August 18, 2020

Draft Report:

Defining the Zones of Shared Risk for Milford, CT

Resilient Connecticut Project's for Coastal Towns in New Haven and Fairfield Counties

Document by: UConn's Community Research & Design Collaborative
UConn's Community Research & Design Collaborative (CRDC) is the umbrella organization for the outreach work of the landscape architecture faculty.

Project Team:
Coordinator: Associate Professor Peter Miniutti
Researcher : Assistant Professor Mariana Fragomeni
Researcher and GIS Mapping: Ph.D. Student Tao Wu
GIS support: Undergraduates Stephen Kelly and Sybren Hoekstra

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Introduction:

- **Project Description**

Resilient Connecticut Project aims to establish resilient coastal communities through smart planning that incorporates economic development framed around transit-oriented development, alongside conservation measures and infrastructure improvements. This approach provides a framework for regional, municipal, and site scale planning to tackle the challenges of future storms, sea-level rise, and riverine flooding. This planning approach connects zones of shared risk with resilience corridors to link critical facilities and provide greater continuity of service to the lower-lying communities.

- **Project Goals**

Zones of shared risk are regions that face common challenges either in existence already or caused by climate change, and therefore risks are shared among or between groups of people that may have different perspectives and priorities for coastal resilience. A Zone of Shared Risk includes the houses, land, infrastructure, hydrological, ecological, social, and institutional elements that contribute to the functioning of a place. Resilience corridor utilizes the concept of urban redevelopment corridors as a mechanism to adapt coastal urban areas at risk. The resilience corridor supports transportation, utilities, stormwater and habitats, and economic development that connect the upland areas of Connecticut where resources exist (resilience zones) down to shorefront communities. The project aims to develop a methodology to identify zones of shared risk and resilience corridors for the project site.

- **Project Location**

The project will encompass coastal towns (excluding Bridgeport) in New Haven and Fairfield Counties.

- **Project Tasks**
    - Work with CIRCA to generate and established methodologies for framing zones of shared risk across multiple scales.
    - Identify zones of shared risk for each municipality and regionally and generate a GIS database with distinct layers.
    - Work on graphic layouts for drawing types to improve the map quality and to create base maps for planning.
    - Prepare selected map results as physical print outs mounted on foam core and as slides to be used to

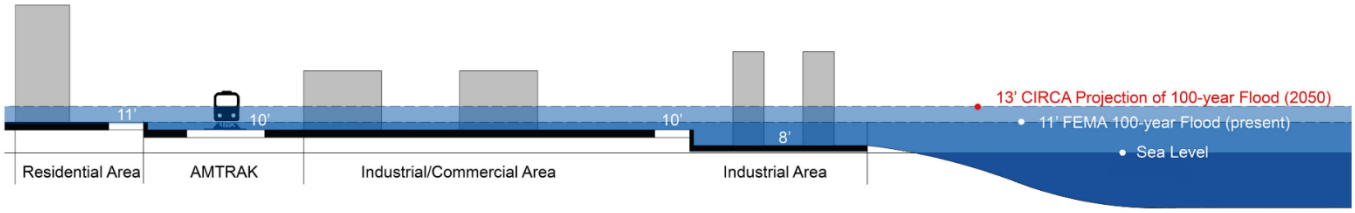


Figure 1: A conceptual section showing FEMA's current 100-year flood event and CIRCA's 100-year flood plus 20"+ for the year 2050. This report is based on CIRCA's data for the year 2050.

Methodology:

The overall project follows a design-oriented approach with the objective of developing a set of base maps to provide context and pertinent information for future project phases and site selection. This overall process has four phases; Program Development, Inventory of existing information, Analysis of the inventoried information and culminating on Planning /Design. This report focuses on the Inventory and Analysis activities.

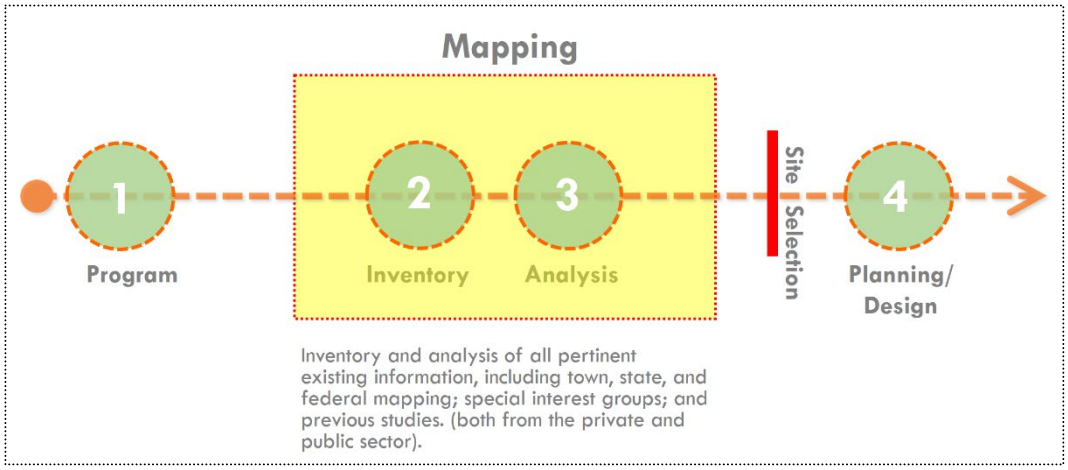


Figure 2: Diagram of Overall Design Oriented Approach. This report covers the development of a prototype for the Inventory and Analysis Phases. Future phases of this project will use this mapping as a basis for future project development.

Inventory Phase

This phase is characterized as "fact-finding" of natural and cultural characteristics of the site. The maps generated in this phase serve as an inventory. Data is collected from a number of sources. It relies mainly on GIS data acquired at the state and local level.

Analysis Phase

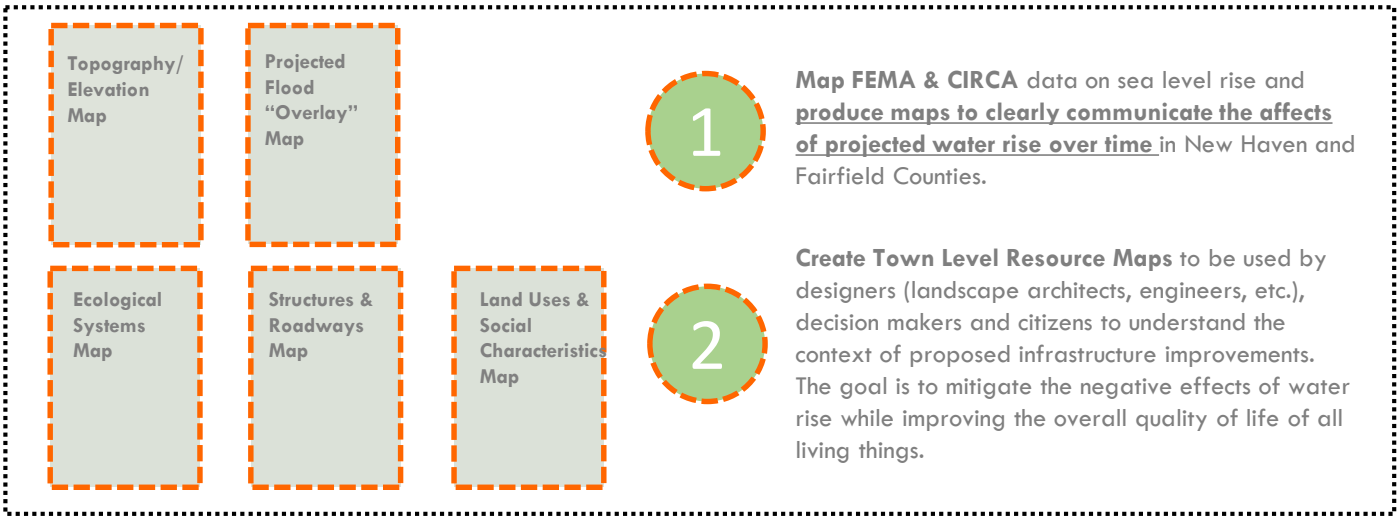
This phase lends meaning to the facts collected during the inventory phase. The goal of the analysis phase is to translate the inventoried information into a series of thematic maps organized into three categories;

Topography and Projected Flooding

Town Level Resource maps; Ecological Systems, Structures and Roadways and Land Uses & Social Characteristics

Zones of Shared Risk

Base Mapping



Zones of Shared Risk

Coastal
Key Map

3

Existing
Conditions
1 – 7

- Plan
- Photo
- Section

Preliminary
Proposed
Interventions
Conditions

- Plan
- Section

4

Historical Context

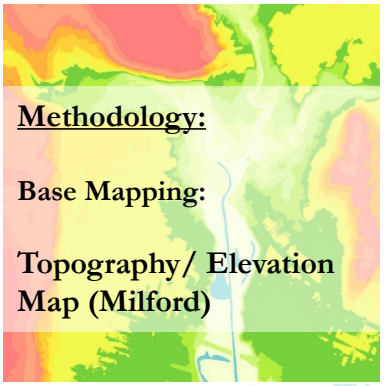
Historical
Aerial Photos
oF Coast

1934 –
2019

5

Series of
Aerial Comparisons

6



Methodology:

Base Mapping:

Topography/ Elevation Map (Milford)

Base Mapping

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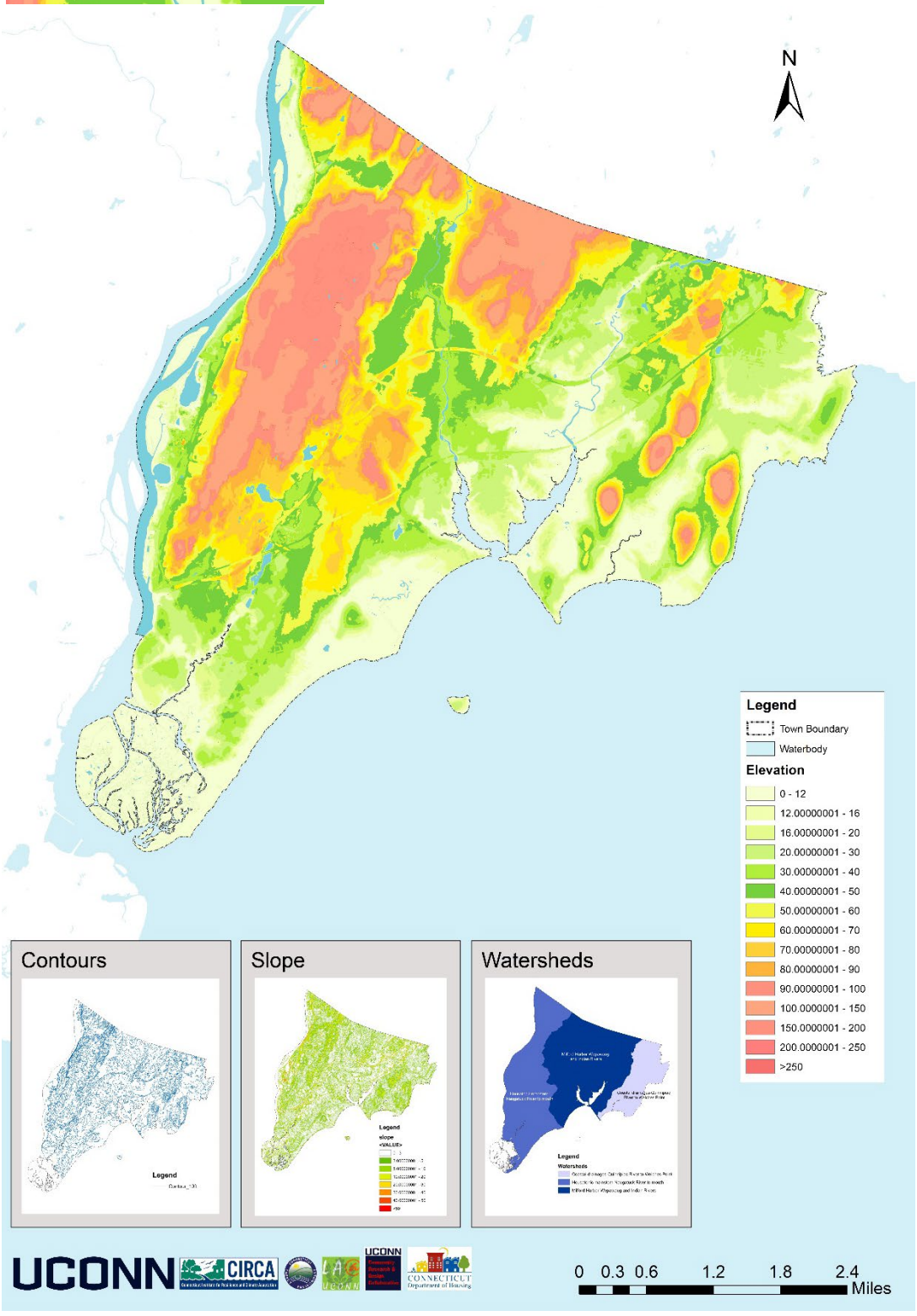
CONNECTICUT ENERGY ENVIRONMENT



Methodology:

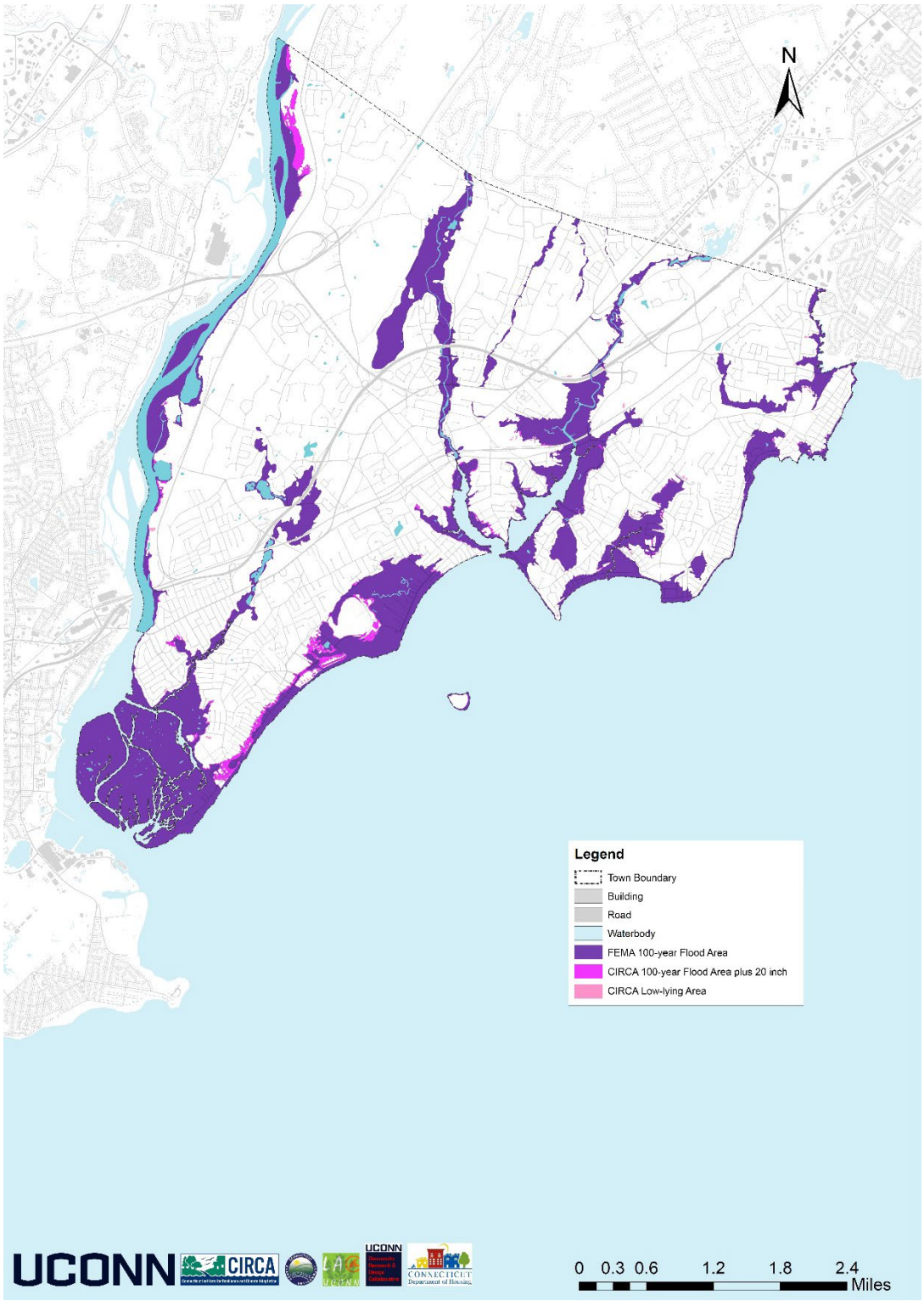
Base Mapping:

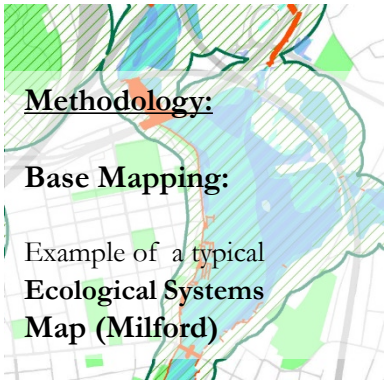
Example of a typical **Projected Flood Map (Milford)**

Base Mapping

- Topography/ Elevation Map
- Projected Flood "Overlay" Map
- Ecological Systems Map
- Structures & Roadways Map
- Land Uses & Social Characteristics Map

1. **Map FEMA & CIRCA** data on sea level rise and **produce maps to clearly communicate the affects of projected water rise over time** in New Haven and Fairfield Counties.
2. **Create Town Level Resource Maps** to be used by designers (landscape architects, engineers, etc.), decision makers and citizens to understand the context of proposed infrastructure improvements. The goal is to mitigate the negative effects of water rise while improving the overall quality of life of all living things.

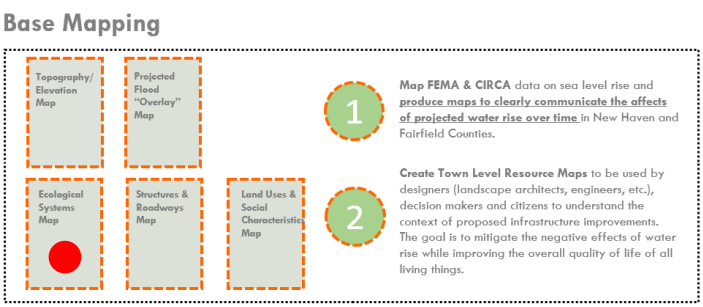


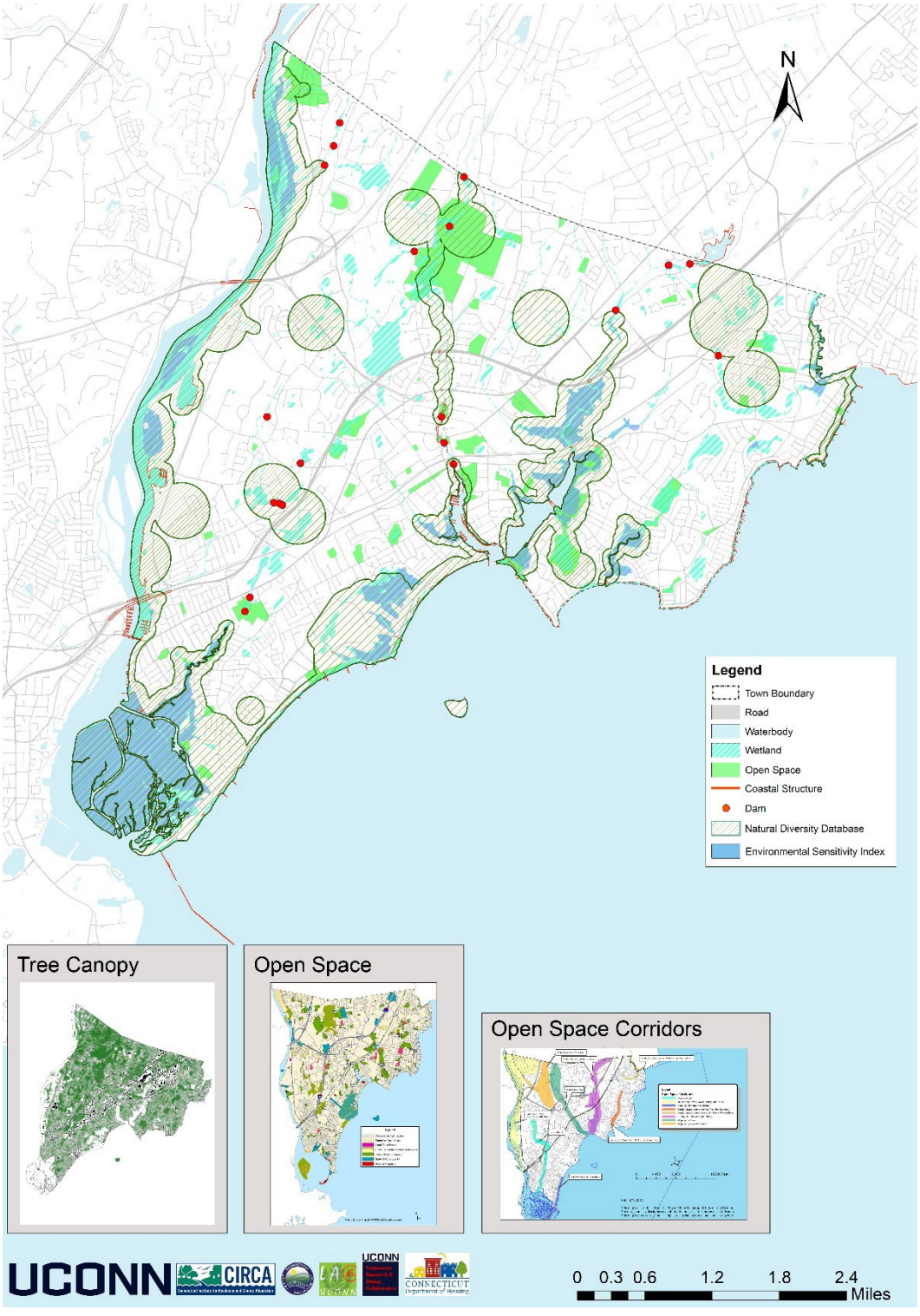


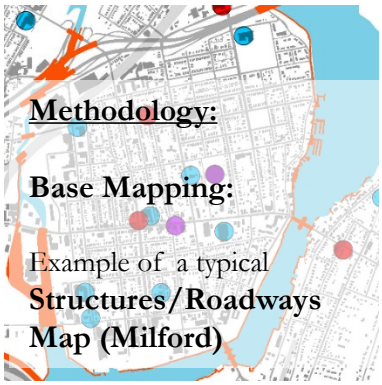
Methodology:

Base Mapping:

Example of a typical **Ecological Systems Map (Milford)**







Methodology:

Base Mapping:

Example of a typical **Structures/Roadways Map (Milford)**

Base Mapping

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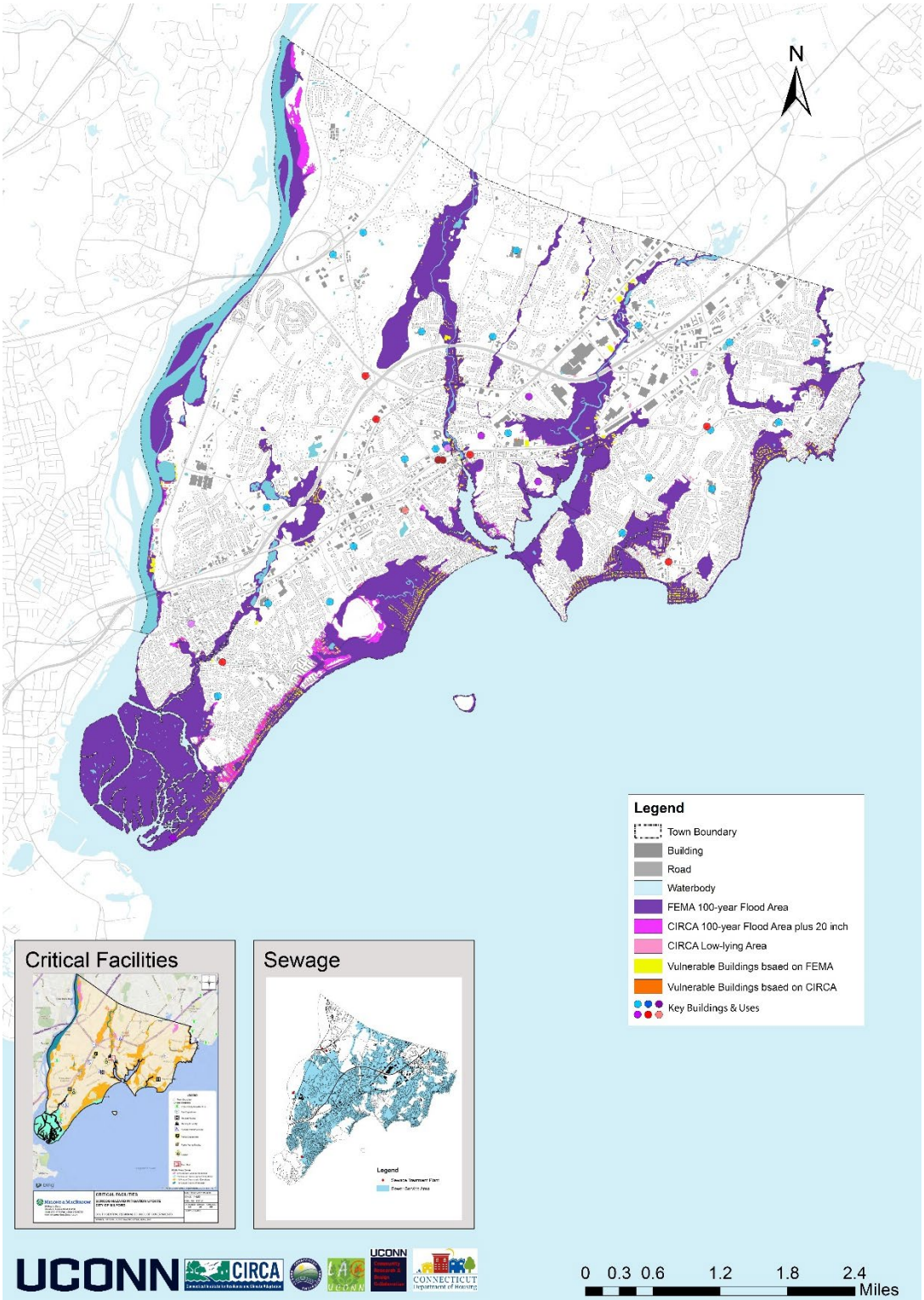
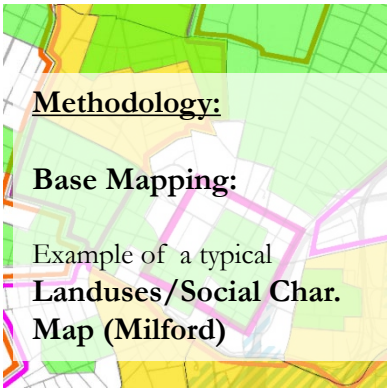
Connecticut Energy Environment



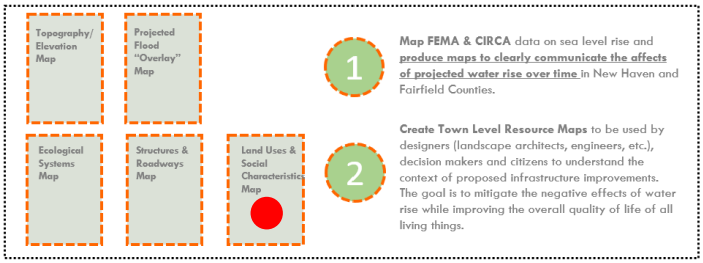


Methodology:

Base Mapping:

Example of a typical **Landuses/Social Char. Map (Milford)**

Base Mapping



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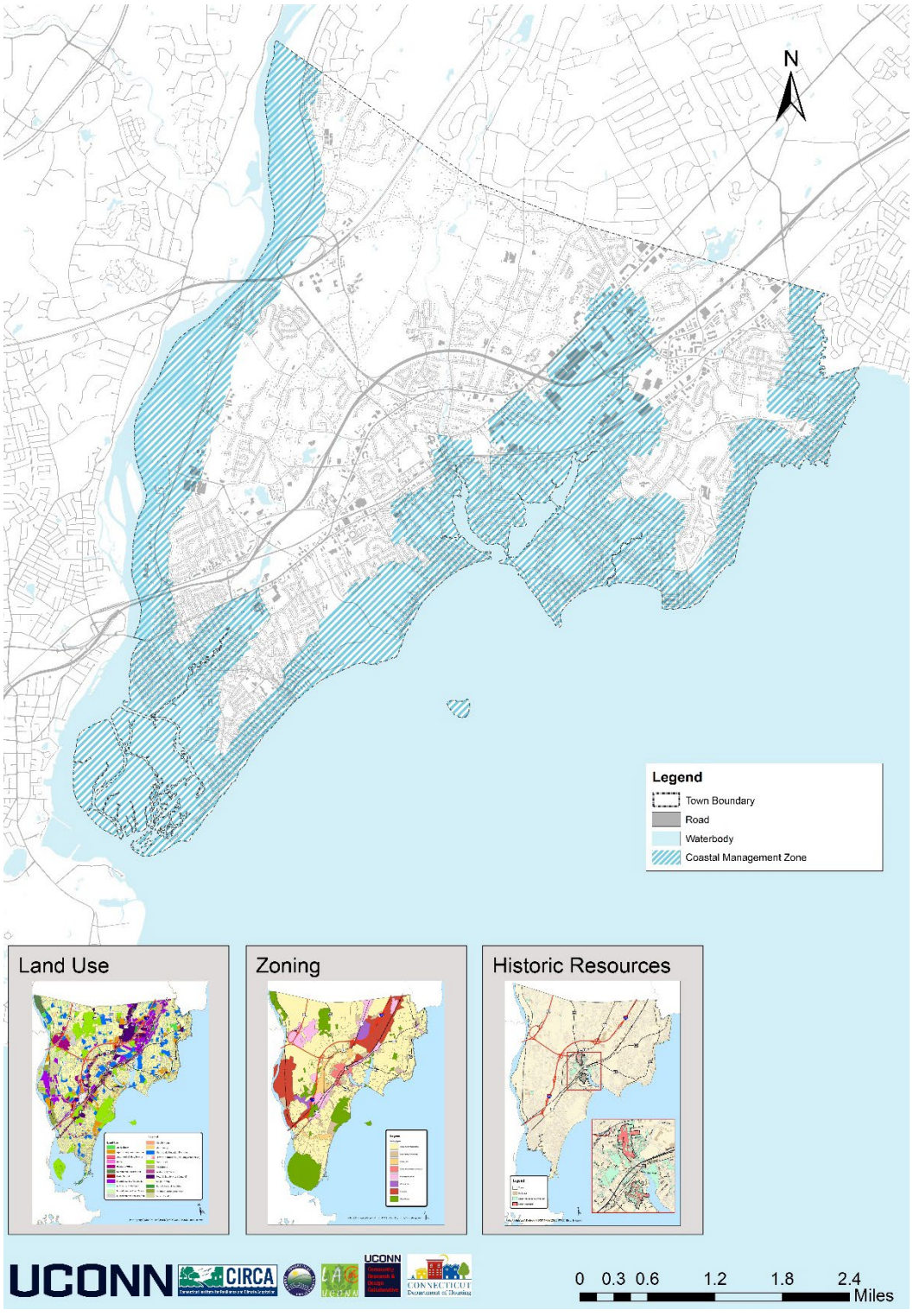
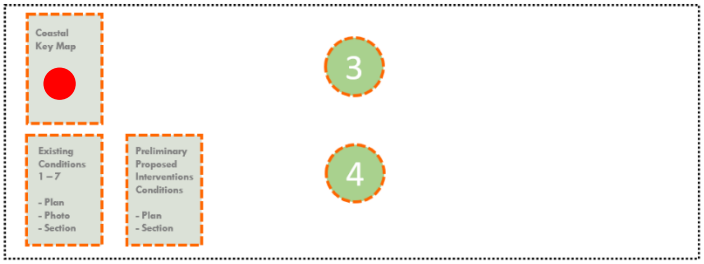
CIRCA — Connecticut Institute for Resilience and Climate Adaptation



