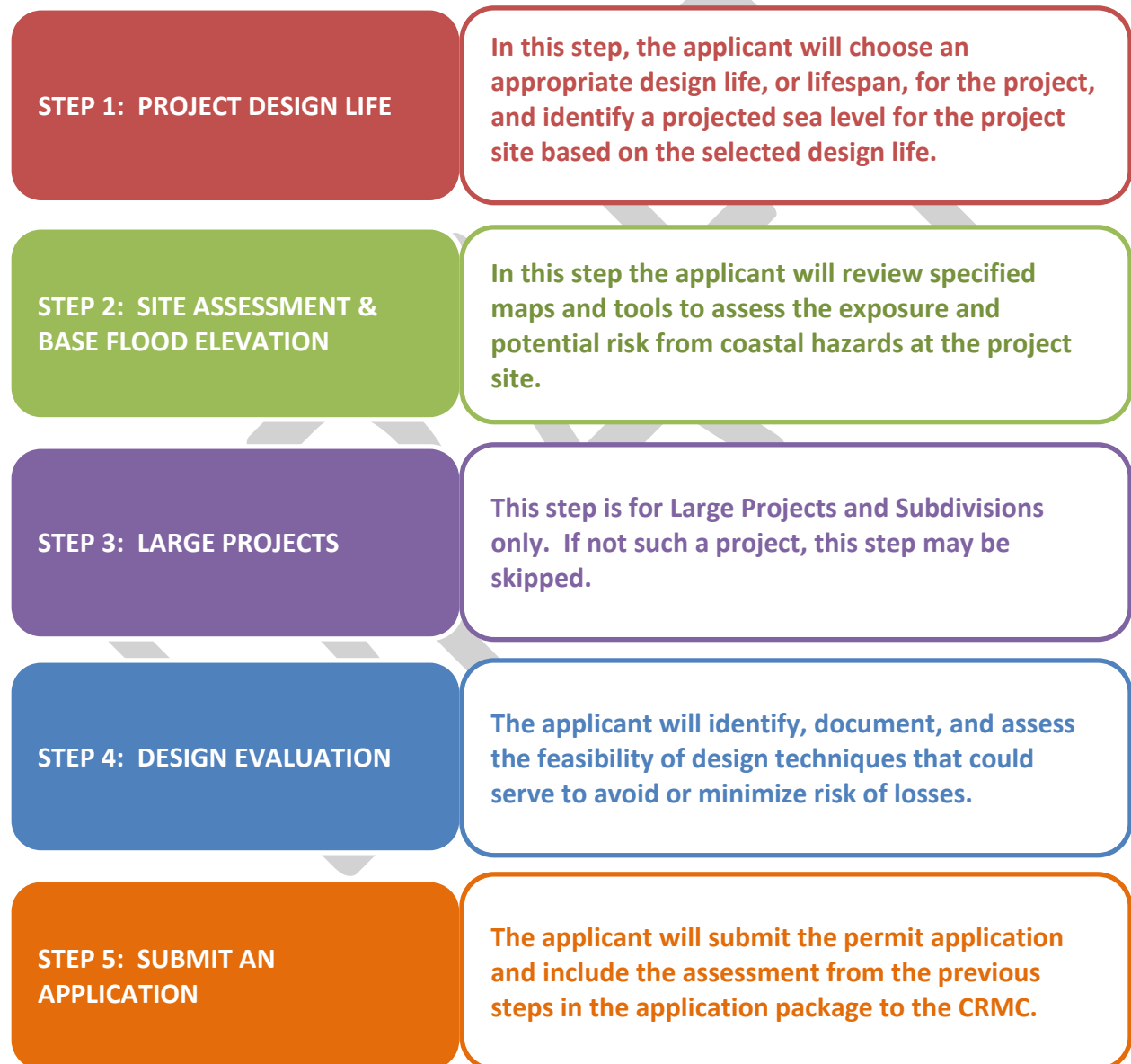


CHAPTER 5

RI CRMC Coastal Hazard Application Guidance

Overview of Process

The steps presented below provide guidance for applicants to address Coastal Hazards for selected projects in the design and permitting process for the Rhode Island Coastal Resources Management Council (CRMC).



Using this Document

This chapter of the Shoreline Change SAMP outlines a process through which applicants will address the coastal hazards associated with climate change as part of coastal applications for new and substantially improved projects, as specified in Section 110 of the Rhode Island Coastal Resources Management Program (RICRMP, also known as the “Red Book”). The goal of this process is to ensure that CRMC approved projects are designed and built with the applicant’s acknowledgement of the risks of building in coastal hazard areas exposed to storm surge, erosion and future sea level rise conditions. Additionally, this process will help to: protect public health, safety, and welfare; minimize damage and losses to nearby infrastructure and properties; and, reduce overall impacts to coastal resources. Adapting to these ongoing and future conditions will ensure Rhode Island is building resilient communities, as well as a strong coastal economy and environment.

The guidance outlined here is intended to help CRMC applicants recognize and minimize risks to protect their investments for the design life of their project. The information contained in this chapter will assist the applicant in evaluating potential impacts from storm surge, erosion and projected future sea level rise, as well as the cumulative impacts of these risks over time (hereafter “Coastal Hazards”) based on the best available science.

This process applies to applications for new and substantial improvements to properties within the planning boundary for the Shoreline Change Special Area Management Plan (Shoreline Change SAMP). The Shoreline Change SAMP Planning Boundary is defined as the land area along the Rhode Island coastline (all 21 coastal communities) projected to be inundated by a 100-year return period storm event (1% annual chance) plus seven feet of sea level rise as illustrated in STORMTOOLS (www.beachsamp.org/stormtools). See Figure 1.

