

Southeastern Connecticut Regional Resilience Vision Project

Summary of Findings | March 2017

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Introduction

This Southeastern Connecticut Regional Resilience Vision Summary of Findings is the culmination of a year of dialogue spearheaded by the Nature Conservancy (TNC), Southeastern Connecticut Council of Governments (SCCOG), and Southeastern Connecticut Enterprise Region (SeCTer). Those involved in articulating this vision included representatives from municipal planning departments, public and private utilities, public health departments, chambers of commerce, major employers, conservation organizations, academic institutions, community non-profits, and state agencies among many others. This effort was greatly enriched by the significant contributions of an outstanding group of individuals that represent the economic, social, and environmental backbone of Southeastern Connecticut. The process of developing a Regional Resilience Vision for Southeastern Connecticut requires participant diversity because the ultimate responsibility for growing a safe, healthy, and resilient region rests in their collective hands.

The project's community engagement process was anchored in both traditional and innovative approaches and techniques. The traditional elements included routine and repeated meetings with the municipalities and organization mentioned above. The innovative element was to hold a series of resilience-scoping sessions sequentially coupled to region-wide workshops – one centered on the challenges and one centered on the solutions for regional resiliency. A process of this type and focus had never been conducted in Southeastern Connecticut previously. This process was however, informed by another regional resilience framework project in Connecticut. The Southern Connecticut Regional Framework for Coastal Resilience project launched in 2014 through a partnership with two Council of Governments (South Central Regional Council of Governments and Connecticut Metropolitan Council of Governments) and TNC in the service of ten coastal municipalities; Fairfield west to Madison including the greater Bridgeport and New Haven areas. That Regional Resilience Framework provided a directly applicable model with positive, evidence-based outcomes and therefore, provided a suitable model to replicate in Southeastern Connecticut.

During the project's meetings and workshops, participants worked to develop a shared understanding of what resilience means for their region. In addition to resilience from extreme weather and a changing climate, participants also explored how the region could anticipate and respond to other chronic economic and social challenges across diverse planning sectors such as energy provisioning, food and water systems, ecosystem services, transportation, and economic stability and growth. By surfacing and integrating these considerations the process identified solutions that address singular as well as multiple challenges across a diverse suite of concerns and fields of expertise.

The content provided in this Summary of Findings is intended to convey a shared understanding and narrative reached by a wide range of stakeholders across the region. What the reader will not find is a step-by-step guide to achieving resilience for Southeastern Connecticut. Rather, the core project team hope is that this process and

this Summary of Findings can help provide direction for responsible parties to work towards a greater, more resilient region. Truly resilient communities are founded on committed leadership, collaboration and strong relationships across all levels of society and planning sectors. While it would be impossible to reach full consensus on a vision for the region, steps have absolutely been taken here via a robust dialogue that was both inclusive and forward thinking. We sincerely hope that this document can assist in that ongoing and necessary conversation towards realizing a truly resilient region in Southeastern Connecticut.

Project Context: Origins, Objectives and Goals

In 2015, the Nature Conservancy's Connecticut Chapter received funding from the Community Foundation of Eastern Connecticut to continue resilience work in Southeastern Connecticut. This investment allowed TNC to capitalize on a decade of community resilience building efforts working to conserve ecosystems and protect people and property in cities, towns, and villages across Connecticut from extreme weather and a changing climate. However, for this project the core project team sought to apply the notion of resilience at a regional scale as well as integrate the implications of shifts in socio-economic conditions. This expansion serves to represent a more relevant, meaningful, and holistic representation of regional resilience in Southeastern Connecticut; and likely elsewhere nationally and internationally.

Early that year, TNC enlisted the support of SCCOG and SeCTer. This core project team subsequently formed the backbone of the regional resilience visioning process. After a series of intensive, information-gathering interviews with municipal staff, the core team gathered a group of land-use and economic development planners to help further define what they hoped to gain from a regional resilience visioning exercise. Current concerns, knowledge gaps, and who they wanted to include in the larger resilience dialogue were identified. The nine municipalities engaged included East Lyme, Groton (City and Town), Montville, New London, Norwich, Ledyard, Salem, Stonington, and Waterford.

Greater awareness of risks from extreme weather and climate change across the nine municipalities was advanced through direct and routine community engagement efforts. This engagement involved between two to four individual listening and scoping meetings with each municipality. These initial meetings created common understanding of current and future risks alongside high priority challenges and potential solutions for each of the municipalities. This information served as the bedrock upon which the subsequent community resilience building efforts were structured. The resulting information encompassed extreme weather and climate change and shifts in social and economic conditions across Southeastern Connecticut.

After these initial discussions and an exhaustive review of all other previous work on hazard mitigation and resilience in the region, the core team gathered a larger municipal-based team comprised of planners from all nine municipalities and regional entities (approximately 25 professionals). This larger planning team then served as the nucleus for a series of scoping sessions to further refine the shared values, context and intent for the Regional Resilience Vision. The larger planning team and core team eventually landed on six systems of concern or planning sectors that came up regularly in conversation including water, food, ecosystem services, transportation, energy, and the regional economy. These planning sectors provided the framework for subsequent dialogues in the two regional resilience workshops; Challenges and Solutions. The total number of participants at these two workshops reached seventy-five with additional stakeholders contacted in post-workshops interviews. These workshops were followed by further engagement with the municipal-based planning team to further refine the solutions and foster collaborative ownership going forward.

Stakeholders

Workshop participants were selected from a wide range of organizations across the region. In addition to planners and economic development professionals, public and private utility representatives, state agencies, community non-profits, academic institutions, public health departments, and major regional employers were engaged among others. Interestingly, many of these groups—especially those with more resources—already had staff tasked with helping their organization adapt to natural hazards and a changing climate. This suggested that the human capital is rapidly embracing a more regional planning perspective that is receptive to risk and resilience considerations.

Organizations that participated in the process included representatives from SCCOG, SeCTer, nine municipalities (East Lyme, Groton (City and Town), Montville, New London, Norwich, Ledyard, Salem, Stonington, and Waterford), Ledge Light Health District, Avalonia Land Conservancy, UConn CLEAR, UConn NEMO, Connecticut College, Millstone Environmental Laboratory, New London Homeless Hospitality Center, Uncas Health District, New London County Food Policy Council, FRESH New London, Eastern Connecticut State University Institute for Sustainable Energy, Thames River Basin Partnership, Norwich Public Utilities, Groton Utilities, Eversource Energy, Norwich Community Development Corporation, Renaissance City Development Corporation, Pfizer, Connecticut Department of Public Health, Connecticut Department of Energy and Environmental Protection, Connecticut Department of Transportation, Connecticut Department of Emergency Management and Homeland Security Region 4, Community Foundation of Eastern Connecticut, and the Eastern Connecticut Conservation District. The Connecticut College Arboretum, the Southeastern Connecticut Council of Governments, Spark Makerspace, and Foundry 66 thankfully provided space to hold meetings and workshops.

Regional Context

As part of the Regional Resilience Visioning process in Southeastern Connecticut, an initial review was conducted to develop a broad narrative of the region's natural and social histories in order to better define the specific challenges and opportunities its communities face from extreme weather, climate change, and shifting socio-economic conditions. This was achieved by researching local histories, resources on local geology, and consultations with local specialists and municipal and regional staff.

Geology

Unlike the rest of Connecticut, the southeastern part of the state sits directly atop the Avalonia Terrane, a chunk of what would one day become Africa, which collided with today's Eastern North America roughly 400 million years ago. As the Atlantic Ocean formed and the continental plates pulled apart, a series of north-south ridges formed across the region encompassing modern day Connecticut including the Housatonic, Connecticut, and Thames River Valleys. These events shaped much of the general landform we observe today in the region. The other major events that shaped the landscape of Southeastern Connecticut were a series of glaciations, the most recent of which, the Wisconsin Ice Age, ended roughly 12,000 years ago. During the Wisconsin glaciation ice extended 4 to 25 miles south of New London County where it deposited the rocks and sediment that now form parts of Long Island and Fishers Island. Today, both of these islands act to an extent as large natural breakwaters helping in some instances to reduce wave energies approaching the Connecticut coast from across the Atlantic Ocean.

As the glaciers retreated, meltwaters rushed into Connecticut's north-south valleys depositing more sediment on top of the bedrock and flowing into a large freshwater lake contained in today's Long Island Sound. Because of several factors, the buildup of sediment along the coast did not reach the rates of other areas along the Connecticut coast and Eastern Seaboard. Additionally, the barrier formed by Long Island prevented additional sediment from washing in from the Atlantic Ocean. As a result, Southeastern Connecticut is considered by geologists to be "sediment starved" and unable to form some of the large barrier islands and extensive marshes found elsewhere on the Eastern Seaboard.ⁱ One can see clearly the uniqueness of Southeastern Connecticut's geology by travelling both east and west. Just over the border into Rhode Island higher wave energies and a larger supply of sediment helped to form the extensive beaches of Watch Hill and Misquamicut. West of Old Lyme, sediment washed down the Connecticut River is carried by Long Island Sound's waters to form the more extensive barrier beaches in Old Saybrook and in Madison. The relative lack of sedimentary deposits along the Southeastern Connecticut coast is both a blessing and curse for the region. Because the region lacked extensive low-lying plains, much of the development over the past couple of hundred years occurred on the well protected, rocky ridges. This has helped to reduce current vulnerability in many

coastal communities with key exceptions involving later development in such places like Midway Oval and Groton Long Point. Unfortunately, many of the neighborhoods that have cropped up in flood prone areas lack the natural infrastructure such as salt marshes, oyster reefs, and eelgrass beds to soften the impact of extreme weather events.

Climate History

Like all the communities on America's Eastern Seaboard, Connecticut is vulnerable to the destructive waves, rain, and winds from hurricanes and tropical storms. While the memories of Irene and Sandy remain vivid in the minds of many present-day residents, perhaps the most noteworthy extreme weather event in Connecticut's history is the Great New England Hurricane of 1938. The eye of this storm traveled up the Connecticut River Valley downing trees as far north as Vermont. Southeastern Connecticut lay at the northeastern edge of the storm's vortex and received some of the strongest winds and highest waves. This event brought down the rail line, shipping fleets, and several other pieces of critical infrastructure in the region.

While Tropical Storm Sandy did create flooding along the coast in New London County, the storm's most damaging energy dissipated prior to making landfall in the region. Tropical Storm Irene on the other hand was a shorter lived storm that did not have time to cause as much destructive force along the southeastern coast as the 1938 event.

The historical record from the time of European colonization chronicles many major coastal storms in Connecticut. Many of these storm descriptions come from observers in New London County. Visual evidence of storms and sea level rise can also be seen in places such as the barrier beach the once stretched across the mouth of Jordan Cove but which is now displaced and permanently inundated. Napatree Point in Westerly, Rhode Island is another local causality of extreme weather, having once formed a continuous beach to the shoreline.

