North Carolina Resilient Coastal Communities Program (RCCP)

Phases I and II - Hatteras Island

Dare County, NC

Prepared For:

NC Dept. of Environmental Quality
Division of Coastal Management
400 Commerce Ave
Morehead City, NC 28577

Prepared By:

WithersRavenel
115 MacKenan Drive
Cary, NC 27511
919.469.3340
License No. F-1479

April, 2022

WR No. 03210062.00

Stephen Marks, PE, CFM
Katherine Knight, EI
Caroline Richardson, AICP

Executive Summary

Dare County underwent a thorough planning process to review coastal hazards for Hatteras Island and identify potential solutions that provide community resilience for the future. This process followed the guidelines for Phases 1 and 2 of the North Carolina Resilient Coastal Communities Program; a four-phase program to help communities maintain quality of life and build resilience to natural hazards. The four phases are summarized below:

Phase 1 – Community engagement, risk and vulnerability assessment

Phase 2 – Planning, Project Identification, and Prioritization

Phase 3 – Engineering and Design

Phase 4 – Implementation

This study describes the process and results of the Phases 1 and 2 implementations. Phase 1 aimed to engage the community through the creation of a Community Action Team (CAT) and to solicit active input and involvement from local citizens. Based on this input, as well as from prior studies and publicly available data, an identification and vulnerability assessment were performed to classify risk of critical infrastructure on Hatteras Island. Phase II leveraged that analysis and public input to generate a list of potential resiliency projects. Identified projects included potential future projects as well as projects that have been recently implemented or are ongoing. Additional input from the community was received for ranking and prioritization. Potential projects were classified into one of three categories to describe implementation time horizon: In-Progress, Near-Term, and Long-Term. Finally, of the 28 identified projects, a portfolio of 13 projects was created to describe the prioritized projects. Those projects are summarized below:

Table 1 - Project Portfolio Summary (Part I of 3)

Priority Rating	Project Name	Description
High	County Stormwater Funding/Utility Study	To implement many of the other projects and the sheer number and scale of projects that will be needed, as well as on-going maintenance, additional funding will be needed. This project would serve to study different funding options, such as implementing a stormwater utility fee or additional apportionment from the general fund and make a recommendation to the county. Identifying funding to improve stormwater drainage and land management preparation for flooding was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR1).
High	Dune Restoration	Projects to plant and stabilize dunes and enforce "keep off the dunes" during peak visitor times, across the island. Installing plantings and sand fencing on dunes on public lands and establish grant programs to support installation of similar projects on private land. Initial installation could occur immediately and then will require ongoing maintenance. This project was ranked the highest by the citizen survey.
High	Storm Drainage Study and Improvements - Avon	Drainage study and improvement of roadside swales, culverts, and grading along NC 12 from the post office to Ace Hardware. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway. There is also potential for the inclusion of nature-based solutions. As a result of the well known and frequent drainage issues in this area, this project was given high priority.

Table 2 - Project Portfolio Summary (Part 2 of 3)

Priority Rating	Project Name	Description
Medium	Storm Drainage Maintenance (Ditch Maintenance)	Work with private landowners and NCDOT to ensure maintenance of drainage ditches and maximize the capability of existing drainage systems and minimize flooding from rainfall and poor drainage. This was identified in the Outer Banks Hazard Mitigation Plan (Action # DAR11) and was identified as a common concern in the citizen survey.
Medium	Backup Communications	Establish redundant communications paths that do not rely on ground-based fiber optic cables. Solutions might include acquisition and installation of satellite equipment to allow cellular providers to maintain service, installation of commercial satellite equipment to provide data transmission capabilities, and access to satellite based internet service from companies like Starlink. Nonterrestrial solutions like these will provide connectivity with the mainland to provide backup communications when service from the single CenturyLink fiber is disrupted. Damage to the fiber line is especially disruptive on Hatteras Island because repairs cannot occur until flooding has receded. Reliable non terrestrial communications are vital not only for emergency response but also to the economy.
Medium	Engineered Wetland – Buxton	Building a constructed wetland to provide additional flood storage and water quality treatment in the Buxton watershed and alleviate some strain on the storm drainage system.
Medium	Establish County Stormwater Management Taskforce	Establishing a public/private taskforce to focus on stormwater issues, including rainfall flooding, and to address stormwater improvements and projects from a joint perspective. It is critical that this taskforce include representatives from NCDOT and the county planning department as significant coordination and cooperation will likely be needed from both parties to address some of the most pressing issues of flooding along NC 12.
Medium	Establish Resilience Hubs	Establish sites that are well known and trusted by the community and have resilient energy and communications systems, and are able to provide programs and services needed to sustain the community before, during and after a disaster. These Hubs could be fully developed at fire stations, county facilities, or faith based locations that are well known and protected during extreme weather events.
Medium	Living Shorelines – Cape Hatteras Secondary School	Living shorelines use plantings and other natural elements such as oyster bags or rock to stabilize the shoreline. This project proposes to design and install approximately 300 LF of living shoreline adjacent to Cape Hatteras Secondary School in Buxton. A living shoreline at this location can also be utilized as a teaching tool and public education resource. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).

Table 3 - Project Portfolio Summary (Part 3 of 3)

Priority Rating	Project Name	Description
Medium	Living Shorelines – Frisco to Hatteras Village	Living shorelines use plantings and other natural elements such as oyster bags or rock to stabilize the shoreline. This project proposes to design and install approximately 1,400 LF of living shoreline along NC 12 between the communities of Frisco and Hatteras Village. A living shoreline at this location serves to protect the soundside of a vulnerable section of NC 12, that was also identified as a hotspot in the citizen survey. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).
Medium	Storm Drainage Study and Improvements - Buxton	Drainage study and improvement of roadside swales, culverts, grading along the turn in NC 12 and Old Lighthouse Road. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Medium	Storm Drainage Study and Improvements – Hatteras Village	Drainage study and improvement of roadside swales, culverts, grading throughout Hatteras Village, specifically along NC 12, Eagle Pass Road, and Pole Road. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Medium	Storm Drainage Study and Improvements – Tri-Villages (Rodanthe, Waves, and Salvo)	Drainage study and improvement of roadside swales, culverts, grading along NC-12 through the Tri-Villages and specifically in the Wind Over Waves area. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.

Acknowledgements

The view and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government or the National Fish and Wildlife Foundation and its funding sources. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Government, or the National Fish and Wildlife Foundation or its funding sources.

Table of Contents

List of Tables

Appendices

Data Attachments

GIS Maps and Data

Previous Study Reports

Introduction

The North Carolina Resilient Coastal Communities Program is a four-phase program to support communities in planning for and creating greater resiliency to coastal hazards. This report summarizes the efforts of phases one and two of the program. This included community engagement and a risk and vulnerability assessment in phase 1 and planning, project identification and prioritization in phase 2. Phases 3 and 4 are planned for the future and include engineering, design, and implementation of select priority projects.

Resiliency is vital to the health, safety, and prosperity of North Carolina's coastal communities as increasingly intense storm events and sea level rise become more prevalent. Planning to strengthen our coastal community's ability to withstand storm events and reduce flooding risk requires a multipronged and multidisciplinary approach to identify risks on a local level and developing solutions that mitigate risk and enable communities to respond and recover more quickly.

Dare county elected to focus the program on Hatteras Island and the communities located there. Hatteras Island faces extreme vulnerability to natural hazards due to its location as a barrier island in the Atlantic Ocean, the scarcity of uplands along the island, the naturally shifting shores, and limited access. There is one road, NC-12, that serves as the primary road through much of the island and has been breached or otherwise made impassible in many storm events, cutting off access to portions of the island. Hatteras Island has a population of about 4,500 people. Hatteras Island is also home to Cape Hatteras National Seashore and Pea Island National Wildlife Refuge.