Additional background information for each step of the process outlined in the following pages can be found following Page 10. For background information on CRMC’s enabling legislation, Shoreline Change SAMP guiding principles, and overall context for the process outlined in this chapter, please refer to Page 16 of this chapter, or review Chapter 1: Introduction.



Figure 1. Shoreline Change SAMP Planning Boundary

Chapter 1, Introduction, of this Shoreline Change SAMP (Section 1.1.4), lays out CRMC's responsibility to ensure that decisions made concerning Rhode Island's coastline are well thought out and based on the best available science. **Toward that end, the vision of the Shoreline Change SAMP is to provide guidance and tools for state and local decision makers to prepare and plan for, absorb, recover from, and successfully adapt to the impacts of coastal storms, erosion, and sea level rise.**

Guiding Principles of the Shoreline Change SAMP

- Serve as a guidance document to support regulatory changes (CRMC policy and standards), and any regulatory changes will be made to the Red Book and other existing SAMPs;
- Be developed in a transparent manner;
- Use best science available to understand changing conditions of Rhode Island's shoreline and help develop appropriate strategies for response;
- Consider synergistic long-range impacts over time of sea level rise, coastal storms, and erosion;
- Incorporate risk identification and awareness in design and development;
- Identify early actions and recommended strategies to monitor, evaluate, and readjust;
- Encourage incremental phasing of adaptation strategies and actions, and keep flexibility in the system;
- Maximize agency coordination and public participation; and
- Emphasize "No Regrets" decisions.

STEP 1: PROJECT DESIGN LIFE

In this step, the applicant will choose a projected design life, or lifespan, for the project, and identify a projected Sea Level Rise (SLR) for the project site for exposure to coastal flooding.

STEP 1 (Please see Page 11 for background information.)

1. The applicant or their chosen design professional will contact the municipal building official to document their FEMA Flood Insurance Rate Map (FIRM) Base Flood Elevation (BFE) for the project site.
2. Using the CRMC Shoreline Erosion Maps available on the CRMC's website, identify the historic erosion rate for the project site.
3. Choose an expected design life of your proposed project by considering how long the development is expected to last on the project site. **NOTE: CRMC recommends a minimum 30-year design life to correspond to the length of a typical mortgage.**
4. Using *Table 1 – Sea Level Rise (SLR) Projections (Feb. 2017)* below, identify the sea level projections that match the expected design life of your proposed project.
5. **Expected outcome from STEP 1: Take the SLR value from Table 1 and carry it forward to STEP 2 to define the risk profile for the project site.**

| Year | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|------|------|------|------|------|------|------|------|------|------|
| SLR | .95 | 1.48 | 2.2 | 3.02 | 4.00 | 5.02 | 6.14 | 7.55 | 8.99 |

Table 1 – Sea Level Rise (SLR) Projections (Feb. 2017). NOAA High. Newport, RI Tide Gauge. All values are expressed in feet relative to NAVD88.

STEP 2: SITE ASSESSMENT AND BASE FLOOD ELEVATION

The applicant will review available maps and tools to assess the exposure and potential risk from coastal hazards at the project site.

STEP 2 (Please see Page 12 for background information.)

Step 2A: What does SLR do to my site (plus access roads)?

- Go to STORMTOOLS for CRMC Permit Applicants. This online Map Journal will provide interactive maps that assist applicants in addressing the requirements of this Step.
- Select the SLR Map Layer that comes closest to the SLR value you derived from STEP 1 to see how SLR impacts your project site and access roads. If your SLR value is between two values, round up to the higher SLR Map Layer.
- Type in or Zoom to your project site address in the address field.
- Identify the roads that connect to your project site and if they show exposure to SLR.

Step 2B: STORMTOOLS Design Elevation (SDE)

- Determine your recommended STORMTOOLS Design Elevation (SDE) using ([xxx.xxxx.xxx](#))
NOTE: SDE maps are currently under development and are expected to be online and available for the entire Rhode Island coastline by mid-2018.
- Reference State Law Elevation Allowances. **NOTE: 1-foot of freeboard (elevation) is required, above BFE is required but up to 5-feet of additional freeboard may be provided voluntarily.**
- Applicant should coordinate with the design engineer on this issue.

Step 2C: Erosion

- See Erosion Maps in RICRMP and meet the Regulatory setbacks (Section 140).
- To calculate projected erosion at the project site, select the multiplier in the Table 2 below that corresponds to the design life year you selected in STEP 1. Multiply the historic erosion rate you identified in STEP 1.2 by the multiplier in the Table 2 to determine projected future erosion for the project site.

| Year | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|-------------------------------------|------|------|------|------|------|------|------|------|------|
| Projected Future Erosion Multiplier | 1.05 | 1.14 | 1.23 | 1.34 | 1.45 | 1.57 | 1.70 | 1.84 | 2.00 |

Table 2 – Projected Erosion Rate multipliers. (Oakley et al., 2016¹)

¹ Oakley, B.A., Hollis, R.J., Patroliia, E., Rinaldi, M., and Boothroyd, J.C., 2016, Projected Shorelines and Coastal Setbacks: A Planning Tool for the Rhode Island South Shore: Technical report prepared for the RICRMC Shoreline Change Special Area Management Plan

Step 2D: Other Site Considerations

- Consider other risk factors that might impact the development, such as coastal habitats, shoreline features, public access, wastewater, stormwater, depth to water table/groundwater dynamics, saltwater intrusion, or other issues not listed above.

Step 2E: STORMTOOLS/Coastal Environmental Risk Index (CERI) - *UNDER DEVELOPMENT*

DRAFT

STEP 3: LARGE PROJECTS AND SUBDIVISIONS (6 OR MORE UNITS)

This step is for Large Projects and Subdivisions only.
This step may be skipped for other projects.

