Resilience Planning for Water Dependent Uses

HOW-TO-GUIDE FOR COASTAL WATERFRONT COMMUNITIES IDENTIFYING COMMUNITY ASSETS

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Intended Users:

- Planners, elected officials, waterfront industry planners and developers, and other practitioners
- This guide assumes that the user has either direct access to, or can procure the use of GIS mapping software, such as ESRI's ArcGIS software.

Objectives:

1. Aid users in assessing potential exposure of water-dependent use to flood events, including permanent inundation, tidal flooding, and extreme coastal flooding in a given geographic area.
2. Provide communities with links to tools and data that will help to prepare for an informed planning decision process, ultimately leading to executable projects and plans.
3. Bring stakeholders together under a common waterfront vision through existing planning processes.

Overview

This guide provides instructions for water-dependent use stakeholders to assess their exposure to coastal flooding events. Throughout this guide, we illustrate methods and tools that are publicly accessible, offering additional alternatives for analyses based on available resources. This document uses two example communities – Cape Charles, VA and Chesapeake, VA - to illustrate the analysis steps. The examples are for illustrative purposes only and demonstrate alternative analysis choices for small and large coastal communities. Small communities and communities with limited resources will be able to compile the information gathered in this guide with little, if any, assistance. Practitioners in larger cities, or those with more resources, may wish to utilize more detailed planning methods, more up-to-date data, or otherwise enhance and build upon the tools herein to assess future exposure to coastal flood hazards.

This guide WILL:

- Help stakeholders analyze the future coastal flooding conditions that may damage community assets and particularly water-dependent uses.

This guide WILL NOT:

- Illustrate methods to brainstorm implementation alternatives, achieve consensus on strategies, or otherwise make informed decisions based on the information compiled while following this guide. For more information, users can reference other resources, including the Coastal Inundation Toolkit.

The guide helps practitioners reconcile between different planning and assessment criteria among different waterfront users to represent a common waterfront vision for use in existing planning processes. Users should consult this guide on a regular basis under existing local, regional, and state planning projects and need not explicitly undertake a stand-alone analysis.

What is Resilience?

Resilience is a measure of a community's ability to "bounce back" to normal functioning after hazardous events. Coastal communities are learning to plan for resilience by creating opportunities to maintain and enhance their social, environmental, and economic well-being. For example, communities can make emergency response operations more efficient, work with social services groups to address individual mental health during recovery, or find ways to leverage the capability of natural assets like wetlands and shorelines to offer long-term environmental protection and benefits to communities.

While resilience typically focuses on flooding and damages from large coastal storms, sea level rise may make less intense and more frequent events caused by tidal flooding more damaging in the future. This guide discusses how to plan for coastal storms, as well as other nuisance and tidal flooding impacts.

What is a Water Dependent Use?

Each state has its definition of water-dependent use as a requirement of compliance with the Coastal Zone Management Act[1]. However, the definitions can vary based on each state and planning process.[2]

Table 1. Potential Definitions of Water Dependent (and related) Uses for Land Use Planning

Use	Definition	Examples
Water Dependent	Require waterfront access and associated infrastructure	Commercial fishermen
Water-Related	Reliant on water-dependent businesses for goods or services	Fish Processing
Water Enhanced	Accrues benefits from waterfront location, but is not dependent on waterfront access	Outdoor Seafood Restaurant

In coastal areas throughout the United States, states and localities may enact different definitions of uses that are allowed and permitted in waterfront development. They can regulate these uses based on local authorities for land use and for permitting. In some cases, localities have enacted specific zones that set aside land for use by industries that require access to waterways for transportation purposes (i.e., Baltimore (Md.), Portland (Or.) and Chesapeake (Va.)). In other cases, local governments maintain waterfront character through planning and economic development tools and strategies (e.g., New York State Local Waterfront Redevelopment planning)

NOAA has also developed a related classification for the ocean economy.[3] Ocean economy industries cover the three different types of water-dependent uses described in Table 1 and can be reconciled with state or local definitions to develop several different concepts of working waterfront communities.