Sea Level Rise

An important aspect of climate is the effects that global temperatures and land form subsidence have had on localized or "downscaled" sea level. Over the course of geologic time, the sea level has ranged from below the floor of Long Island Sound to many miles inland in Connecticut. Since 1938, the mean sea level as measured at the New London tide gauge has risen at a rate of roughly 0.10inch/year. If this current trend were to continue, this would amount to roughly 0.84 feet in 100 years. However, scientists project that these observed changes in climate may in fact accelerate, leading to sea levels perhaps six feet higher by century's end.

Rising sea levels threaten coastal communities with permanent inundation of neighborhoods and infrastructure as well as natural defenses such as marshes and barrier beaches. The loss of these ecosystems where they occur in proximity to the built environment can result in increased impact magnitudes from storm surge. In

addition, increased sea levels decrease the overland distance that storm surge need to travel before encountering buildings and infrastructure. In addition to concerns for human safety and ecosystem health, extreme coastal storms and sea level rise also pose significant risks for communities. A 2016 study conducted by TNC in partnership with Lloyd's Tercentenary Research Foundation estimated that temperate coastal wetlands eliminate more than \$625 million in flood-related property damages during Hurricane Sandy and a 20% reduction in losses annually in Ocean County, New Jersey. ⁱⁱ

Planning Trends

To strengthen the understanding of the region's current context, meetings with municipal planners coupled with a detailed review of local and regional Plans of Conservation and Development (POCD) (i.e., master or comprehensive plans) were conducted. This surfaced the key trends in local-to-regional planning and initiated considerations of connections to resilience at multiple scales. The top three trends are described below as well as an elaboration on their relevance to regional resilience.

Economic Change/Ageing Demographic

Many municipalities speak in their POCDs to the dramatic shift in the regional economic center from military and pharmaceutical output in New London and Groton to the casino and service industry around Montville and Ledyard. Though regional employment grew by ~15% between 1990 and 2000 as the new service sector picked up, the lost industrial jobs and overall median income decreased. As these trends continued, residents employed in the service sector struggled to find affordable housing in a region whose real estate market was built for higher-income families and vacationers with seasonal homes. It appears that these trends have led to a movement of young and middle-aged workers away from the region and a strong need for municipalities to diversify the housing stock. As a result of these shifts and expected continued growth, the municipalities in the focus area are concerned with protecting drinking water sources, restructuring their housing stock, and attracting young entrepreneurial talent to diversify their economies.

Adjustments to housing stock may offer an opportunity for municipalities to relocate residential areas vulnerable to sea level rise, inland flooding and extreme weather (i.e. Midway Neighborhood, Groton) to more densely developed, diverse, and resilient parts of the region. In doing so, municipalities can reduce the environmental footprint of development, protect residents from environmental hazards, and possibly attract younger and more diverse residents looking for more mixed use and walkable centers (i.e., triple-bottom line of resilience).

Water Quality

As the population and economy of the region continues to grow, SCCOG and others are concerned with ensuring that areas are receiving an adequate and clean supply of drinking water. In a Regional Water Supply Plan, the largest water utility in the area (Southeastern Connecticut Water Authority) concludes that new sources of groundwater rather than surface reservoirs will be required to satisfy future

development demands. As a result, protecting and developing groundwater sources is essential for the region's growth. Many of the municipalities in the focus area spend time in their POCDs discussing water sources and runoff quality. As sea levels rise and storms intensify, it will be more important than ever to protect public water sources from salt water inundation, polluted discharge, and contaminated surface runoff.

There is still much uncertainty surrounding issues of drinking water supply. These questions will most likely not be adequately answered until the state finalizes its Water Plan. One particular area of uncertainty is how much of the region's population gets its water from private well sources and how sustainable those sources will be long term. Rising sea levels may inundate aquifers near the coast making well water undrinkable, while increased precipitation could overload already stressed stormwater systems and send untreated runoff directly into waterbodies and other drinking water sources.

Village Centers

Most of the POCDs proposed enhancing the quality of their villages to attract younger professionals and bolster their appeal to tourists. The vision that these municipalities shared were walkable, mixed use spaces that could provide alternative housing opportunities while attracting businesses and tourists. In the POCDs, these goals often included an action item for implementing "design district" overlays. These overlays were mainly concerned with maintaining the historic authenticity of the spaces but some municipalities wrote about improving the streetscapes and environmental aesthetics.

If properly planned, village center redevelopment can be a vehicle for smarter growth that minimizes environmental footprints and exposures while providing a benefit to the local economy. However, many existing village centers such as Mystic and Jordan Village in Waterford face significant flood exposure. When re-visioning these developments, both local, regional, and state planning authorities should consider the costs of long-term resilience in tandem with the economic benefits these areas can and may provide.

Workshops

Planning for extreme weather, a changing climate, and shifting social and economic conditions is an inherently interdisciplinary endeavor. Therefore, the collective planning team felt it was important to cast a wide net when initiating these conversations. In a series of two workshops—one focused on regional challenges and the next on solutions to those challenges—the core team facilitated dialogues between a wide array of stakeholders as mentioned above.

Challenges Workshop

During the challenges workshop dialogues, participants were first asked to brainstorm all relevant challenges that fell within each of the six planning sector and identify those challenges which were most important (**bolded statements below**) to address for community resilience building across the region.

Water

Top challenges

- **The impacts of nonpoint source pollution on the health of the region’s surface and ground water:** Nonpoint sources of pollution as defined under the Clean Water Act are those sources that do not originate from a single location. These include runoff from human-made impervious surfaces such as roads, parking lots, and rooftops. As this water enters lakes, rivers, oceans, and wetlands certain chemicals and nutrient that are picked up can poison organisms or fuel algal blooms that destabilize ecosystems. In areas where aquifers are unprotected, including much of Southeastern Connecticut’s groundwater resources, nonpoint source pollution can also contaminate water for private and public wells. Current climate change scenarios predict an increase in volume and intensity of precipitation in the Northeast of the United States. Without further actions to reduce nonpoint source pollutions, these issues will only continue to intensify in this region.
- **Aging and outdated stormwater systems are more easily overburdened by intense rainfall and the effects of sea level rise:** Reducing flooding in populated areas and along transportation corridors requires pipes, culverts, drainage ditches, infiltration basins, outfalls, and several other systems designed to move water away from natural landscape depressions. These infrastructural components require routine maintenance to function properly. Often municipalities fail or are unable to prioritize these activities in their budgets, which leads to increased flood risk in these communities. These challenges are exacerbated by the fact that this infrastructure was often not engineered to a standard that can meet the demands of a changing climate (1970s design storms vs 2030s). The overall capacity of these systems cannot handle the more intense rainfall events that the region will face, and as sea level continues to rise, these systems lose the hydraulic head required to convey stormwater away from developed areas. In some cases, this infrastructure may work against itself, sending ocean water back up the pipes and flooding developed areas from the drains. In addition to challenges facing the engineered stormwater infrastructure, landscape features such as forests and wetlands have always played a critical role in reducing downstream flooding. However, as development increases, the ability of this “green” or natural infrastructure to perform its past infiltration, cleansing, and storage function becomes compromised.
- **Important infrastructure vulnerable to storm surge:** The high pressure at the edge of a hurricane system creates abnormally high sea levels referred to as “storm

surge.” This can often lead to flooding much further inland than communities generally experience. Much of the coastal transportation and wastewater treatment infrastructure is vulnerable to physical damage from hurricane storm surge as well as the corrosive impact of salt water on electrical components of these systems. Such damage can cut off emergency access, cripple the region’s economy, and jeopardize the habitability of some neighborhoods and villages. In addition to flooding, the force of high energy waves hitting buildings and infrastructure can cause significant structural damage. These threats are magnified when structures are placed near the ocean or when coastal erosion and/or sea level rise bring the shoreline closer to existing structures.

- **Rising sea levels intruding into aquifers and septic systems:** As sea level rises, salt water will enter water that was previously fresh. These changes could also contaminate drinking wells, compromise home septic systems, and corrode associated electrical systems. For communities that do not have access to public drinking water well contamination could render some coastal neighborhoods unlivable without significant infrastructure investments. If rising water infiltrates septic systems, this could cause these systems to fail and leach contaminated water into water bodies, aquifers, and downstream ecosystems.
- **Lack of clear policies in place to handle water shortages:** Water availability for communities is influenced by several factors including precipitation, population size and density, infrastructural capacity, absence of water contamination, and the requirements of regional industries, agriculture, and ecosystems. Additionally, in periods of drought farmers may need to increase irrigation, which could exacerbate existing shortages in parts of the region. While Southeastern Connecticut has not faced any significant region-wide shortages in recent memory, the uncertainty around climate change and future population pressures could pose a threat to this surplus. The drought of the last few years has noticeably lowered a few individual reservoirs in Norwich, Stonington, and Niantic. Possibly because water shortages have not hurt the region in the past, there is no clear plan in place to handle this if the event arises. Lack of awareness in communities around this issue could hinder investments in more infrastructure and prevent more efficient water distribution in the future should rationing or redistribution be required.
- **Homeowners most vulnerable to coastal storms impacts are often some of the municipalities’ highest tax payers:** Development in many coastal neighborhoods often requires public funds to support the necessary roads, utilities, and flood protection infrastructure. Many of these coastal areas were settled over the past century by some of the wealthiest residents, who are among the top tax payers today. This means that many municipalities are reliant on these coastal communities as major sources of revenue. The increasing flood insurance rates, storm threats, and sea level rise compound the vulnerability for municipal budgets if these residents voluntarily move out of the region en masse.

Other challenges

- Brokering water sharing/exchange deals between municipalities and service areas.
- Apathy among regional residents towards water quality issues.
- Insufficient wastewater and drinking water infrastructure for when coastal residents evacuate further inland.
- Insufficient septic system capacity in some areas to handle the growing trend from seasonal to year-round residents.
- Environmental impacts of drought on lobster populations and the timing and distribution of fish populations.
- Conflicts in some coastal communities between the need to raise homes for flood insurance purposes and height restrictions in building code.
- Beach closures from water contamination.
- Limited water backup supplies in case of drought.
- Increasing temperatures in Long Island Sound are decreasing the ability for Millstone to cool its reactors, which may eventually lead to plant permanently shutting down.

Food

Top Challenges

- **Regulatory hurdles faced by producers:** New farmers often find that one of their largest challenges is navigating the regulatory hurdles from multiple state and local agencies to get their product to market. These regulations include those that come from the Department of Agriculture, Department of Public Health, consumer protection groups, local health districts, and farmers' markets. These regulations are largely intended to keep consumers safe, prevent harm to local ecosystems, and maintain the particular aesthetic character of a community. Additionally, farmers may run into limitations from local zoning ordinances on what they can grow. New farmers often lack the time or resources to navigate these regulatory processes and, in some cases, regulations have not yet caught up to innovative business models and agricultural practices. This creates a significant barrier to increasing local food production.
- **Limited infrastructure for producers and distributors:** Many local farmers feel limited in what they can produce by a lack of nearby processing facilities. There is no meat processing facility in Southeastern Connecticut, and some farmers choose to go to cheaper facilities in Rhode Island. These increases in transportation costs for farmers are a significant burden. However, setting up a meat processing facility is a very complex legal endeavor from a public health and environmental standpoint. In addition, these facilities often require large amounts of natural gas, which is in short supply in the region. Smaller-scale farmers also face difficulty distributing their final product as many farms are located outside of the more

densely developed consumer hubs and there is no centralized facility to store local food products in bulk.