STEP 3 (Please see Page 13 for background information.)

The CRMC recommends consulting its Sea Level Affecting Marshes Model ([SLAMM](http://www.crmc.ri.gov/maps/maps_slamm.html)) Maps to assess potential impacts to large projects and subdivisions from salt marsh migration resulting from projected sea level rise.² CRMC SLAMM maps can be accessed here: http://www.crmc.ri.gov/maps/maps_slamm.html.

The CRMC recommends using the 5-foot SLR projection within SLAMM to assess future potential project impacts on migrating marshes.

² The final report on sea level and marshes can be viewed here: <http://www.beachsamp.org/wp-content/uploads/2015/06/Rhode-Island-Sea-Level-Affecting-Marshes-Model-Technical-Report-11.pdf>

STEP 4: DESIGN EVALUATION

The applicant will identify, document, and assess the feasibility of design techniques that could serve to avoid or minimize risk of losses.

STEP 4 (Please see Page 14 for background information.)

1. **Expected outcomes from Step 4: This step may involve an iterative process of project modifications and reexamination of impacts, leading to one or more alternatives for the project site. Designs may include relocation, fortification, and/or employ other alternatives to accommodate Coastal Hazards impacts. The alternative that will minimize risks from coastal hazards and avoid or minimize impacts to coastal resources should be identified. The applicant is encouraged to select the alternative that will avoid and/or minimize the risks to the project, abutting structures, infrastructure, and coastal resources.**
2. The design decisions and creativity to meet this challenge is up to the applicant. On hazard-constrained sites with a high level of exposure from Coastal Hazards, minimizing risk may be the only option for the proposed project and, in some cases, relocation of the project may be the best option. In all cases, projects must be sited and designed to address all applicable regulatory standards. Considerations involved in choosing and designing an appropriate adaptation strategy are further described below:
 - a. **Assess Design Constraints and Validate Project Design Life:** Determine whether there are any significant site or design constraints that might prevent future implementation of possible adaptation measures. Based on the analysis, some project locations may be constrained due to lot size, elevation, preserve of protected resource (i.e., wetland), steep slopes, and/or limited access, such that no viable development area can be identified on the parcel for the design life chosen. In some cases applications may proceed in the face of these risks but, care should be taken to avoid resource impacts and minimize risks as much as possible, including identifying alternative routes or access to and from the project site.
 - b. **Identify and Document Adaptation Options:** Identify possible adaptation strategies for the proposed project, and evaluate each adaptation option for the ability to minimize risk for the PROPOSED DEVELOPMENT and potential adverse impacts on coastal resources. Options for adaptation should be considered for the chosen design life of the proposed project to ensure that CURRENT development does not negatively impact coastal resources in the future. Applicants are expected to

describe and evaluate the viability of the strategies considered, and provide an example or reference that can be reviewed by CRMC in its review.

For example, an option that is often considered for sea level rise is to elevate structures to provide flood protection. However, while elevating the structure may decrease the risk of flood damage, the additional elevation of the building may subject it to greater from wind exposure. *Therefore, construction methods and materials must meet applicable building code requirements for the expected wind loads. It should be considered that although elevation of buildings may be of little long-term utility if the supporting infrastructure, such as the driveways, roads, utilities, wells, or on-site wastewater treatment systems, is subject to flooding, erosion, or storm damage.*

- c. **Ensure Design Flexibility:** If the likelihood of exposure and damage is expected to increase over time, it may be appropriate to design the project with some exposure to risk, but with design flexibility that will allow future project modifications and improvements to further minimize risks or losses in the future.

For example, modifications and improvements could include the use of fortification and foundation elements that will allow for building relocations or removal of portions of a building as it is threatened by Coastal Hazards over time. For related on-site waste treatment systems, planning for relocation of these systems away from areas susceptible to tidal inundation, storm surge, erosion or rising water tables may be necessary to ensure long-term use of the site.

- d. **Develop Project Modifications:** If the project site is highly constrained from exposure to Coastal Hazards, the applicant may benefit from plans to incrementally relocate the project as site conditions change to a point where the site is unable to support continued use. For example, identifying triggers through monitoring sea level rise and tidal inundation levels, or erosion rates may result in a change to the design of the project and need to implement improvements. Applicants are encouraged to prepare an implementation plan that outlines how and when adaptation measures will be incorporated into the project over the design life.
- e. **Plan for Monitoring:** Where impacts are realized, the applicant is expected to implement adaptation measures in a timely manner. Potential Coastal Hazard impacts over time should be considered to ensure project modifications, or additional adaptation efforts can be implemented in the future.

STEP 5: SUBMIT AN APPLICATION

The applicant will submit the permit application and include the assessment from the previous steps in the application package to the CRMC.

CRMC expects that this process will result in a more resilient shoreline across the state of Rhode Island. The intent of this process is to reduce risk, ensure longevity of developments, and increase awareness of coastal hazards among coastal property owners and business sectors.