Phase 1

Step 1: Develop a Community Action Team

The community action team (CAT) was selected to represent a diverse group of stakeholders with extensive experience responding to the hazards faced by Dare County. The team includes county employees and elected officials who serve to represent the community and are intimately aware of the specific needs of the community. County employees also assisted in recommending other individuals to join the CAT. Representatives from utility services and the department of transportation were included because of the importance of their services during times of disaster and the high vulnerability that they face. A large percentage of Hatteras Island is federally protected lands so representatives of the federal agencies were included as well. Finally, because a focus of this program is on creating nature-based resiliency solutions, representatives of environmental organizations working in the area were included.

Table 4 - Community Action Team (Part 1 of 2)

Name	Organization	Position
Barton Grover	Dare County - Planning	Grants & Waterways Administrator
Donna Creef	Dare County - Planning	Planning Director - Retired
Drew Pearson	Dare County - Emergency Management	DCEM Director
James Wooten	Dare County - Emergency Management	DCEM Planner
Danny Couch	Dare County	County Commissioner
Win Bridgers	NCDOT Division One	Deputy Division Engineer
Ronnie Sawyer	NCDOT Division One	Division Maintenance Engineer
Catherine Peele	NCDOT Ferry Division	Planning and Development Manager
David Hallac	National Park Service	Superintendent, Cape Hatteras NS
Mark Dowdle	National Park Service	Deputy Superintendent, Outer Banks Group

Table 5 - Community Action Team (Part 2 of 2)

Name	Organization	Position
Michael Barber	National Park Service	Public Affairs Specialist, Outer Banks Group
Scott Lanier	Fish and Wildlife	Refuge Manager, Alligator River NWR
Arthur Beyer	Fish and Wildlife	Field Coordinator, Alligator River NWR
Sarah Toner	Fish and Wildlife	Wildlife Refuge Specialist
Susan Flythe	Cape Hatteras Electric Cooperative	EVP & GM
Pat Irwin	Dare County Water Department	Public Utility Director
Erin Fleckenstein	Coastal Federation	Coastal Scientist and Regional Manager
Lora Eddy	The Nature Conservancy/Dare Soil & Water	Community Resilience Specialist

The CAT had three formal meetings during the development of this report. Meeting agendas and attendance lists can be found in Appendix A. The meetings were held on the following dates.

- October 7, 2021 – *Virtual*
- October 26, 2021 – *In Person at Dare County Emergency Management Office, with Virtual Option*
- February 2, 2022 – *Virtual*

Step 2: Set Vision and Goals

The community action team collaborated to develop a community vision and goals for the risk and vulnerability assessment efforts. The vision was developed with the intent to capture not only the natural hazards and challenges that Hatteras Island faces but also to celebrate the things that make the island a desirable place to live now and in the future.

VISION STATEMENT: A RESILIENT HATTERAS ISLAND IS A MIX OF NATURAL AND BUILT COMMUNITIES WHERE THE PEOPLE, ECONOMY, AND ECOSYSTEMS ARE BETTER ABLE TO RECOVER, POSITIVELY ADAPT TO, AND THRIVE AMID CHANGING CONDITIONS AND CHALLENGES, INCLUDING DISASTERS AND CLIMATE CHANGE; TO MAINTAIN QUALITY OF LIFE, HEALTHY GROWTH, AND DURABLE INFRASTRUCTURE SYSTEMS; WHILE CONSERVING RESOURCES FOR PRESENT AND FUTURE GENERATIONS.

The following goals were established to guide the development of potential projects to support the creation of projects that will not only serve the community but also meet the program intent and lend themselves to future grant efforts.

GOALS:

- IDENTIFY AREAS OF CONCERN IN RELATION TO SEA LEVEL RISE AND CRITICAL INFRASTRUCTURE. USING 1 FT AND 80CM (ROUGHLY 2.5') PROJECTED RISE.
- DEVELOP PLAN TO MINIMIZE INFRASTRUCTURE VULNERABILITIES AND PROVIDE REDUNDANCY IN CRITICAL INFRASTRUCTURE
- INCORPORATE THE USE OF NATURE-BASED SOLUTIONS TO MITIGATE THE IMPACT OF NATURAL HAZARDS BY CONSIDERING A NATURE-BASED COMPONENT IN EACH PROJECT, TO BE IMPLEMENTED AS DETERMINED TO BE ECONOMICALLY FEASIBLE

- IDENTIFY POPULATIONS AND LOCATIONS WITH HEIGHTENED VULNERABILITY TO FUTURE NATURAL HAZARDS, DEVELOP ENGAGEMENT AND EDUCATION STRATEGIES FOR THESE GROUPS, AND INCORPORATE THIS FEEDBACK INTO THE RESILIENCY PLAN
- RANK AND PRIORITIZE LONG TERM VIABILITY OF PROJECTS
- PRIORITIZE PUBLIC OUTREACH, EDUCATION, AND AWARENESS

Step 3: Review Existing Local Plans and Efforts

The Outer Banks Regional Hazard Mitigation Plan (OBXHMP) was recently completed in 2020 and was utilized as the basis for much of the risk assessment. The planning area for the Outer Banks Regional Hazard Mitigation Plan covers Currituck County and Dare County, including the incorporated towns. The hazards identified in the Outer Banks plan include natural and man-made disasters and risks. For the purpose of this resiliency study, a focus was placed on the natural disasters profiled in the plan. An excerpt from the Outer Banks Regional Hazard Mitigation Plan is attached in Appendix B.

In addition, Table 6 presents a complete list of documents that were reviewed as part of this effort.

Table 6 - Resource List (Part 1 of 2)

Document	Publication Date
Shoreline Erosion Assessment and Alternatives for the Avon Beach Restoration	November 2020
2009 Dare County Land Use Plan Update	February 24, 2011
Hatteras Island Economic Impact	June 20, 2013
A Study of the Economic Impacts of Oregon Inlet Navigability to Dare County, the Surrounding Region, and the state of North Carolina	May 2014
North Carolina Sea Level Rise Assessment Report	March 31, 2015
Dare County Repetitive Loss Area Analysis	December 2015
North Carolina 2019 Oceanfront Setback Factors & Long-Term Average Annual Erosion Rate Update Study	January 16, 2019
Dare County 2020 Economic Development & Diversification Strategic Plan	December 19, 2016
Dare County Repetitive Loss Area Analysis 2020 Update	September 21, 2020
Shoreline Erosion Assessment and Plan for Beach Restoration Rodanthe and Buxton Areas	November 2013
Coastal Vulnerability Assessment of Cape Hatteras National Seashore (CAHA) to Sea-Level Rise	
Dare County Stormwater Master Plan	June 4, 2001
Dredging Study	April 2018
Beach Nourishment Executive Summary	November 2016
The Economic Impacts of the Recreational Bluefin Tuna Fishery in Hatteras, North Carolina	February 2002
Economic Value and Impact of Visitation to Cape Hatteras National Seashore: Addressing Onsite Sampling	
Dare County Regional Airport Economic Impact Assessment	June 2019
Hatteras Village Resilience Evaluation and Needs Assessment	April 2018
Hurricane Matthew Resilient Redevelopment Plan - Dare County	May 2017
Inventory of Coastal Engineering Projects in Cape Hatteras National Seashore	March 2013
Report on Costs, Benefits, and Management Issues related to Maintaining North Carolina's Shallow Draft Navigation Channels	November 2005
NC 12 Feasibility Study Hatteras Village	February 2016

Table 7 - Resource List (Part 2 of 2)

Document	Publication Date
A Multi-Hazard Vulnerability Assessment of Coastal Development along Cape Hatteras National Seashore	September 2016
Outer Banks Regional Hazard Mitigation Plan	June 2020
Assessing coastal community resilience: a pilot project in North Carolina	May 2018
Identify Cultural Resources Sites Affected by Sea Level Rise at Cape Hatteras National Seashore	
Cape Hatteras National Seashore Sediment Management Framework Final Environmental Impact Statement	March 2021
Channel Maintenance and Dredge Material Report: Dare County, North Carolina	March 2021

Step 4: Develop a Community Engagement Strategy

The Hatteras Island community is an unincorporated area of Dare County, made up of seven villages- Rodanthe, Waves, Salvo, Avon, Buxton, Hatteras, and Frisco. The initial plan was to hold town hall style in person meetings to gather community input regarding opinions on different resiliency approaches and areas in which resiliency efforts are most needed. However, due to the COVID-19 pandemic, it was decided that in person meetings were not a viable option. There was successful in-person community engagement in the development of the Outer Banks Hazard Mitigation Plan, which occurred prior to the COVID-19 pandemic, and was heavily relied upon in this assessment report. In an effort to prevent redundancy and in response to the pandemic, surveys were utilized to get maximum community insight with minimal public health risk and effort required of community members.