- **Competition for farmland with other, more profitable land-uses:** While local food production is clearly valuable for regional resilience, this value does not always translate into revenue for local farmers. Residential developments or solar farms can bring in significantly more tax revenue for a municipality than keeping the land in agricultural use. Therefore, the economic incentives often encourage municipalities to convert previously zoned farmland into other land-uses. In this way, regional governance can reduce the total amount of farmable land.
- **Food deserts in Groton and Norwich:** While the region as a whole may currently have enough food supply from local and non-local sources to meet the demands of its population, there are a few areas where lack of vehicular availability prevents residents from accessing this supply. According to the USDA's Food Access Research Atlas, these food deserts are located in the Fort Trumbull neighborhood of New London, the City of Groton, the Town of Groton surrounding the U.S. Naval Base, and downtown Norwich.
- **Environmental threats to agriculture:** The on-the-ground viability of local agriculture is also undermined by human- and naturally-induced changes in the environment. Currently, lawn chemicals and road runoff into waterways has a detrimental effect on aquaculture operations. Lobsters in particular are declining due to warming temperatures and hypoxia. Observers document nationally collapsing bee populations—a trend that poses a serious risk to the viability of most of our pollinator-dependent crops. Additionally, the general unpredictability of future hardiness zones, frosts, and precipitation patterns makes planning very difficult for farmers today.

Other Challenges

- Incentivizing farmers to sell products to schools and hospitals where they may get a lower return than farmers markets.
- Limited funding opportunities for new farmers.
- Resistance in communities towards more flexible uses of farmland such as breweries and agro-tourism.
- State testing of waterways after rain events is not always timely which can lead to shellfish beds closures that last a day or two longer than necessary.
- Channel dredging can cause siltation that smothers shellfish beds.
- Future drought conditions threaten on-farm water availability.
- For some lower-income residents, a principal source of protein is through fishing. As fish stocks are depleted through overfishing and invasive species in Long Island Sound, these residents lose this important part of their diet.
- Power outages could affect the ability for recipients of subsidized groceries to access this system.

- Disconnect between a need for reliable help for farmers and lack of access to transportation by employable residents.
- Few training opportunities for on-farm jobs.
- With little interest in farming from younger generations, many older farmers have no succession plans, which increases the likelihood of farms being zoning away from agricultural use.
- Increase of invasive species and parasites in Long Island Sound.
- Meeting the demands of changing demographics and cultures in the region.
- Farming today often requires investments in high cost technology.
- Volunteer planning and zoning commissions can be pressured by large farms and agri-business into making environmental unsound decisions.
- Inconsistent zoning between municipalities for uses accessory to farming (e.g. farm store, winery, petting zoo, brewery).
- Effects of power outage on local seafood storage.

Ecosystems

Top Challenges

- **Impacts of changing water quality and quantity on ecosystems:** Even in a water rich area such as Southeastern Connecticut, human communities continually make decisions about how water is allocated between their own uses and the needs of the ecosystems around them. By damming reservoirs, communities take water away from downstream rivers and floodplains. In constructing more efficient storm sewers, communities are helping to transport water faster to local water bodies but at the risk of carrying over-nutrient and potentially toxic water that wetland ecosystems would naturally filter out. The I-95, Amtrak, and Groton-New London Airport were identified as vectors of nonpoint source water contamination located adjacent to important ecosystems such as tidal wetlands. As sea level rises, the region may begin to face water quality challenges that have not been experienced in the past. These include the inundation of septic tanks which can leach large amounts of nitrogen and other contaminants into waterways and lead to hypoxia.
- **Loss or alteration of ecosystem services:** Even where open space is preserved, environmental and human impacts reduce the ability of ecosystems to provide the same services they have in the past. As sea level rise erodes coastal ecosystems, these natural buffers such as salt marshes and eelgrass beds lose their ability to protect communities from storm waves and erosion. Land use decisions can also have large effects on ecosystem services. For instance, cutting down forests for development can lead to increased downstream flooding. Other times, a lack of active management by humans can reduce ecosystem function. As salt marshes advance inland, landowners and land managers must take care to ensure that the site hydrology does not end up over inundating certain areas or that invasive species do not forever outcompete a more resilient, native plant community. The decisions to reserve land for future salt marsh advancement is not always

considered when planning. However, the benefits derived from these ecosystem services can often be difficult to quantify, making decisions to protect them sometimes difficult to reach in budget constrained municipalities.

- **Lack of smart, balanced, and resilient built environment:** Early European settlers in the region planned and constructed their settlements for easy access to water ways for transportation, trade, fishing, water power, and later tourism. As a result, several communities in the region are built in floodplains and on top of historic wetlands. This puts today's built environment at greater risk of flooding and compromises the ability of wetland soils and vegetation to store and purify water entering the region's waterbodies. The physical and chemical balances of ecosystem suffer when the built environment is not planned around these processes.

Other Challenges

- Limited amount and distribution of natural resources and ecosystem services/benefits currently in the region. Impacts from natural disasters, climate change, and/or future development would reduce the abundance and distribution of these natural assets even further. The challenge becomes to retain as much of the existing ecological services/benefits as possible.
- Current development rarely factors in the complete suite of services and benefits provided to communities in the region by ecosystems and natural infrastructure. The need becomes to increase ecosystem services integration into existing development and instituting measure in future development. Currently, there are limited attempts to do so.
- Concerns about immediate and longer term impact on natural resources from sea level rise – particularly all tidally influenced wetlands.
- Future upgrades or additions to transportation infrastructure and systems (rail, roads, ports, and ferries) may impact existing ecosystem services/benefits if these considerations are not integrated.
- Impacts from storm surge on shoreline stabilization.
- Balancing the use of ecosystems for recreation and public access with protecting ecosystem function and resilient habitat corridors.
- Legal challenges as salt marshes advance inland. These include drainage/runoff regulations, post-flood redevelopment, and flooding of private and public assets.
- Challenges to current cooperative water sharing agreements between Connecticut and Rhode Island posed by drought.
- Limited stormwater treatment capacity which is exacerbated by rising sea levels.
- Tourism attraction and quality of life in region negatively impacted by degradation of natural resources.
- Lack of conversation around water conservation and how to allocate resources between natural, agricultural, and developed areas.
- Threats of water pollution caused by many wastewater treatment plants and pumps being in low-lying areas.

- Limited awareness and educational opportunities within communities with regards to ecosystem services.
- Plants and animal species migrating into the region from the south are and may further disrupt local ecosystems.

During the solutions workshop, participants elaborated on some of these challenges when bringing up the multi-generational nature of coastal properties in the region and long-term connections with the land. This connection while providing strength of community amongst residents in some cases presents a challenge to thinking progressively about how parcels will change in the future and how natural resources can be used to reduce risk. The multi-generation connections and approaches (“this is the way we have always done it”) may limit the use of ecosystem services for resilience without education on more balanced alternatives.

Transportation

Top Challenges

- **Flood exposure at the New London transportation center:** Downtown New London is home to a regional significant transportation hub for the Amtrak, regional trains and buses, and ferries with service to Long Island, Block Island, and Fishers Island. This center also boasts one of the state’s three deepwater ports and is easily accessed from I-95 and the Groton-New London Airport. Due to its low-lying position, flood models suggest that this transportation center could become inaccessible in a large storm. Photographs from the Hurricane of 1938 show significant flood damage in most of this area. Furthermore, the above ground electrical system that powers the trains is vulnerable to high winds and flying debris; not to mention warping of rail lines due to extreme heat. Such a disruption in these transportation services could have far reaching consequences for not only Southeastern Connecticut but for New England and the mid-Atlantic states.
- **Primary arterial roads are vulnerable to flooding, tree falls, and ice impacts:** While I-95 and I-395 are built to the standards of a 500-year storm, many of the main state roads in Southeastern Connecticut such as Route 1 and Route 156 are vulnerable to the impacts of more common storms. These roads host a good deal of regional traffic and many serve as evacuation routes for shoreline communities. This vulnerability has implications for both regional economic activity and human safety.
- **Unreliable public transportation to emergency shelters and employment centers:** If roads become inaccessible for public bus service, residents who lack access to a car could become stranded in their homes. These issues are exacerbated as the elderly population of the region increases. Furthermore, even non-emergency disruptions in public transportation can prevent transit-dependent employees from reporting to work. This could lead to reduced economic output and to these employees losing their jobs.

- **Aging infrastructure:** The state Department of Transportation and many municipalities often lack adequate funding to maintain or even conduct regular safety assessments of roads, bridges, and other public infrastructure. In extreme weather conditions, this could pose a serious risk to residents and could put a damper on long-term economic and community recovery.
- **Conflict between use of Thames River Amtrak bridge and access to the Groton Submarine Base:** In the event of an emergency that required the Groton Submarine Base to have access to Long Island Sound, the moveable Amtrak bridge would be required to stay open. This could present significant challenges for not just Southeastern Connecticut but all train travel along the Eastern Seaboard.

Other Challenges

- Underperforming communications technology that warns residents of road closures, etc.
- Lack of plans to re-track freight trains and to utilize New London-Worcester line for evacuation in the case of an emergency.
- Difficulties coordinating natural hazard mitigation and emergency management plans across federal, state, and local entities.
- Access to gasoline could be cut off if access to the port of New Haven were compromised.
- Few transportation alternatives in emergency situations such as reliable bike and pedestrian infrastructure.
- Long standing dispute over completion of Route 11 in Salem.
- Norwich Business Center is in Special Flood Hazard Area.
- Keeping bike lanes and sidewalks clear in the winter.
- With limited access to ambulances, there would be difficulty for EMS to reach vulnerable populations and to evacuate large scale facilities such as regional hospitals and nursing homes.

Energy

Top Challenges

- **Insufficient preparedness and capacity to recover from flooding and high wind weather events:** While utility companies work hard to decrease the risk to the largest transmission lines, many municipalities struggle to protect local electrical lines from falling trees and other storm debris. Downed power lines can leave neighborhoods or whole villages without power for weeks. Often the responsibility for tree pruning falls on municipal offices that lack the resources to keep up with these tasks. To make matters more difficult, pruning that is perceived as being over-zealous can be met with community outcry. In addition to hazard mitigation measures, the region also lacks a large enough trained workforce capable of efficiently repairing electrical lines after a large storm. When a shortage of crews is required to respond to multiple downed lines, utility companies may have to turn

off large portions of the grid while crews move between sites. This can create confusion and frustration amongst energy consumers.

