



Guidance for the Consideration of Climate Change Impacts in the Planning and Design of Municipal Wastewater Collection and Treatment Infrastructure

Overview

The following guidance builds on and clarifies existing studies, resources, and coastal efforts available regionally and within Rhode Island, most notably the “TR-16” *Guide for the Design of Waste Treatment Works* issued by the New England Interstate Water Pollution Control Commission; the RIDEM report [Implications of Climate Change for RI Wastewater Collection and Treatment Infrastructure](#); and [STORMTOOLS](#), a Rhode Island-based sea level rise and storm surge online map viewer based on the 2015 “North Atlantic Coast Comprehensive Study” (or “NACCS”) data from the United States Army Corps of Engineers.

This guidance is intended for the planning and design of all expansions or upgrades of existing municipal wastewater collection and treatment infrastructure as well as new wastewater systems. It is limited to municipal wastewater systems and certain private systems that collect, treat, and discharge wastewater into the waters of the state. This guidance is not intended for use at wastewater systems with subsurface disposal.

Goals

Per TR-16 wastewater facility design guidance, RIDEM seeks at a minimum the protection of systems from:

- **Interruptions in operations** at Base Flood Elevations, or equivalent, as discussed below; as well as,
- **Damages to structural and electrical integrity** at Base Flood Elevations, or equivalents, as discussed below, with an additional two feet of freeboard for non-critical structures and systems and three feet for critical structures and systems.
- **These protections will be achieved to the maximum extent practicable** as determined by cost-benefit analyses.

Notes for guidance use

RIDEM welcomes preliminary meetings prior to planning and design initiatives for particular projects so the implementation of this guidance can be mutually discussed and agreed upon.

For the purposes of this guidance, *critical components* are all structures and systems that are necessary for process operations, such as forward flow, treatment in accordance with RIPDES permit limits, sludge handling and disposal, etc. *Non-critical components* are all other structures and systems, such as administration buildings and laboratories.

Designers should consider component/system life expectancy to be twenty years for mechanical and electrical systems and fifty years for tankage and similar structures. The location of new infrastructure should consider longer life expectancies, especially in coastal areas subject to sea level rise and coastal erosion.

Base Flood Elevations and their equivalents, now and in the future

The Federal Emergency Management Agency (FEMA) establishes Base Flood Elevations (BFEs) for areas subject to a “100-year” base flood event, which means that the location has a one (1) percent chance of such flooding being equaled or exceeded in any given year. The BFEs are numerical flooding depths modeled for coastal and riverine areas of detailed study. This extent of flooding is represented on FEMA’s regulatory Flood Insurance Rate Maps (FIRM) and adopted by each community. For coastal flooding, FEMA BFEs include *both* inundation levels from surge from a 100-year storm event (known as the “stillwater elevation” or “SWEL”) and an estimate of wave heights, where applicable.

Because FEMA BFEs are based on historic flooding, they are not intended to address climate change. To do so, regional guidance from the NEIWPCC TR-16 design standards for wastewater treatment facilities suggests using current FEMA BFEs with the addition of two and three feet (for non-critical and critical components, respectively) to account for flooding from extreme rain events for inland areas and sea-level rise in coastal areas.

In Rhode Island, the STORMTOOLS mapping tool provides equivalent, future-looking inundation levels for coastal regions. The [STORMTOOLS Design Elevation \(SDE\) maps](#) are alternative BFE maps for coastal waters of Rhode Island. These maps take into account surge and wave predictions, coastal erosion, and sea level rise to generate SDEs to assist in the design of structures and infrastructure in the state. Maps can be generated for 0, 2ft, 3ft, 5ft, 7ft, and 10ft of sea level rise.

Other mapping and modeling efforts may eventually provide other helpful methods to determine equivalent inland and coastal BFEs, inundation levels, or waves for use in planning and design of future wastewater infrastructure. Also available is the NOAA sea level rise [viewer](#) and [data](#), which provides updated information on sea-level rise projections.