An initial survey was conducted to gather community insight as to what hazards are most important to the community as well as general attitudes regarding potential resiliency efforts and types of projects. The survey was promoted via email list-serv, the Dare County website, flyers in public locations, local publications, and a geo-targeted Facebook ad campaign.

The survey was published November 24th, 2021 and closed December 17th, 2021. A total of 1,121 responses were received with 819 of those being permanent residents of Dare County, 314 permanent residents of Hatteras Island, and 212 non-resident Hatteras Island property owners. See Appendix C for the full survey and results. Some key learnings from the survey included

- ~40% of residents/property owners unsure if property has a FEMA elevation certificate.
- ~41% of residents/property owners unsure if structure is elevated above the FEMA Base Flood Elevation
- The three most significant threats (per public perception) are Beach Erosion, Tropical Weather Systems, and Flooding – Heavy Precipitation
- The three least significant threats (per public perception) are Extreme Temperatures, Drought, and Saltwater Intrusion
- Ability of Hatteras Island to withstand and recover from minor storms and limited flooding
    - ~79% able or completely able
    - ~15% unable or somewhat unable
- Ability of Hatteras Island to withstand and recover from major storms and extensive flooding
    - ~47% able or completely able
    - ~33% unable or somewhat unable
- Demographic Summary
    - ~82% older adults
    - ~15% low-income individuals
    - ~13% People with disabilities
    - ~3% People of racial or ethnic minorities

- An open-ended question asking which areas are most affected by environmental issues was used to identify hot spot locations. There was a total of 710 responses. Locations that were located on Hatteras Island and received at least 5 mentions are listed below.
    - Ocean View Drive Avon
    - Mirlo Beach
    - NC 12 - Entering Hatteras Village
    - Buxton Motels
    - NC 12 - south of Basnight Bridge
    - NC 12- near the Food Lion in Avon/Kinakeet
    - Entrance to Wind Over Waves
    - Cottage Ave/Tower Circle/Ocean Drive/Old Lighthouse Rd
    - Eagle Pass Rd
    - NC 12 - between Hatteras and Frisco
    - Pole Road to Hatteras Inlet
    - NC 12 - S Curves/North of Rodanthe
- The five most effective flood protection measures (per public perception) are Elevating Structures, Resilient Construction Standards, Utilities Redundancy & Backup, Resiliency Hubs for post-storm power and supplies, and Land Use Planning
- The five least effective flood protection measures (per public perception) are Shallow Groundwater pumping, Engineered Beach (Beach nourishment), Low Impact Development (LID), Enhanced shoreline revetments (rock/concrete erosion protection), Stormwater wetlands and ponds (SCMs)
- Another open-ended response was given for citizens to express any additional concerns. There was a total of 216 individual responses, with the following themes
    - Development – overcrowding
    - Taxes & affordable housing
    - Septic systems & fill on new construction lots
    - Beach nourishment
    - Rising groundwater
    - Assistance raising structures and bringing older structures to code
    - Drainage ditch maintenance
    - NC 12 – maintenance, replace with bridge sections

Following development of the project list by the CAT, a second citizen survey was conducted for further public input on prioritization of the proposed project list. Individuals who submitted their contact information at the end of the first survey were sent this second follow up survey. The survey was opened March 1st, 2022 and closed March 9th, 2022. A total of 134 responses were received. The survey listed each project idea and asked respondents to rank them as Lowest Priority, Low Priority, Neither Low Priority nor High Priority, High Priority, or Highest Priority. See Appendix C for the full survey and results. Discussion of the results is included in the following Phase 2 Project Prioritization section.

Step 5: Map Critical Assets and Natural Infrastructure

The critical assets selected for mapping included public buildings, emergency response facilities, and critical infrastructure. A shapefile of critical assets that were identified in the Outer Banks Hazard Mitigation Plan was obtained and used as the basis of the critical asset inventory. Additional critical assets were added from information obtained via NC OneMap, critical transportation features, and natural features that are at the core of the tourism industry Hatteras Island relies upon. A full list of critical assets and infrastructure mapped is included in Table 8, below, and mapped on Exhibit 2 found in Appendix D.

Table 8 - Critical Assets (Part 1 of 3)

Asset ID #	Asset Type	Location	Village	Ownership	Hazards	Estimated Value	100-yr flood plain	500-yr flood plain	1' Sea Level Rise	80 cm Sea Level Rise
1	NC Highway 12			Public	flooding, ocean over wash, unable to travel		n/a	n/a	n/a	n/a
2	Cape Hatteras Reverse Osmosis and Anion Exchange Water Plant	50225 Water Association Rd	Frisco	Public	flooding, high winds	$1.2 million	no	no	no	no
3	Joseph "Mac" Midgett Reverse Osmosis Water Plant	23697 NC 12 Hwy	Rodanthe	Public	flooding, high winds	$989,858	no	no	no	no
4	Cape Hatteras Elementary School	47500 Middle Ridge	Buxton	Public	flooding, high winds	$8.95 million	no	no	no	no
5	Cape Hatteras Secondary School	48576 Highway 12	Buxton	Public	flooding, high winds	$18.53 million	yes	yes	no	yes
6	East Albemarle Regional Library - Hatteras Branch Library	57709 Highway 12	Hatteras	Public	flooding, high winds	$1.06 million	yes	yes	no	yes
7	Avon Volunteer Fire Department, Inc.	40159 Harbor Rd.	Avon	Public	flooding, high winds	$1.85 million	no	no	no	no
8	Buxton Fire Prevention Association, Inc.	47152 NC Hwy 12	Buxton	Public	flooding, high winds	$1.24 million	no	no	no	no
9	Chicamacomico Banks Fire Department/Dare County Emergency Medical Services Station 6	24297 Atlantic Dr.	Rodanthe	Public	flooding, high winds	$1.56 million	yes	yes	no	yes
10	Chicamacomico Banks Fire Department/Salvo Fire Department Station 48	27209 Roth Rd.	Salvo	Public	flooding, high winds	$957,229	no	yes	no	no
11	Frisco Fire Prevention Association, Inc.	52470 NC Hwy 12	Frisco	Public	flooding, high winds	$485,231	yes	yes	no	yes
12	Hatteras Fire Protective Association, Inc./Dare County Sheriff's Department - Hatteras Substation	57717 NC Hwy 12	Hatteras	Public	flooding, high winds	$378,018	yes	yes	no	yes
13	Hatteras Island Rescue Squad Station 35	48103 NC Hwy 12	Buxton	Public	flooding, high winds	$495,420	no	no	no	no
14	Dare County Emergency Medical Services Station 3	50346 NC Hwy 12	Frisco	Public	flooding, high winds	$510,539	no	no	no	no

Table 9 - Critical Assets (Part 2 of 3)