- **Communications disconnect between energy consumers and providers:** Observers in the region attribute some of the conflicts between energy consumers and providers to a lack of awareness amongst consumers about everything that goes into providing them with energy. These conflicts arise in planning microgrids, implementing renewable technologies, and in rate hikes. While a decentralized and diverse energy system is theoretically more resilient than one with central distribution and a few energy sources, the cost to transition to these kinds of systems are quite high. “Micro-grids” require a significant investment in expertise, planning, and re-wiring to implement while the economics around alternative energy sources such as solar are still fraught with questions such as how home producers should contribute to maintaining the grid. Increasing energy rates to fund investments in new infrastructure may often just lead to angry customers.
- **Uncertainty surrounding inner workings of energy grid:** For security reasons, energy utilities limit access to much of the regional data on energy import and export. This lack of information hinders the ability of municipalities and other organizations to prioritize and advocate for local investments in infrastructure such as solar production and micro-grid technology. In many instances, planners and decision-makers believe that such investments are critical to the economic and social resiliency of their communities. In addition to concerns surrounding the future of fossil fuel consumption, the communities of Southeastern Connecticut face the possible decommissioning of a local nuclear power plant in the future. Millstone Nuclear Power Plant currently produces nearly half of all the power needs for the state of Connecticut, and the shutdown of this service could mean a sizeable hike in energy costs for regional consumers.

Other Challenges

- Threat of damage to the Millstone reactors.
- Fluctuations in energy quality and stability across the regional grid.
- Threat of terrorism to Millstone and to other components of the energy infrastructure.
- Inability of low to moderate income families to afford alternative energy sources, which may hinder larger scale economic transitions towards cleaner energy.
- Land use conflicts between large scale agriculture and the potential for large solar arrays.
- Poor supply of natural gas in the region.
- Under-developed storage technology for alternative energy production such as solar, wind, and tidal.

Economy

Top challenges

- **Short and long-term effects of flooding and power outages on business continuity:** For many small businesses, the loss of just a couple of weeks of revenue can lead to permanent closure. This loss of business can come from local transportation routes becoming compromised by flooding or snow. Also, storm-induced power outages can affect a business's ability to access financial information or perform transactions. Those businesses that rely on refrigeration, even a few hours of lost power can spoil their entire inventory. According to the Department of Emergency Services and Public Protection's RESF7 report, few businesses in the region have plans in place to recover from such scenarios.
- **Serving lower income communities with food, transportation, and shelter in emergency situations:** Many residents of Southeastern Connecticut are dependent on public transportation which can become cut off in the event of an emergency. This could prevent these communities from accessing food. If power goes down, especially during the winter, these residents may need ways of finding warmer shelter. Importantly from an economic perspective, this lack of access to transportation may prevent employees from reporting to work. This could lead to reduced economic activity and to these workers losing their jobs.
- **Limited training in and testing of preparedness plans for municipalities and social service organizations:** Without proper consideration of emergency management and disaster mitigation, communities too often assume a reactive rather than proactive approach to natural hazards. Investments often pour in following a disaster and dry up during calmer periods. Some municipal and organization staff in the region note their discomfort with the apparent lack of robust disaster training available to their municipalities and organizations.
- **Economic ripple effects:** "The economy is based on connections," noted one workshop participant. Therefore, damage to one part of the region can quickly compound upon itself. If downtown Mystic were to be critically damaged for instance, region-wide tourism could decline precipitously. The complexity of the economic system makes anticipating vulnerabilities and planning for disaster significantly more difficult than in other systems such as transportation and energy.
- **Vulnerability of tax base to storm damage and sea level rise:** Even in good times, municipalities can struggle to fully fund the services and programs necessary to sustain safe, healthy, and well-educated communities. Because municipalities receive their revenue from progressive property taxes, lack of funding can be a particular problem in communities with relatively lower-income residents. Many coastal municipalities in Connecticut receive a significant amount of their revenue from contributions of waterfront homeowners. These residents tend to be wealthier than the rest of the population but are also more vulnerable to property damage from storms and sea level rise. This situation can create a cycle under which

municipalities feel they need to invest more in infrastructure to and from these coastal neighborhoods.

Other Challenges

- Most major employers and top-paying, residential taxpayers sit in coastal areas.
- A few of the region's major employers have multiple branches and could choose to relocate operations if they deemed their current position to be too vulnerable because of coastal exposure and infrastructure vulnerability.
- In addition to lower income communities, other significant regional demographics such as college students, the elderly, and those stuck in the New London transportation center may lack mobility during storms and prevent them from retreating to safety.
- Lack of certainty regarding how to compensate those who provide recovery assistance.
- Limited emergency response and hazard mitigation policy coordination between the federal, state, and local levels.
- Important seasonal industries such as recreation, fishing, and environmental tourism are particularly vulnerable to climate change and extreme weather.
- A large-scale power outage could prevent residents and businesses from accessing bank accounts, communication systems, prescription drugs, and gasoline.
- Business discontinuity for local suppliers could lead buyers to look elsewhere.
- Water quality contamination could decrease development opportunities.
- The long term dislocation of residents could have profound economic impacts.
- Limited coordination between the communities along the I-95 corridor. Few plans in place to coordinate evacuations across state lines.
- Heightened crime vulnerabilities during emergency situations if law enforcement is otherwise occupied.
- If supplies of important commodities are disruption such as oil, this could lead to a short term price spike that would hurt small businesses reliant on this commodity.
- Most employees need vehicles to reach their employers.
- General wage stagnation; Limited business diversity in the region.
- Economic impacts of Millstone decommissioning.
- Economic impacts of increasing substance abuse, domestic violence, and mental health problems in the area.
- Many residents work outside of the region which fragments the social fabric.
- Increased costs of health and social service following a traumatic event.
- Decline in manufacturing.
- Limited regional coordination.
- Vulnerability of IT to cyber-terrorism.
- Increasing population age.
- Limited willingness or ability to invest in infrastructure improvements.
- Local permitting processes can be a significant burden for new businesses.

Solutions Workshop

At the solutions workshop, participants were given the top challenges generated in the last workshop and asked to articulate possible solutions (**bolded text below**) to these challenges as specifically as possible. At the end of these discussions, participants were then asked to come to consensus on a set of “overarching solutions” that can be applied to individual and multiple challenges and across planning sectors.

Water

Challenge: Planning for water shortages

- The prime concern and focus for participants during the solutions workshop was around private wells about which there is little available information. As a result, state regulators and municipal officials may be unable to anticipate water shortages or how much extra public capacity may be needed. A first step towards this kind of planning, therefore, may be **an assessment of the location of all private wells in the region**. An additional step suggested was to **utilize existing Public Water Supply Mapping** available on the CT DPH, Drinking Water Section’s website to help inventory areas with public water supplies versus private well water supplies.
- Even without this kind of upfront assessment, there are actions that residents and businesses can take to more efficiently use drinking water. These include **using non-potable water such as collected rainwater to flush toilets and irrigate vegetable gardens and lawns**. These kinds of measures could be championed by municipalities, local health departments, and/or in schools.
- A pipe was recently installed across the Thames to connect the Groton Reservoir with Lake Konomoc, which supplies New London, Waterford, and East Lyme. Additional connections could be installed to **link with the Norwich water supply and balance out Groton’s current surplus**. Two plans of note are currently looking at the state’s water supply: The Water Resilience Plan and the State Water Plan.

Challenge: Assess current public and private water supply and distribution capacity

- **Develop greater understanding of the current supply of water in the region between reservoirs and public and private wells to help make more information decisions about future development**. This information could also be helpful for other ongoing efforts aimed at addressing supply security, efficient use/reuse, and education to move towards greater water resiliency across the region.

Challenge: Nonpoint source pollution/saltwater intrusion into septic systems

- To address pollution from impervious surface runoff, all participants seemed to generally support a range of broad-based actions. One strategy included **using rain gardens and bioswales to infiltrate stormwater before it entered waterways**. Executed at a large enough scale, these interventions could also protect against downstream flooding.
- Another strategy would be to **require septic system inspection at point of property sale**.
- Additionally, municipalities could continue to **improve existing combined sewer systems to minimize chance of direct discharge during heavy rain events**. Norwich has a combined sewer system, which means that during large rain events a bypass may occur, diverting untreated raw sewage into regional waterways.
- **Build upon past projects and foster future opportunities across the region to utilize green infrastructure and improve gray infrastructure to enhance capture and infiltration of runoff**. Nonpoint source pollution often requires changes across the entire stormwater management system to fully address. Green infrastructure projects such as bioswales and rain gardens prevent polluted waters from entering regional waterbodies and can serve as public amenities. Grey infrastructure such as pipes and culverts are also useful in transporting water to places where it can more easily infiltrate. Where appropriate, planners could encourage cross-municipality storm sewer connections that more effectively operate at the watershed level.
- In addition, there is a need to **development a long-term plan for upgrading identified infrastructure to reduce the impacts of saltwater intrusion**.

Challenge: Storm surge threats to infrastructure:

- One approach that participants suggested to reducing these threats was to **reduce the need for that infrastructure in the first place by phasing homes and businesses out of areas serviced by that vulnerable infrastructure**. At the planning level, municipalities can work to **discourage development and redevelopment in these high-risk areas**. Also, one participant expressed a sentiment that municipalities weren't doing enough to enforce FEMA's regulations, which require properties that have been 50% destroyed in a storm to be demolished.
- The conversation also considered the combined effects of inland and coastal flooding as these are often difficult to tease apart. Participants suggested a **cross-municipality planning effort to identify chokepoints in the stormwater management system** (i.e. roads and properties that are repeatedly flooded). With this information in hand, the regional and municipal planning

bodies could more easily identify investment opportunities for green infrastructure, permeable pavement, and grey infrastructure improvements. This type of planning could perhaps even be encouraged more broadly through state legislation.

Overarching Solutions Identified

- **Develop a regionally specific decision support process to help municipalities assess and plan for flooding, efficient use/reuse, and nonpoint source pollutions, simultaneously.**
- Effective water planning must be highly integrated across challenged areas to maximize the return on infrastructure investments and avoid contamination between different water uses. A **regionally specific planning template** might include information such as the important waterbodies and water supplies that need protection and areas of particular concern for salt water intrusion. The decision support process could guide planners as to the priorities for water planning in the region and provide useful templates for conducting municipal-wide assessments.
- Funding is a major obstacle for these kinds of infrastructure projects. Therefore, all of these approaches should be paired with **continued lobbying around water-related issues**. The Clean Water Fund administered by DEEP provides financial aid to municipalities through grants and loans for planning, designing, and constructing water pollution control facilities. It is financed through a combination of federal funding; state general obligation bonds for the grant portion and state revenue bonds for the loan portion.
- **More efficient water use and reducing the load on stormwater infrastructure** will always be net positive actions to reduce localized flooding and contamination of waterways. There are many ways this can be accomplished like green infrastructure, rainwater re-use, and a **general culture of water conservation amongst consumers and providers**.
- As many of the municipalities in the region face the same issues of flooding and nonpoint source pollution. Participants suggested that an organization **develop a regionally specific process** or template for how municipalities can assess and plan around these issues.
- **Focus outreach efforts in school classrooms**. The Last Green Valley Initiative has an established curriculum that they run in local middle schools about the water cycle. Other concerned organizations and/or agencies could review this curriculum to see if there is room to expand it and perhaps provide support to run in more schools, nursing homes, and community centers.
- Municipal natural hazard mitigation plans offer strong backing and funding options in some cases for municipalities to protect areas from flooding.
- **Outreach and education on implementation of water conservation measures** which may include reducing outdoor water use and installation of low-flow water fixtures and energy-efficient water using appliances.