Methodology:

Zones of Shared Risk Map (Milford)



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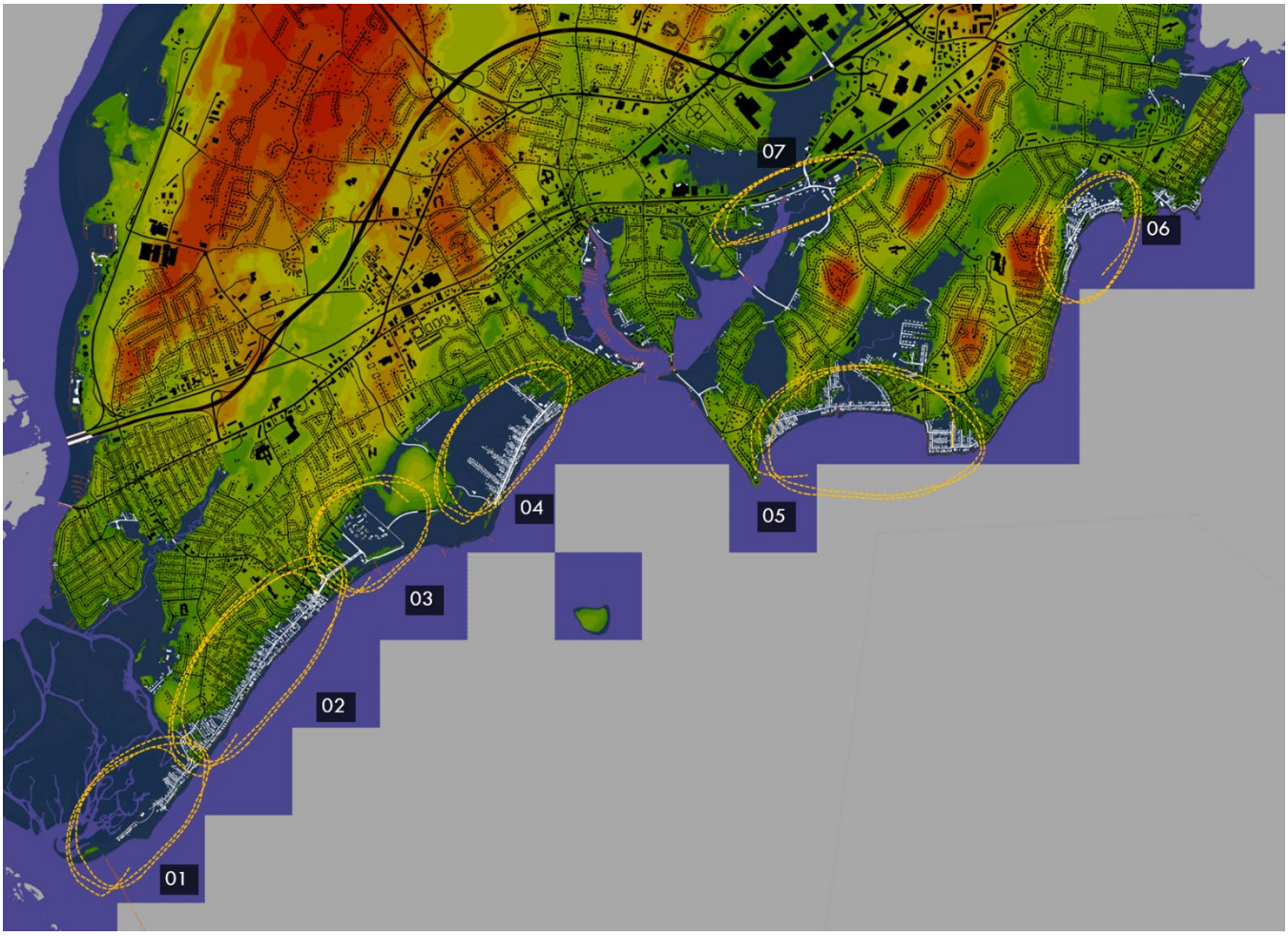
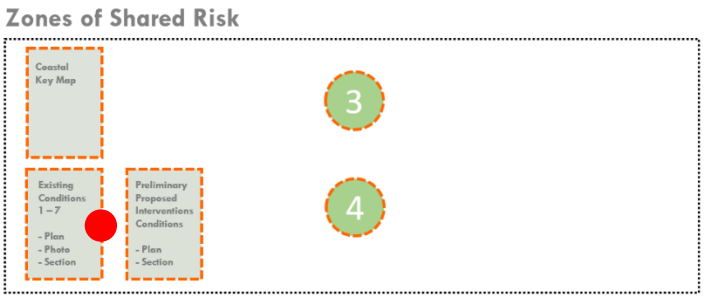


Methodology:

Zones of Shared Risk Map (Milford)



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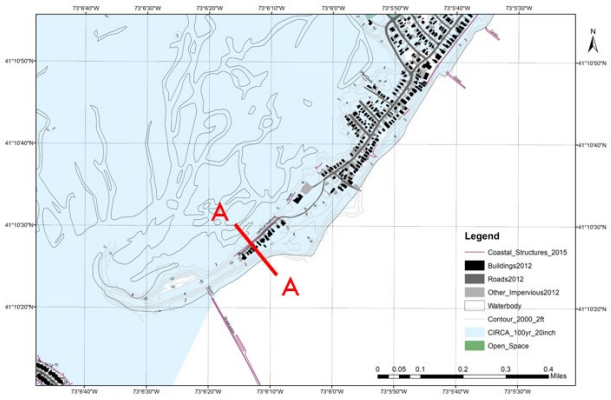
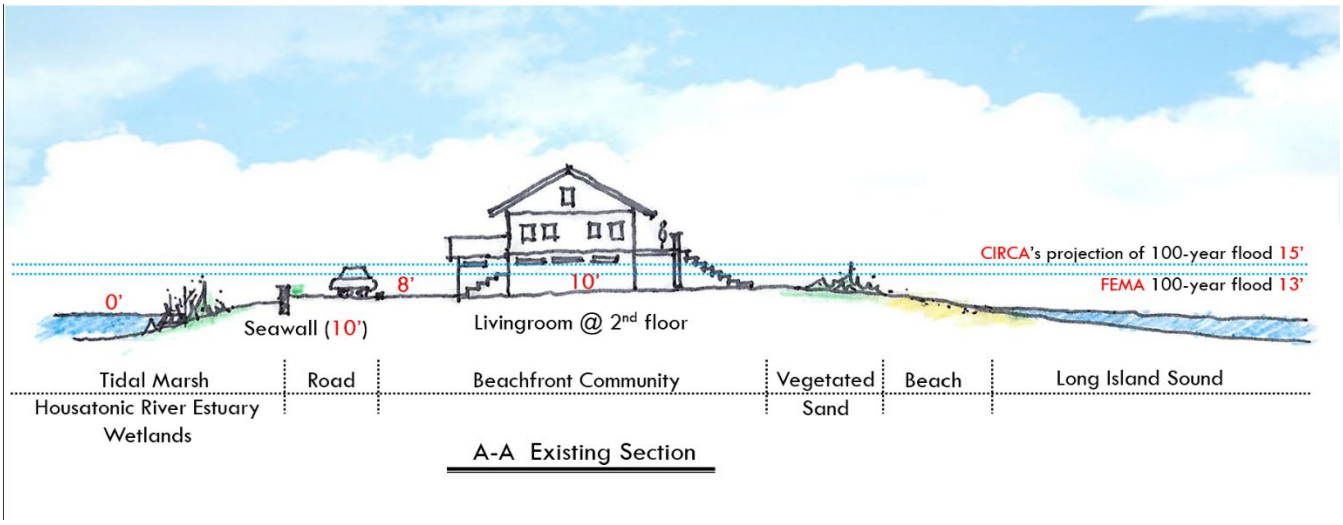


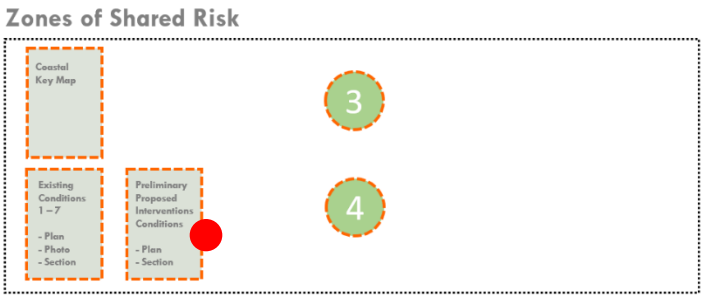
Zone VE (Base Flood Elevation is 13')

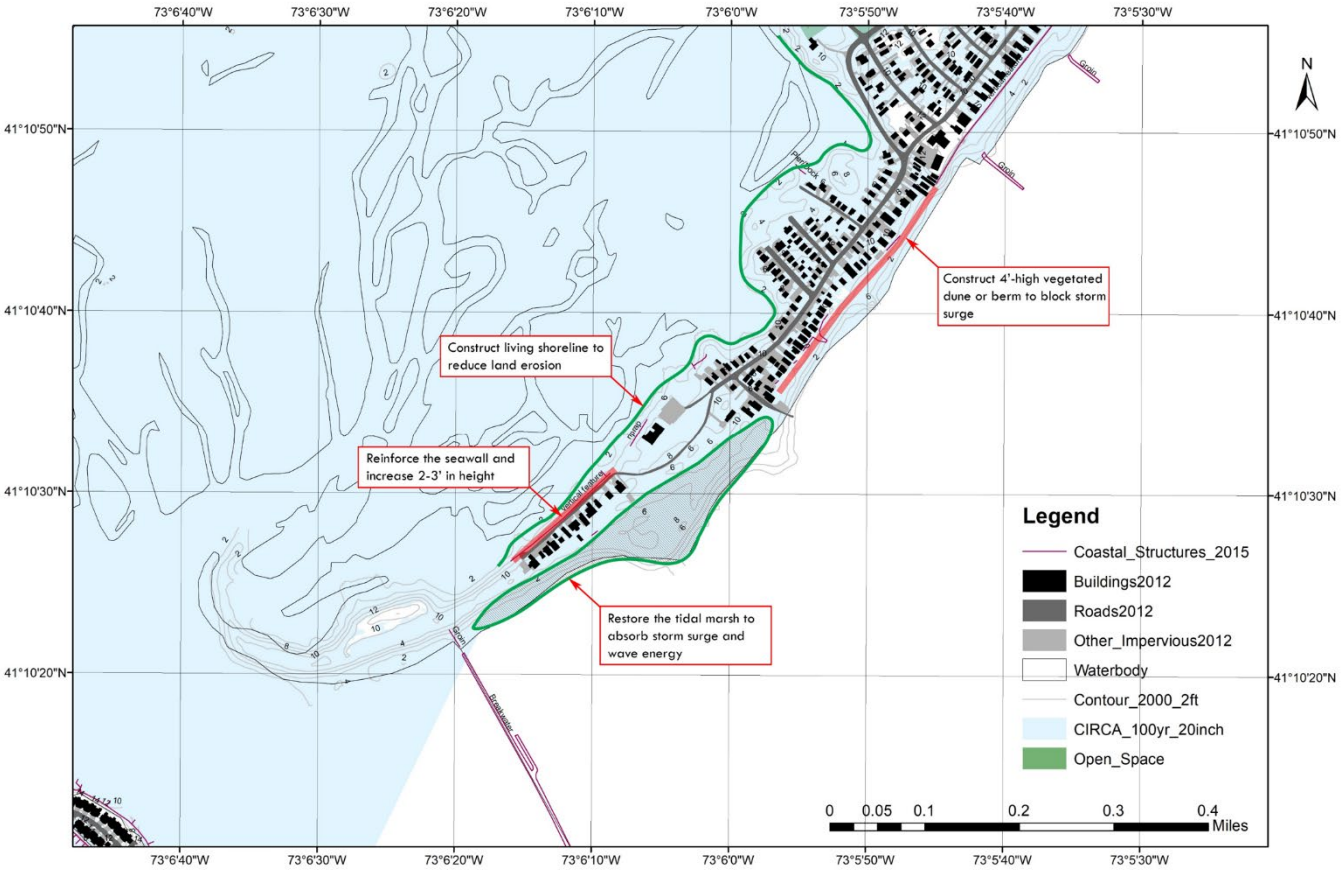


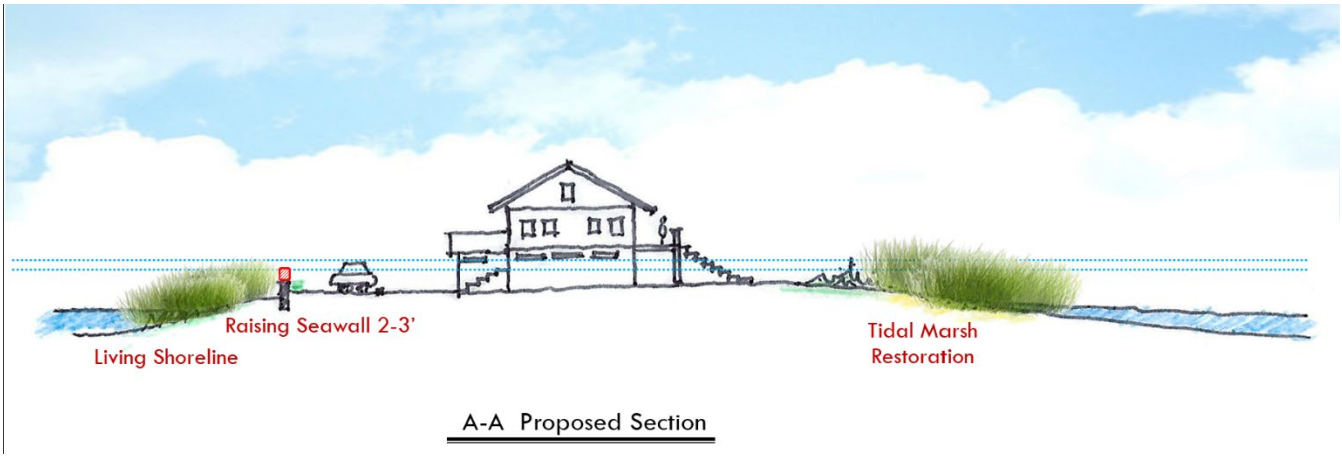
01 Zone of Shared Risk – Existing Conditions