Asset ID #	Asset Type	Location	Village	Owner ship	Hazards	Estimated Value	100-yr flood plain	500-yr flood plain	1' Sea Level Rise	80 cm Sea Level Rise
15	US Coast Guard Station Hatteras	59248 Coast Guard Rd	Hatteras	Public	flooding, high winds	$2.08 million	no	no	no	no
16	NC DOT Ferry Division Hatteras Terminal	59063 NC 12 Hwy	Hatteras	Public	flooding, high winds, erosion	$858,137	no	yes	no	yes
17	Hatteras Village Clinic/Helo Landing Pad	57635 NC 12 Hwy	Hatteras	Public	flooding, high winds	$582,026	yes	yes	no	yes
18	Hatteras Village Water Tower	56170 Odens Ct	Hatteras	Public	flooding, high winds	$530,200	yes	yes	no	yes
19	Hatteras Community Center	56658 NC 12 Hwy	Hatteras	Public	flooding, high winds	$623,657	yes	yes	no	no
20	NPS Billy Mitchell Airstrip	53252 Billy Mitchell Rd	Frisco	Public	flooding, high winds	$487,200	no	no	no	no
21	Frisco Well Head/Pumping Station	51512 NC 12 Hwy	Frisco	Public	flooding, high winds	$91,400	yes	yes	no	yes
22	Frisco Pump Station	51212 NC 12 Hwy	Frisco	Public	flooding, high winds	$107,600	yes	yes	no	yes
23	Frisco Satellite Offices - DC	50347 NC 12 Hwy	Frisco	Public	flooding, high winds	$955,400	yes	no	no	no
24	Buxton Water Tower and Treatment Plant	49815 NC 12 Hwy	Buxton	Public	flooding, high winds	$912,449	yes	yes	no	no
25	Buxton Public Works Yard	47027 Buxton Back Rd	Buxton	Public	flooding, high winds	$81,220	yes	yes	no	no
26	Fessenden Annex	47017 Buxton Back Rd	Buxton	Public	flooding, high winds	$140,562	yes	yes	no	no
27	Fessenden Center	46830 NC 12 Hwy	Buxton	Public	flooding, high winds	$724,924	yes	yes	no	no
28	Avon Water Tower and Pump Station	40162 Harbor Rd	Avon	Public	flooding, high winds	$630,100	yes	yes	no	no
29	Rodanthe Water Well/Pump	24203 Seabreeze Ct	Rodanthe	Public	flooding, high winds	$112,800	yes	yes	no	no
30	Rodanthe Water Tower	24034 NC 12 Hwy	Rodanthe	Public	flooding, high winds	$223,711	yes	yes	no	no
31	Emergency Ferry Dock/Helo LP - Rodanthe	23170 Myrna Peters Rd	Rodanthe	Public	flooding, high winds	$496,000	yes	yes	no	yes
32	RWS Community Center and Jug Handle Bridge Approach	23646 NC 12 Hwy	Rodanthe	Public	flooding, high winds, erosion	$361,860	yes	yes	no	no
33	Beach Shoreline			Public/ Private	flooding, erosion		n/a	n/a	n/a	n/a
34	Soundside Marshes			Public/ Private	flooding, erosion		n/a	n/a	n/a	n/a
35	Dunes			Public/ Private	flooding, erosion		n/a	n/a	n/a	n/a
36	Basnight Bridge			Public	high winds	$252 million	n/a	n/a	n/a	n/a
37	Oregon Inlet			Public	inlet filling in		n/a	n/a	n/a	n/a

Table 10 - Critical Assets (Part 3 of 3)

Asset ID #	Asset Type	Location	Village	Ownership	Hazards	Estimated Value	100-yr flood plain	500-yr flood plain	1' Sea Level Rise	80 cm Sea Level Rise
38	Hatteras Inlet			Public	inlet filling in		n/a	n/a	n/a	n/a
39	Rodanthe "Jug Handle" Bridge			Public	high winds	$145.33 million	n/a	n/a	n/a	n/a
40	Drainage Channel/Ditches			Public/ Private	flooding		n/a	n/a	n/a	n/a
41	CenturyLink Fiber connection			Private	flooding, high winds		n/a	n/a	n/a	n/a
42	National Park Service - Hatteras Island Visitor Center	46500 Lighthouse Road	Buxton	Public	flooding, high winds	$7.71 million	yes	yes	no	no

Step 6: Conduct a Risk and Vulnerability Assessment

Physical Vulnerability

The Outer Banks Regional Hazard Mitigation Plan identified 23 different hazards. The community action team chose to focus on the hazards of flooding, storm surge, sea level rise, and erosion. Flooding hazards were determined by the Special Flood Hazard Areas mapped by FEMA as part of the National Flood Insurance Program and maintained in North Carolina by the North Carolina Floodplain Mapping Program. The current flood maps for Hatteras Island were made effective 6/19/2020. Storm surge was assessed as the storm surge inundation associated with a category 2 hurricane in the National Storm Surge Hazard Maps – Version 2 by NOAA's National Hurricane Center. Sea level rise data was derived from two sources, the NOAA Sea Level Rise Viewer and the North Carolina Sea Level Rise Impact Study. NC Division of Coastal Management 2020 Erosion and Accretion rates were used for erosion mapping. These hazards were mapped with the critical assets and large-scale exhibits are included in Appendix D.

Social Vulnerability

The Centers of Disease Control and Prevention (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) develops a Social Vulnerability Index (SVI) based off fifteen census-derived factors. The purpose of the SVI is to help identify communities that may be more vulnerable and require more assistance in responding to disaster. The SVI has four themes, Socioeconomic Status, Household Composition, Race/Ethnicity/Language, and Housing/Transportation. Socioeconomic status is determined by the factors of poverty, unemployed, per capita income, and no high school diploma. Household composition/disability is comprised of the factors of aged 65 and over, aged 17 and younger, single-parent household, and aged 5 and over with a disability. Race/Ethnicity/Language is determined by the factors of minority and English language ability. Housing type/Transportation is comprised of the factors of multi-unit, mobile homes, crowding, no vehicle, and group quarters. The prepared Dare County Map can be found in Appendix E.

The SVI is prepared by census tract and Hatteras Island is comprised of one census tract. The CDC overall SVI score for Hatteras Island is 0.7481 (moderate to high vulnerability). For the socioeconomic theme Hatteras Island scores 0.7299 (moderate to high vulnerability), household composition/disability theme scores 0.808 (high vulnerability), minority language theme score is 0.2948 (low to moderate vulnerability), and housing/transportation score is 0.8015 (high vulnerability). The SVI scores are supported by the self-identified demographics in the citizen survey and known hazards of living on a barrier island. Natural disaster is a significant source of vulnerability that affects everyone on Hatteras Island. Older age was also a significant factor that was shared by many of the respondents in the survey. Additionally, based on the citizen survey, continued availability of affordable housing for permanent residents and support for longtime residents to stay in the face of increased development and rising taxes are two specific concerns of social vulnerability.

Critical Asset Vulnerability Assessment

In addition to determining the overall social vulnerability of the island population, the vulnerability of each critical asset was assessed using a vulnerability index, combining exposure, sensitivity, and adaptive capacity. The table below documents the vulnerability score of each asset. The vulnerability score is calculated by adding the exposure score and sensitivity score and subtracting the adaptive capacity.

Exposure – all of HI is vulnerable and highly exposed to the hazards of concern, so the exposure score is relative. Exposure was determined based on the FEMA flood zones and sea level rise. An exposure score of 0 was assigned to assets located entirely outside of the flood zones and not impacted by sea level rise up to 80 cm. A value of 1 was assigned to assets in the 500-year flood zone, 2 was assigned to assets in the 100-year flood zone, 2.5 was assigned to assets in the 100-year flood zone and 80 cm of sea level rise, and 3 was assigned to assets in the 100-year flood zone and 1' of sea level rise.

Sensitivity – the sensitivity score seeks to quantify to what degree an asset is impacted by the hazards. The scores were primarily determined by the sensitivity to flooding (from any source, i.e. rainfall, tropical storm, storm surge) and typical design standards per service use classification. A score of 1 was given to assets that were not likely to experience damage or a service disruption in a flooding event, a 2 for assets that may be affected, and a 3 for assets that would likely be damaged or have a service disruption in a flooding event. No assets were given a score of 0 due to the unique nature of Hatteras Island.