Food

Challenge: Limited processing and distribution infrastructure

- **Explore cooperative funding, sourcing, and distribution models in order to meet growing demands for local foods among area residents, schools, and other institutions.** While single farmers may experience difficulty achieving the scale of production required to fulfill all of the demands of consumers in the region, groups of farmers may strategically join forces to access larger markets, distribution and processing infrastructure, apply for larger sources of funding, and achieve higher economies of scale. As farmers notoriously have little time to devote off the farm, these initiatives could be mediated by a third party or sustained by consumer groups or larger regional institutions. The Food Hub Assessment conducted by the New London County Food Policy Council examines what a cooperative distribution system could look like in the region.
- **Scope feasibility of large scale municipal composting.** Large scale composting can provide a benefit to farmers, area residents, and local businesses while reducing the burden on landfills and the environment. Many municipalities in the United States already run large-scale composting. These operations could collect farm wastes, food scraps, and garden waste and in turn provide low-cost materials for landscapers and residents in region. Other forms of composting could also generate energy such as the system currently in place in Pittsfield, Massachusetts.
- **Scope feasibility of regional processing facility.** The USDA already provides special funding for communities to develop processing facilities. This may be a first step for organizations and farmers to consider. In tandem, or as an alternative, an individual or organization could conduct a study to identify opportunities for on-site processing that do not have excessive permitting costs associated with them. At what point, for instance, does the volume of a product require more permitting? Can farms still turn a profit by producing certain products at a smaller scale? Organizations and farmers could then brainstorm ways to make these opportunities commercially viable. For larger scale meat processing a lack of natural gas availability in the region is a major obstacle. Participants suggested that discussions are needed to expand this energy type in the region.
- **Scope feasibility of cooperative distribution system.** Organizations and farmers may also want to explore cooperative distribution models to meet growing demands for local foods among area residents, schools, senior centers, restaurants, and other institutions. The CT Farm Fresh, a business located in East Haddam, currently provides sourcing, distribution, and home delivery services from several farms in the area. Finding ways to bolster and build upon this existing service could help to alleviate some of the challenges facing local farmers.

Challenge: Regulatory hurdles faced by producers

- **Look to streamline regulatory requirements across multiple state agencies.** An assessment of all regulatory requirements for farm operations may yield redundancies or processes that can be simplified. To encourage the growth of the food economy, this assessment should look to reduce regulatory burden on new or established farm operations below certain size and/or output thresholds. **Model ordinances at the municipal level** for permitting and even incentivizing non-traditional agricultural practices (i.e., greenhouses) and non-farm uses (i.e., breweries) may also help foster small farms.
- According to participants, one of the biggest challenges facing farmers from a regulatory standpoint occurs at the state level with multiple agencies requiring different permits; many of which include the same information. **Looking for opportunities to streamline these regulations could make it easier for new farmers to establish themselves.** Additionally, municipalities and public health departments could look for ways to streamline their permitting requirements with those at the state level. Participants discussed the problems with a “one-size-fits-all” approach to regulation where smaller farmers are penalized because of safety concerns that only apply to much larger operations. Participants suggested that **regulations could identify size or output thresholds** where certain regulations would come into effect.
- One particular issue that farms face is permitting non-farm uses such as event spaces and breweries. These are generally regulated by municipal planning and zoning departments. Participants suggested that it may be helpful to **create a model regional ordinance** that municipalities can adopt. This would make it more clear to farmers across the region what they can expect to do on their farms. If municipalities can **agree to expand the allowed on-farm uses**, participants suggested that this could help **make agriculture more attractive to the next generation of farmers.**
- In more urbanized parts of the region, participants felt that there were **opportunities to capitalize on innovative new agricultural practices** such as aquaponics and indoor growing. Perhaps zoning regulations could develop new ordinances to permit or even incentivize these kinds of businesses. They could also take steps to encourage corner retail markets that would sell locally sourced food.

Challenge: Competition for farmland with more profitable land uses

- **Create greater housing opportunities in currently developed areas and take steps to promote agricultural careers to the next generation.** While these strategies may seem disparate, these may be two concurrent strategies for alleviating conflicts over farmland by simultaneously making development of non-farmland more attractive and making farmland more desirable to keep in its current use.

- Accessory apartments are converted garages or smaller dwellings that can be placed on single-family lots. In many cities and towns, provisions for these types of dwellings are used as a way to **increase living density and reduce development pressure in other parts of the communities**. Participants believe that these are an overlooked opportunity in Southeastern Connecticut and could help prevent further development of the region's farmland. **Transfer of development rights** is another planning tool in which landowners are prevented from building on a property that the municipality wants to conserve in return for the right to develop somewhere else in the community where they want to encourage growth. Often this is carried out within a single community, however, participants brought up the idea of carrying this out between municipalities and **at a regional scale**.
- Often farmland is sold for development when farmers retire and do not have successors to continue their business. Participants suggested that by **developing an internship and/or pipeline program for local youth**, the region could create more demand from those who would want to continue farming. Additionally, local retailers could take further steps to **promote locally grown food**, which would raise awareness of these issues and perhaps **make local agriculture more profitable and attractive to young people** as a career.

Challenge: Uncertain future environmental conditions

- **Explore ways to accommodate the uncertainty of future environmental conditions.** Crop diversification, value-added products, and additional on-farm uses such as event spaces are all ways to buffer against the uncertainty farmers face when planning for changing environmental variables including temperatures, growing season length, and precipitation rates. Additionally, **farming techniques focused soil health** may also significantly increase the resilience of crops to disease, moisture fluctuations, and temperatures variability while more effectively absorbing precipitation.
- **Increased focus on reducing flood risk to farmers through dam removal, soil erosion control measures, and watershed management plans.** Looking on a regional scale, the success of agriculture is highly dependent on the management of soil and nutrients across the landscape. While seasonal flooding is an important nutrient and organic matter source for many agricultural systems throughout the world, the extensive damming and development that has taken place in New England's watersheds has disrupted these patterns and made the flooding much more catastrophic for farms in floodplains. Additionally, modern farming practices that do not account for soil health often create conditions ripe for wind and water erosion. Planning for these various threats to soil health and sediment and nutrient flows may help to improve the productivity of agriculture region-wide.
- At the farm level, participants suggested that certain practices could help to build the resilience of local agricultural businesses. These practices include the

diversification of revenue streams through alternative crops, value-added products, and additional on-farm uses such as event spaces. Modern farming techniques such as indoor hydroponics and hoop houses give farmers greater control over the growing climate and can help reduce the vulnerability of farm production to climate change.

- Another possible threat facing farmers is soil erosion caused by intense rainfall events. Farmers can take action to reduce this vulnerability by **strategically planting trees and other deep-rooted perennial crops.** At a municipal planning level, stormwater management regulations can help to ensure that valuable farmland soil is not lost to erosion. This could be particularly important in urban areas that may want to promote outdoor urban farming on constrained lots.
- At the regional scale, participants suggested that **municipalities should continue to take steps to reduce flooding threats to farmers.** This might occur through continued dam removal as recommended by natural hazard mitigation plans as well as watershed-scale flood management plans.

Challenge: Limited food access for some communities

- **Conduct a food-shed mapping effort across the region to determine sources, types, and quantities of locally produced food.** Food-shed mapping assessments are a promising new way to determine the viability of regional food systems. This assessment could measure both current production as well as production potential in the region. This information can help municipalities and local organizations set regional production goals and prioritize where and how it wants to enhance opportunities for new farm businesses.
- Some participants believed that parking regulations imposed by municipalities were limiting the development of more supermarkets in places that needed better food access.

Other solutions

- Participants felt that more **year-round farmers' markets** could help to increase demand and access to healthy food. By encouraging **more processing and preservation of local produce, perhaps through a farmer cooperative,** more farmers would have a product to sell year round. This kind of processing could also take place in schools and help ensure that students had access to locally grown food in every season while supporting local farms year-round.
- **Schools could also teach more programs in cooking and meal planning,** which may help families make better use of healthier options available locally.
- **Food production on municipal park land** is another growing trend in municipal planning nation-wide. Participants expressed an interest in edible “food forests” in urban areas as an intriguing way to bring healthy food closer to those who need it most.

Ecosystems

Challenge: Reduction in coastal protection and water purification services

- **Continued collaborative leadership that champions the benefits of ecosystem services from the municipal to regional scale.** There is great awareness and concern amongst the region's planners on the importance of appropriately valuing all of the benefits of ecosystem services for community resilience, economic growth, and environmental health. It may be important for **municipalities to continue to champion these issues** from within as a way to advance regional projects and initiatives.
- **Assess the services provided by natural assets with monetary values when making decisions within the context of economic growth and development across the region.** Most large and important decisions in the region are made with municipal finances in mind. However, the accounting that goes into these decisions does not always include the value of natural capital. While there are no universally standardized ways to value natural assets, planners can **reference past studies of ecosystem value from elsewhere to estimate value of local natural spaces.** Without the ability to compare alternatives (i.e., ecological cost and economic return), natural assets will likely continue to be discounted or marginally considered.
- Participants agreed that approaches to addressing this challenge should happen across multiple scales. At the planning scale, local, regional, and state actors can proactively **work to identify highly vulnerable areas for both the built environment and functionally important ecosystem.** The rationale behind this is that in some cases certain ecosystems (notably coastal wetland) may be providing services that are as valuable if not more valuable than the cost of mitigation actions that can be taken for the built environment (i.e. levees, flood-proofing). As the climate continues to change, the loss of these services could make previously well protected areas more vulnerable. Additionally, areas that are currently built out, may have more value to the greater community going forward as restored ecosystems. Local land trusts can play an important role in ensuring that future growth does not jeopardize existing and future critical ecosystem function. The possible **relocation of coastal transportation and other infrastructure may create some intriguing opportunities to restore ecosystem services** at a large scale along this highly developed coastline. The most notable opportunity is the Amtrak line, which is currently being considered for relocation.
- At the local scale, municipalities can **more strictly enforce and/or enact stricter standards for rebuilding in high hazard areas.** This would help to ensure that there are fewer structures in harm's way long term while increasing the opportunities for coastal and riverine habitat types to persist and adapt. With more space to adapt to rising water levels and other changing conditions, ecosystems can increase their potential to enhance services to the adjoining built environment.

- Municipalities, land trusts, and other landowners can also make **use of natural infrastructure and “living shoreline” techniques** where site conditions and impacts warrant. Living shorelines are adaptable natural features that may be used where flooding is an issue in coastal and riverine environments. Living shorelines can be used to both slow the force of waves and reduce more gradual, everyday erosion. In doing so, these strategies can help to increase the level and longevity of ecosystem services provided in the region. Along more natural shorelines, landowners can also take important steps to maintain existing ecosystem services and encourage the habitats to adapt to changes in climate such as increased precipitation, sea level rise, extreme heat, and drought.
- **Define ways to incorporate ecosystem services directly into permitting requirements for MS4 at the municipal level.** New MS4 stormwater permitting requires that municipalities reduce the amount of pollutants entering their waterways via stormwater systems. A potential opportunity for addressing the issue of declining ecosystem services would be to find ways to **incorporate ecosystems services directly into the permitting requirements at the municipal level.** There are many strategies municipalities can take to encourage replacing impervious cover with green infrastructure such as raingardens and bioswales. One example is to **institute a stormwater fee** where property owners must pay a small sum relative to the amount of impervious surface on their property.
- Finally, participants discussed the need to **properly value the services provided by natural assets within the context of economic growth and development across the region.** Without estimates of monetary value municipalities and developers will never be able to truly assess the pros and cons of building in certain areas. Participants noted that these estimates would not have to be especially rigorous to at least start a conversation. Some suggested using studies taken elsewhere on the value of ecosystem services to get ballpark numbers. Without the ability to compare planning strategies based on similar metrics (i.e. expected economic return), planners worry that natural assets will continue to be assigned a low economic value.