Activity 1. Find the definitions of water-dependent use in your state.

The Coastal Zone Management Act is administered by state agencies. Review NOAA's links to your state agency website to determine the different types of uses that comprise water depend use in your state and locality. The definition should include the adjacency and functional requirements of the sites and their users in order to be deemed water dependent.

[1] (Ounanian, 2015)
[2] (Bowling, 2013)
[3] (NOAA, 2015)

What is planning?

Planning processes help communities to develop visions for the built environment and the regulatory rules that help to enable those futures to come to life. There are several different types of planning processes that might occur in your community, described in Table 2 below.

Table 2. Descriptions of Local Planning Documents That May Benefit from an Enhanced Assessment of Water Dependent Use

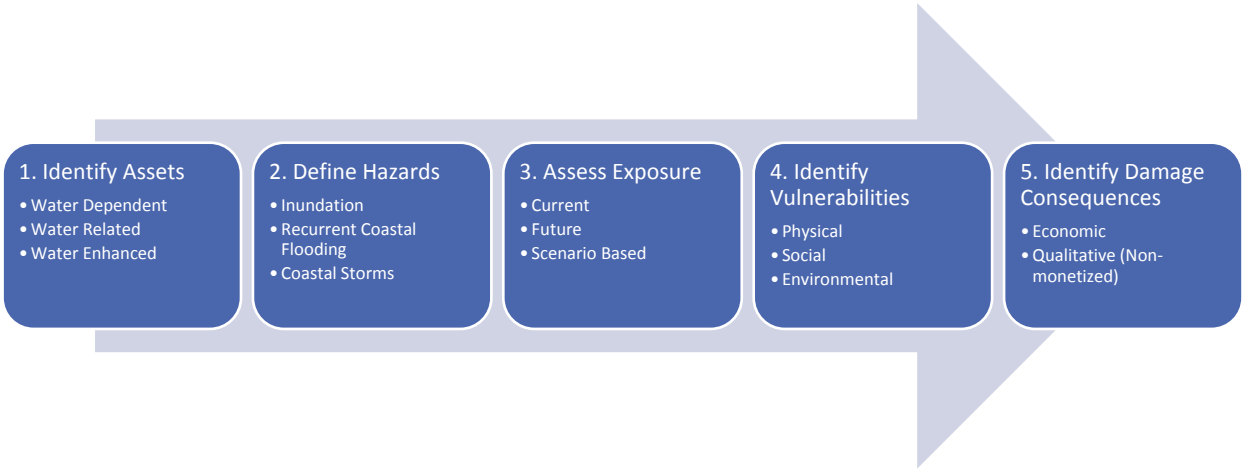
Type of Planning Document	Scope
Master Plan / Comprehensive Plan	Comprehensive plans are recognized and often required throughout the United States to set forth a vision of community goals. They can be legally binding or advisory depending on the state in which you live.
Area Plans (e.g., Waterfront / Harbor Plan)	Neighborhoods and localities within the jurisdiction of a Master Plan may create specific plans for individual regions or areas.
Long Range Transportation Plan	Undertaken by Metropolitan Planning Organizations (MPO) to program federal funding for transportation projects in a region.
Comprehensive Economic Development Study (CEDS)	Plans were undertaken to become eligible for federal programs through the US Economic Development Agency.
Hazard Mitigation Plan	Regional and local plans required by FEMA to receive hazard mitigations and emergency funding in the event of a natural disaster. These plans allow regions to incorporate sea level rise and other climate change impacts.
Climate Adaptation Plan	Some states and localities have recently developed specific plans that coordinate land use and natural systems planning to adapt to a changing climate.

If you are not aware of any specific discussion of water-dependent use in the plans in Table 2, you will need to collect the plans and review areas where the authors might more thoughtfully consider water-dependent uses.

Activity 2. Collect the planning documents for your state, regional, and local jurisdictions. Then, review the documents to answer the 4 questions below to understand how water-dependent uses have been considered in each of the planning documents.