Adaptivity – man made infrastructure tends to be static and natural infrastructure is typically much more dynamic, the adaptivity score seeks to capture the ability of assets to change in response to a hazard. No consideration was given to the likelihood or frequency of being impacted by a hazard, but rather the asset's ability to respond to the hazard. Natural infrastructure was scored the highest with large or extensive man-made infrastructure scoring the lowest.

Table 11 - Critical Asset Vulnerability Assessment (Part 1 of 2)

Asset ID #	Asset	Exposure Score (0-3)	Sensitivity Score (0-3)	Adaptive Capacity (3-0)	Vulnerability Score (0-6)
1	NC Highway 12	3	3	1	5
2	Cape Hatteras Reverse Osmosis and Anion Exchange Water Plant	0	2	1	1
3	Joseph "Mac" Midgett Reverse Osmosis Water Plant	0	2	1	1
4	Cape Hatteras Elementary School	0	3	1	2
5	Cape Hatteras Secondary School	2.5	3	1	4.5
6	East Albemarle Regional Library - Hatteras Branch Library	2.5	3	1	4.5
7	Avon Volunteer Fire Department, Inc.	0	3	1	2
8	Buxton Fire Prevention Association, Inc.	0	3	1	2
9	Chicamacomico Banks Fire Department/Dare County Emergency Medical Services Station 6	2.5	3	1	4.5
10	Chicamacomico Banks Fire Department/Salvo Fire Department Station 48	1	3	1	3
11	Frisco Fire Prevention Association, Inc.	2.5	3	1	4.5
12	Hatteras Fire Protective Association, Inc./Dare County Sheriff's Department - Hatteras Substation	2.5	3	1	4.5
13	Hatteras Island Rescue Squad Station 35	0	3	1	2

Table 12 - Critical Asset Vulnerability Assessment (Part 2 of 2)

Asset ID #	Asset	Exposure Score (0-3)	Sensitivity Score (0-3)	Adaptive Capacity (3-0)	Vulnerability Score (0-6)
14	Dare County Emergency Medical Services Station 3	0	3	1	2
15	US Coast Guard Station Hatteras	0	2	1	1
16	NC DOT Ferry Division Hatteras Terminal	2.5	1	1	2.5
17	Hatteras Village Clinic/Helo Landing Pad	2.5	3	1	4.5
18	Hatteras Village Water Tower	2.5	1	1	2.5
19	Hatteras Community Center	2	3	1	4
20	NPS Billy Mitchell Airstrip	0	2	1	1
21	Frisco Well Head/Pumping Station	2.5	2	1	3.5
22	Frisco Pump Station	2.5	2	1	3.5
23	Frisco Satellite Offices - DC	2	3	1	4
24	Buxton Water Tower and Treatment Plant	2	1	1	2
25	Buxton Public Works Yard	2	2	1	3
26	Fessenden Annex	2	3	1	4
27	Fessenden Center	2	3	1	4
28	Avon Water Tower and Pump Station	2	2	1	3
29	Rodanthe Water Well/Pump	2	2	1	3
30	Rodanthe Water Tower	2	1	1	2
31	Emergency Ferry Dock/Helo LP - Rodanthe	2.5	1	1	2.5
32	RWS Community Center and Jug Handle Bridge Approach	2	3	1	4
33	Beach Shoreline	3	3	3	3
34	Soundside Marshes	3	3	3	3
35	Dunes	3	3	3	3
36	Basnight Bridge	3	1	0	4
37	Oregon Inlet	3	2	2	3
38	Hatteras Inlet	3	2	2	3
39	Rodanthe "Jug Handle" Bridge	3	1	0	4
40	Drainage Channel/Ditches	3	3	2	4
41	CenturyLink Fiber connection	3	1	0	4
42	National Park Service - Hatteras Island Visitor Center	2	3	2	3

An asset inventory summarizing critical infrastructure and asset values by sector was prepared from the NC Buildings Footprint dataset from the North Carolina Floodplain Mapping Program. Note that the building footprint dataset counts each structure as an individual asset, where a facility is comprised of several buildings each building has been counted individually.

Table 13 - Estimated Asset Values

Sector	# of Critical Assets at Risk	Asset Value
Food and Agriculture	0	---
Banking and Finance	8	$4,048,509
Chemical and Hazardous	0	---
Commercial	323	$75,624,242
Communications	0	---
Critical Manufacturing	24	$1,810,599
EM	0	---
Healthcare	6	$2,103,984
Government Facilities	31	$2,756,582
Nuclear Reactors, Materials and Waste	0	---
Postal and Shipping	0	---
Transportation Systems	0	---
Energy	7	$289,387,377
Emergency Services	10	$2,397,892
Water	26	$3,640,001
Education	5	$28,156,000

Phase 2

Potential Solutions

Through a review of the resources and previous studies, initial potential resiliency projects were identified. Then the Community Action Team brainstormed additional project ideas and finally the citizen survey results were used to guide the chosen implementation locations and prioritization of projects. Timelines of Long-Term, Near-Term, and currently In-Progress were assigned to each project. Currently in progress projects were included in the initial project list because they play an important role in developing resiliency on Hatteras Island and many of them have not been in progress long enough for the effect of the efforts to be evident yet. The initial project list sorted by time horizon is listed below.

Table 14 -Project List (Part 1 of 4)

Time Horizon	Project Name	Project Description
In-Progress	Beach Nourishment - Avon & Buxton	Beach nourishment for Avon beach and renourishment for Buxton, project is coming up summer 2022.
In-Progress	Elevate Structures	Provide assistance to elevate structures and homes that are currently below the BFE or are repetitive loss properties, to meet current ordinance requirements and protect against flooding and sea level rise. Repetitive loss areas are identified in the 2020 Dare Repetitive Loss Area Analysis Update. Fourteen homes on Hatteras Island are anticipated to be elevated over the next two years through FEMA's Hazard Mitigation Grant Program. An additional twenty-two home elevation applications have been submitted by Dare County for Hatteras residents.

Table 15 - Project List (Part 2 of 4)

Time Horizon	Project Name	Project Description
In-Progress	Flood Gauges	Install flood gauges at each village and areas subject to frequent flooding in order to better monitor and alert individuals to changing conditions. This project was identified in the Outer Banks Hazard Mitigation Plan (Action #DAR9). Dare County will be installing five new flood gauges on Hatteras Island during 2022 to add to the existing four flood gauges already located on the island.
In-Progress	Stormwater Master Plan Study	Update the 2001 Dare County Stormwater Master Plan with a focus on the Hatteras Island Villages. This was identified in the Outer Banks Hazard Mitigation Plan (Action #DAR3). Dare County will begin updating the Stormwater Master Plan in 2022.
In-Progress	Stormwater/Flood Ordinance Review	Review and recommendation of stormwater ordinances for unincorporated Dare County. Dare County will review and recommend updates to stormwater ordinance as part of the Stormwater Master Plan update.
In-Progress	Flood Insurance Education and Outreach Program	In the citizen survey 11% of respondents indicated that their residence was not elevated above the BFE and 41% were unsure; an education and outreach program seeks to educate those who are unsure. Dare County currently educates the public on flood insurance via the "Low Risk is not No Risk" campaign, which informs the public about flood risk and flood insurance via social media, traditional forms of media, and other forms of public outreach.
Near-Term	County Stormwater Funding/Utility Study	To implement many of the other projects and the sheer number and scale of projects that will be needed, as well as on-going maintenance additional funding will be needed. This project would serve to study different funding options and recommend to the county. Identifying funding to improve stormwater drainage and land management preparation for flooding was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR1)
Near-Term	Storm Drainage Study/Improvement - Avon	Drainage study and improvement of roadside swales, culverts, grading along NC 12 from the post office to Ace Hardware. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Near-Term	County Resiliency Staff Position	Establish a full time staff position to promote resiliency efforts, seek funding, and provide support for projects.
Near-Term	Engineered Wetland - Peter's Ditch Area	Building a constructed wetland to provide additional flood storage and water quality treatment in the Peter's Ditch watershed and alleviate some strain on the storm drainage system.
Near-Term	Establish County Stormwater Management Taskforce	Establishing a public/private taskforce to focus on stormwater issues, including rainfall flooding, and to address stormwater improvements and projects from a joint perspective.