Challenge: Conflicts between built environment and ecosystem function

- **Explore and catalogue financial mechanisms and incentives for property owners to maintain and enhance natural infrastructure and associated services.** There are several grants and tax incentives available to landowners for conservation and restoration. These sources are often dispersed amongst various foundations, agencies, and organizations and not readily accessible in one place. Without understanding these alternatives, landowners and developers often default to traditional engineering and site design practices. A **common list of these opportunities that municipalities and organizations can share with landowners** can help the region as a whole move towards greater integration of built and natural environments.

- **Integrate natural infrastructure into zoning codes to reduce conflicts between development and community resilience.** Zoning codes represent a high leverage point to encourage the construction and protection of natural infrastructure in communities. Some possible ordinances include requirements of a minimum accepted volume of stormwater runoff on a site and progressive overlay districts that create a coastal development buffer that keeps up with sea level rise. Planning documents such as the POCDs can also **consider longer planning horizons to better anticipate future environmental conditions.**
- **Conduct outreach and education for residents and business owners on where and what natural alternatives could be considered alongside standard hard engineering approaches to improve resilience.** Private landowners are not always aware of the financial benefits of natural and hybrid coastal engineering projects. As a result, there is still a small market for these strategies. Municipalities and organizations may consider **conducting an outreach campaign directed specifically at vulnerable landowners** about these benefits.
- Conflicts between property protection and ecosystem services can be difficult to negotiate when coastal landowners have long-term and often multi-generational connections to their land. The participants suggested that initiatives **focus in on areas slated for redevelopment and work to reshape how landowners think about their property** either through financial or cultural means.
- Redevelopment of high risk areas and/or adjoining areas need **to incorporate the full suite of ecosystem services** that are available at a site or could be created there. Participants also discussed the opportunity to take advantage of easements as a tool to minimize the footprint of development and redevelopment for community resilience purposes.
- By more fully accounting for the service costs associated with coastal and high risk riverine areas (roads, water infrastructure, emergency management, etc.), participants suggested that planners and developers would make more informed decisions about where and how to build. There is a need to **explore and catalogue additional financial incentives for property owners** to encourage the continued maintenance and enhancement of natural infrastructure and services. Perhaps there are ways to incentivize developers and landowners to **more harmoniously integrate the built environment with ecosystem function.**
- For residents, municipal officials, business owners, and other community leaders to consider the benefits of natural infrastructure and to use ecosystem services to improve resilience there must be **greater awareness on the trade-offs of hard infrastructural applications** such as seawalls. Participants suggested some form of **outreach and education** associated with these issues, where natural alternatives could be presented alongside standard hard engineering approaches where appropriate.

- Participants also brought up the idea of **changing the cultural dialogue associated with the coastal lifestyle**. The “coastal dream” is very individualistic and often does not fully consider the true cost to society and to the environment from living in high risk areas. Participants suggested that the conversation around coastal hazard mitigation could be guided from preventing flooding of the built environment to accommodating it through existing natural assets such as salt marshes and floodplain forests (i.e., “living with the water”). Also, focusing the conversation around **how ecosystem services improve public safety** may help to elevate the importance of ecosystems for a broader audience.

Challenge: Effects of reduced water quantity and quality

- Participants believe that **regional water conservation should be prioritized** and that organizations should try to communicate the economic impacts of reduced water quantity and quality from environmental degradation. Furthermore, there is a need to **integrate the conversation, planning, and practices between water quantity and quality**. Currently, this topic tends to be disconnected or not considered jointly in various ongoing planning initiatives.
- In addition to communication and education, participants also brought up the possibility of **instituting mandatory water conservation policies based on land use**. For example, single family residential properties may only be allowed to use a certain amount of water per year.

Overarching Solutions Identified

- **Collaborative leadership championing the benefits of ecosystem services from the municipal to regional scale will have positive effects**. Currently, awareness of the value of ecosystems services resides in and amongst various staff across the municipalities but is rarely amplified and made a core issue for the region.

Transportation

Challenge: Ageing infrastructure

- All structures eventually deteriorate over time and therefore need routine maintenance to ensure their continued operability. While most maintenance shortcomings can only be solved through additional funding and personnel, participants also drew attention to the opportunity to re-think how roads, bridges, culverts, etc. are designed in the first place. There a need to **retrofit existing and design new infrastructure for storms of the 2030s versus 1970s**. For instance, given expected increased precipitation, perhaps it makes sense to increase the engineered capacity (i.e., 2050s design storm) of roads to mitigate polluted runoff and reduce the vulnerability to flooding. The state Department of Transportation currently designs its roads to take these

considerations into account to some extent but these standards do not necessarily apply to local roads and do not fully address the issues of increased storm runoff as precipitation intensity continues to escalate.

- In both the Transportation and Ecosystems breakout groups, participants discussed the possibility of **connecting transportation funding with MS4 permitting needs**. Certain roads may contribute more than others to overall nonpoint source pollution in a given municipality. Because these roads in theory would cost the municipality more, transportation improvements could be **prioritized based on the road runoff volumes** and would either reduce impervious cover or include green infrastructure solutions to reduce runoff entering waterways.
- Participants also suggested that there could be **more coordination of resources and personnel between municipal public works departments** to synchronize activities and reduce costs of maintaining contiguous local roads.
- Lastly, participants expressed a need to **create longer-term assessments of the regional transportation network**. By understanding the on-the-ground impacts of sea-level rise and precipitation events, regional and municipal planners can better understand which roads to invest in (i.e., **reinforced resilient transportation/community corridors**) and which may need to be phased out of use. By conducting this assessment at a regional scale, municipalities will have a better sense of which transportation-related investments to prioritize for regional resilience.

Challenge: Vulnerability of primary arterial roads to storms

- **Prioritize state and local funding for infrastructure improvements that will contribute to future community resilience building.** Looking at a longer time horizon, regional and municipal transportation planners and engineers could ensure that their efforts would not be undermined by future sea levels, inland flooding, and intense precipitation events. These assessments could be coupled with local planning and vulnerability assessments of roads and the neighborhoods and businesses they service. In some cases, these vulnerable roads may be important to double down on and protect while in others, the tough decision may be to reduce maintenance or phase the road out of use. Projects that can make the case for their contribution to the resilience of the whole community and region could benefit from a **streamlined permitting process** and easier access to funding at the municipal, state, and federal level.
- **Cross-municipality collaboration to identify the largest regional transportation vulnerabilities and share planning, engineering, and monetary resources to enhance regional resilience.** The impacts of transportation vulnerabilities on regional resilience frequently cross municipal borders. Therefore, it makes sense for **municipalities to share resources** to address these challenges. Funding towards raising an important regional road for instances could be shared by all affected municipalities. Some other options for regional collaboration around transportation could include **collaborating**

on model ordinances and design standards for resilient transportation projects that limited localized flooding through green infrastructure and better conveyance.

- **Integrate green infrastructure and natural assets into transportation upgrades and retrofits through design standards and codes.** Green infrastructure often provides cost effective means to improve the longevity of transportation engineering projects. However, these strategies are not always implemented where they could create the most value. One way to promote these practices could be to **universally include them in municipal design standards and building codes for upgrades, retrofits, and new installations.**
- Flooding of arterial roads during storm events has the potential to strand many people and hinder emergency access. Mitigating this vulnerability at the infrastructure level can be approached from several angles and often is best served by utilizing multiple strategies. Inland and coastal wetlands provide storm storage and buffers that can slow and infiltrate storm surge and flood waters before they become a problem for motorists. **Roads can also be raised above flood levels** in some cases.
- In addition to infrastructure improvements, participants suggested **improving evacuation communications** as a cost-effective way to mitigate these vulnerabilities in response and recovery phases of a major disaster.
- As sea levels rise, the upslope advancement of salt marshes is hindered in certain areas by roads. If the marsh is unable to make this transition, there will be a loss of biodiversity and protective ecosystem services along the coast. Where possible, those responsible for **transportation planning should accommodate this natural resource movement** by re-sizing culverts and/or consider removing less critical roads where exposure to said infrastructure becomes too expensive to accommodate. In some instances, undersized culverts may increase vulnerability of adjacent communities during storms as storm surge becomes bottlenecked and increases in velocity or reduces dewatering times post event.
- Road transport in and out of **Groton-New London Airport** is vulnerable to both sea level rise and storm flooding in a few locations. Assessing and adapting to these specific threats for example should be a regional priority for transportation planning.

Challenge: Emergency transportation for transit-dependent communities

- To reduce the needs of transit-dependent communities during emergencies, municipalities and public transit services could **establish mutual aid agreements** with nearby inland urban centers such as Hartford and Worcester to share busses with real-time mapping of available transportation assets (i.e., buses, taxis, etc.).
- **Smart phone apps for real-time bus mapping** is already being used in Hartford and New Haven to improve user-accessibility to public transit. This kind of information could also be useful in emergency situations as those who

don't regularly make use of these services can more easily plan their evacuation. This information could also be included in existing reverse 911 services and/or social media notifications.

- The **current capacity of public transit** may not be enough to adequately manage larger scale evacuations. Participants suggested that the **region could conduct assessments now leading to justified mutual aid agreements for emergency situations.**

Overarching Solutions Identified

- Funding for infrastructure improvements at the state, region, and local level could be **prioritized based on how much it will contribute to future community resilience building.** This means that communities would consider current as well as future vulnerabilities of roads and the neighborhoods they service when making construction and maintenance decisions. In tandem with this, projects that do demonstrate a pressing need from a community resilience perspective could be afforded a **streamlined permitting and funding process** to allow municipalities to more easily proceed.
- Municipalities could also **work together to identify the largest regional transportation vulnerabilities and then share planning, engineering, and monetary resources to enhance the resilience** of these areas. More generally, municipalities could collaborate on **model ordinances and design standards** for transportation projects involving new construction, retrofitting, and /or repair of infrastructure that institute resilience.

