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Floodplain Building Elevation Standards for Critical Facilities and Activities

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Executive Summary

Flood protection elevations are a critical safety factor for construction in the flood plain as well as a regulatory compliance step in relevant construction.[1] Determining the appropriate flood protection height required for an infrastructure project can be complex. Factors determining the applicable standards can vary depending on location, funding source, construction type and critical/ non-critical designation. To identify the project's base flood elevation, a series of questions must be answered about the project to help guide the regulatory / statutory analysis:

In which FEMA flood zone is the facility located?
What type of facility is being constructed, altered, repaired, or renovated?
What actions or activity currently occur, or will occur, in the facility?
Is this a new facility or a substantial improvement to an existing facility?
How is the project funded?
What state and/ or federal flood protection standards to account for sea level rise apply?

The answers to these questions will help to determine which standards or guidance should be used and if the location and use of the facility calls for the application of a more conservative flood protection approach. It may be necessary to calculate flood protection height using multiple methods and then assess the appropriate flood protection height needed to meet statutory minimums, protect the project from site specific vulnerabilities, and justify funders cost/benefit analysis.

I. Definitions

Federal and state regulations and guidance use related language to describe structures and the actions that occur within. To avoid confusion between similar terms, clear definitions are crucial to navigate the design standards applicable to structures involved in essential functions. As an example, definitions below are provided as applied to wastewater facilities:

Critical Action (FEMA):

Any action[2] for which even a slight chance of flooding is too great.[3] It may or may not be associated with a critical facility. For projects funded by Hazard Mitigation Assistance grants, FEMA is responsible for determining if an action is a critical action. If a critical action is identified, FEMA must evaluate potential harm to the action from the 500-year-flood.[4]

Critical Facilities (FEMA):

> Are structures and institutions that are deemed by the local community and other jurisdictions as critical to the continuity of the community before, during, and after an event. Although the affected jurisdiction has the primary responsibility for determining what structures and institutions are critical facilities, FEMA reserves the right to make a final determination as needed to support the review and approval of an HMA project application.[5]

Critical Activity (CT DEEP Municipal Wastewater Section):

> For state funded projects, any activity deemed to be vital to the core operation of wastewater facilities or that will prevent a facility to return to full function as safely and quickly as possible after a flood event.[6]

Critical Activity (DEEP Land and Water Resource Division):

> Per CGS § 25-68b, this means any activity, including, but not limited to, the treatment, storage and disposal of hazardous waste and the siting of hospitals, housing for the elderly, schools, or residences, in the 0.2 per cent floodplain in which the commissioner determines that a slight chance of flooding is too great.[7]

II. Introduction

The threat of coastal flooding on Connecticut shoreline communities and infrastructure is growing. Sea level rise from increasing global temperatures exacerbates coastal flooding during storm events leading to inundation of areas historically not prone to flooding.[8] Hurricanes have increased in intensity during the last century[9] and storm tracks are predicted to continue to shift northward[10] leading to increased probability of harm to people and property from storm surge.[11] More homes, roads, businesses, and critical infrastructure are now vulnerable to coastal flooding. Current modeling suggests a prudent planning strategy should anticipate sea level rise in Long Island Sound of 0.5 m (1.8 ft) by 2050.[12] Connecticut state and local governments have taken steps to incorporate best evidence into policy for mitigating coastal flooding damage by creating standards for building elevation and floodproofing.[13] At the federal level, the Federal Emergency Management Agency (FEMA) requires projects to meet standards as a condition of receiving federal funding.

The National Flood Insurance Program (NFIP) was created to provide affordable insurance to owners of property in designated floodplains and to encourage communities to adopt and enforce floodplain management regulations.[14] While federal NFIP requirements for buildings and structures are essentially unchanged since the 1970's and function as minimums, FEMA has issued guidance[15] directing use of the latest International Building Code (IBC) and

American Society of Civil Engineers (ASCE) standards regulating building elevation height in coastal flood hazard areas.[16] Communities incorporating higher standards into state and local regulations, ordinances, and codes can benefit from NFIP Community Rating System incentives through discounted flood insurance premiums.[17] However, coordination during planning between federal, state and local building elevation standards can cause confusion.