STEP 5

- 1. Complete the permit application.** Prepare the analysis as described above. The Application Checklist for permit applications, provided at the end of this document, covers the typical information that might be included in a permit application necessary for CRMC review. Applicants who are unfamiliar with the permit process should consult CRMC or its website for instructions on how to complete a permit application, or consider hiring the appropriate environmental and/or design consultants.³
- 2. Submit a complete permit application.** CRMC Staff will review the application for completeness to ensure that there is sufficient information to analyze the project for all appropriate CRMC policies and regulatory standards, as applicable.
- 3. Once a complete application has been accepted,** CRMC Staff will review the analysis of the potential hazards and resource impacts associated with the proposed project and site access. Ideally, the application will provide all necessary project information at the filing stage. In some instances, additional information may be needed after the application has been accepted. This is normally limited to clarifications or further details regarding the submittal. During this stage in the permit application process, the permit staff may suggest appropriate project modifications that were not part of the initial application, or place conditions on the project permit if it is to be approved. Completion of these steps does not guarantee an approval of the application or an agreement that the design life will be met if approved.
- 4. Expected outcomes from STEP 5: *This step, combined with supporting documentation from the previous steps, should provide a basis for evaluating impacts from Coastal Hazards and on coastal resources, and provide the basis for a complete application.***

³ <http://www.crmc.ri.gov/applicationforms.html>

Background Information for the 5-Step Application Process

STEP 1 - BACKGROUND:

1. In this step, the applicant will consider the viability of their project site, and the expected life span for their project, referred to in this process as “design life,” and determine if projected future sea level scenarios and related tidal cycles are expected to expose their project to tidal waters.
2. Given the current uncertainty about the magnitude and timing of future sea level rise, an analysis based on the applicant’s chosen design life will examine the consequences associated with specific planning horizons using the most recent NOAA sea level rise data curve with the expectation that water levels are not likely to exceed the indicated height within the chosen planning horizon.
3. Section 145 of the RI CRMP provides timelines for short-, mid-, and long-term planning for 2035, 2050, and 2100, respectively (see Table 2), based on the Newport, RI NOAA tide gauge.

Table 2. Design planning horizons recommended by CRMC⁴ (Feb. 2017)

| Time Horizon | Projected Sea Level Rise: NOAA Sea Level Rise High Curve in Rhode Island | Projected Sea Level Rise with Annual Extreme High Tides |
|---------------------|---|--|
| 2035 | 1 foot | 2-3 feet |
| 2050 | 2 feet | 3-4 feet |
| 2100 | 7 feet | 8-9 feet |

⁴ The projections for these planning horizons reflect NOAA’s high curve on the USACE Sea Level Change Curve Calculator as of February 2017, and are based on sea level in 1990 from the Newport Tide Gauge.

4. The design life for the project will help determine the appropriate projections of Coastal Hazards to which the project site could be exposed while the development is in place. Importantly, the point of this step is to consider the level of risk from Coastal Hazards a property owner is willing to assume.
5. The projections for the impacts of Coastal Hazards associated with this design life are expected to be used throughout this analysis and evaluation. If constraints are identified with this analysis, defining adaptation measures will be expected as outlined in Step 4 of this process. If a developable area on the site is identified with no long-term resource impacts from Coastal Hazards, the applicant will be expected to document this in their permit application package.

STEP 2 - BACKGROUND:

1. Online mapping tools have been developed by the CRMC and the University of Rhode Island to assess spatial relationships of project sites and the related ingress/egress areas within the Shoreline Change SAMP Planning Boundary to Coastal Hazards.⁵ STORMTOOLS is an online mapping tool intended for use by coastal dwellers, property owners, and government decision makers to understand risk from changing coastal conditions, including storm surge, coastal erosion, and projected sea level rise. STORMTOOLS is hosted online using ESRI software, ArcGIS.com, and individual data layers are downloadable for use in desktop GIS software through Rhode Island Geographic Information Systems (RIGIS.org). The following pages illustrate the tools and provide applicants with instructions on how to use the information and data provided within each tool for use in evaluating the Coastal Hazards that may interact with the project site or ingress/egress areas.
2. **STORMTOOLS for Coastal Permit Applicants** has been designed for permit applicants to assess the exposure and risk from coastal processes, and for RI CRMC permit review staff to evaluate permit applications. The applicant is expected to review and document the following six Coastal Hazards using the tools indicated below.
 - 2A. **Sea Level Rise** – illustrate inundation using STORMTOOLS
 - 2B. **STORMTOOLS Design Elevation (SDE)** – identify the SDE and compare that to the FEMA Flood Insurance Rate Map (FIRM) BFE assigned to the project site
 - 2C. **Coastal Erosion** – determine historical and projected exponential rate and amount of change using SHORELINE CHANGE MAPS with the multipliers provided to determine future conditions

⁵ These tools are identified in Section 145 (STORMTOOLS for sea level rise and storm surge), Section 140 (shoreline change maps) and Section 210.3 (SLAMM for marsh migration), respectively.

2D. Other Site Considerations – document other forces or factors that might impact the development, such as depth to water table/groundwater dynamics, or assessment of coastal resources which may include consideration of coastal habitats, shoreline features, public access, wastewater and stormwater, and how the proposed development may impact these over your chosen design life with the potential effects of Coastal Hazards as identified in Step 2.

Coastal permit applications are expected to identify: 1) the presence of any of the following types of coastal resources in the area of the proposed project; 2) if exposure to Coastal Hazards might result in impacts to the coastal resource or the proposed development; and 3) how these may change over time.