ASCE Flood Resistant Design and Construction Standards

As referenced under International Building Code (IBC), the American Society of Civil Engineers (ASCE) has established design standards (ASCE 24-14 and 7-22 Supplement 2) that increase the Flood Hazard Area for various Risk Categories to improve the performance of structures subjected to flood events and to meet the target reliabilities of the standard. Pursuant to IBC and Rhode Island state and local building codes, the ASCE standards may need to be taken into consideration. A summary of the ASCE standards and DEM's expectations can be found [here](#).

Thus, the planning and design of all expansions or upgrades of existing wastewater infrastructure should evaluate if they first meet the *substantial improvement* clause to determine if the ASCE design standards will be applicable. *Substantial improvements*, as defined per ASCE 24-14, are "any repair, alteration, addition, or improvement of a building or structure, the cost of which equals or exceeds 50% of the market value of the structure". Projects that constitute substantial improvements, new infrastructure (e.g. new WWTF and/or pump stations), and/or relocation of existing infrastructure shall be designed in accordance with ASCE design standards and DEM expectations. To do this, consideration must be given to the feasibility of designing to the ASCE design standards to the maximum extent practicable, including assessing the environmental, financial, technical, and operational impacts. DEM will assess projects on a case-by-case basis and approvals will be given based on the most viable design. To expedite the planning and design approval process, coordination with DEM should occur in the early stages of project development.

If a project does not fall within the ASCE design criteria (substantial improvements, new infrastructure, and/or the relocation of existing infrastructure), the below BFE criteria will apply.

Estimating BFE or equivalent for wastewater planning and design purposes

For riverine facilities:

- **Planning and design** of inland wastewater infrastructure, designers may use:
 - *FEMA FIRMS and/or corresponding Flood Insurance Study* for current 100-year BFEs (for uninterrupted operations).
+ Two and three feet to account for future conditions (that is, freeboard) during the life of the project;
 - *The RIDEM WWTF Climate Study*, which provide 100-year FEMA BFEs with the addition of two and three feet (for structural and electrical protections). This data is available on [RIGIS](#).
 - *Or alternative method, as approved by RIDEM*, to determine an equivalent BFE that accounts for climate change.

For coastal facilities:

- For **planning and design** purposes for coastal wastewater facilities, designers may use:
 - *The RIDEM WWTF climate study*. (Note that this study used STORMTOOLS data and methodology to estimate 100-year storm surge elevations with two and three feet of sea-level rise to account for climate change, then added a wave component (based on the 1-dimensional FEMA wave model "WHAFIS") to help derive an equivalent BFE); or, similarly,
 - [STORMTOOLS Design Elevations \(SDE\)](#), which generates maps to estimate 100-year elevations for coastal waters of Rhode Island using surge predictions, wave models, and coastal erosion, *which must be added*, two and three feet (for non-critical and critical components, respectively) to account for future conditions (that is, freeboard) during the life of the project;
 - *Or alternative equivalent methodology*, as approved by RIDEM. Note that the RIDEM WWTF climate study refers to other data sets and resources that are available as of the date of its publishing, such as individual save points from the Army Corps NACCS study, which can be downloaded [here](#).

Cost-Benefit Analysis

Per TR-16, cost-benefit analyses are required to estimate the cost-effectiveness of adaptation measures in light of projected flooding elevations. Such cost-benefit analyses shall include an examination of the costs of protection versus cost of equipment/system repairs or replacement, as well as the environmental impacts should collection or treatment components fail or be subject to inundation. In cooperation with RIDEM, designers should consider multiple methods to estimate BFEs (or an equivalent BFE) that account for climate change. Facilities with both coastal and riverine impacts must plan and design for the highest BFEs estimated by analyzing both coastal and riverine impacts.

Operations and Maintenance

Designers must consider operational plans and system flexibility to better respond to flooding conditions or the recovery thereof, such as quick connects for bypass pumping, dedicated locations and connections for emergency generators and backup chemical feeds, safe transformer elevations, site access, etc. Coordination with plant operators must be part of such design elements.