Table 16 - Project List (Part 3 of 4)

Time Horizon	Project Name	Project Description
Near-Term	Establish Resilience Hubs	Establish sites that are well known and trusted by the community and have resilient energy and communications systems, and are able to provide programs and services needed to sustain the community before, during and after a disaster. These Hubs could be fully developed at fire stations, county facilities, or faith-based locations that are well known and protected during extreme weather events
Near-Term	Living Shorelines - Cape Hatteras Secondary School	Adjacent to Cape Hatteras Secondary School- a living shoreline at this location can also be utilized as a teaching tool and source of public education. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).
Near-Term	Living Shorelines- Frisco/Hatteras Village	Between Frisco and Hatteras Village - a living shoreline at this location serves to protect the soundside of a vulnerable section of NC 12 that was also identified as a hotspot in the citizen survey. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).
Near-Term	Living Shorelines- Rodanthe Harbor	Rodanthe Harbor - a living shoreline at this location provides some additional stabilization and protection at the emergency ferry route and helipad. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).
Near-Term	Storm Drainage Improvement - Buxton	Drainage study and improvement of roadside swales, culverts, grading along the turn in NC 12 and Old Lighthouse Road. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Near-Term	Storm Drainage Improvement - Tri-Villages (Rodanthe, Waves, Salvo)	Drainage study and improvement of roadside swales, culverts, grading along NC-12 through the Tri-Villages and specifically in the Wind Over Waves area. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Near-Term	Storm Drainage Maintenance (Ditch Maintenance)	Work with private landowners and NCDOT to ensure maintenance of drainage ditches and maximize the capability of existing drainage systems and minimize flooding from rainfall and poor drainage. This Drainage study and improvement of roadside swales, culverts, grading along NC-12 through the Tri-Villages and specifically in the Wind Over Waves area. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.was identified in the Outer Banks Hazard Mitigation Plan (Action # DAR11) and was identified as a common concern in the citizen survey.

Table 17- Project List (Part 4 of 4)

Time Horizon	Project Name	Project Description
Near-Term	Storm Drainage Study/Improvement - Hatteras Village	Drainage study and improvement of roadside swales, culverts, grading throughout Hatteras Village, specifically along NC 12, Eagle Pass Road, and Pole Road. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Near-Term	Property Buyout	Property buyouts of repetitive loss properties located throughout Hatteras Island. Properties bought out through the FEMA buy-out program can be used for limited purposes and would primarily serve as land returned to an open space condition and associated increased infiltration and natural floodplain function. Areas are identified in the 2020 Dare Repetitive Loss Area Analysis Update.
Near-Term	Public Education and Outreach Program	A targeted education and outreach program to encourage property buyout or granting of conservation easements.
Near-Term	Dune Restoration	Projects to plant and stabilize dunes and enforce "keep off the dunes" during peak visitor times, across the island.
Near-Term	Backup Communications	Establish redundant communications paths that do not rely on ground-based fiber optic cables. Solutions might include acquisition and installation of satellite equipment to allow cellular providers to maintain service, installation of commercial satellite equipment to provide data transmission capabilities, and access to satellite-based internet service from companies like Starlink. Non-terrestrial solutions like these will provide connectivity with the mainland to provide backup communications when service from the single CenturyLink fiber is disrupted. Damage to the fiber line is especially disruptive on Hatteras Island because repairs cannot occur until flooding has receded. Reliable non terrestrial communications are vital not only for emergency response but also to the economy
Long-Term	Beach Nourishment - Frisco to Hatteras Village	Beach nourishment along NC 12 between Frisco and Hatteras Village is an option for protection of NC 12 presented in the NC 12 Feasibility Study for Hatteras Village.
Long-Term	Bridge NC 12- Hatteras Village Frisco	Replace a section of NC 12 between the towns of Frisco and Hatteras Village with a bridge. This area was identified as a hot spot location in the citizen survey and the solution was presented as an option in the NC 12 Feasibility Study for Hatteras Village.
Long-Term	Utilities Interconnections	Connecting the Rodanthe and South Hatteras Water Systems so in the case of failure in one of the systems, redundancy exists.
Long-Term	Sewer Feasibility Study	A feasibility study of the possibility, potential cost, and funding options for a municipal sewer system to replace septic systems. With rising ground water levels and increased development, the reliance on septic is unstainable and was also recognized as a concern in the citizen survey.

Projects were then prioritized through two surveys, one sent to the CAT and one to the citizens who indicated a desire to remain involved and receive updates in the initial citizen survey. The survey listed each project idea and asked respondents to rank them as Lowest Priority, Low Priority, Neither Low Priority nor High Priority, High Priority, or Highest Priority, which was then assigned a numeric value of 1-5 respectively. See Appendix C for the full surveys and results. The projects were then sorted by average score and ranked. To assign priority, the top five projects were ranked high priority, the bottom five were ranked low priority, and the remainder were ranked medium priority. This process was followed for both the CAT survey results and the second citizen survey results. Consideration of the CAT priority, Citizen priority, and additional factors such as cost, effort required, and alignment with program goals was made and an overall priority assigned to each project.

Table 18 - In-Progress Project Prioritization

Project	CAT Average	CAT Ranking	CAT Priority	Citizen Average	Citizen Ranking	Citizen Priority	Overall Priority
Beach Nourishment - Avon & Buxton	4.33	1	High	3.94	5	High	**High**
Stormwater Master Plan Study	3.89	4	High	4.02	3	High	**High**
Elevate Structures	3.67	12	Medium	3.68	16	Medium	**Medium**
Flood Gauges	3.33	18	Medium	3.64	17	Medium	**Medium**
Stormwater/Flood Ordinance Review	3.50	16	Medium	3.58	21	Medium	**Medium**
Flood Insurance Education and Outreach Program	3.00	26	Low	3.36	26	Low	**Low**

Table 19 - Long-Term Project Prioritization

Project	CAT Average	CAT Ranking	CAT Priority	Citizen Average	Citizen Ranking	Citizen Priority	Overall Priority
Beach Nourishment - Frisco to Hatteras Village	4.00	2	High	3.73	12	Medium	**High**
Bridge NC 12- Hatteras Village Frisco	3.22	22	Medium	3.46	25	Low	**Medium**
Utilities Interconnections	3.78	7	Medium	3.75	11	Medium	**Medium**
Sewer Feasibility Study	2.56	27	Low	3.59	19	Medium	**Low**

Table 20 - Near-Term Project Prioritization (Part 1 of 2)

Project	CAT Average	CAT Ranking	CAT Priority	Citizen Average	Citizen Ranking	Citizen Priority	Overall Priority
County Stormwater Funding/Utility Study	4.00	2	High	3.71	15	Medium	**High**
Dune Restoration	3.78	7	Medium	4.41	1	High	**High**
Storm Drainage Maintenance (Ditch Maintenance)	3.56	14	Medium	4.11	2	High	**High**
Backup Communications	3.67	12	Medium	3.90	7	Medium	**Medium**
County Resiliency Staff Position	3.33	18	Medium	3.52	23	Low	**Medium**

Table 21 - Near-Term Project Prioritization (Part 2 of 2)