- i. **Coastal Habitats:** Coastal habitats, especially those that have a connection to water, such as beaches, dunes and coastal wetlands, are likely to be impacted by Coastal Hazards.
- ii. **Shoreline Features:** Shoreline features include coastal beaches, barrier islands and spits, coastal wetlands, coastal headlands, bluffs and cliffs, rocky shores, manmade shorelines, and dunes. CRMC jurisdiction and regulations for setbacks and buffer zones surrounding onshore development includes land area within a 200 foot distance from the inland edge of the coastal feature.⁶
- iii. **Public Access:** In the RI CRMP, the term public access is “a general term used to describe the ways and means by which the public may legally reach and enjoy the coastal areas and resources of the State” (RI CRMP § 335(A)(1)). New and substantially improved development must protect existing public access ensure access along the coastline.⁷ Public access resources include both lateral and perpendicular public access ways, public access easements, beaches, public trust areas and lands, and trails. These areas may become hazardous or unusable during the project life as a result of impacts from Coastal Hazards. Coastal erosion and sea level rise may present barriers to or eliminate public access over time because adjacent land uses may not allow that access to migrate with the shoreline. Additionally, hardening of the shoreline can create barriers to public access along lateral access ways as erosion takes place.⁸

⁶ See Section 210 of the CRMP for more information about Shoreline Features
<http://www.crmc.ri.gov/regulations/RICRMP.pdf>

⁷ See Section 335 of the CRMP for more information on Public Access <http://www.crmc.ri.gov/regulations/RICRMP.pdf>

⁸ See Section 300.7 of the CRMP for more information about Shoreline Protection Facilities
<http://www.crmc.ri.gov/regulations/RICRMP.pdf>

- iv. **Wastewater and Stormwater:** Coastal Hazards may cause stormwater drainage outfalls with low elevations to back up during rainfall events, or push seawater inland through stormwater infrastructure, causing flooding in areas that are not in direct contact with the sea. Coastal Hazards, sea level rise in particular, may also cause a rise in the groundwater table, reducing the groundwater separation distance to on-site wastewater treatment systems (OWTS) and shortening the life of the system. Both of these changes could alter on-site drainage and limit future drainage options. These changes can also affect regimes of freshwater wetlands near saltwater wetlands.⁹ Recent research covering the ability of soil-based OWTS to treat wastewater in coastal regions of the Northeastern United States can be found in Cooper et al., 2016.¹⁰
- v. **Groundwater and Salt Water Intrusion:** Consider how salt water intrusion or rising groundwater tables associated with sea level rise may impact private drinking water wells and septic systems.

2E. STORMTOOLS/Coastal Environmental Risk Index – **UNDER DEVELOPMENT**

STEP 3 - BACKGROUND:

1. In addition to the other Steps above, large projects and subdivisions of 6 or more units located in the vicinity of coastal wetlands should evaluate the project for potential impacts to coastal wetlands under future conditions. For example, will a proposed project accommodate or impede coastal wetland migration into upland areas? Coastal salt marshes are projected to either migrate or drown in place as a result of rising sea levels. This step offers an opportunity for the applicant to provide for migration of wetlands and increase the resilience of the project site.

STEP 4 - BACKGROUND:

1. Given the results of the analysis conducted in Steps 1 - 3 above, the applicant is expected to consider project changes, types of adaptation strategies, and design alternatives that would be most appropriate given the degree of risk posed by Coastal Hazards, and how long the development might be free from risk. The permit application might identify triggers within the chosen design life (e.g., a certain amount of sea level rise) when certain

⁹ The final report on sea level and marshes can be viewed here: <http://www.beachsamp.org/wp-content/uploads/2015/06/Rhode-Island-Sea-Level-Affecting-Marshes-Model-Technical-Report-11.pdf>

¹⁰ <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0162104> - "Hell and High Water: Diminished Septic System Performance in Coastal Regions Due to Climate Change"

adaptation measures should be implemented to reduce risk and/or impacts to coastal resources.

2. Protective devices including seawalls, revetments, and groins substantially alter natural landforms along the shoreline. **Shoreline protection structures are prohibited along shorelines classified as Type 1 Conservation Areas** in the CRMP. Type 1 waters make up 50% of Rhode Island's coastline, and thus these protective devices would not be considered appropriate mitigation measures in many cases.
3. When structural shoreline protection is proposed, the Council shall require that the owner **exhaust all reasonable and practical alternatives** including, but not limited to, the relocation of the structure and nonstructural shoreline protection methods¹¹, including use of natural/nature based infrastructure designed to adapt to changing conditions over time.
4. Land divisions and lot line adjustments in high hazard areas can change hazard exposure and should therefore be undertaken only when they can be shown to **not degrade or create new vulnerability**. In particular, new lots or reconfigured lots with new development potential should be created to minimize shoreline hazard risks.
5. It is important, in identifying adaptation measures to prevent hazards impacts to the development, that **these measures should not exacerbate other risks**¹². For example, placing fill into an area that is predicted to be affected by Coastal Hazards could negatively impact adjacent resources, such as wetlands, if the fill is displaced during a storm event or increases stormwater flooding. Additionally, permit reviews will assess if proposed developments will rob sediment supply to beaches. The RI CRMP may limit certain adaptation measures in these cases.
6. The best way to minimize risks to both development and coastal resources is to **avoid areas or portions of the site that are or will become hazardous** as identified by the analysis in the previous steps. Such avoidance often includes changes to the proposed project to bring the size and scale of the proposed development in line with the capacity of the project site.
7. If it is not feasible to site or design a structure to completely avoid impacts from Coastal Hazards, the application may need to include **measures that fortify or otherwise modify the development** to prevent risks to the development or to coastal resources. Some changes, such as the use of additional setbacks, may be necessary at the outset of the project. Other changes, such as elevation, added floodproofing, or relocation of the project to another site during the design life may be viable adaptive strategies that can be applied in the future after the initial project completion. The CRMC currently offers applicants in its regulations, RI Code of Regulations (RICR) 650-RICR-10-00-01.4.3, an incentive for expedited

¹¹ RI CRMP Section 300.7.

¹² See Chapter 7 for more information on specific adaptation measures.

review of projects seeking Insurance Institute for Business & Home Safety (IBHS) Fortified Home™ program designation.

8. The applicant may consider **designing the project to be moved or relocated** in the future when conditions warrant. This is especially important for severely constrained lots, or lots that are expected to experience significant change when threatened by coastal hazards.

Why has CRMC developed this process?