Methodology:

Zones of Shared Risk Map (Milford)







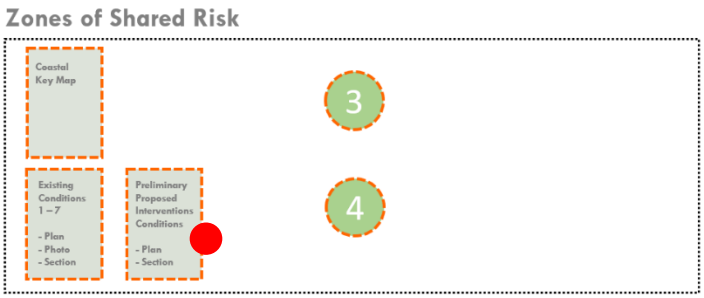
A-A Proposed Section

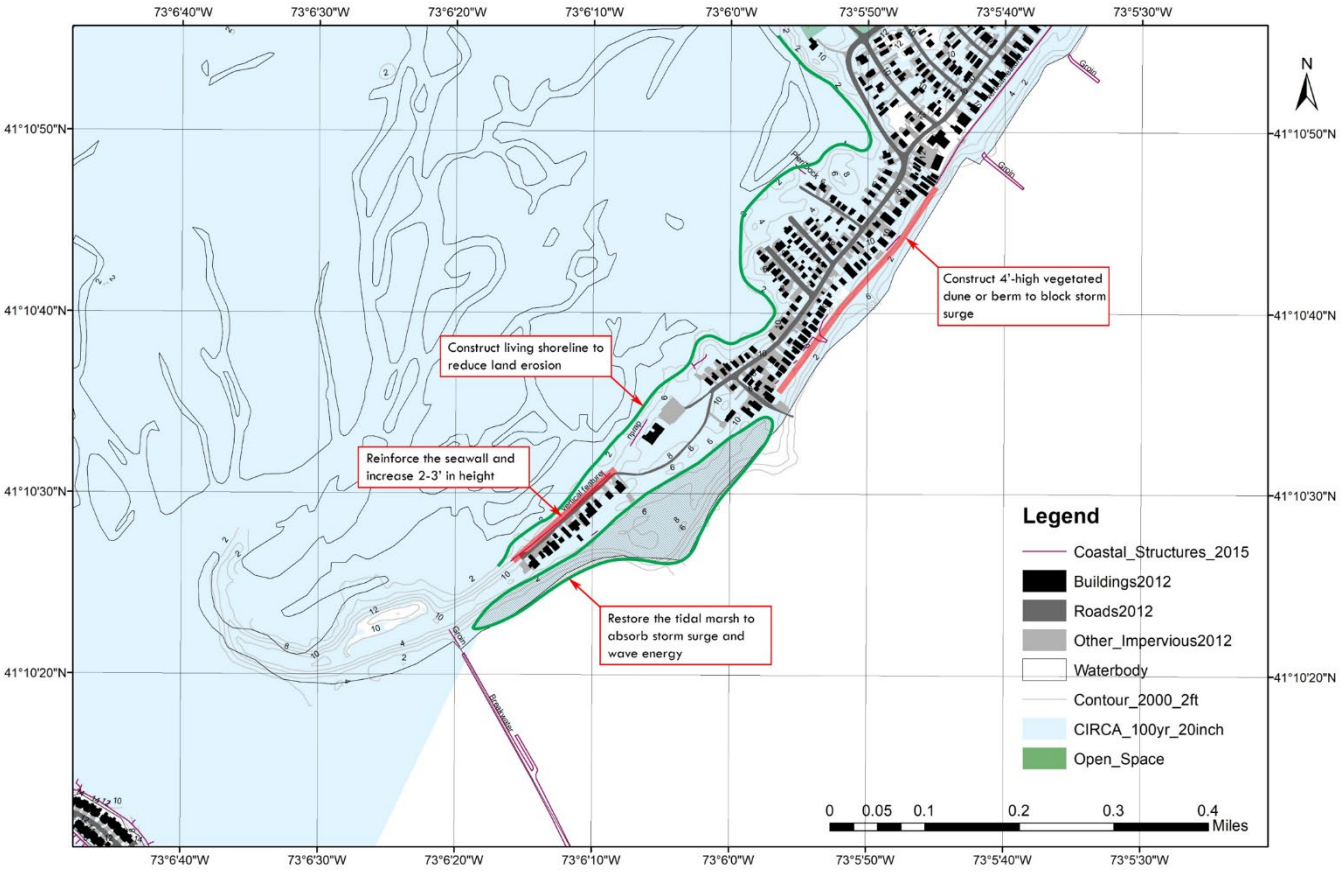
01

Zone of Shared Risk – Preliminary Proposed Intervention Conditions

Methodology:

Zones of Shared Risk Map (Milford)





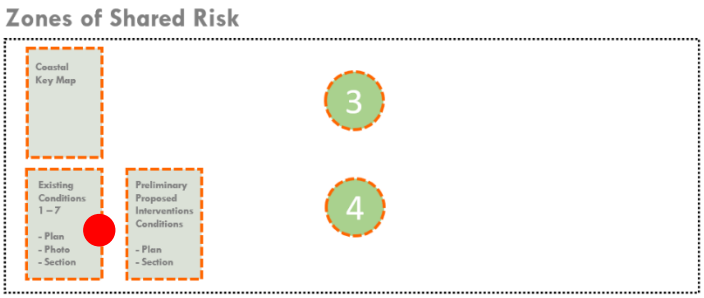
B-B Proposed Section

01

Zone of Shared Risk – Preliminary Proposed Intervention Conditions

Methodology:

Zones of Shared Risk Map (Milford)



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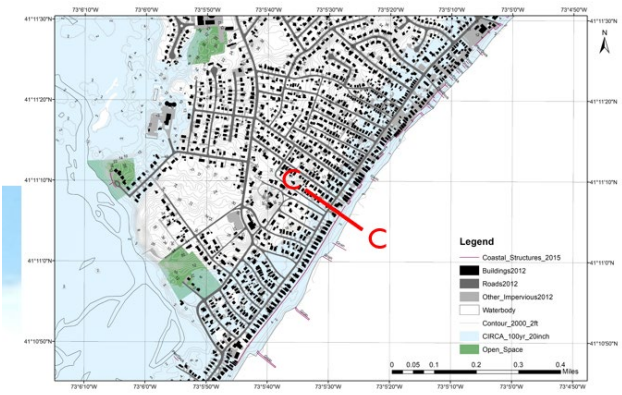
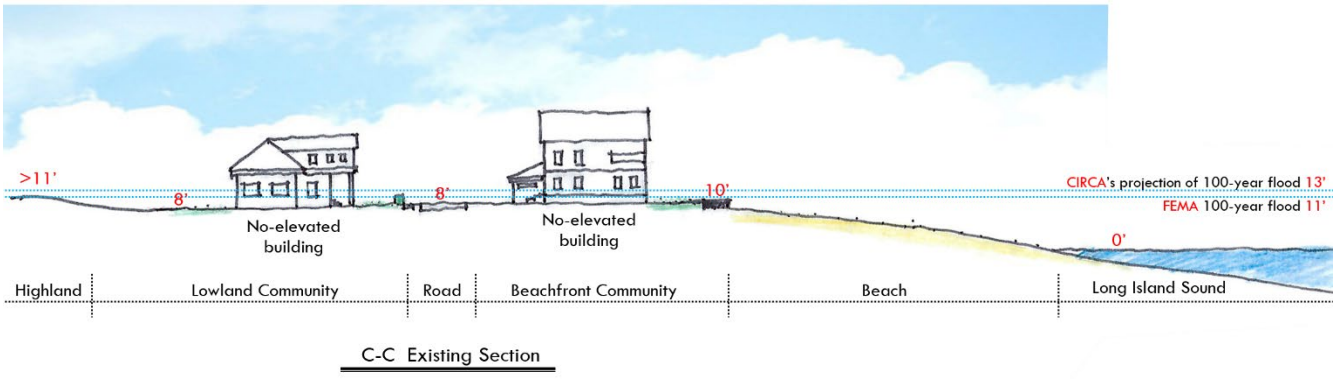


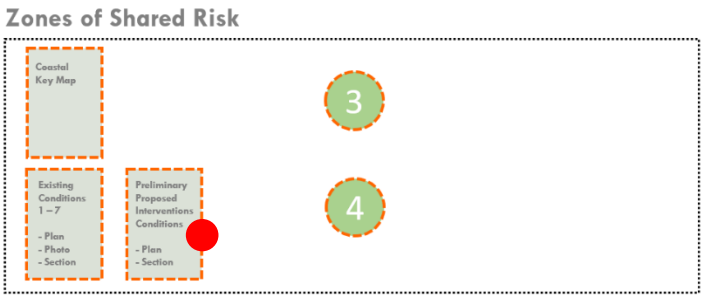


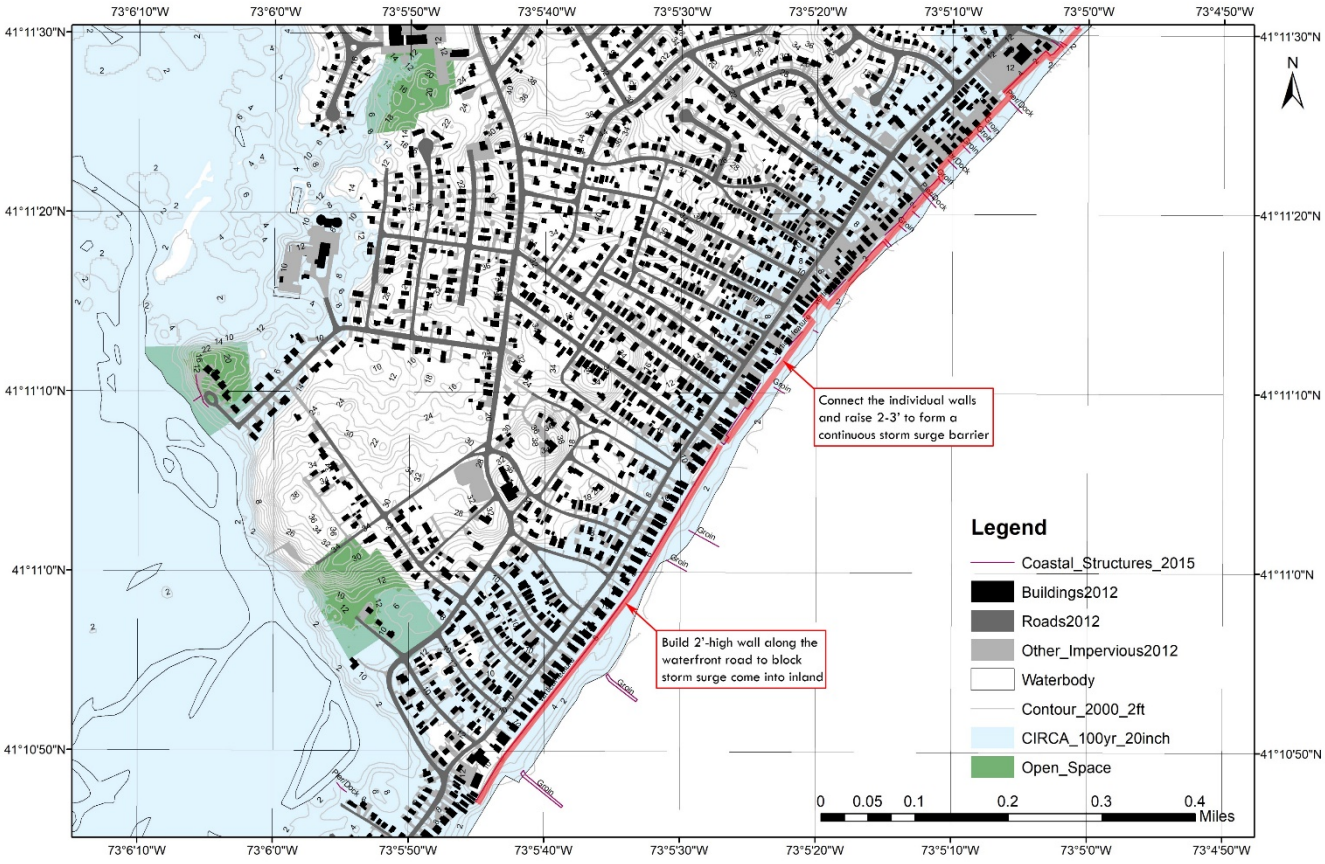
C-C Existing Section

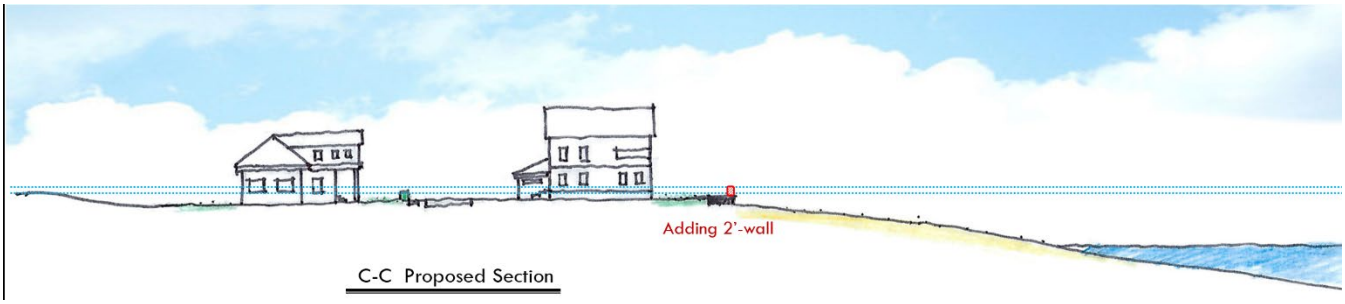
02 Zone of Shared Risk – Existing Conditions

Methodology:

Zones of Shared Risk Map (Milford)







02 Zone of Shared Risk – Preliminary Proposed Intervention Conditions

Methodology:

Zones of Shared Risk Map (Milford)

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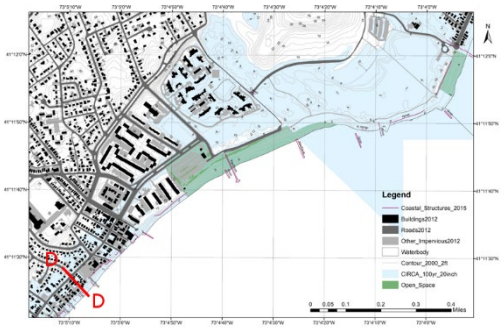
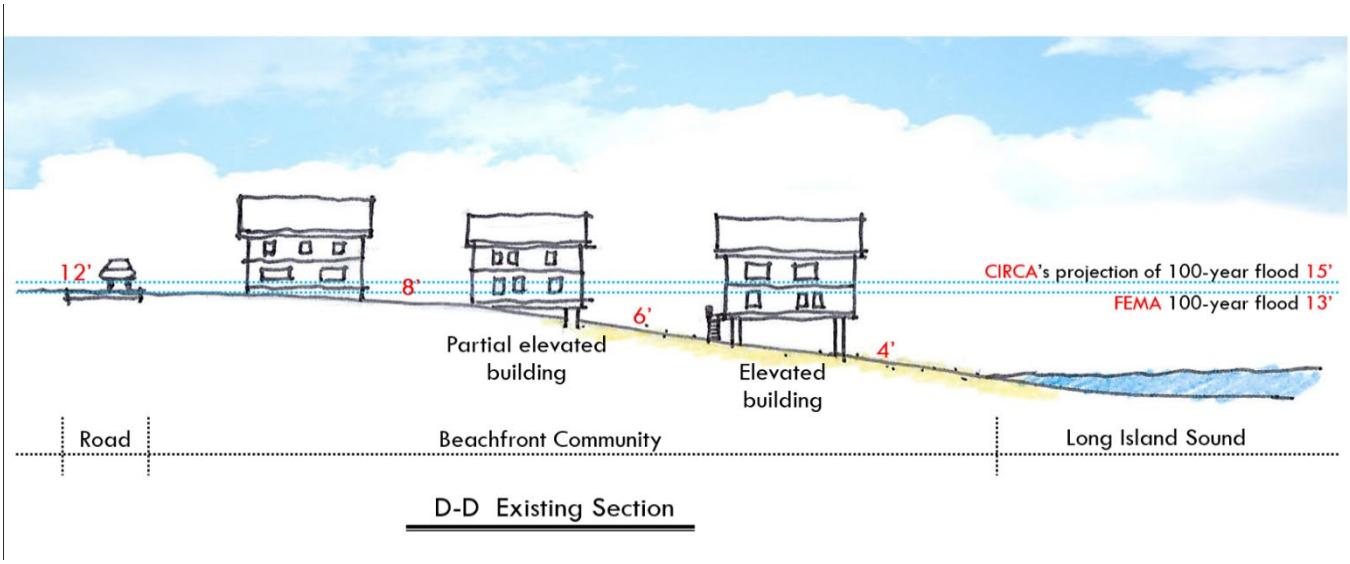