Project	CAT Average	CAT Ranking	CAT Priority	Citizen Average	Citizen Ranking	Citizen Priority	Overall Priority
Engineered Wetland - Buxton	3.33	18	Medium	3.73	12	Medium	**Medium**
Establish County Stormwater Management Taskforce	3.78	7	Medium	3.63	18	Medium	**Medium**
Establish Resilience Hubs	3.56	14	Medium	3.72	14	Medium	**Medium**
Living Shorelines - Cape Hatteras Secondary School	3.11	23	Low	3.53	22	Medium	**Medium**
Living Shorelines- Frisco/Hatteras Village	3.44	17	Medium	3.97	4	High	**Medium**
Living Shorelines-Rodanthe Harbor	3.33	18	Medium	3.59	19	Medium	**Medium**
Storm Drainage Study/Improvement - Avon	3.89	4	Medium	3.78	9	Medium	**Medium**
Storm Drainage Study/Improvement - Buxton	3.78	7	Medium	3.78	9	Medium	**Medium**
Storm Drainage Study/Improvement - Hatteras Village	3.78	7	Medium	3.91	6	Medium	**Medium**
Storm Drainage Study/Improvement - Tri-Villages (Rodanthe, Waves, Salvo)	3.89	4	High	3.89	8	Medium	**Medium**
Property Buyout	3.11	23	Low	3.49	24	Low	**Low**
Public Education and Outreach Program	3.11	23	Low	3.19	27	Low	**Low**

Project Portfolio

From the initial project list, 13 projects have been further developed for inclusion in the project portfolio. All the projects selected are in the near-term time horizon and were given a priority ranking of either high or medium. Only near-term projects were included in the portfolio to best align with Phase 3 and 4 of the program. However, that does not preclude further development of any of the remaining projects included on the near term or in-progress lists, nor does it mean some of the long term projects are not important to further develop and pursue.

Table 22 - Portfolio Project #1

Project Name	County Stormwater Funding/Utility Study
Project Description	In order to implement many of the other projects and the sheer number and scale of projects that will be needed, as well as on-going maintenance, additional funding will be needed. This project would serve to study different funding options, such as implementing a stormwater utility fee or additional apportionment from the general fund, and make a recommendation to the county. Identifying funding to improve stormwater drainage and land management preparation for flooding was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR1).
Hazard(s) Addressed by Project	Flooding
Type of Solution	Funding Source
Project Estimated Cost	$50,000 - $100,000
Potential Implementation Funding Sources	General Fund
Projected Estimated Timeline	1 year
Priority Rating	High
Project Map	N/A

Table 23 - Portfolio Project #2

Project Name	Dune Restoration
Project Description	Projects to plant and stabilize dunes and enforce "keep off the dunes" during peak visitor times, across the island. Installing plantings and sand fencing on dunes on public lands and establish grant programs to support installation of similar projects on private land. Initial installation could occur immediately and then will require ongoing maintenance. This project was ranked the highest by the citizen survey.
Hazard(s) Addressed by Project	Flooding, Sea Level Rise, Hurricane and Tropical Storms
Type of Solution	Nature Based
Project Estimated Cost	$500 per LF
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	1 year to establish, then ongoing
Priority Rating	High
Project Map	N/A

Table 24 - Portfolio Project #3

Project Name	Storm Drainage Maintenance (Ditch Maintenance)
Project Description	Work with private landowners and NCDOT to ensure maintenance of drainage ditches and maximize the capability of existing drainage systems and minimize flooding from rainfall and poor drainage. This was identified in the Outer Banks Hazard Mitigation Plan (Action # DAR11) and was identified as a common concern in the citizen survey.
Hazard(s) Addressed by Project	Flooding
Type of Solution	Plans and Policies, Infrastructure
Project Estimated Cost	$50,000 - $100,000 annually
Potential Implementation Funding Sources	General Fund, Grant Funds, Tax or Tax Incentive Program
Projected Estimated Timeline	1 year to establish, then ongoing
Priority Rating	Medium
Project Map	N/A – all of Hatteras Island

Table 25 - Portfolio Project #4

Project Name	Backup Communications
Project Description	Establish redundant communications paths that do not rely on ground-based fiber optic cables. Solutions might include acquisition and installation of satellite equipment to allow cellular providers to maintain service, installation of commercial satellite equipment to provide data transmission capabilities, and access to satellite-based internet service from companies like Starlink. Non-terrestrial solutions like these will provide connectivity with the mainland to provide backup communications when service from the single CenturyLink fiber is disrupted. Damage to the fiber line is especially disruptive on Hatteras Island because repairs cannot occur until flooding has receded. Reliable non terrestrial communications are vital not only for emergency response but also to the economy.
Hazard(s) Addressed by Project	Hurricane and Tropical Storms
Type of Solution	Infrastructure
Project Estimated Cost	$200,000 - $2,000,000
Potential Implementation Funding Sources	Grant Funds, FEMA
Projected Estimated Timeline	Dependent on solution selected
Priority Rating	Medium
Project Map	N/A

Table 26 - Portfolio Project #5

Project Name	Engineered Wetland – Buxton
Project Description	Building a constructed wetland to provide additional flood storage and water quality treatment in the Buxton watershed and alleviate some strain on the storm drainage system.
Hazard(s) Addressed by Project	Flooding, Sound Water Quality
Type of Solution	Nature Based Infrastructure
Project Estimated Cost	$100,000 - $200,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	1 year
Priority Rating	Medium
Project Map	

Table 27 - Portfolio Project #6

Project Name	Establish County Stormwater Management Taskforce
Project Description	Establishing a public/private taskforce to focus on stormwater issues, including rainfall flooding, and to address stormwater improvements and projects from a joint perspective. It is critical that this taskforce include representatives from NCDOT and the county planning department as significant coordination and cooperation will likely be needed from both parties to address some of the most pressing issues of flooding along NC 12.
Hazard(s) Addressed by Project	Flooding
Type of Solution	Planning & Policy
Project Estimated Cost	$0
Potential Implementation Funding Sources	General Fund
Projected Estimated Timeline	1 year to establish, then ongoing
Priority Rating	Medium
Project Map	N/A

Table 28 - Portfolio Project #7

Project Name	Establish Resilience Hubs
Project Description	Establish sites that are well known and trusted by the community and have resilient energy and communications systems, and are able to provide programs and services needed to sustain the community before, during and after a disaster. These Hubs could be fully developed at fire stations, county facilities, or faith based locations that are well known and protected during extreme weather events
Hazard(s) Addressed by Project	Flooding, Hurricane and Tropical Storms
Type of Solution	
Project Estimated Cost	$250,000 per hub
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	1 year
Priority Rating	Medium
Project Map	N/A

Table 29 - Portfolio Project #8

Project Name	Living Shorelines – Cape Hatteras Secondary School
Project Description	Living shorelines use plantings and other natural elements such as oyster bags or rock to stabilize the shoreline. This project proposes to design and install approximately 300 LF of living shoreline adjacent to Cape Hatteras Secondary School in Buxton. A living shoreline at this location can also be utilized as a teaching tool and public education resource. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).
Hazard(s) Addressed by Project	Soundside erosion, Sound water quality, Storm Surge
Type of Solution	Nature Based
Project Estimated Cost	$50,000 - $100,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	1 year
Priority Rating	Medium
Project Map	

Table 30 - Portfolio Project #9

Project Name	Living Shorelines – Frisco to Hatteras Village
Project Description	Living shorelines use plantings and other natural elements such as oyster bags or rock to stabilize the shoreline. This project proposes to design and install approximately 1,400 LF of living shoreline along NC 12 between the communities of Frisco and Hatteras Village. A living shoreline at this location serves to protect the soundside of a vulnerable section of NC 12, that was also identified as a hotspot in the citizen survey. Encouraging the use of natural barriers over hard structures to control shoreline erosion was also identified in the Outer Banks Hazard Mitigation Plan (Action #DAR13).
Hazard(s) Addressed by Project	Soundside erosion, Sound water quality, Storm Surge
Type of Solution	Nature Based
Project Estimated Cost	$250,000 - $300,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	1 year
Priority Rating	Medium
Project Map	