1. Are working waterfronts specifically addressed as an element of the master plan or within an area plan in our community?
2. Does the hazard mitigation plan for our community consider the unique needs and characteristics of watermen and other working waterfront employment?
3. How do economic development plans and strategies consider investing in and enhancing our waterfront and water dependent uses?
4. In the cases where we have a climate adaptation plan, how are our water-dependent uses considered for future adaptation?

Process Overview for Assessing Exposure



Once you have identified the definition of water-dependent use and the plans that apply to your area of concern, you can begin to assess how those planning processes can assess future coastal hazards. Five steps will offer an initial assessment of water-dependent use exposures to future coastal flood hazards.

1. **Identify Water-Dependent Use Locations:** In the case where policies do not explicitly identify water-dependent use, you will need to develop a working geospatial data set to evaluate future coastal flood exposure. Once you construct the dataset, stakeholders can update the data on a regular basis to enhance future planning documents.
2. **Define Hazards:** Once stakeholders have developed a geospatial dataset of working waterfront facilities and statistics, we can then evaluate the potential exposure of those assets to different types of coastal flood hazard exposures. We can do so through scenarios that represent different times and different assumptions about sea level rise and the magnitude of coastal flooding that one might experience in their study area.
3. **Assess Exposure:** By using available flood hazard mapping and tools, or creating your inundation maps, stakeholders can understand the height, depth, and extent of flood waters associated with certain types of flood events. You can then overlay those data with the water-dependent assets that you were able to define in Step 1 to assess exposure.
4. **Identify Vulnerabilities:** Planners must also consider what happens when those assets get wet. How vulnerable are assets that are highly sensitive to sea level rise when compared with other assets that are designed to get wet? We use the term vulnerability to describe how sensitive assets are two different types of hazards. You can identify vulnerabilities in assets by talking to the people that are responsible for owning and maintaining them.
5. **Identify consequences:** We also need to understand the consequences of those assets and their sensitivities to flooding. While there will be comparably large economic consequences for a port shutdown, the consequences of losing a park or public access, while not necessarily as impactful in monetary terms, could certainly be socially impactful on a population. There are several methods that you can use to determine the benefits and costs of different adaptation scenarios, as well as for considering those costs that you may not be able to communicate in dollar terms.

1. Identify Water-Dependent Assets

There are several different ways that individuals identify community assets when conducting exposure assessments. Water-dependent assets include places that fit one of the definitions in Table 1 and are consistent with the definition set forth by your state Coastal Zone Management Act.

Table 3. Data Sources for Water-Dependent Use Asset Identification

Analysis Scale	Data Resource
County	1. Coastal County Snapshots 2. Quick Report Tool for Socioeconomic Data 3. American Community Survey 5-Year Estimates
Zip-Code	1. US Census Zip Code Business Patterns (ENOW Downscaling Guidance)
Point Locations	1. Private Data (Dun & Bradstreet, ReferenceUSA) 2. Waterfront Organizations (e.g., Local Marine Trades Association) 3. Waterfront User Survey (e.g., Local site visits and surveys)

Table 3 summarizes the options for gathering data at different scales, from as large as a county to as small as an individual point location. County and zip-code data are helpful for communities to understand the overall contribution of water-dependent firms in the region. For example, NOAA's ENOW data provides employment, establishment, and GDP statistics. These data, however, are not immediately suitable for determining exposure to flooding. To analyze polygon datasets, users must set a threshold for the change between current and future submerged land area to assess future exposure.

To conduct a more detailed exposure assessment of water levels, analysts should develop a set of individual point locations. Data can be gathered from private data providers, professional service directories, or other local sources (like user surveys) to develop a spatially accurate set of water-dependent assets to assess for future flood exposures. Once you can gather the data at the scale required for your analysis, you will need access to GIS software to create maps for your analysis. You should prepare a map using the mapping software that indicates the locations of the points in your region.

Activity 3. Create a geospatial database of water-dependent use locations

- Determine if you are going to use a polygon (e.g. county, zip-code, parcel, etc.) or point data set based on available resources.
- If using a **polygon data set**, determine a threshold for the percentage of submerged land area (or a similar measure), that you will use to determine the overall exposure for the water-dependent uses within the selected geography.
- If using a **point data set**, determine how you will 'ground truth' the data set using local resources such as marine trades directories, user surveys, or other methods of validating point locations.