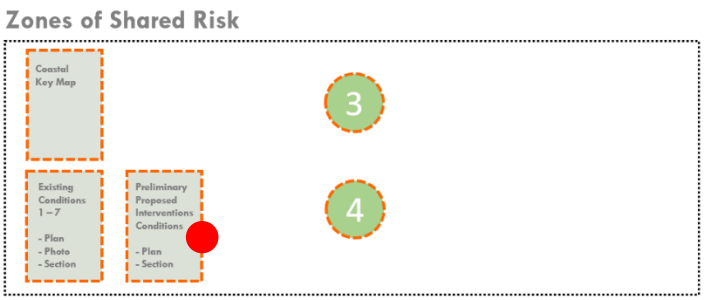
Zone AE (Base Flood Elevation is 12')

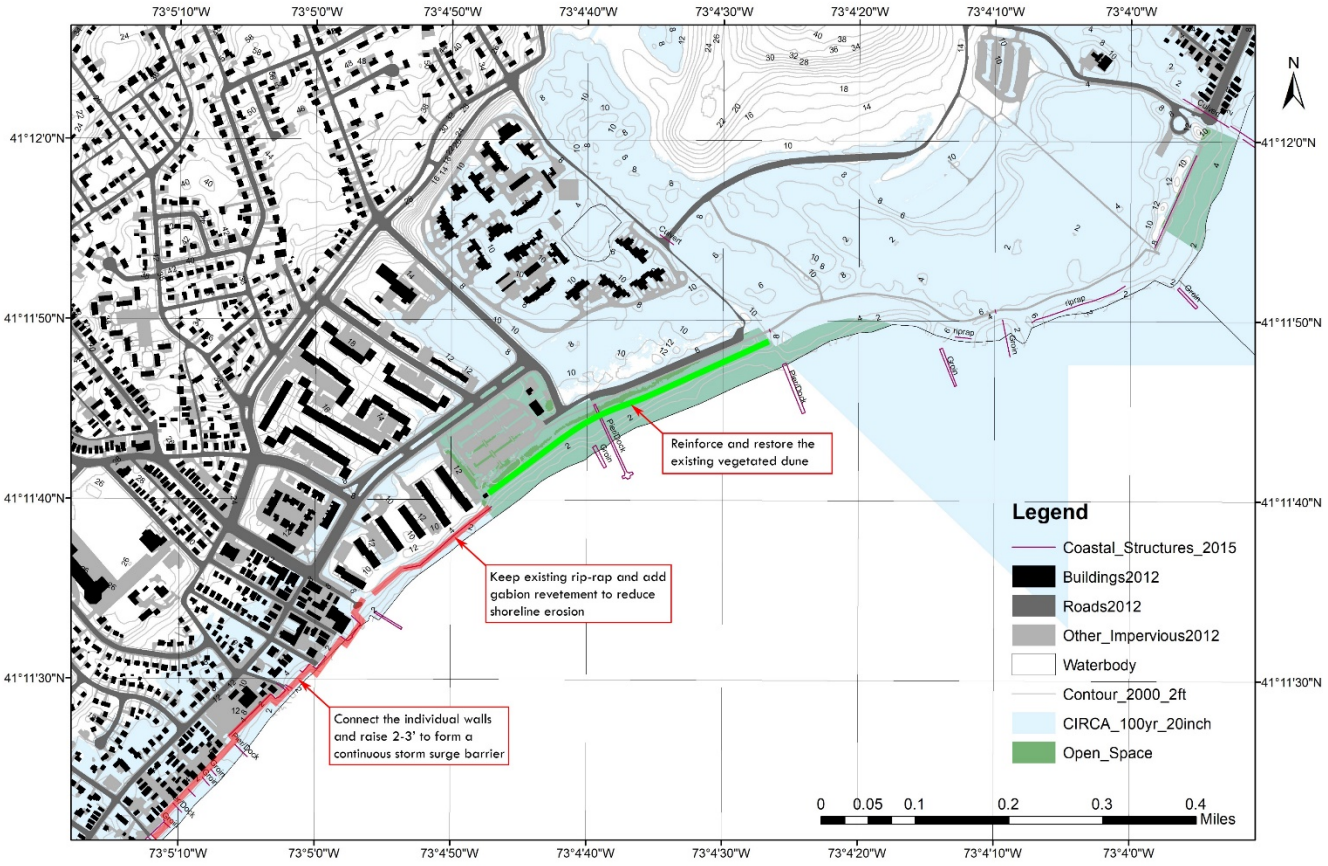


03 Zone of Shared Risk – Existing Conditions

Methodology:

Zones of Shared Risk Map (Milford)

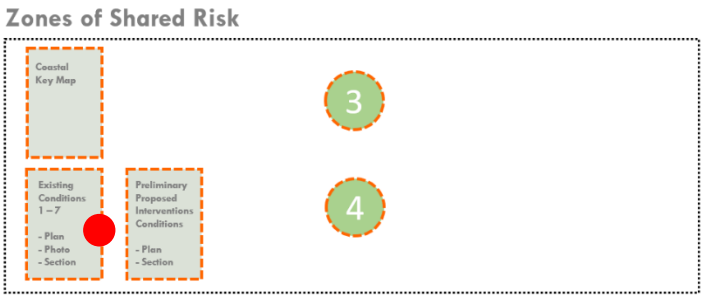


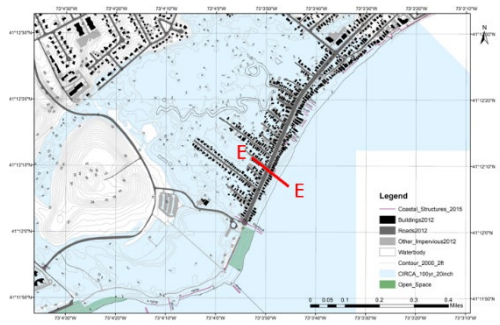


03 Zone of Shared Risk – Preliminary Proposed Intervention Conditions

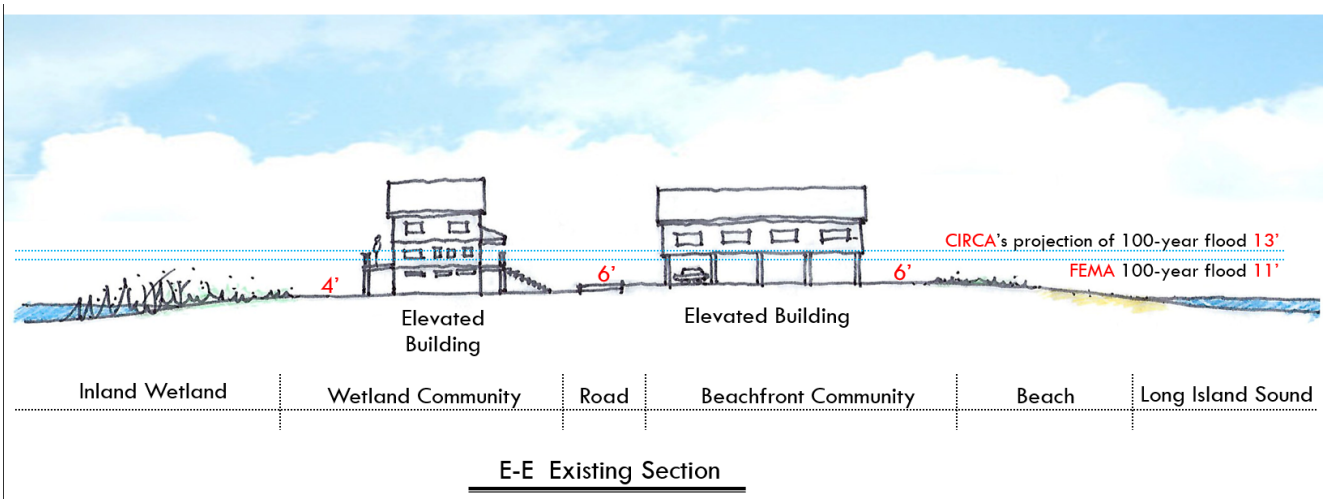
Methodology:

Zones of Shared Risk Map (Milford)





Zone AE (Base Flood Elevation is 11')

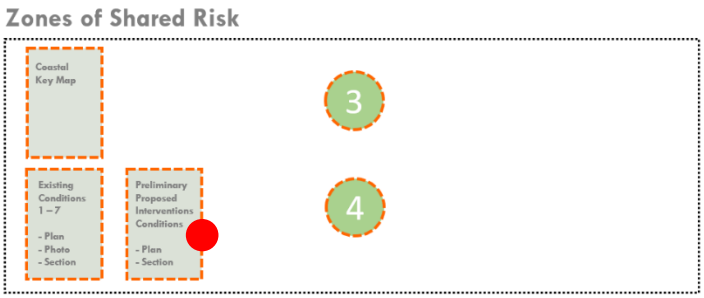


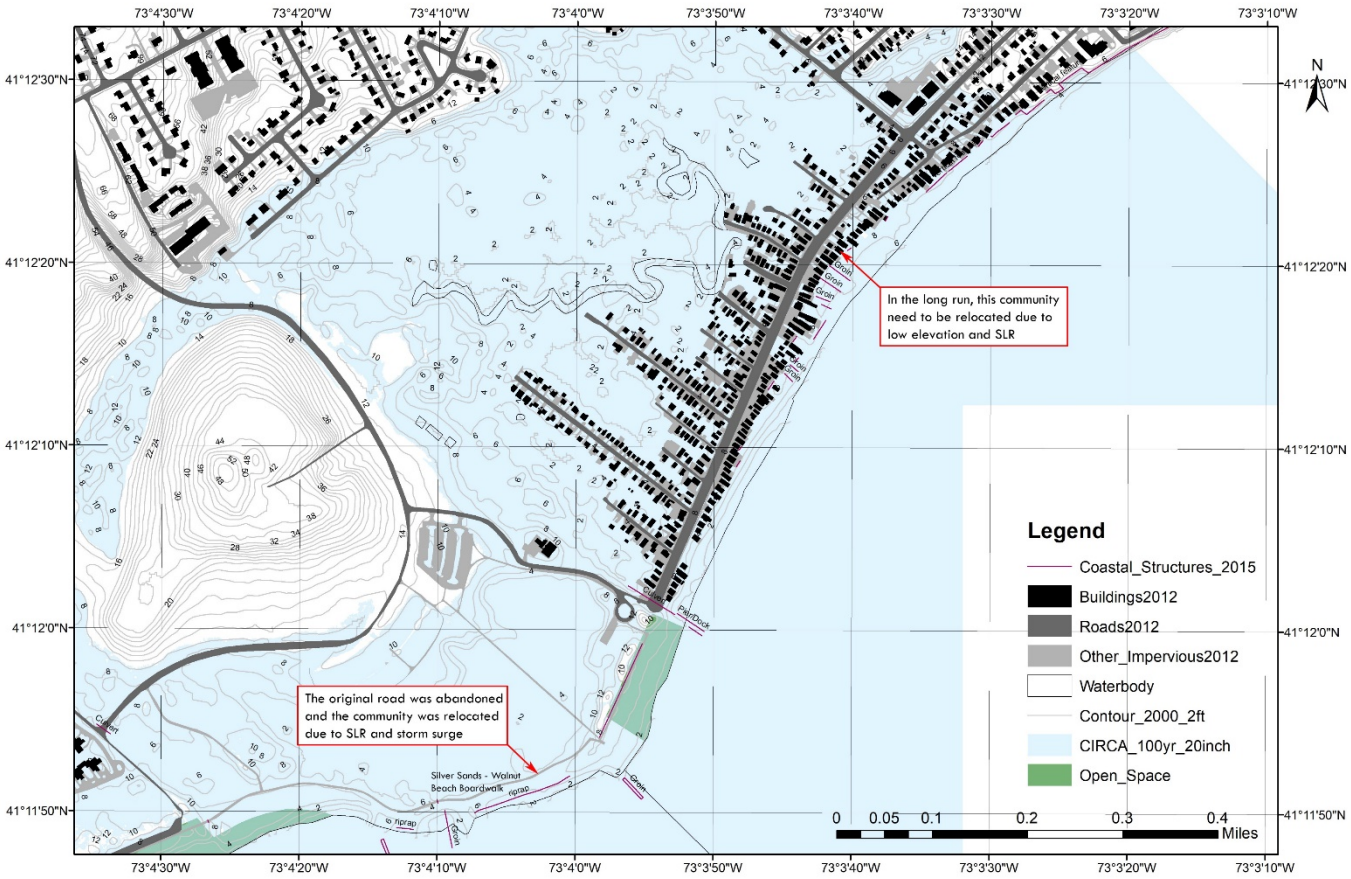
E-E Existing Section

04 Zone of Shared Risk – Existing Conditions

Methodology:

Zones of Shared Risk Map (Milford)