Critical and non-critical structures are subject to different standards regarding flood protection measures. Currently, Connecticut has 1,940 "critical" facilities[18] and 133 are within the FEMA Special Flood Hazard Area (SFHA).[19] This number does not include 94 Water Pollution Control Facilities (i.e. wastewater treatment plants, pumping stations, etc.) in the state because mapping data for these facilities were not available at the time the State Hazard Mitigation Plan report was written.[20] However, water pollution facilities are a good illustration of how federal and state standards interact when upgrades to critical facilities are planned. For example, Connecticut DEEP Municipal Water Section has developed a process for critical wastewater infrastructure to undergo resiliency evaluation and improve flood protection to the maximum extent feasible when new facilities are planned, or existing facilities modified, in addition to applicable federal standards.[21] Other types of critical activities may be subject to different state standards. To add clarity to this process and provide an update to Rath *et al.* 2018, we provide a review of current federal and state building height elevation standards for critical activities and infrastructure in coastal flood hazard zones with a focus on water pollution control facilities.

III. Federal Flood Elevation Standards

The National Flood Insurance Program (NFIP) managed by FEMA provides a federal framework for flood risk analysis and mitigation.[22] The NFIP provides flood insurance to property owners, businesses, and renters in areas prone to flooding determined by mapping flood risk.[23] FEMA produces Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS) used by communities to determine flood risk areas divided into flood risk zones. Connecticut municipalities have adopted flood management regulations as a condition of participation in NFIP.[24] Communities with flood prone areas are required to adopt and enforce regulations for management of floodplains designed to mitigate the impact of flood events.[25] Municipalities, states, and the federal government have standards for flood elevation of structures in different flood risk zones. However, the flood height elevation standards mandated in the federal NFIP are minimums and have not been substantially updated since the 1970's.[26] But, FEMA has continually issued updated guidance documents designed to improve structural integrity and prevent loss during flood events by encouraging use of design best practices and standards.[27] FEMA's 2007 Design Guide for Improving Critical Facility Safety from Flooding and High Winds uses the American Society of Civil Engineers (ASCE) critical facility category system

based on occupancy found in ASCE 7-05.[28] The most current version of the ASCE classification system was updated in ASCE 24-14: Flood Resistant Design and Construction.[29]

Recently, under Executive Order 14030 Climate Related Financial Risk, FEMA reintroduced the Federal Flood Risk Management Standard (FFRMS) for certain non-critical actions concerning structures in the 100-year floodplain/ Special Flood Hazard Areas.[30] In August 2021, FEMA issued interim FFRMS policy, FEMA Policy FP-206-21-0003, as a partial implementation applying only to certain non-critical actions concerning structures in the 100-year floodplain/ Special Flood Hazard Areas. Critical actions in Special Flood Hazard areas remain subject to minimum elevation requirements broadly described in 44 CFR § 9.11.(c)(1) "The Agency shall minimize: Potential harm to lives and the investment at risk from the base flood, or, in the case of critical actions, from the 500-year flood." Further guidance updates from FEMA covering critical actions may be forthcoming. Until then, the agency relies on non-binding guidance documents to encourage more rigorous standards.

After Hurricane Sandy caused extensive coastal flooding in the Northeast, FEMA issued a recovery advisory addressing the need to reduce flood effects on critical facilities citing ASCE 7-05 standards.[31] Critical facilities and activities are those essential to community function where "even a slight chance of flooding is too great a threat"[32] including hospitals, fire and police stations, power generation, schools, drinking and wastewater treatment. Facilities dealing with toxic, flammable, or reactive substances are also considered critical.[33] Best practices design standards for critical activities are higher than for residential structures or those deemed non-critical.[34]

In 2019, FEMA issued a guidance document comparing standards of the NFIP and International Codes (I-Codes) as flood provisions meet or exceed NFIP requirements in I-Codes from 2012 on.[35] All 50 states have adopted or use at least one I-Code.[36] The International Building Code (2015 and later) references ASCE-24-14 requirements for siting, design, and construction in flood hazard zones.[37] FEMA has explicitly said that ASCE 24 standards meet or exceed minimum NFIP requirements.[38] In ASCE 24, Flood Design Classes replace Occupancy/ Risk Categories for determining a structure's minimum elevation in combination with location in a flood hazard zone. The four Flood Design Classes have detailed definitions and structures falling under the FEMA definition of "critical facility" are mainly in Flood Design Class 4, though facilities handling toxic materials, and buildings associated with utilities are in Flood Design Class 3.[39] FEMA notes that in ASCE 24 standards, "Essential facilities (Flood Design Class 4) must be elevated or protected to the BFE +2 or 500-year flood elevation, whichever is higher."[40]