2. Define the Hazards

Communities must plan for more than a future hurricane or nor'easter to have a robust assessment of future flood hazard exposure. This analysis uses the process described in NOAA's "What Will Adaptation Cost" to determine the potential sea level rise and coastal flood information. However, you may also have local planning guidance to help you to determine the types of events and exposures to use for different planning processes in your region and locality. For the detailed guidance on developing an exposure assessment, users should reference NOAA's what will adaptation cost document, and make choices depending on resources available to them for the particular planning process. At a minimum, users should use these tools to plan for the following:

- Portray at least two different scenarios of sea level rise that give you a "range" to plan within. For example, you might want to plan for values between the NOAA intermediate High and NOAA High scenarios for sea level rise in your region.
- Project forward for three types of flooding:
    - Permanent Tidal Inundation (MHHW)
    - Recurrent Coastal Flooding (99% AEP through 10% AEP)
    - Coastal Storm Flooding (Above 10% AEP)
- It is also helpful to compare historical storm events to these project future water levels to allow individuals to ground their perceptions of the hazard in some experiences where possible.
- In addition to historic storm events, individuals can also compare modeled FIRM mapping from FEMA, SLOSH Hurricane inundation modeling from NOAA, and other mapping products to the water levels determined through the approach taken by "What Will Adaptation Cost."

Regardless of the mapping you choose, there are several assumptions that analysts must clarify for the reader.

- Do your maps reflect "Stillwater" or do they also model wave action, velocity, and other dynamic ocean processes that occur during storms?
- What is the vertical datum from which you are measuring? NAVD88 is the reference datum for construction code officials and other engineering and design professionals. Flood exposure tools often reference MHHW to take a conservative approach toward planning for inundation areas.

Activity 4. Select or flood hazard mapping products to conduct the exposure assessment.

- Option 1: Access inundation and coastal storm flood data from federal resources and mapping platforms.
- Option 2: Access data custom inundation data from local map viewers.
- Option 3: Develop customized extreme water levels for your exposure assessment.

3. Assess Various Exposure Scenarios

You can begin conducting an exposure assessment when you have determined the type of mapping that you will use for exposure assessment and the set of water-dependent use locations (points or polygons). The simplest way to assess exposure is by using visual inspection on a mapping program to understand if the extent of the flood surpasses the asset about which you are concerned. NOAA provides additional guidance regarding stakeholder engagement, facilitation, and participation through their Coastal Flood Exposure Mapper.

If desktop mapping software is available, there are other measures that you can calculate utilizing mapping software that will determine whether or not different types of assets may be affected by coastal flooding. These programs will allow you calculate measures such as:

- Number of identified water-dependent assets inundated by a particular flood scenario
- Number of flood scenarios that impact a particular asset
- Area of land/wetlands inundated under a given flood scenario
- Linear miles of roadway inundated under a given flood scenario

NOAA's Coastal Flood Exposure Mapper also provides other resources for advanced GIS users, including access to data sets and web mapping services. Where the water level exposures in the Coastal Flood Exposure Mapper may be limited or inconsistent with local planning guidance, these data and services still provide planners with the opportunity to assess exposures to consistent sets of vulnerable assets between platforms.

Activity 5. Conduct an Exposure Assessment

- Identify physical, social, and environmental assets (in addition to your water-dependent uses) that may be inundated by future coastal flooding.
- Option 1. Visually inspect if the assets that you were able to identify in Activity 2 are inundated under the given flood scenarios.
- Option 2. Analyze exposures using desktop GIS software.

4. Identify Vulnerabilities in Water Dependent Uses

There are several ways to define the vulnerability of a given asset based on exposure to flood waters. There are many aspects to vulnerability aside from just physical and engineering vulnerability. Vulnerabilities are attributes of specific physical, social, and environmental assets.