The CRMC is mandated to uphold all applicable sections of the federal **Coastal Zone Management Act of 1972 (CZMA)**. The CZMA requires that the CRMC provide for the protection of natural resources within the coastal zone, including wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and fish and wildlife and their habitat, and must manage coastal development to improve, safeguard, and restore the quality of coastal waters, and protect existing uses of those waters. The CRMC must develop management plans that give full consideration to ecological, cultural, historic, and aesthetic values, as well as needs for compatible economic development. SAMPs are identified in the CZMA as effective tools to meet this mandate (16 U.S.C. §1456b).

In 16 U.S.C. § 1451 Congressional findings (Section 302), the Congress finds that:

(I) Because global warming may result in a substantial sea level rise with serious adverse effects in the coastal zone, coastal states must anticipate and plan for such an occurrence.

In 16 U.S.C. § 1452 Congressional declaration of policy (Section 303), the Congress finds and declares that it is the national policy—

2) to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and esthetic values as well as the needs for compatible economic development, which programs should at least provide for—

(B) the management of coastal development to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands; and

(K) the study and development, in any case in which the Secretary considers it to be appropriate, of plans for addressing the adverse effects upon the coastal zone of land subsidence and of sea level rise.

(3) to encourage the preparation of special area management plans which provide for increased specificity in protecting significant natural resources, reasonable coastal-dependent economic

growth, improved protection of life and property in hazardous areas, including those areas likely to be affected by land subsidence, sea level rise, or fluctuating water levels of the Great Lakes, and improved predictability in governmental decision making

CRMC is Rhode Island's responsible agency for carrying out the Shoreline Change SAMP effort and abiding by the guiding principles outlined above. The enabling legislation is documented in **Title 46, Chapter 23 of the Rhode Island General Laws**. Section 46-23-1, Legislative Findings, states:

46-23-1 (a)(1) Under article 1, § 17 of the Rhode Island Constitution, the people shall continue to enjoy and freely exercise all the rights of fishery, and the privileges of the shore, to which they have been heretofore entitled under the charter and usages of this state, including but not limited to fishing from the shore, the gathering of seaweed, leaving the shore to swim in the sea and passage along the shore; and they shall be secure in their rights to use and enjoyment of the natural resources of the state with due regard for the preservation of their values; and it is the duty of the general assembly to provide for the conservation of the air, land, water, plant, animal, mineral and other natural resources of the state, and to adopt all means necessary and proper by law to protect the natural environment of the people of the state by providing adequate resource planning for the control and regulation of the use of the natural resources of the state and for the preservation, regeneration, and restoration of the natural environment of the state.

46-23-1(a)(2) The general assembly recognizes and declares that the coastal resources of Rhode Island, a rich variety of natural, commercial, industrial, recreational, and aesthetic assets, are of immediate and potential value to the present and future development of this state; that unplanned or poorly planned development of this basic natural environment has already damaged or destroyed, or has the potential of damaging or destroying, the state's coastal resources, and has restricted the most efficient and beneficial utilization of these resources; that it shall be the policy of this state to preserve, protect, develop, and, where possible, restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long range planning and management designed to produce the maximum benefit for society from these coastal resources; and that preservation and restoration of ecological systems shall be the primary guiding principle upon which environmental alteration of coastal resources will be measured, judged, and regulated.

46-23-1 (b)(1) That effective implementation of these policies is essential to the social and economic well-being of the people of Rhode Island because the sea and its adjacent lands are major sources of food and public recreation, because these resources are used by and for industry, transportation, waste disposal, and other purposes, and because the demands made on these resources are increasing in number, magnitude, and complexity; and that these policies are necessary to protect the public health, safety, and general welfare. Pursuant to 16 U.S.C. § 1452 ("The Coastal Zone Management Act"), the General Assembly hereby directs the council (referred to as "CRMC") to exercise effectively its responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone.

46-23-1 (b)(2) Furthermore, that implementation of these policies is necessary in order to secure the rights of the people of Rhode Island to the use and enjoyment of the natural resources of the state with due regard for the preservation of their values, and in order to allow the general assembly to

fulfill its duty to provide for the conservation of the air, land, water, plant, animal, mineral, and other natural resources of the state, and to adopt all means necessary and proper by law to protect the natural environment of the people of the state by providing adequate resource planning for the control and regulation of the use of the natural resources of the state and for the preservation, regeneration, and restoration of the natural environment of the state.

Section 46-23-6 states the **RI CRMC Powers and Duties** as:

The primary responsibility of the council shall be the continuing planning for and management of the resources of the state's coastal region. The council shall be able to make any studies of conditions, activities, or problems of the state's coastal region needed to carry out its responsibilities

In the Rhode Island State Building Code (2012 Rhode Island General Laws, Title 23 - Health and Safety; Chapter 23-27.3 - State Building Code), Chapter 23-27.3-100.1.5.5 states **CRMC's role in hurricane, storm, and flood standards**:

23-27.3-100.1.5.5 Hurricane, storm, and flood standards. – The state building code standards committee has the authority in consultation with the building code commissioner, to adopt, maintain, amend, and repeal code provisions, which shall be reasonably consistent with recognized and accepted standards and codes, including for existing buildings, for storm and flood resistance. Such code provisions shall, to the extent reasonable and feasible, take into account climatic changes and potential climatic changes and sea level rise. Flood velocity zones may incorporate freeboard calculations adopted by the Coastal Resources Management Council pursuant to its power to formulate standards under the provisions of § 46-23-6.

