine Creek Road	9.75	Stormwater runoff	Low slope	FEMA 0.2% (500-year) – source is Mill River
Mill Plain Road	9.67	Stormwater runoff	Low capacity to accept stormwater	FEMA 0.2% (500-year) – source is Mill River
Round Hill Road	7	Stormwater runoff	Low capacity to accept stormwater	FEMA 0.2% (500-year) – source is Ash Creek and Turney Creek
North Benson Road	6.11	Stormwater runoff	Low slope and submerged tidal outlets	FEMA 1% (SFHA) – source is Ash Creek and Turney Creek

Unlike most flooding in coastal communities the underpasses adjacent to the Post Rd. corridor suffer from significant stormwater induced flooding which flows to the low-points beneath the rail bridges and overwhelms the existing drainage network. The next phase of the study will work to develop solutions targeting the specific concerns and constraints at each underpass.

Summary

The Resilient Downtown Fairfield Project is a unique opportunity to build resilience through actionable solutions while simultaneously developing a replicable approach for addressing the many flood-prone underpasses along the Connecticut shoreline. A review of the existing conditions at the four underpasses and within downtown has confirmed the vulnerability echoed by the community. The underpasses currently experience flooding as a result of intense rain events, and the flooding can be further exacerbated when a storm system is accompanied by a storm surge, which hinders the functionality of the existing drainage network. Additionally, climate change will continue to increase the frequency with which the community experiences intense rainfall events and systems producing storm surges. By middle of the century Fairfield could experience 20 more days annually with 1 inch of rain or more and an additional 1.6 feet of sea level rise.

The impacts of climate change will place a greater strain on the community's existing drainage and flood control systems and increase the likelihood for underpass flooding within the study area.

Next Steps

The next phase of the project will work to develop strategies for combatting the flooding concerns highlighted by this investigation. A portfolio of options that address the existing drainage and flood control systems, incorporate green infrastructure strategies and looks at ways underpass infrastructure can be modified to reduce their flooding potential will be developed.

In addition to adaptive strategies the next phase will investigate monitoring and warning systems. The existing conditions process uncovered a major data gap in the reporting of previous incidents of underpass flooding. To better predict when flooding may occur and better understand their return frequency, accurate recording of flood dates and depths will be critical.

The initial portfolio of options will be vetted through a public process and benefit cost analysis. This will help develop an understanding of which of the options are preferred by the community and provide the greatest level of protection against future flooding.