Energy

Challenge: Energy infrastructure and storm damage

- **Take steps to strengthen and redesign the distribution system.** Microgrids and other similar strategies provide redundancy and can isolate damage to the electrical distribution system. In doing so, they can help the region to respond more quickly to energy infrastructure damage and interruptions. Participants expressed an interest in examining the potential **benefits of using microgrids in urban areas and village centers** in conjunction with locally sourced energy such as solar panels.
- **Ensure that state and local emergency response plans include provisions for speeding up recovery of energy systems post disaster.** As the loss of power can have severe impacts on businesses and potentially deadly impacts on residents, recovery of the energy systems is a high priority for overall regional disaster recovery and longer term community resilience building. Communities could review emergency response plans along with the state and utility plans to ensure that **energy recovery is fully considered.**
- One of the most fail safe approaches to protecting power lines is to bury them in much the same way that one would communications and water lines. Participants offered this as a solution but conceded that this could be a very

expensive proposition that would have limited application except within existing urban areas such as New London and Norwich.

- Another approach is to **manage the vegetation immediately adjacent to powerlines** to prevent damage from falling trees. UCONN CLEAR is developing a program called Stormwise which is intended to address this very need.
- In the immediate aftermath of a storm, recovery is often limited by the availability of staff. Energy companies such as Eversource have **mutual aid agreements** and memorandums of understanding with other energy service entities, which allows technicians from other regions to come and provide help. Where possible, participants suggested, these **agreements should be strengthened and expanded**.
- Lastly, participants pointed out that given **Millstone's** inordinate importance for energy supply, every effort should be made to ensure that this **facility is properly prepared** for extreme weather events and climate change.

Challenge: Communications disconnect between consumers and providers

- **Improve communications among stakeholders within the energy system.** Steps could be taken to help consumers better understand the challenges that energy providers face. Similarly, providers and regulators that tend to work on larger scales than municipal offices may benefit from a better awareness of the needs of communities and large institutions such as universities. In addition to information, such communication could also surface opportunities for sharing resources and creative ideas.
- **Target and incentivize consumer behavior such as in-home energy conservation (i.e., Smart Living) and tree removal on private property as a strategy to improve overall regional energy resilience.** Often the biggest changes occur from the culmination of many small actions. These decisions often happen in the home and on properties but can have profound effects on overall community resilience. There are already a number of initiatives by energy providers to connect with and educate consumers. Participants felt that many of these projects, which are available through multiple media platforms, should be **strengthened and expanded**. Other outreach programs such as the Institute for Sustainable Energy at Eastern Connecticut State University could also provide effective collaboration in this regard. In particular, participants wanted to see more efforts to raise consciousness amongst consumers about energy consumption, sources of energy, and how these decisions affect the costs of one's energy bill.
- Consumers could also be **made more aware of existing funds** for energy audits, energy efficient lightbulbs, faucets, etc. that are already included in the current billing procedures. However, participants stated that there should be a clear communication as to the **follow up steps from an energy audit**. There is a need to provide home owners with the **follow-on conversation about longer**

term planning to reduce energy consumption and sources of energy available. Participants believed that there is a messaging opportunity to help tie household-level decisions in with a more sustainable and resilient regional energy future.

- Some participants working in the planning sector said that they would benefit from **more user-friendly policy guidance documents concerning the particulars of energy sources**. Currently, some municipal planners find it difficult to include considerations of energy resilience into Hazard Mitigation Plans and Plans of Conservation and Development because of lack of data related to energy provision. Where appropriate, municipalities should work with energy utilities to determine how and where these documents can include considerations of energy-related decisions.

Challenge: Uncertainty regarding future of local energy production

- With regards to the future of Millstone, participants expressed **concern that citizens and community leaders are not considering the effects of increasing water temperatures in Long Island Sound** on the power plant's ability to function and that they are putting too much faith in a technological fix. Participants felt that this reality could be an impetus for more community leaders to look closely at opportunities for other, locally produced energy sources.
- Participants expressed the sentiment that improve battery storage technology will truly revolutionize the future of energy production and consumption. Unfortunately, the technology necessary for this is not quite ready.
- Participants felt that local institutional and academic knowledge could be **better harnessed to promote collaboration** across sectors for regional energy resilience.

Overarching Solutions Identified

- **Lobby for more regular state building code updates that include concurrent updates to energy efficiency standards.** While working directly with producers and consumers can have real benefits for energy efficiency, stakeholders can also address these issues through legislation. The state building codes provide the foundation that all building projects in municipalities must abide by. The current time frame for updating these codes may not be sufficient for keeping up with advances in building technology, renewable energy, and national energy policy. **Conducting these updates with more regularity** may provide more opportunities for concerned citizens and organizations to have their voices heard on these issues. As an additional benefit, more regularly updated state building codes and energy efficiency standards may provide more flexibility in the face of changing environmental conditions.

- For the region to recover more quickly from energy infrastructure damage, steps could be taken to **strengthen and possibly redesign the distribution system**.
- Efforts could be made to **improve communications** among the various actors within the energy system (providers, consumers, regulators, universities, etc.). Energy issues could perhaps be **integrated into the core curriculum** as a way of raising general awareness.
- **Targeting and incentivizing consumer behavior** such as in-home energy conservation and vegetation management on private property can have large impacts on regional energy resilience. The **Smart Living Catalogue** is an excellent source of information in regards to energy efficient tools and strategies.
- Communities and states should make sure that they have **response plans** in place specifically designed to speed up recovery of energy systems.

Economy

Challenge: Effects of coastal hazards on municipal grand lists

- **Make an economic argument for resilience planning and emergency management to community leaders and municipal officials.** A fiscal impact study of extreme weather, sea level rise, heat/drought, and precipitation scenarios across Southeastern Connecticut may help to better align economic development and capital expenditures with environmental reality. This study can be conducted at different levels of detail. For instance, a simple study could compare projections of flooded properties with their tax contribution while others may consider factors such as loss of business and degradation of natural assets.
- **Reduce long-term, over-reliance on high-value, residential property for tax revenue.** By planning to move development off the coast and away from river edges, municipalities can decrease the vulnerability of their grand lists to sea level rise and extreme weather events. As a long-term strategy, this transition can be accomplished in conjunction with economic development activities by **incentivizing future development in higher density villages and city centers** that are already well protected from flooding hazards. This will also help to centralize municipal services and lower the cost of those services to tax payers.
- **Ensure that planning documents prioritize more compact mixed use areas with infilling that have a smaller footprint and are away from current and future coastal and riverine ecosystems.** Moving the built environment that supports economic activity out of harm's way may be the best investment from a community resilience building perspective. While such actions may require significant upfront costs and public engagement, in the long run, this will eliminate many emergency management, utility service, and road/facility

maintenance costs. These acts will also reduce the vulnerability of the tax base to extreme events and sea level rise longer term.

- **Economic diversification should be a central priority.** A general diversification of the economy may help to reduce residential development demands on local ecosystems. As ecosystems degrade due to rising sea levels, economic diversification can help to minimize the impact that the loss of these scenic and recreational assets may have on the regional tourism economy.
- Improving the **diversification of revenue generators** (i.e., businesses, etc.) will also enhance local elasticity during economic/market fluctuations at the state and national level.
- To reduce the infrastructure costs, it was suggested that municipalities could **transfer responsibility and cost to the homeowners and neighborhood associations in certain areas.** Perhaps municipalities would charge these property owners/associations with a fee to help maintain local roads, sewer and water systems, and basement pump-outs. This would decrease the tax burden on and increase the equitability for the rest of the communities currently being asked to provide for these property owners disproportionate use of service.
- Municipalities could also **reduce their reliance on coastal neighborhoods by encouraging residential growth or infill in other more centralized parts of their communities.**
- Participants suggested that **mandatory evacuations pre-storm** would be a way to reduce emergency service costs during and soon after an event.

Challenge: Short and long-term effects of flooding and power outages on business continuity and resource recover

- In 2015, the Regional Emergency Planning Team produced a series of documents for handling various issues during disaster situations in eastern Connecticut. The Regional Emergency Support Function 7 concerns private sector recovery and response. This document includes a **model ordinance that municipalities may consider** that would establish a Recovery Management Organization to help coordinate business recovery. If proper statutory authority could be secured at the municipal level, adopting this ordinance would provide a local structure to address this challenge.
- Participants expressed an interested in **expanding post-disaster recovery drills to include local businesses.** This would help to make these exercises more closely simulate an actual event while helping business owners better understand the vulnerabilities they face and steps to improve resiliency.
- Other solutions included:
 - Partner with other organization to respond to disasters to help get businesses back up and running;
 - **Inventory all businesses in the area that currently have generators;**
 - Establish **mutual aid agreements between municipalities** to assist with permitting and inspections post-disaster;

- Where it is not the case, **grant municipal staff that authority** to act to protect public health, safety, and welfare during post-disaster recovery.

Challenge: Post-storm transportation complications and limited access for businesses and employees

- **Inventory available space for temporary operations and coordinate with relevant parties to ensure that enough space is available in the immediate aftermath of disasters.** Communities can help with business recovery by exploring opportunities to share important business infrastructure such as office spaces and refrigerators during and immediately following storm events.
- Participants developed a couple of ways to address the problems of employees being penalized and/or fired for missing work during a storm event. On the legislative side of things, organizations could **lobby for additional employee protections during disaster situations.** Another complimentary approach could be to **designate shelters near major employers and/or business areas** where employees and families could stay in the days immediately following the disaster. This strategy could be explicitly included in regional and municipal hazard mitigation plans.

Challenge: Negative effects of natural resource degradation on economy

- Participants discussed the need to **more accurately map and quantify the value of local natural resources** to individual municipalities and the region to more accurately justify the necessary investments to conserve them.
- Planners must also **consider the long-term implications of guiding development in a changing climate.** Criteria for future development could **prioritize more compact, mixed-use areas** that have a smaller footprint and are away from current and future coastal and riverine ecosystems.
- A general diversification of the economy may help to reduce the demands on local ecosystems while decoupling some of the negative effects associated with natural resource degradation. For example, many municipalities rely heavily on coastal homeowners for a large portion of their tax revenue. By **developing other reliable sources of revenue via new businesses,** municipalities will be less driven to protect these areas at all costs. This may make the eventual **voluntary buyout** of these properties less disruptive to the municipal budget. Additionally, if recreational opportunities were to decrease due to future declines in water quality and availability, a more diversified economy will be better equipped to absorb the loss of tourism revenue.

Challenge: Preparedness training for municipalities, businesses, and social service organizations

- **Improve coordination of disaster recovery between public and private stakeholders.** Currently, municipalities and individual businesses assume responsibility for their individual disaster recovery plans and conducting

practice exercises. Small businesses often do not have the time or resources to invest in these activities. However, recovery of the public and private sectors overlaps in many areas such as transportation and utilities. By hosting **recovery drills with a wider range of stakeholders**, communities may be able to more efficiently plan for and respond to disasters. Regional planning agencies may be well-positioned to advance more collaborative disaster recovery planning and response because of their unique ability to integrate state and local initiatives.