IV. Connecticut Building Height Elevation Standards

The Connecticut Flood Management Act governs siting of structures such as wastewater treatment facilities in floodplains.[41] The Act defines "base flood" as "flood which has a one per cent chance of being equaled or exceeded in any year, as defined in regulations of the National Flood Insurance Program (44 CFR 59 et seq.), or that flood designated by the commissioner pursuant to section 25-68c."[42] Base flood for a critical activity " means the flood that has at least a .2 per cent chance of being equaled or exceeded in any year."[43] CT DEEP's Municipal Facilities Section has determined critical activities for wastewater treatment facilities to be "[a]ny activity deemed to be vital to the core operation of wastewater facilities or that will prevent a facility to return to full function as safely and quickly as possible after a flood event."[44]

The State DEEP issued guidance in 2017 covering flood height elevation requirements for wastewater treatment and collection system facilities funded through the state Clean Water Fund (CWF).[45] Projects funded through the state CWF are required to adhere to design guidelines found in *Technical Report No.16 Guides for the Design of Wastewater Treatment* Works (T-16).[46] Municipalities planning or designing new wastewater infrastructure construction or improvements located in flood prone areas are directed by the state to conduct a "resiliency evaluation" that considers sea level rise over the life span of the wastewater infrastructure or equipment.[47] Resiliency evaluation allows for assessment of the impact of flood on the facility or equipment, including potential worst-case severe weather events and climate change which may be exacerbated by unique site-specific conditions. In particular, a resiliency evaluation should consider the effects of sea level rise on vulnerable infrastructure located in coastal and tidal areas of the State.[48] Municipalities have flexibility in choosing an evaluation method allowing for determination of the appropriate site-specific protective elevation. One or more of the following approaches can be used to determine flood height elevation:

- Freeboard Value Approach (FVA): Freeboard (100-year base flood elevation + X, where X is 3 feet for critical actions and 2 feet for other actions);
- Climate-Informed Science Approach (CISA): Utilizing the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science;
- 0.2 percent annual chance Flood Approach: 0.2 percent annual chance flood (also known as the 500-year flood); or
- The elevation and flood hazard area that result from using any other method identified in an update to the Federal Flood Risk Management Standard (FFRMS).[49]

In Public Act 18-82, floodproofing minimums were established for

> "…water and sanitary facilities… as established pursuant to subsection (b) of section 22a-94, not less than an additional two feet of freeboard above base flood and any additional freeboard necessary to account for the most recent sea level change scenario updated pursuant to subsection (b) of section 25- 68o, as amended by this act [.] "

It is important to note that *BFE +2 feet* is considered a statutory *minimum* flood protection elevation in Connecticut for non- critical structures in the coastal boundary.[50] Critical infrastructure, critical activities and actions, or sites with unique vulnerabilities may necessitate higher flood protection elevations.[51]

For Connecticut municipalities to be compliant with floodplain building elevation requirements, they must consider NFIP requirements, the requirements of the Connecticut State Building Code, and local requirements.[52] All Connecticut municipalities have enacted floodplain regulations and/or ordinances that meet or exceed NFIP requirements.[53] Although state building code standards for floodplain building elevation take precedence, municipalities do have authority to enact higher design standards through municipal ordinances or zoning regulations.

V. Conclusions

Current FEMA guidance for siting, design, and construction of structures in flood hazard zones references best practice standards (IBC, ASCE) that are periodically updated and revised to reflect the current level of knowledge available to prevent future hazard losses.[54] But, FEMA regulations themselves have not been substantially modified to reflect this which can lead to confusion when projects are proposed. FEMA periodically evaluates NFIP requirements to determine if standards for construction and design are adequate and sufficiently rigorous to avoid or minimize loss on a cost/ benefit basis.[55] For residential buildings, in 2007, NFIP building standards were found to reduce flood loss in new construction. But these standards

> "…are implemented in conjunction with the Flood Insurance Rate Map (FIRM), which does not account for increasing flood hazards in the future. Thus, while NFIP building standards may be generally effective today, their future effectiveness will be reduced as the FIRM becomes obsolete due to changing flood conditions. Revising building standards may be one way to compensate for changing flood conditions in the future."[56]

In May 2021, FEMA issued a fact sheet summarizing flood provisions in the NFIP in comparison to higher or more specific standards found in 2021 I-Codes and ASCE 24-14.[57] In particular, the Fact Sheet again reproduced tables from ASCE 24 of minimum elevation requirements by flood design class and definitions of flood design classes.[58] These tables are unchanged from those included in the 2015 factsheet highlighting new provisions of ASCE-24.[59] Additionally, FEMA produces documents every three years itemizing changes to I-Codes related

to flood resistant provisions.[60] While future modifications of regulations to incorporate best practices standards may occur, FEMA guidance now explicitly endorses use of ASCE-24 standards as cited in I-codes. The potential for a regulatory gap exists, but states or municipalities seeking approval for construction of critical facilities in flood hazard zones are encouraged to meet the stricter minimums set forth in the ASCE-24 standards. Because FEMA and Connecticut use different guidance and evaluations to determine the appropriate flood protection elevation, multiple methods may be used to calculate the height for a particular project. The complex decision-making process for determining flood height protection elevations including flood risk, federal and state statutes, regulation, and guidance is summarized in Figure 1.