In addition to services provided to the state of Rhode Island by its CRMC, the **Resilient Rhode Island Act of 2014 established** the Rhode Island Climate Change Coordinating Council (EC4), and states in Section 42-6.2-2 (3), Purpose of the Council, duties shall include:

Advance the state's understanding of the effects of climate change including, but not limited to, sea level rise, coastal and shoreline changes, severe weather events, critical infrastructure vulnerability, and ecosystem, economic, and health impacts;

And in the same Act, Section 42-6.2-8 states the powers and duties of state agencies, exercise of existing authority:

Consideration of the impacts of climate change shall be deemed to be within the powers and duties of all state departments, agencies, commissions, councils, and instrumentalities, including quasi-public agencies, and each shall be deemed to have and to exercise among its purposes in the exercise of its existing authority, the purposes set forth in this chapter pertaining to climate change mitigation, adaptation, and resilience in so far as climate change affects the mission, duties, responsibilities, projects, or programs of the entity.

To meet the challenges presented by sea level rise and coastal shoreline change, CRMC has been

working to gather and monitor the best available science and data for use in effective decision making. Data provided by the U.S. National Oceanic and Atmospheric Administration (NOAA), points to accelerating sea levels globally and in the northeastern U.S. As sea levels rise, storm surge and the effects of coastal flooding and erosion are projected to impact areas farther inland. These processes will result in damage to more properties and infrastructure in Rhode Island coastal cities and towns, including those that have never before experienced flood damage.

The following sources have been consulted to ensure CRMC is using the best available data on sea level change, as well as a multitude of other studies and data:

- U.S. Army Corps of Engineers (USACE), Sea Level Change Curve Calculator (<http://www.corpsclimate.us/ccaceslcurves.cfm>). This web-based tool allows users to select a tide gauge of interest and view both USACE and NOAA historic rates of sea level change, and projections of sea level change by year in a table and graphically as a curve.
- University of Colorado (UC) Sea Level Research Group - (<http://sealevel.colorado.edu/>) The Group reports current satellite altimetry measurements of the rate of global sea level rise of 3.4 +/-0.4mm per year since 1993.
- Relative sea level rise in Rhode Island measured more than 4 millimeters per year between 1983 and 2009 (Carey et al. 2015).

In 2016, CRMC adopted an update to the **RI Coastal Resources Management Plan (RICRMP), Section 145, Policies, of the “Red Book”** that addresses these changes:

- 1. The Council will review its policies, plans and regulations to proactively plan for and adapt to climate change and sea level rise. The Council will integrate climate change and sea level rise scenarios into its programs to prepare Rhode Island for these new, evolving conditions and make our coastal areas more resilient.*
- 2. The Council’s sea level rise policies are based upon the CRMC’s legislative mandate to preserve, protect, and where possible, restore the coastal resources of the state through comprehensive and coordinated long-range planning.*
- 3. The Council recognizes that sea level rise is ongoing and its foremost concern is the accelerated rate of rise and the associated risks to Rhode Island coastal areas today and in the future. The Council recognizes that the lower the sea level rise estimate used, the greater the risk that policies and efforts to adapt sea level rise and climate change will prove to be inadequate. Therefore, the policies of the Council may take into account different risk tolerances for differing types of public and private coastal activities. In addition, the Council will regularly review new scientific evidence regarding sea level change.*
- 4. The Council relies upon the most recent NOAA sea level rise data to address both short- and long term planning horizons and the design life considerations for public and private infrastructure. The Council’s policy is to adopt and use the sea level change scenarios published by NOAA in Technical*

Report OAR CPO-1 (Parris et al., 2012), and the sea level rise change curves for Newport and Providence as provided in the USACE sea level rise calculator. As of 2015 the range in sea level rise change is projected by NOAA to be a maximum of approximately 1.0 foot in 2035, 2.0 feet in 2050 and 7.0 feet in 2100. In addition, the Council adopts and recommends the use of the StormTools online mapping tool developed on behalf of the CRMC by the University of Rhode Island Ocean Engineering program to evaluate the flood extent and inundation from sea level rise and storm surge.

The process described in this document is intended to provide applicants the information to assess the changing future conditions and allow applicants seeking coastal permits to plan for adaptation to those conditions. Throughout the permit application process, applicants are expected to consult specific requirements for various project types, which are detailed within the RI CRMP.¹³

Coastal Hazards described in this process will also trigger applicants seeking coastal permits to consider the following for their project site:

- Identify the level of exposure of proposed project site to Coastal Hazards including projected sea level rise scenarios, storm surge inundation, wave impacts, and erosion. Depending on the site boundaries, applicants will be expected to examine the potential for expansion of the floodplain within the Shoreline Change SAMP Planning Boundary.
- Applicants will be asked to consider site exposure to Coastal Hazards as well as exposure/impacts to the transportation system offering ingress and egress. For example, the project site may not be inundated by projected Coastal Hazards, but roads may be unpassable or access to infrastructure could be suspended.
- In cases of projects subject to review in RI CRMP Section 320, such as subdivisions, major commercial developments, and public infrastructure which are expected to have a long design life, applicants may want to conduct a pre-application meeting with CRMC to clarify which analyses are recommended for the proposed project.

As mentioned at the start of this Chapter, this document is intended to provide guidance and tools for state and local decision makers to prepare and plan for, absorb, recover from, and successfully adapt to the impacts of coastal storms, erosion, and sea level rise. Any regulatory changes resulting from this guidance document will be subject to the CRMC review and adoption process, and documented in Section 110 of the RI CRMP.

How does this process relate to other local, state and federal programs?