Table 31 - Portfolio Project #10

Project Name	Storm Drainage Study and Improvement - Avon
Project Description	Drainage study and improvement of roadside swales, culverts, and grading along NC 12 from the post office to Ace Hardware. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway. There is also potential for the inclusion of nature-based solutions. As a result of the well-known and frequent drainage issues in this area, this project was given high priority.
Hazard(s) Addressed by Project	Flooding
Type of Solution	Infrastructure
Project Estimated Cost	$50,000 - $1,000,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	2-5 years (1 year drainage study and 1-4 years implementing recommended improvement
Priority Rating	High
Project Map	

Table 32 - Portfolio Project #11

Project Name	Storm Drainage Study and Improvement - Buxton
Project Description	Drainage study and improvement of roadside swales, culverts, grading along the turn in NC 12 and Old Lighthouse Road. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Hazard(s) Addressed by Project	Flooding
Type of Solution	Infrastructure
Project Estimated Cost	$50,000 - $1,000,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	2-5 years (1 year drainage study and 1-4 years implementing recommended improvement
Priority Rating	Medium
Project Map	

Table 33 - Portfolio Project #12

Project Name	Storm Drainage Study and Improvement – Hatteras Village
Project Description	Drainage study and improvement of roadside swales, culverts, grading throughout Hatteras Village, specifically along NC 12, Eagle Pass Road, and Pole Road. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Hazard(s) Addressed by Project	Flooding
Type of Solution	Infrastructure
Project Estimated Cost	$50,000 - $1,000,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	2-5 years (1 year drainage study and 1-4 years implementing recommended improvement
Priority Rating	Medium
Project Map	

Table 34 - Portfolio Project #13

Project Name	Storm Drainage Study and Improvement – Tri-Villages (Rodanthe, Waves, and Salvo)
Project Description	Drainage study and improvement of roadside swales, culverts, grading along NC-12 through the Tri-Villages and specifically in the Wind Over Waves area. This area was identified as a hot spot in the citizen survey and presents a safety hazard with ponding on the roadway.
Hazard(s) Addressed by Project	Flooding
Type of Solution	Infrastructure
Project Estimated Cost	$50,000 - $1,000,000
Potential Implementation Funding Sources	General Fund, Grant Funds
Projected Estimated Timeline	2-5 years (1 year drainage study and 1-4 years implementing recommended improvement
Priority Rating	Medium
Project Map	

References

Allen, T.R. 2017, Identify Cultural Resources Sites Affected by Sea Level Rise at Cape Hatteras National Seashore. Prepared for NPS. January 2017.

ArcGIS web application. (n.d.). Retrieved March 21, 2022, from https://www.arcgis.com/apps/webappviewer/index.html?id=f5e463a929ed430095e0a17ff803e156

Bohnsack et al. 2002, The Economic Impacts of the Recreational Bluefin Tuna Fishery in Hatteras, North Carolina. 2002.

Centers for Disease Control and Prevention. (2021, August 27). CDC/ATSDR SVI data and documentation download. Centers for Disease Control and Prevention. Retrieved January 21, 2022, from https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html

Centers for Disease Control and Prevention. (2022, March 15). CDC/ATSDR social vulnerability index (SVI). Centers for Disease Control and Prevention. Retrieved March 21, 2022, from https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

Coastal Protection Engineering of North Carolina. 2021, Channel Maintenance and Dredge Material Management Report Dare County, North Carolina. Prepared for Dare County. March 2021.

CSE. 2013, Shoreline Erosion Assessment and Plan for Beach Restoration Rodanthe and Buxton Areas Dare County, North Carolina. Prepared for Dare County Board of Commissioners. November 2013.

CSE. 2020, Shoreline Erosion Assessment and Alternatives for the Avon Beach Restoration, County of Dare, North Carolina. Prepared for Dare County Board of Commissioners.

Dare County Planning Department. 2015, Dare County Repetitive Loss Area Analysis. December 2015.

Dare County Planning Department. 2020, Dare County Repetitive Loss Area Analysis. September 2020.

Dare County. 2011, 2009 Dare County Land Use Plan Update. Dare County, North Carolina. https://www.darenc.com/departments/planning/land-use-plan

Dare County. 2017, Hurricane Matthew Resilient Redevelopment Plan. May 2017.

Flynn, Michael. 2016, A Multi-Hazard Vulnerability Assessment of Coastal Development Along Cape Hatteras National Seashore. September 2016.

Giles, Andrew. 2019, Scientific Research and Collecting Permit, Buxton. December 2019.

Giles, Andrew. 2019. Investigators Annual Report, Cape Hatteras. May 2019.

Gregory, Monica. 2018, Assessing Coastal Community Resilience: A Pilot Project in North Carolina. May 2018.

Hatteras Village Resilience Evaluation and Needs Assessment. April 2018.

Jay, Katya. 2018, Investigators Annual Report, Cape Hatteras. December 2018.

Landry, C.E., Lewis, A.R., Liu, H., & Vogelsong, H.G. 2015. Economic Value and Impact of Visitation to Cape Hatteras National Seashore. April 2015.

Lane, Brent. 2013, Hatteras Island Economic Impact. Presented to Outer Banks Visitors Bureau. July 2013.

Lane, E.B., Watts, D.T. 2019, Dare County Regional Airport Economic Impact Assessment. Prepared for Dare County Airport Authority. June 2019.

Moffatt & Nichol. 2005, Report on Costs, Benefits, and Management Issues related to Maintaining North Carolina's Shallow Draft Navigation Channels, Final Report. November 2005.

Moffatt & Nichol. 2014, A Study of the Economic Impacts of Oregon Inlet Navigability to Dare County, the Surrounding Region, and the State of North Carolina. May 2014. https://www.darenc.com/home/showdocument?id=212

N.C. Coastal Resources Commission Science Panel. 2015, North Carolina Sea Level Rise Assessment Report 2015 Update to the 2010 Report and 2012 Addendum. January 2016.

National storm surge hazard maps - version 2. (n.d.). Retrieved March 21, 2022, from https://www.nhc.noaa.gov/nationalsurge/

National Wetlands Inventory. (n.d.). Retrieved March 21, 2022, from https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/

NCDCM. 2019, North Carolina 2019 Oceanfront Setback Factors & Long-Term Average Annual Erosion Rate Update Study. January 2019.

NCDEQ. 2016, Beach Nourishment Study. November 2016.

NCDOT, NCDEQ. 2018, Dredging Studies. April 2018.

NCSU. 2016, 2020 Economic Development & Diversification Strategic Plan. Dare County, North Carolina. Presented to Dare County Board of Commissioners. December 2016.

NOAA Logo Sea Level Rise Viewer. View site. (n.d.). Retrieved March 21, 2022, from https://coast.noaa.gov/slr/#/layer/slr/0/-8533408.439180866/4283972.583090703/6/satellite/none/0.8/2050/interHigh/midAccretion

NPS. 2013, Inventory of Coastal Engineering Projects in Cape Hatteras National Seashore, National Resource Technical Report. March 2013.

Outer Banks Regional Hazard Mitigation Plan. June 2020.

Pendleton, E., Thieler, R., Williams, J. 2005, Coastal Vulnerability Assessment of Cape Hatteras National Seashore to Sea-Level Rise. https://pubs.usgs.gov/of/2004/1064/images/pdf/caha.pdf

Sea level rise data download. (n.d.). Retrieved March 21, 2022, from https://coast.noaa.gov/slrdata/

The nature conservancy and scientists. (n.d.). Retrieved March 21, 2022, from https://apnep.nc.gov/media/1964/open

URS Corporation. 2001, Stormwater Master Plan, Dare County, North Carolina. June 2001.

URS Corporation. 2016, NC 12 Feasibility Study Hatteras Village, Dare County, North Carolina. Prepared for NCDOT. February 2016.

WSP. 2020, NC 12 Ocracoke Island Hot Spot, Hyde County, North Carolina. Prepared for NCDOT. April 2020.