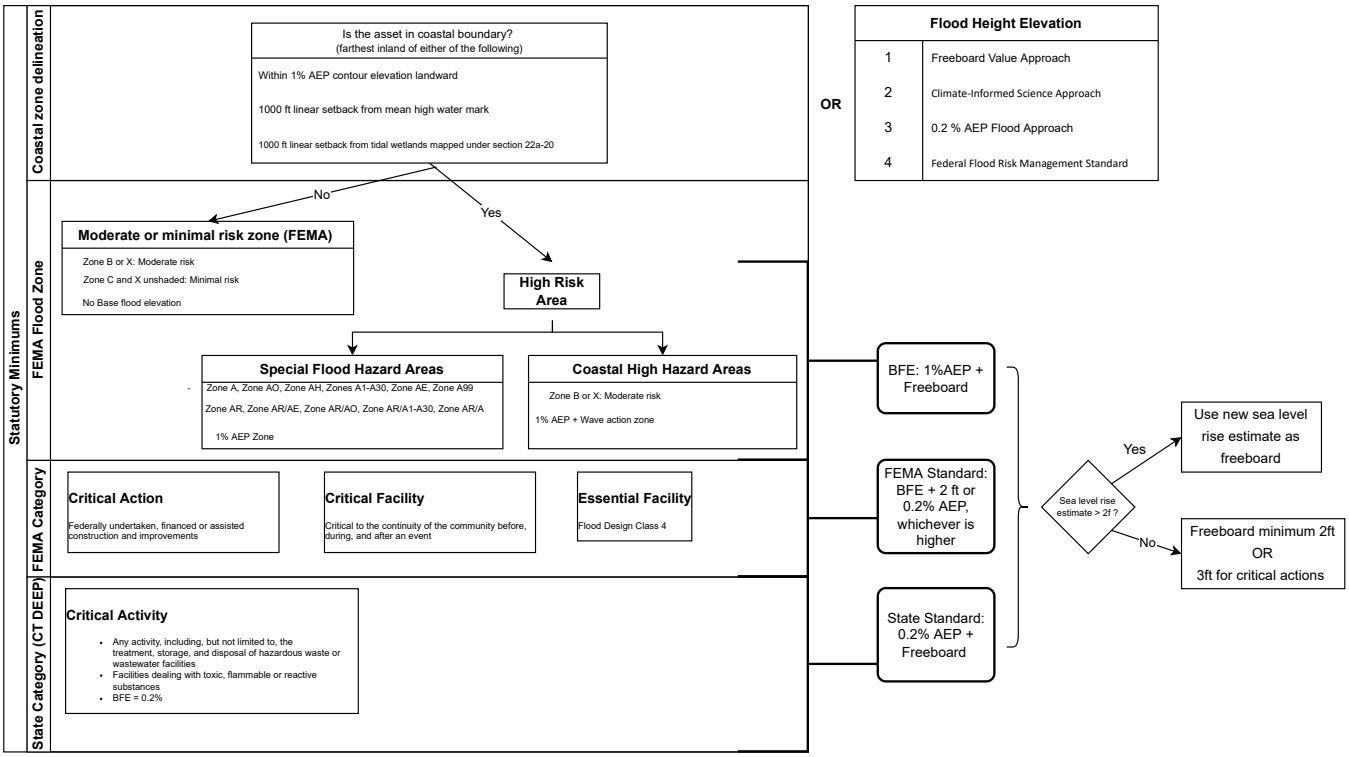

Figure 1. Flowchart for statuary minimums for flood height elevation including federal and state guidance, climate and flood risks, and characterization of infrastructure category. A separate full page version of the figure can be found at https://resilientconnecticut.uconn.edu/wp-content/uploads/sites/2761/2022/03/Statutory-flowchart-for-flood-height-elevation.pdf.

The minimum flood protection elevation for a project must take into consideration the different state and federal statutes, standards, and guidance that may be applicable to the project, the funding source, and the different methodologies available for establishing flood protection elevations. The best justifiable choice between differing flood protection elevation calculations may be to adopt the most conservative elevation.

Endnotes

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DISCLAIMER: This white paper addresses issues of general interest and does not give any specific legal advice pertaining to any specific circumstance. Parties should obtain advice from a lawyer or other qualified professional before acting on the information in this paper.