Currently, projects reviewed through the CRMC application process are examined for sea level rise as part of the hazards analysis, but to date projects have not been mandated to meet specific requirements to adapt to future conditions. The guidelines in this document offer direction and

¹³ The RI CRMP (Red Book) can be accessed online here: <http://www.crmc.ri.gov/regulations/RICRMP.pdf>

support for a thorough examination of Coastal Hazards and their associated impacts based on current climate science and coastal responses to changing sea levels over time. This information is expected to assist in evaluating consequences of future change, thereby empowering the applicant to make an informed decision on the long term use and viability of their project.

While CRMC is offering this guidance, the Rhode Island State Building Code regulates construction in the state of Rhode Island. The mission and purpose of the State Building Commission is to, "...safeguard and establish minimum requirements necessary to protect public health, safety and welfare in the built environment. Model building codes provide for protection from fire, structure collapse and general deterioration."¹⁴ While the Rhode Island State Building Code is the required source for regulations on any proposed construction project, the guidelines offered in this document for coastal permit applications are intended to assist applicants in making informed decisions based on future coastal conditions.

At the municipal level, state law mandates that local comprehensive plans consider the effects of sea level rise along with other natural hazards.¹⁵ Such coordination between local comprehensive plans and CRMC adaptation policies, standards, and the coastal permit process will help ensure that coastal development and resources are resilient over time.

The National Flood Insurance Program (NFIP), managed by the U.S. Federal Emergency Management Agency (FEMA), and locally by the Rhode Island Emergency Management Agency (RIEMA), identifies properties at risk from coastal and riverine flooding based on past storm events. In addition, structures that are built within FEMA designated floodplains are regulated by the Rhode Island State Building Code.

The process described in this document differs from the FEMA floodplain analysis in that it requires the applicant to consider future risk from coastal hazards. From this assessment, the applicant will have an opportunity to address future conditions that might include setbacks, elevation, or fortification to reduce the exposure of the development to coastal hazards, possibly resulting in reduced flood insurance premiums for some developments. In addition, this process offers applicants an opportunity to consider "code-plus" techniques, such as the Insurance Institute for Business and Home Safety's (IBHS) FORTIFIED™ program¹⁶, which can serve to increase the ability of the development to withstand storm impacts beyond minimum requirements outlined in the Rhode Island State Building Code.

While the result of the analysis outlined in this document may encourage an applicant to elevate or otherwise floodproof/stormproof their proposed project, thereby resulting in a positive change in homeowners or flood insurance premiums, the process outlined in this document is independent from the National Flood Insurance Program.

¹⁴ State of Rhode Island, Building Code Commission, <http://www.ribcc.ri.gov/>

¹⁵ RIGL 45-22.2-2 (a) and RIGL 45-22.2-6 (b) (10)

¹⁶ Insurance Institute for Business and Home Safety, FORTIFIED program, <https://disastersafety.org/fortified/>

Which projects are expected to follow this process?

The process described below will be used for: new development projects, substantially improved development projects; and all projects which:

- Require Council Assent based on the [Guidelines for Applicants](#) in the introduction of the RI CRMP; and
- Are defined in Section 110 of the RI CRMP.

What are the roles of the Applicant and CRMC?

This document and the process described herein are intended to ensure the applicant and CRMC are using the same information and data sources to:

- Evaluate the current site conditions for a project and assist in evaluating the possible future conditions; and
- Clearly articulate the level of coastal risk the applicant is willing to accept during and after construction of their project.

The applicant is expected to follow the 5-step process outlined earlier in this Chapter. The applicant will pay particular attention to the “Projected Outcomes” identified within each Step, and document the outcomes in their application to CRMC.

CRMC will use the process outlined in this document to assess exposure and potential impacts to coastal developments based on identified Coastal Hazards. It is expected that the resulting application and Council Assent will acknowledge the results of this assessment and include this information in the formal documentation issued with the permit, regardless if the applicant has chosen to use the outcomes identified from the process in the design of the project.

Definitions used in this document:

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| Shoreline Change SAMP Planning Boundary | Includes the land area within each of the 21 Rhode Island coastal communities projected to be inundated by a 100-year return period (1% annual chance) storm event plus seven feet of sea level rise as illustrated in STORMTOOLS (www.beachsamp.org/stormtools). |
| Coastal Resilience | <i>Coastal resilience means building the ability of a community to "bounce back" after hazardous events such as hurricanes, coastal storms, and flooding – rather than simply reacting to impacts.</i> Source: NOAA, National Ocean Service, Office for Coastal Management |
| Coastal Hazards | Projections for sea level rise, storm surge, wave action, coastal erosion, and their cumulative impacts (e.g. storm surge with sea level rise). |
| Critical Infrastructure | <i>There are 16 critical infrastructure sectors whose assets, systems, and networks, whether physical or virtual, are considered so vital to the United States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof. Those sectors include: chemical; commercial facilities; communications; critical manufacturing; dams; defense industrial base; emergency services; energy; financial services; food and agriculture; government facilities; healthcare and public health; information technology; nuclear reactors, materials and waste; transportation systems; and, water and wastewater systems.</i> Source: U.S. Department of Homeland Security, Critical Infrastructure Sectors |
| Ingress/Egress | The area around the proposed development where state and local roadways provide vehicular and other access to a property. |
| Return Period | Also referred to as "Recurrence Interval," this term indicates the probability of water levels resulting from storm events of different intensities. |

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| RI Coastal Resources Management Program (RI CRMP, a.k.a. “Red Book”) | The RI CRMP is the regulatory document that guides coastal decision making and permitting in Rhode Island: <i>Pursuant to 16 U.S.C. § 1452 ("The Coastal Zone Management Act"), the General Assembly hereby directs the council (referred to as "CRMC") to exercise effectively its responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone.</i> |
| STORMTOOLS | STORMTOOLS is a web-based map viewer that allows the Rhode Island user to access high resolution maps that illustrates coastal risk at a parcel level. |

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