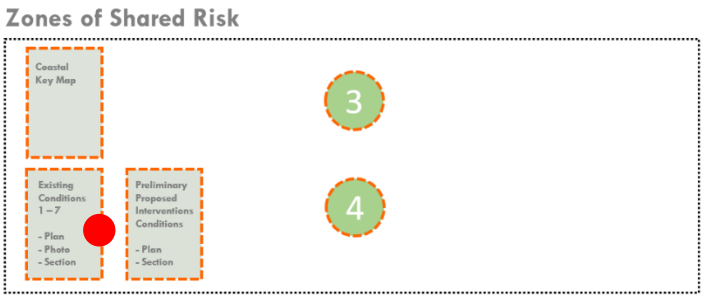


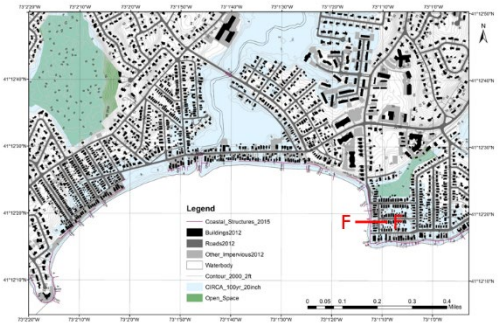


04 Zone of Shared Risk – Preliminary Proposed Intervention Conditions

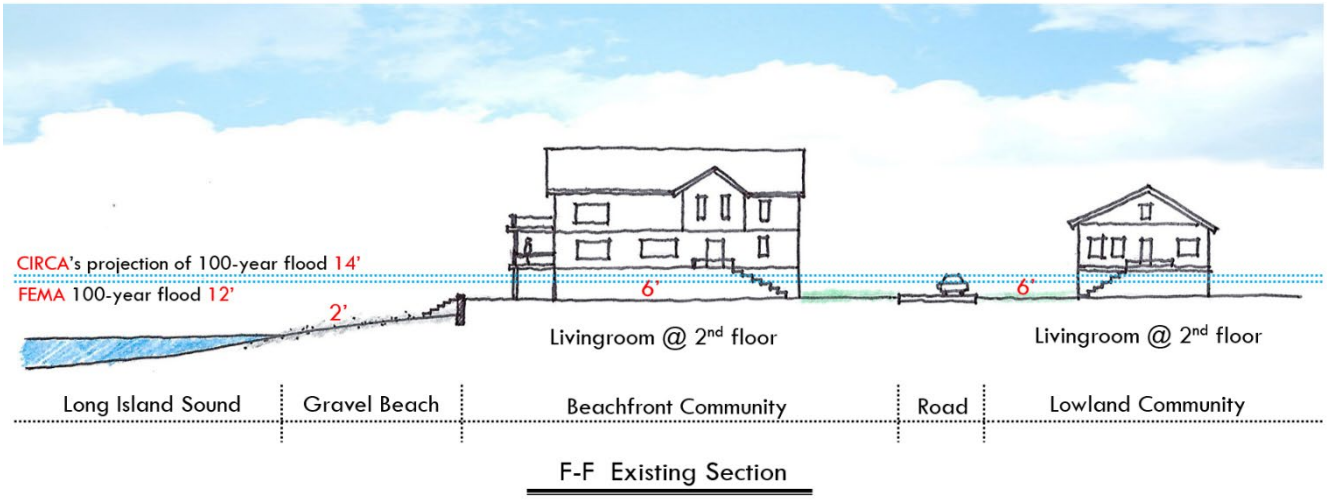
Methodology:

Zones of Shared Risk Map (Milford)





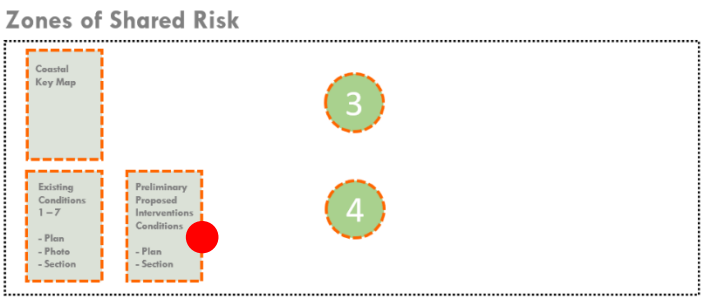
Zone AE (Base Flood Elevation is 12')

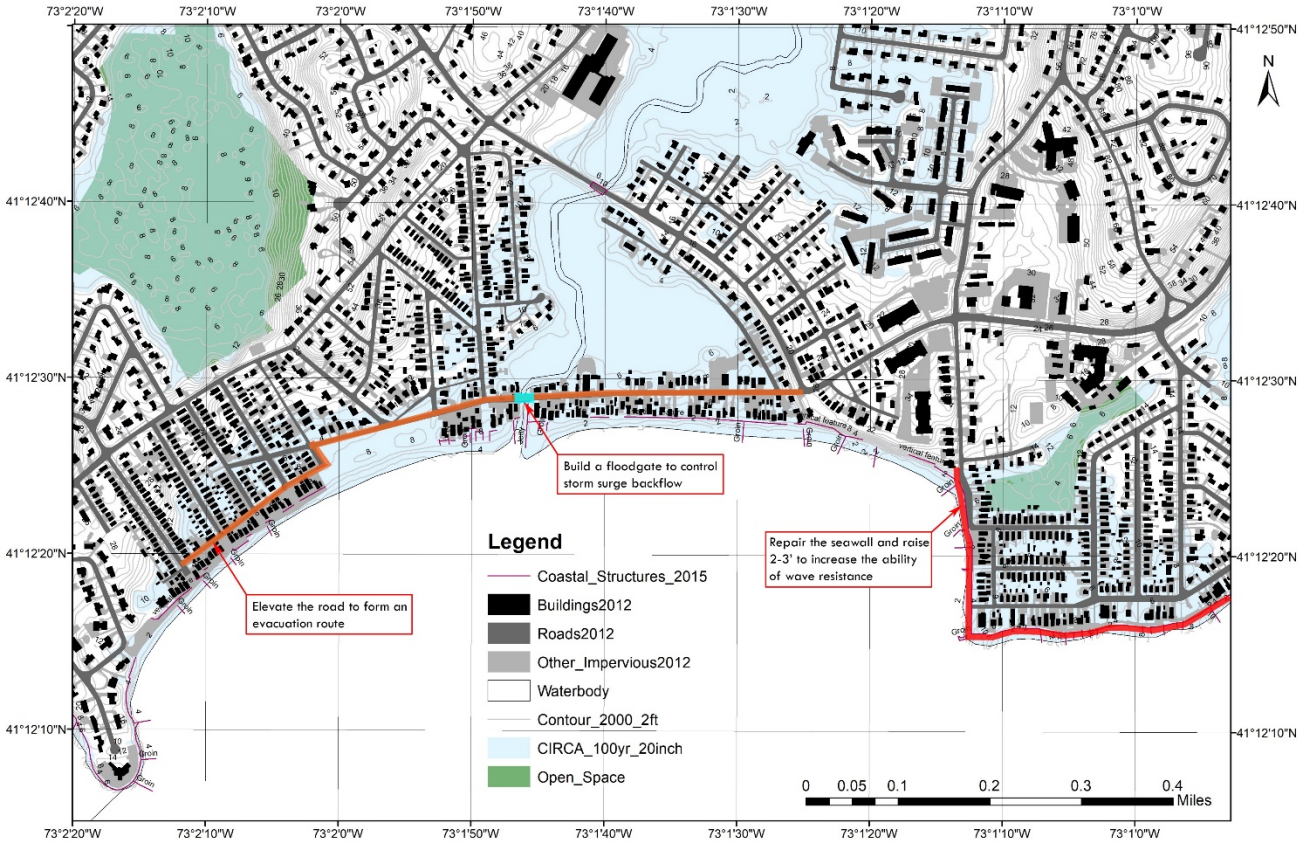


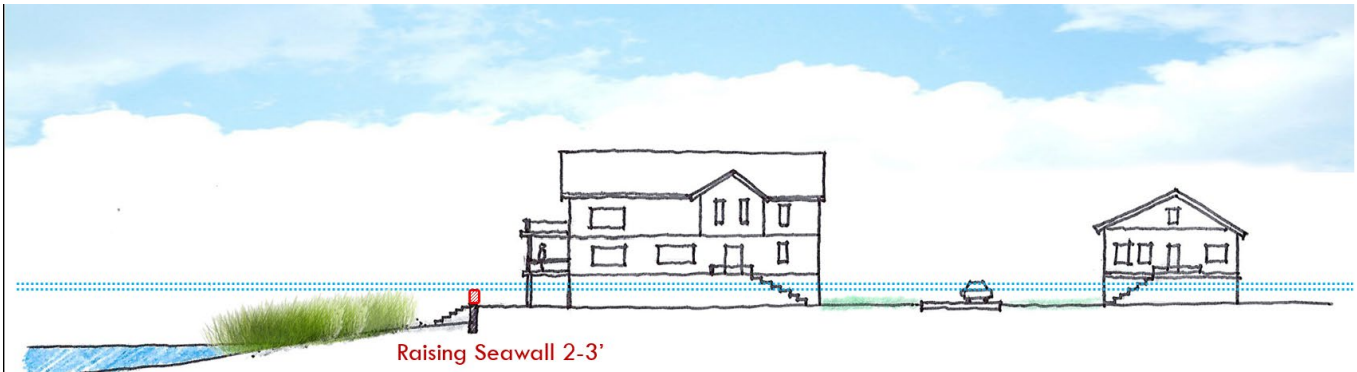
05 **Zone of Shared Risk**

Methodology:

Zones of Shared Risk Map (Milford)







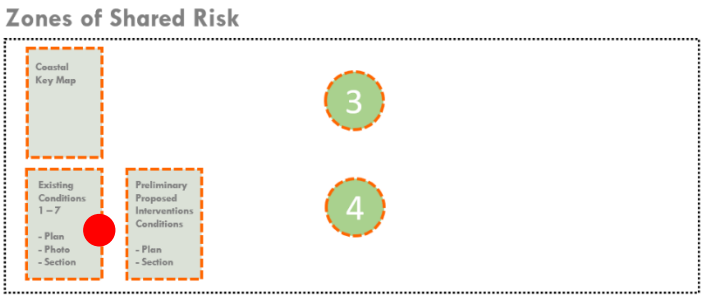
F-F Proposed Section

05

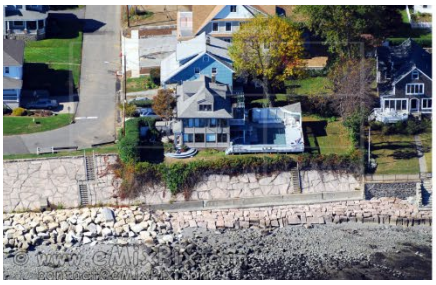
Zone of Shared Risk – Preliminary Proposed Intervention Conditions

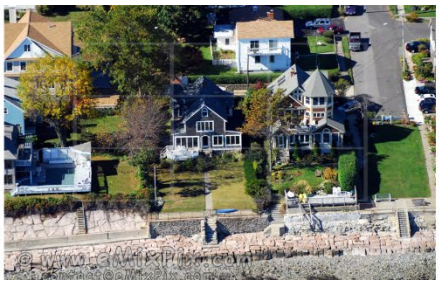
Methodology:

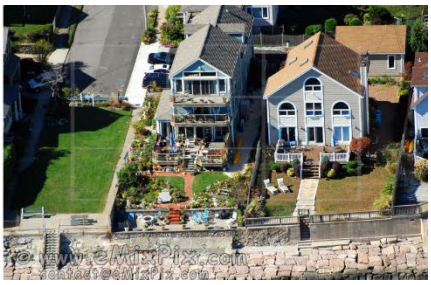
Zones of Shared Risk Map (Milford)

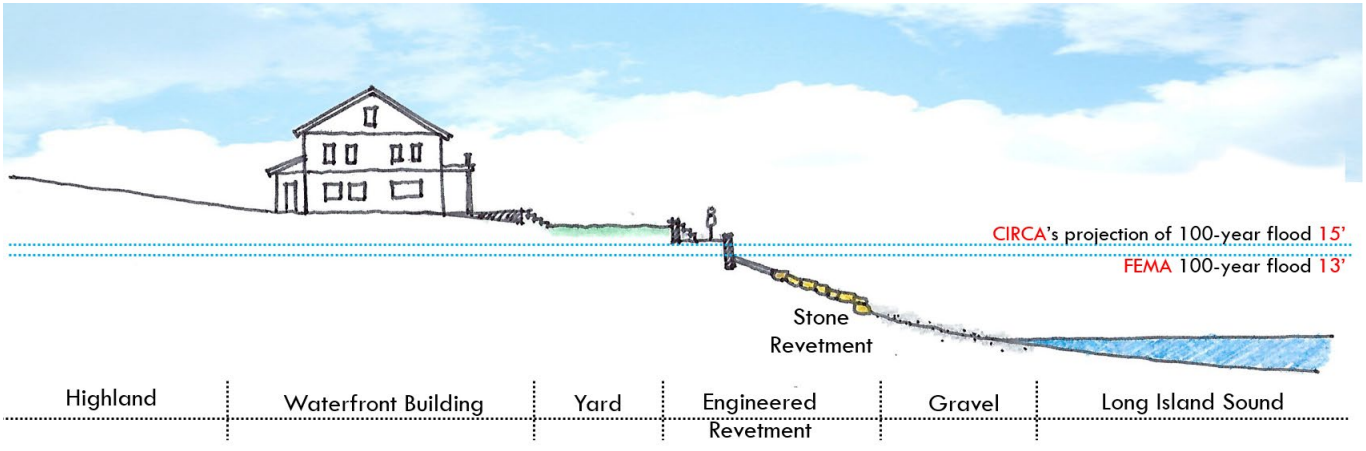


Zone AE (Base Flood Elevation is 13')







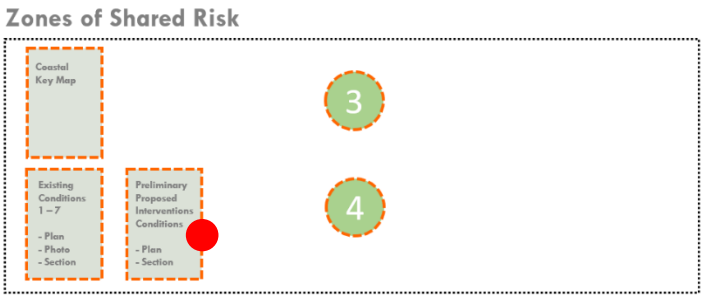


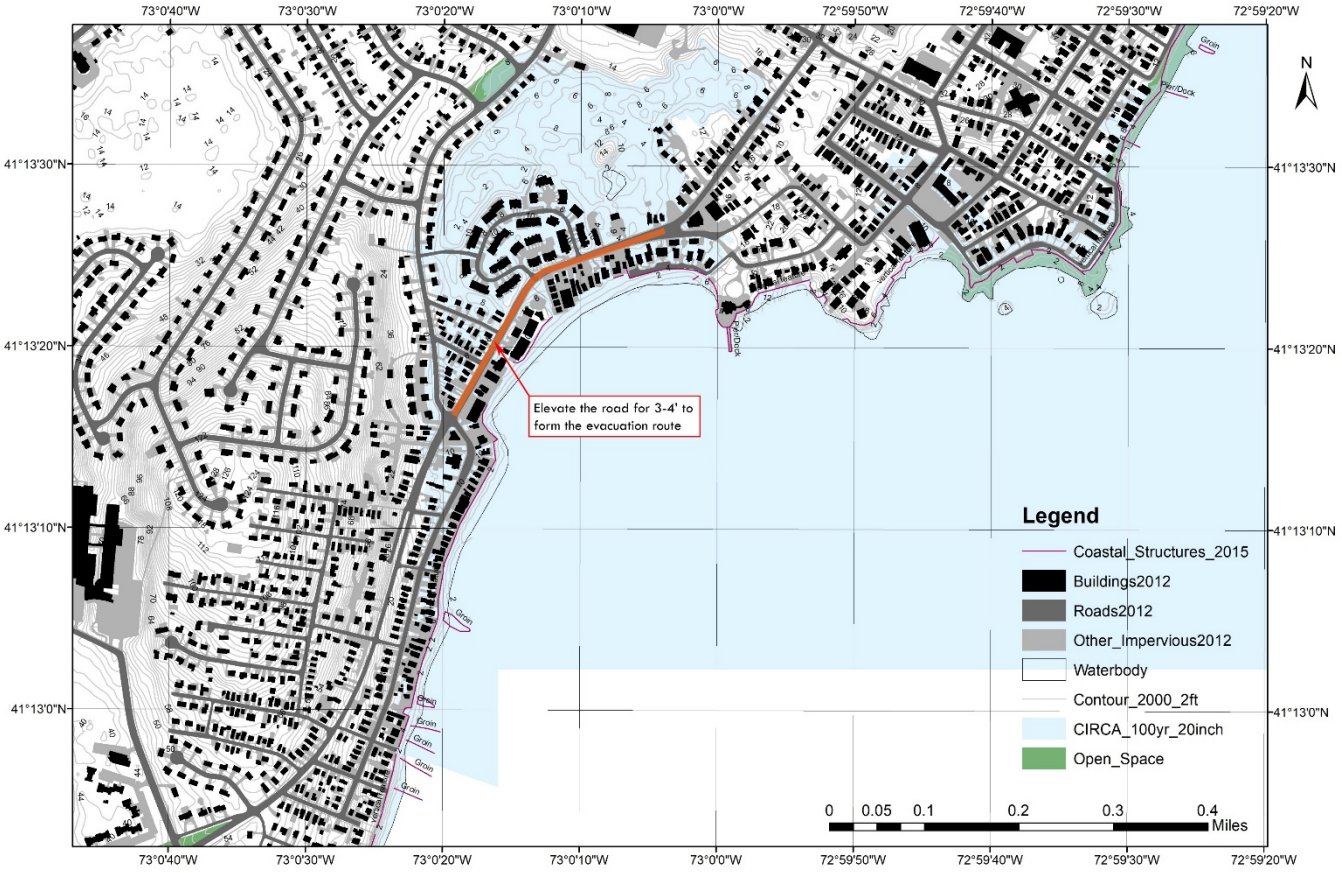
G-G Existing Section

06 Zone of Shared Risk – Existing Conditions

Methodology:

Zones of Shared Risk Map (Milford)

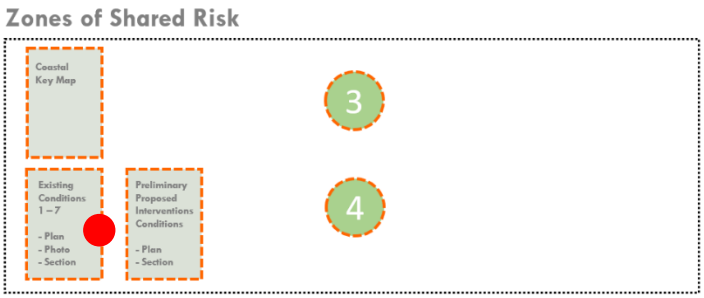


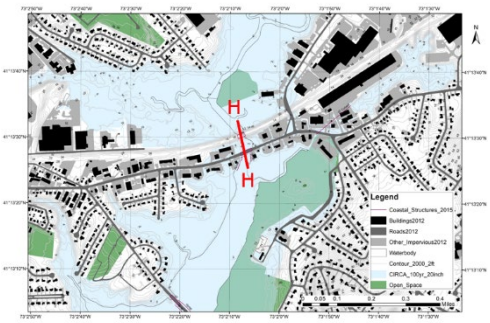


06 Zone of Shared Risk – Preliminary Proposed Intervention Conditions

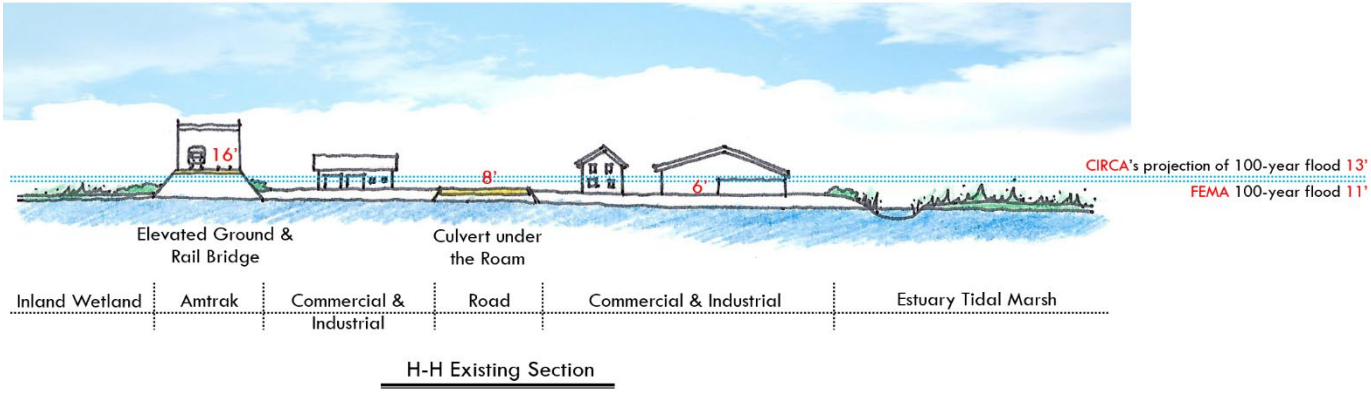
Methodology:

Zones of Shared Risk Map (Milford)





Zone AE (Base Flood Elevation is 11')



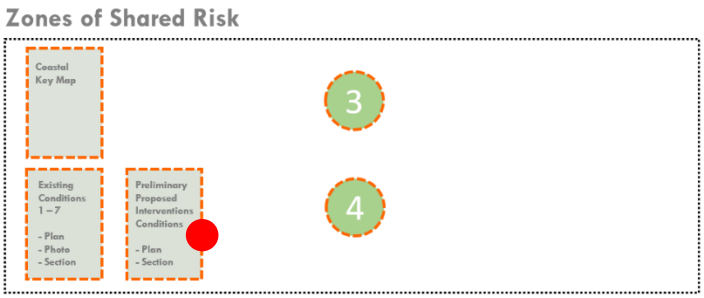
H-H Existing Section

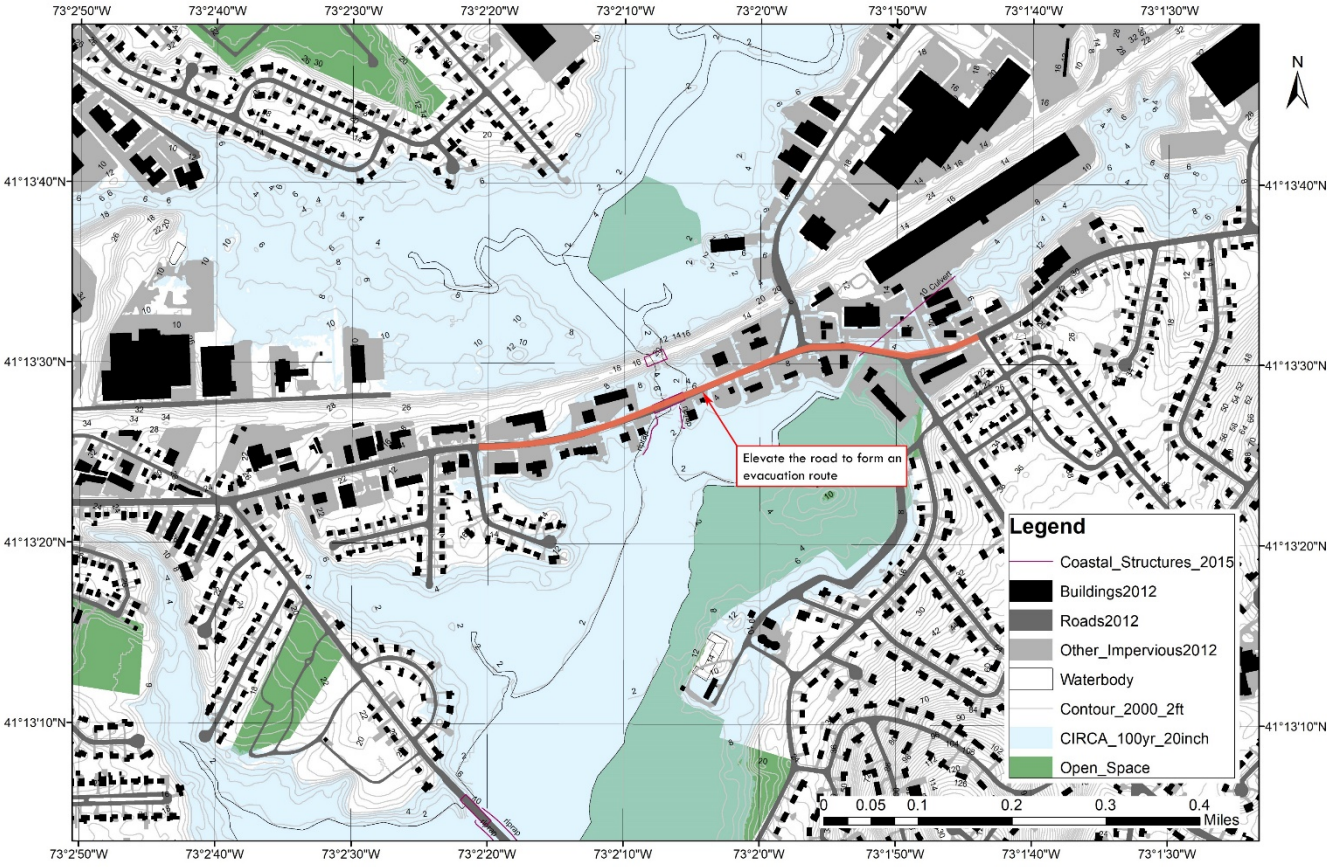
07

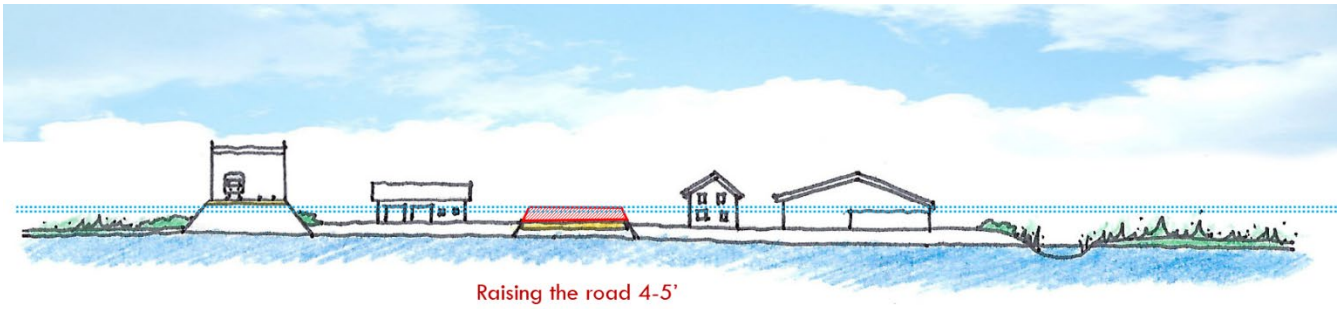
Zone of Shared Risk – Existing Conditions

Methodology:

Zones of Shared Risk Map (Milford)



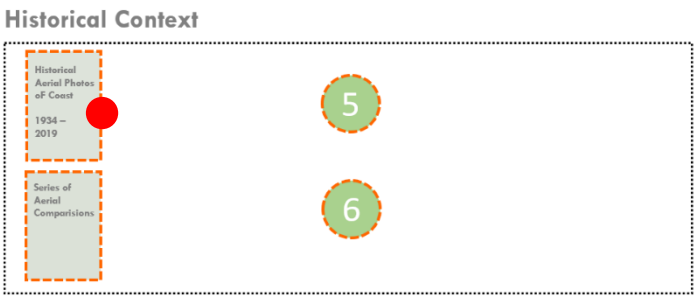




H-H Proposed Section

07

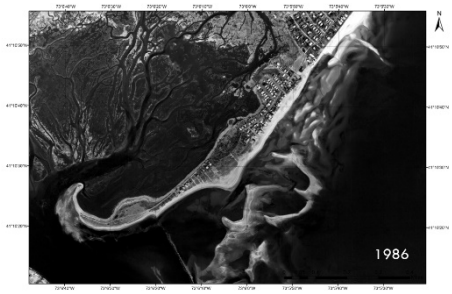
Zone of Shared Risk – Preliminary Proposed Intervention Conditions

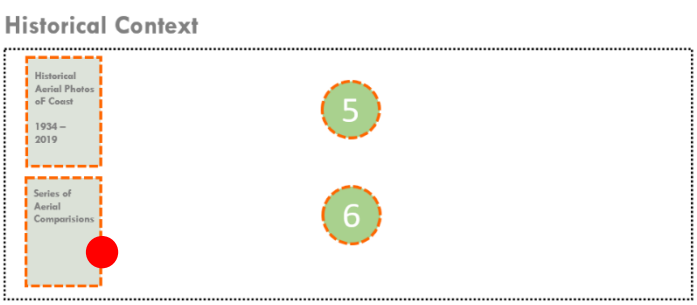


Barrier islands are a coastal landforms and a type of dune system with high dynamics.

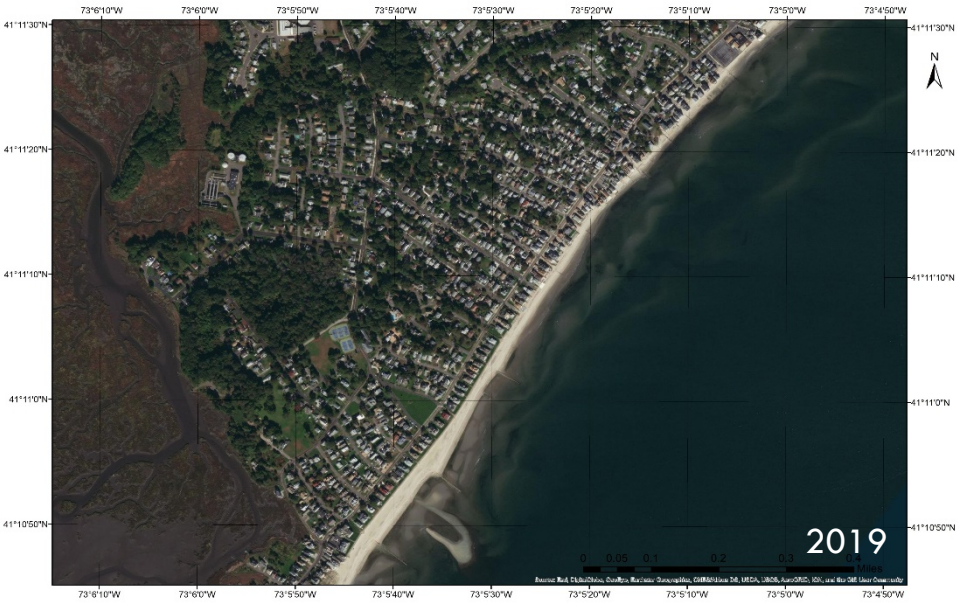
Milford Point kept changing in morphology from1934 until now due to the action of coastal erosion and longshore drift and human activities (breakwater, groin, etc.).

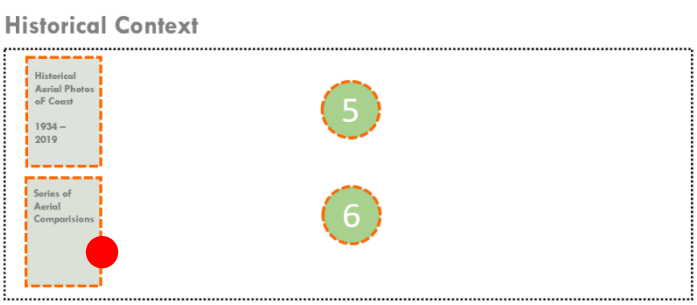
The development and conservation on the barrier island should consider this dynamics, to facilitate the reinforcement and expansion and avoid further erosion.