Physical Vulnerability

Some assets are built to get wet, while others are not designed to withstand exposure to flooding. For example, a dock at a marina is meant to withstand more flooding by design than the building behind it or the machinery that operates the HVAC system in the building. Each of these assets has different physical vulnerabilities to flooding.

Social Vulnerability

From a social perspective, certain communities demonstrate pre-existing stressors or vulnerabilities that cause the communities to be disproportionately impacted by flooding and storms. This concept of social vulnerability is used in coastal communities to understand population vulnerabilities to all types of natural hazards, not just flooding.

Environmental Vulnerability

In addition to people and assets, natural and living resources also demonstrate aspects of vulnerability. There is a myriad of resources that can help users understand what the particular vulnerabilities of an ecosystem are to flood hazards and sea level rise. For example, the marsh migration index allows users to understand where constrained resources are that may not be available for adaptation.

Resources for Vulnerability Data

- Community Risk and Vulnerability Assessment Data
- Social vulnerability data
- NMFS Fisheries Vulnerabilities
- Local studies

Activity 6. Determine areas of concern for social, environmental, and economic vulnerabilities using spatial data.

1. Physical Vulnerability
2. Social Vulnerability
3. Environmental Vulnerability

5. Defining Potential Consequences

There are several tools that users can use to determine the potential consequences of damages to a given sector of the economy that is supported by working waterfronts. Once you have assessed the vulnerabilities of the assets, you can determine how flood exposure scenarios will impact the vulnerable assets. You can do this by using impacts from historical storms or projecting hypothetical damages through modeling.

Option 1: Interview asset owners through interviews or other expert elicitation processes to discuss prior damages as a result of recent events and historic storms. In this approach, an analyst can qualitatively assess potential impacts using a scale similar to that presented in Figure 1.

Figure 1. Illustrative Impact Magnitude Scale

Impact Magnitude
5 - Catastrophic - Permanent damage and loss of infrastructure service.
4 - Major - Extensive infrastructure damage requiring extensive repair.
3 - Moderate - Widespread infrastructure damage and loss of service. Damage recoverable by maintenance and minor repair.
2 - Minor - Localized infrastructure service disruption. No permanent damage.
1 - Insignificant - No infrastructure damage.

Source: NAVFAC Climate Change Guidebook (Leidos Inc. & Louis Berger Inc., 2017)

Option 2: Use HAZUS, or another suitable modeling software, to develop estimated losses for different exposure scenarios.

NOAA's ENOW tool offers a quick guide to localities that want to provide an overall context of the discussion of the economy with their local officials. The ENOW statistics provide GDP, Employment, and Establishment estimates for many (but not all) water-dependent use in coastal areas and the great lakes regions of the United States.

Lastly, land-side disruptions may also have impacts related to the use of waterways. Commercial shipping patterns, recreational activities, and other water-based activities may change as a result of recurrent flooding or increasing flood heights associated with coastal storms. To understand spatial patterns of water-based activities, stakeholders can refer to marine spatial planning efforts, or other efforts to describe water-based activities at the federal, state and local levels.

Activity 6. Define potential impacts of future flood exposures

- Option 1: Expert interviews discussing damage magnitudes from historic events
- Option 2: Formal analysis using HAZUS or other modeling tools

Appendix A: Programs and Resources

It is important to adequately characterize the contributions of working waterfronts to maintain the economic, cultural, and environmental resilience of coastal areas. To adapt to a changing climate, stakeholders must:

1. Identify and inventory critical waterfront assets
2. Define future hazards
3. Assess future exposures
4. Identify vulnerabilities
5. Identify consequences

The additional resources below provide videos, case studies, and tools for adaptation that may help you assist your waterfront community.

Federal Resources:

What Will Adaptation Cost?

Natural and Nature-Based Infrastructure

Regional and Local Planning and Adaptation Examples:
Virginia Working Waterfront Master Plan

Gloucester, Massachusetts

Washington Sea Grant – Hazards, Resilience, and Climate Change

Great Lakes Coastal Resilience Planning Guide

NYC Urban Waterfront Adaptive Strategies

Please suggest additional resources here: mcampo@ejb.rutgers.edu

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