- Disaster preparedness is generally a difficult topic to get people excited about, and it is easy for such efforts to be overlooked. However, **well-coordinated training exercises** have the potential to have a significant payoff by limiting the loss of business revenue and emergency management costs. Participants believed that finding more effective ways to push for more training opportunities would be worthwhile. By conducting an economic study of the region's vulnerabilities to large storms, planners and emergency managers may be able to more effectively make their case for better planning and training opportunities with elected officials. **Trainings could also be tailored for specific business types.**
- In addition to lobbying for more training opportunities, participants discussed ways to make these trainings more effective. These strategies should involve as many real-life players in trainings as possible including business owners and social service organizations. This would help to **identify communication and response gaps** while elevating stakeholder awareness of their vulnerabilities. Participants also suggested that municipalities and insurance agencies try to share documents to ensure that all parties have what they need to coordinate a more effective recovery.
- Lastly, participants discussed preparation strategies including **stockpiling generators when lower priced** so that municipalities, businesses, and social services can all be assured access. Businesses and municipalities could also **collaborate to identify alternative temporary office spaces** for businesses to house employees in the case of damaged business facilities.

Overarching Solutions Identified

- Participants believed that **making an economic argument for resilience planning and emergency management** can increase the receptivity of community leaders and municipal officials. The NGOs and/or consultants could help municipalities with mapping and quantifying the economic impacts of different extreme weather and climate scenarios.
- Participants also believed that **disaster recovery could be more effectively coordinated** within and between municipalities, non-profits, and the private sector. Regional planning agencies such as SCCOG and SeCTer may be well-positioned to spearhead broader disaster recovery planning beyond the emergency management community because of their charge to integrate state and local initiatives.

- **Planning to move development away from the coast and rivers** will help to reduce emergency management costs longer term. This can be accomplished by **incentivizing future development in well-protected, inland areas**. It was suggested that for existing, vulnerable developments, municipalities can potentially nudge long-term coastal relocation by **charging coastal property owners for the disproportionate costs of maintaining exposed infrastructure**. Participants also suggested that there are potential conflicts amongst coastal development policies that could be better aligned. For instance, FEMA insurance policies often pay for damaged houses to be rebuilt where they are, which may not be the desire of the municipal or in the best interest of other rate payers and local tax paying residents.
- One of the most important actions agreed upon by the participants is to help business recovery by **inventorying available space for temporary operations and coordinate with relevant parties** to ensure that enough space is available in immediate aftermath of disasters.

Final planner team meeting

After the challenges and solutions workshops, the larger planner team and core team reconvened to discuss findings and how to carry the project outcomes forward. During this working session, a few additional ideas emerged while others were re-iterated more strongly.

- Becoming compliant with the new MS4 regulations is a heavy burden of time and resource on municipal planning departments. Any efforts to share resources and information between municipalities was recognized as a meaningful endeavor and solid example of the benefits of regionalization. Because reducing impervious surface often requires buy-in from private landowners, it would be especially useful to create shared public outreach material that planning departments could use. Some participants also suggested creating a regional MS4 process or stormwater reduction credit trading bank. Others considered how farmland preservation could tie in with stormwater management and flood mitigation.
- Identify specific projects that would solve multiple challenges and impacts. For instance, are there any road raising projects that would also act as important surge barriers to other critical infrastructure or neighborhoods?
- Develop a central repository of mapping data rather than having each municipality maintain their own GIS database.
- Identify two to three immediate, municipally-meaningful, regional-based projects. Educational and outreach material around stormwater and coastal/ riverine resilience were highlighted as good candidates.

- Develop a program to help businesses in Special Flood Hazard Areas invest in building improvements, other forms of flood mitigation, or voluntary buy-outs and relocations.
- The SCCOG is already planning to hold semi-annual planner meetings to discuss local topics related to the POCD. This could provide a good venue to continue discussions around community resilience building.
- Develop a catalogue of all organizations working in the regional and state on issues related to resilience. Work with them to clarify roles and responsibilities.
- An economic impacts analysis looking at the impacts of flooding and sea level rise on municipal grand lists returned as a high value project.
- A large focus of the conversation centered on ensuring that existing efforts were being appropriately leveraged. An interesting opportunity brought up by one planner was how some coastal neighborhoods are already paying for environmental cleanup projects to protect their beaches and coastal ecosystems. The resources going towards these efforts could potentially be used more efficiently by investing in upstream or adjoining improvements.
- Evaluate risks (environmental, economic, social, etc.), establish value metrics, assign priorities, agree to act (i.e., elected officials)
- Create/facilitate stakeholder meetings to focus on a specific resilience issue at a regional scale. Each topic could have a dedicated group with a template for agreement and implementation.
- When asked about the greatest regional flooding challenges, participants mentioned Shaw's Cove in New London, the New London Transportation Center, and along Route 32 in Quaker Hill.

Specific Projects – Conceptual Designs

To better illustrate the types of actions needed to facilitate and realize resilience in the region, the core team, in consultation with the larger planning team, identified specific projects for the purposes of developing in-depth, illustrative conceptual designs. To serve as a bridge from very local to regional scales, a nested set of projects were selected. The first focused on actions to make a critical intersection more resilient (Jordon Village). This resilient intersection design represented a very local issue that is commonly reported across the region. The second design project focused on the collective challenges faced by all municipalities when dealing with the complexities of balancing economic, social, residential, and environmental tradeoffs to make a vulnerable area of a municipalities more resilient (Poquonnock Bridge). The third design project focused on a shared resource between two municipalities (Lower Niantic). This project reflects the need for multiple municipalities to work collaboratively towards resilience on behalf of a common resource. These three designs are intended to provide examples actions needed to build resilient communities using multiple scales from very local to multiple municipalities.

Jordan Village

Sitting within the floodplain of the lower Jordan Brook, the intersection of Rope Ferry Road and Great Neck Road in Waterford, Connecticut is vulnerable to both flooding from the river as well as coastal storm surge from Long Island Sound. During a heavy rain storm in March 2010, the banks of Jordan Brook overflowed and water flooded this intersection to a depth of nearly three feet. This event demonstrated how both Rope Ferry Road and Great Neck Road could be cut off by flooding at this transportation choke point. This weakness is particularly important for the Town to address given that Great Neck Road is the main evacuation route for most of the Waterford's residents living south of Rope Ferry Road in the event of a major disaster.

While fully securing this evacuation route will take a number of different tactics with agencies and organizations working in tandem, there are important steps that the Town and its citizens can take immediately to begin reducing their vulnerability. Working with the Town Planning and Development Department, TNC developed a conceptual site design for a series of rain gardens that can increase the water storage capacity of the landscape surrounding the intersection and all the waterways that drain into it. This will help to divert floodwater and surface runoff from the road away from the intersection and allow it time to infiltrate thus limiting problems for traffic. This design built off the streetscape and pedestrian circulation improvements put forth in the Waterford Town Center Vision and Strategic Plan. The Town Planning Department as well as other planners in the region are very conscious of the vulnerability of the regional transportation network at this intersection. When considering future redevelopment in Jordan Village, the Town should intentionally consider reserving and integrating additional space for flood storage.

Poquonnock Bridge

The land surrounding the Poquonnock River Estuary (Town of Groton) constitutes one of the largest, contiguous glacial sediment deposits along the Connecticut Coast. The relatively flat low-lying land created by this geologic feature made this area ideally suited for agriculture, both for the native Pequots and European colonists. However, the level ground also made it valuable in later years for a railroad, low-income housing development, and an airport. Today, the area in and around the mouth of the Poquonnock River in Groton is highly developed, putting many residents, businesses, and infrastructure at risk to hurricane flooding and sea level rise.

In partnership with the Town of Groton Planning and Development Department, TNC developed graphic depictions of foreseeable risk scenarios to help communicate these complex vulnerabilities in a useful way to the community and other stakeholders. The use of conceptual designs creates an opportunity to build feedback on what exposed assets are most important to people and what projects are most feasible to act on immediately. In addition, TNC developed long-term, alternative

land-use planning concepts that provide instruments for furthering the dialogues on next steps.

Lower Niantic

The Lower Niantic River is bounded on the west by the Village of Niantic and the east by Town of Waterford. With the notable exception of Oswegatchie Hills, most of the parcels along the shoreline on this stretch of the River are developed. This development is largely residential with a few marina districts and Camp Niantic; the Connecticut Army National Guard base. Many of the residences along the Lower Niantic were originally seasonal, transitioning to year-round over the second half of the twentieth century. The combined effects of clearing coastal forests for development, septic systems, intense fishing pressure, and various forms of pollution took a severe toll on the overall ecosystem and aquatic and semi-aquatic habitats of this area including salt marshes, beaches, and eelgrass and shellfish beds. Many homes and businesses face a direct exposure to extreme coastal weather, which will only become exacerbated with continued sea level rise.

Fortunately, many past efforts by the municipalities and local non-profits to reduce and eliminate pollution sources as well as consistent monitoring from the Millstone Environmental Lab have helped to stabilize some of this ecosystem decline. The designs produced by TNC for the Lower Niantic are aimed at reversing this decline by identifying restoration projects that can help protect coastal property owners from the effects of storm surge while contributing to the improved health of the River ecosystem. The next step should be to enlist the help of a coastal engineer to develop a more accurate depiction of specific vulnerabilities and the feasibility of constructing the restoration conceptual designs developed by TNC for Lower Niantic.

Other Resilience Projects

Over the course of meeting with regional stakeholders and reviewing local and regional planning documents, a few other specific projects with direct relevance for regional resilience were identified. The list below should not be considered comprehensive or necessarily up to date, but reflects some of the key projects and concerns municipalities have highlighted in previous planning activities involving risk and resilience.

Project	Town	Status
The Avenues	Waterford	Flood vulnerable neighborhood along Niantic River. Town is interested in a planning study of for a possible “green retrofit” for resilience.

Downton Master Plan	New London	Recommended in POCD. Should take into account current and future flood vulnerabilities at Shaw’s Cove and Transportation Center.
“Mini-park” zoning	East Lyme	Recommended in POCD as a way to improve pedestrian experience in commercial centers and could also be an opportunity to incorporate more green stormwater infrastructure.
Septic system study	Stonington	Recommended in POCD to look at effects of sea level rise on septic systems in community.
Dodge Paddock and Beal Preserve	Borough of Stonington	Ongoing project spearheaded by the Avalonia Land Trust to manage an important piece of natural infrastructure in the Borough of Stonington.
Shipping Street Redevelopment	Norwich	Proposed waterfront development currently complicated by floodway designation.

Conclusion

Southeastern Connecticut is a collection of communities each with its own individual history and identity. However, the fate of each community is closely tied to the social, environmental, and economic health of the whole region. Therefore, the challenges facing Southeastern Connecticut are best tackled collectively with multiple municipalities, organizations, associations, institutions, foundations, and businesses working together across the region. Our sincere hope is that this resilience building process and Summary of Findings helps communities secure greater clarity on the common challenges they face while providing a positive vision for continued dialogue, resource sharing, and collaborative leadership needed to create a truly resilient region.

ⁱ Patton, P., Kent, J.M. (1991) *A Moveable Shore: The Fate of the Connecticut Shore*. Duke University Press Books. Durham, North Carolina.

ⁱⁱ Narayan, S., Beck, M.W., Wilson, P., Thomas, C., Guerrero, A., Shepard, C., Reguero, B.G., Franco, G., Ingram, C.J., Trespacios, D. (2016) *Coastal Wetlands and Flood Damage Reduction: Using Risk Industry-based Models to Assess Natural Defenses in the Northeastern USA*. Lloyd’s Research Foundation, London.