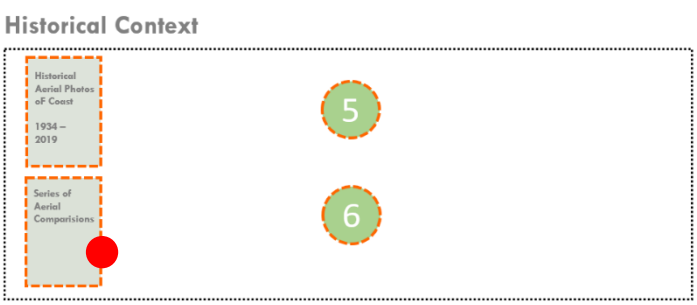


Walnut Beach's shoreline was moving seaward due to sand replenishment. The expanded sand beach and other amenities (walkway, etc.) makes it a desirable place. With the sea level rise, beach erosion will be accelerate, and beach nourishment would be a high-cost strategy.

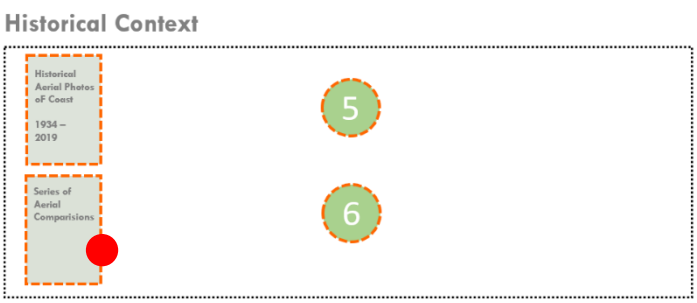




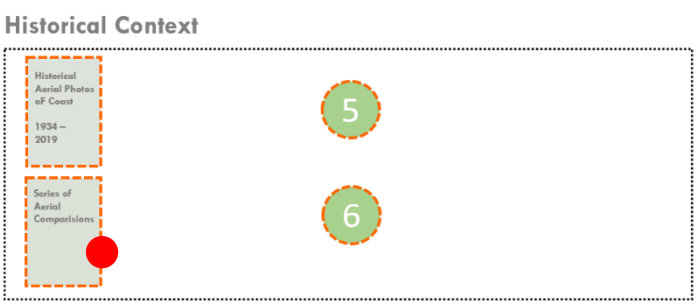
Along the Silver Sand State Park were once occupied by a coastal community, and the coastal thoroughfare connected the west and east. The long-term erosion and SLR caused the community retreat and relocation and finally it became an open space, and the thoroughfare was replaced by Silver Sands – Walnut Beach Boardwalk as well.



In no more than one century, the community along the Fort Trumbull Beach has far advanced into the very low wetlands. The elevation of most of the ground is 2-6' with very high vulnerability to wetland flood and coastal flood. The vulnerability will increase with the sea level rise. The strategic retreat can be incorporated as a long-term planning.



Bayview Beach has the similar problem with Fort Trumbull Beach community with both threat from the storm surge, coastal flooding and inland wetland flooding. Especially the community on the east side, although a seawall was constructed along the shoreline, the repeatedly flooding occurred due to very low ground elevation.



The shoreline along Burwells Beach didn't change much due to engineering protection of revetment and beach nourishment. The risk for the storm surge is the main focus for the buildings that are close to shoreline. The community located in the wetland is vulnerable to inland wetland flooding.

Report: Defining the Zones of Shared Risk for Resilient Connecticut Project's for Coastal Towns in New Haven and Fairfield Counties

Appendix "A" - Definitions

Appendix "B" - CDC Social Vulnerability Index Dataset

Appendix "C" - Link of Data Source and References

Appendix "D" – Map Tutorial

Appendix "A" - DEFINITIONS OF TERMS USED

Environmental Sensitivity Index (ESI) → a summary of sensitive coastal resources. This includes biological resources (such as birds and shellfish beds), sensitive shorelines (such as marshes and tidal flats), and human-use resources (such as public beaches and parks).

Historic District → area registered at the federal, state, or local level due to the concentration of historically and culturally valuable properties within it.

Key Buildings → Critical facilities that carry out essential community functions during and immediately after a disaster. These structures were identified using local datasets that follow FEMA guidelines and definitions, or national datasets provided by Homeland Security. These structures are broadly categorized in three groups: Primary (emergency services, health and medical, and transportation), secondary (government and military facilities, and education), and tertiary (mailing, communication, and landmarks).

Natural Diversity Database → represents approximate locations of endangered, threatened and special concern species and significant natural communities in Connecticut. This dataset was developed by CT-DEEP and is based on data collected over the years by staff, scientists, conservation groups, and landowners.

Opportunity Zones → areas identified as eligible for federal incentives that aim to attract capital investment in low-income communities. The aim of the program is to attract long-term investments (10+ years) by offering incentives on tax treatment on capital gains.

Social Vulnerability Index (SVI) → an index developed by the Center for Disease Control (CDC) to help emergency response planners and decision-makers to identify areas that will most likely need support before, during, and after a hazardous event.

Vulnerable Dams → dams identified in documents, particularly local or COG hazard mitigation plans as highly vulnerable, susceptible to failure, or that could cause extensive destruction if breached.

Wetland → refers to inland wetlands, which according to the CT Inland Wetlands and Watercourse Act is defined by soil type. The soil types are poorly drained, very poorly drained, alluvial, and floodplain. Inland wetlands are generally regulated at the municipal level.

Figure 1: A conceptual section showing FEMA's current 100-year flood event and CIRCA's 100-year flood plus 20"+ for the year 2050. This report is based on CIRCA's data for the year 2050.

Appendix "B" - CDC Social Vulnerability Index Dataset

This project used the Center for Disease Control's Social Vulnerability Index (SVI) database to identify communities within the studied counties that will most likely need support before, during, or after a flood related hazardous event (Flanagan et al. 2011, Wolkin et al. 2015, Flanagan et al. 2018). It also allowed for the evaluation of the potential expansion and intensification of social vulnerability further inland, due to sea level rise. This database uses Census data at the tract level and is ranked in 15 social categories, grouped into four themes: Socioeconomic Status, Household Composition, Race/Ethnicity/Language, and Housing/Transportation. Such themes highlight factors such as poverty level, lack of vehicle access, crowded housing, and language barriers, to aid decision-makers in understanding the potential challenges to prevention and emergency management responses. For this project the data was used to develop social vulnerability maps at the regional and city scale.

At the regional level the SVI database was used to map the overall vulnerability and rank each city based on the overall percentage rank established by the index. Cities were ranked in three categories: Low (0% to 32%), Moderate (33% to 67%), and High (68% to 100%). The resulting map highlighted cities that were at a higher risk for social vulnerability. Additional maps were created using the SVI's four theme groups to determine the main drivers of vulnerability. At the city scale the database was used to identify the areas most affected at tract level. At this level areas were ranked in four categories: Low (0% to 32%), Intermediate (33% to 66%), High (67% to 90%) and Very High (91% to 100%). In addition the analysis of SVI at the city level showed that some tracts had more than 10 factors in the 90th percentile for the state, these areas were further highlighted in maps to indicate their heightened level of social vulnerability. Supporting maps were also created at the city level to identify the main vulnerability drivers in accordance to SVI's four theme groups.

References

Flanagan, B., E. Gregory, E. Hallisey, J. Heitgerd, and B. Lewis, 2011. "A Social Vulnerability Index for Disaster Management." Adobe PDF file Journal of Homeland Security and Emergency Management 8(1).

Flanagan, B., E. Hallisey, E. Adams, A. Lavery. "Measuring Community Vulnerability to Natural and Anthropogenic Hazards: The Centers for Disease Control and Prevention's Social Vulnerability Index." Adobe PDF file Journal of Environmental Health; Denver Vol. 80, Iss. 10, (Jun 2018): 34-36.

Wolkin, A., J. Rees Patterson, S. Harris, E. Soler, S. Burrer, M. McGeehin, S. Greene. "Reducing Public Health Risk During Disasters: Identifying Social Vulnerabilities." Adobe PDF file Journal of Homeland Security and Emergency Management. Volume 12, Issue 4, Pages 809–822. 2015.

5.1.2020

Report: Defining the Zones of Shared Risk for Resilient Connecticut Project's for Coastal Towns in New Haven and Fairfield Counties

Appendix C - Link of data source and references:

1. GIS data source:

1.1 Connecticut Department of Energy & Environmental Protection (CT DEEP) (CT.GOV)
https://portal.ct.gov/DEEP/GIS-and-Maps/Data/GIS-DATA

- Connecticut Town Polygon (Town Boundary)
- Connecticut Waterbody Polygon (Waterbody)
- Connecticut 10 Feet Contours (Contour Line)
- Connecticut Watershed Boundary Dataset Poly (Watershed)
- Connecticut Railroads (Railroad)
- FEMA DFIRM for CT (FEMA Flood Insurance Map)
- SLAMM V2 Connecticut Coastal Structures 2015 (Coastal structure)
- Municipal and Private Open Space (Open space)
- Natural Diversity Database Areas (Diversity)
- Connecticut Coastal 2002 Environmental Sensitivity Index Mapping (Sensitivity)
- Connecticut Dams (Dam)
- Coastal Boundary (Coastal management area)

1.2 UCONN Connecticut Environmental Conditions Online (CT ECO)
http://www.cteco.uconn.edu/projects/ms4/impervious2012.htm#formats

- statewide 2012 buildings
- statewide 2012 roads

1.3 U.S. Fish and Wildlife Services - National Wetland Inventory (FWS.GOV)
https://www.fws.gov/wetlands/data/State-Downloads.html

- Connecticut Wetlands

1.4 NLCD 2011 USFS Tree Canopy Cover (MRLC.GOV)
https://www.mrlc.gov/data/nlcd-2011-usfs-tree-canopy-cover-conus

- Tree Canopy

1.5 U.S. Government's open data (DATA.GOV)
https://prd-tnm.s3.amazonaws.com/StagedProducts/Struct/GDB/STRUCT_Connecticut_State_GDB.zip

- Key buildings (Critical Facilities)

https://catalog.data.gov/dataset/nominated-opportunity-zone-census-tracts

- Designated Opportunity Zone Census Tracts (Opportunity zone)

1.5 UCONN Map and Geographic Information Center (CT MAGIC)
http://magic.lib.uconn.edu/magic_2/vector/37800/sewerserviceareact_37800_0000_1998_s24_ctdep_1_t.htm

- Sewer Service Areas

http://magic.lib.uconn.edu/magic_2/vector/37800/sewagetreatmentplantct_37800_0000_1999_s24_ctdep_1_t.htm

- Sewage Treatment Plants

1.6 CDC's Social Vulnerability Index (SVI.CDC.GOV)
https://svi.cdc.gov/

- Social Vulnerability Index (SVI)

2. References:

The information of zoning, land use, historic resources, critical facilities, etc. are coming from the town's POCD and resilience plan, and COG HMP:

2.1 Town's POCDs

- Greenwich

2019 Plan of Conservation and Development (POCD): https://www.greenwichct.gov/438/Plans-Studies

- Stamford

2015 Master Plan: https://www.stamfordct.gov/land-use-bureau-divisions/pages/plans

- Darien

2016 Plan of Conservation and Development:
http://www.darienct.gov/filestorage/28565/28567/28890/29006/POCD_Part_1_-Introduction_061016.pdf

- Norwalk

Norwalk Citywide Plan: 2019–2029 Plan of Conservation & Development:
https://tomorrow.norwalkct.org/wp-content/uploads/Norwalk-Citywide-Plan.pdf

- Westport

2017 Plan of Conservation and Development: https://www.westportct.gov/home/showdocument?id=12159

- Fairfield

2016 Fairfield Town Plan of Conservation and Development:
https://www.fairfieldct.org/filestorage/10726/11028/12429/20922/POCD.pdf

- Stratford

Town of Stratford Plan of Conservation and Development:
http://www.townofstratford.com/filestorage/39879/57150/StratfordFinalPOCD01-06-2014.pdf

- Milford

2012 Milford Plan of Conservation and Development:
https://www.ci.milford.ct.us/sites/milfordct/files/pages/existing_milford_pocd_dec2012-2022.pdf

Appendix "C" continued

Hazard Mitigation Plan Update 2013:
https://www.ci.milford.ct.us/sites/milfordct/files/file/file/hazard_mitigation_plan_2013.pdf

- West Haven

2017 West Haven Plan of Conservation and Development:
https://www.cityofwesthaven.com/DocumentCenter/View/1260/West-Haven-Plan-of-Conservation-and-Development-2017-PDF?bidId=

City of West Haven Coastal Resilience Plan 2017: https://portal.ct.gov/-/media/DOH/Sandy_Relief_Docs/Planning_Docs/T-2---West-Haven-Coastal-Resilience-Plan.pdf?la=en

- New Haven

New Haven Vision 2025 A Plan for a Sustainable, Healthy, and Vibrant City:
https://www.newhavenct.gov/civicax/filebank/blobdload.aspx?blobid=25816

City of West Haven Coastal Resilience Plan 2017: https://portal.ct.gov/-/media/DOH/Sandy_Relief_Docs/Planning_Docs/T-2---West-Haven-Coastal-Resilience-Plan.pdf?la=en

- East Haven

Town of East Haven Plan of Conservation and Development 2019 Update:
https://www.townofeasthavenct.org/sites/easthavenct/files/uploads/final_plan_1-20-19.pdf

- Branford

Branford 2019 Plan of Conservation and Development: https://www.branford-ct.gov/sites/default/files/field/files-docs/adopted_2019_pocd_effective_020119_rfs_with_modified_cover_letter.pdf

Town of Branford Coastal Resilience Plan 2016:
https://www.cakex.org/sites/default/files/documents/Branford_CRP_fullreport.pdf

- Guilford

Guilford Plan of Conservation and Development Update 2015: http://www.ci.guilford.ct.us/wp-content/uploads/FINAL-Guilford-PoCD-2015.pdf

- Madison

Madison 2013 Plan of Conservation & Development:
https://www.madisonct.org/DocumentCenter/View/323/Table-of-Contents-and-Introduction-PDF
Town of Madison Coastal Resilience Plan 2016:
https://www.madisonct.org/DocumentCenter/View/1681/Coastal-Resilience-Plan-6-2016?bidId=

Appendix "C" continued

- Madison

Madison 2013 Plan of Conservation & Development:
https://www.madisonct.org/DocumentCenter/View/323/Table-of-Contents-and-Introduction-PDF
Town of Madison Coastal Resilience Plan 2016:
https://www.madisonct.org/DocumentCenter/View/1681/Coastal-Resilience-Plan-6-2016?bidId=

2.2 COG's HMPs

Natural Hazard Mitigation Plan 2016-2021 Update for the South Western Region (**Greenwich, Stamford, Darien, Norwalk, Westport, Fairfield**): https://westcog.org/wp-content/uploads/2016/05/HMP-2016-WestCOG-South-Plan.pdf

2019 Natural Hazard Mitigation Plan Update for Metro COG Region (**Fairfield, Stratford**): https://metrocog-website.s3.us-east-2.amazonaws.com/MetroCOG+-+2019+Regional+Natural+Hazard+Mitigation+Plan+(Final)+7.24.19.pdf
Fed

South Central Region Multi-Jurisdiction Hazard Mitigation Plan Update 2018 (**Milford, West Haven, New Haven, East Haven, Branford, Guilford, Madison**):
https://onedrive.live.com/?authkey=%21AKnb1UFhmg1prZs&cid=79CDB7B6C5EFF172&id=79CDB7B6C5EFF172%21105&parId=79CDB7B6C5EFF172%21104&o=OneUp

Note:

1. Digital Elevation Model (DEM) with 1-meter resolution on NOAA website can't be accessed online any more. We have downloaded all DEM data for the 14 towns before.
2. The towns of Guilford and Madison have no sewage system GIS layer, and POCD and HMP of the two towns have no any information about sewage system as well, it seems like they might not have.
3. I've already clipped the data town by town to reduce the size of files and make it user-friendly, except Key buildings (Critical Facilities), since after clipping, some information will be lost, so I only keep this data for the whole of Connecticut.