[1] William R. Rath, Christopher P. Kelly, & Kristie A. Beahm, *Floodplain Building Elevation Standards: Current Requirements & Enhancement Options for Connecticut Shoreline Municipalities* (2018), https://circa.uconn.edu/wp-content/uploads/sites/1618/2018/03/Floodplain-Building-Elevation-Standards.pdf.
[2] "Action" is defined in 44 CFR 9.4 (b) as any action or activity "providing federally undertaken, financed or assisted construction and improvements."
[3] 44 CFR § 9.4.
[4] FEMA, *Hazard Mitigation Assistance Guidance* (2015), https://www.fema.gov/sites/default/files/2020-07/fy15_HMA_Guidance.pdf at 48.
[5] *Id.*
[6] CT DEEP Municipal Wastewater Section, (2022), personal communication.
[7] CT DEEP, *Clean Water Fund Memorandum (2017-001) Storm Resiliency of Municipal Wastewater Infrastructure* (2017). Note the critical activity definition employed by DEEP's municipal facilities section is more comprehensive as it relates to municipal wastewater infrastructure compared to the one provided in Section 25-68B of the general statutes which is enforced by DEEP Land and Water Resources Section. When there is overlap, particularly as it applies to the storage of hazardous materials at wastewater treatment facilities or pump stations (e.g., diesel fuel for the operation of emergency generators), the most conservative state standard applies.
[8] CAROLYN KOUSKY, BILLY FLEMING, & ALAN M. BERGER, A BLUEPRINT FOR COASTAL ADAPTATION: UNITING DESIGN, ECONOMICS, AND POLICY (2021).
[9] Kieran T. Bhatia et al., *Recent increases in tropical cyclone intensification rates*, 10 NATURE COMMUNICATIONS 635 (2019), https://doi.org/10.1038/s41467-019-08471-z.
[10] Anji Seth et al., *Connecticut Physical Climate Science Assessment Report (PCSAR): Observed trends and projections of temperature and precipitation* (2019), https://circa.uconn.edu/wp-content/uploads/sites/1618/2019/11/CTPCSAR-Aug2019.pdf. at 54.
[11] SAMANTHA MONTANO, DISASTEROLOGY: DISPATCHES FROM THE FRONTLINES OF THE CLIMATE CRISIS (2021).
[12] James O'Donnell, *Sea Level Rise in Connecticut Final report February 2019* (2019), https://circa.uconn.edu/wp-content/uploads/sites/1618/2019/10/Sea-Level-Rise-Connecticut-Final-Report-Feb-2019.pdf.
[13] C.G.S. § 25-68o ; *See* Appendix A, William R. Rath, Christopher P. Kelly, and Kristie A. Beahm, *supra* note 1. for building standards of Connecticut shoreline towns as of early 2018.
[14] FloodSmart | The National Flood Insurance Program, https://www.floodsmart.gov/ (last visited Sep 10, 2021).
[15] Note that "guidance" is non-binding but in many cases, is often relied on in enforcement actions. Guidance clarifies and explains how an agency interprets legally enforceable regulation. Guidance documents are not subject the APA rulemaking process but provide a mechanism to convey current agency policy and expectations. Regulations are legally binding and subject to APA rulemaking procedures. Regulations have the force of law and are created under delegated legislative authority to interpret, implement, or specify statutes.
[16] REDUCING FLOOD LOSSES THROUGH THE INTERNATIONAL CODES, COORDINATING BUILDING CODES AND FLOODPLAIN MANAGEMENT REGULATIONS 5TH ED., (2019), HTTPS://WWW.FEMA.GOV/SITES/DEFAULT/FILES/2020-07/FEMA_REDUCING_FLOOD_LOSSES_RFL_5TH-ED.PDF.
[17] NATIONAL FLOOD INSURANCE PROGRAM COMMUNITY RATING SYSTEM | FEMA.GOV, HTTPS://WWW.FEMA.GOV/FLOODPLAIN-MANAGEMENT/COMMUNITY-RATING-SYSTEM (LAST VISITED JUL 14, 2021).

[18] DESPP, *2019 Connecticut Natural Hazards Mitigation Plan Update* (2019) at 126.
[19] *Id.* at 192.
[20] *Id.* At 52-53. Note that Latitude and Longitude information on WWTP locations is available with DEEP's Municipal Wastewater Program. Not all WWTP are located within AE or VE special flood hazard zones.
[21] CT DEEP, *supra* note 7.
[22] Flood Insurance | FEMA.gov, https://www.fema.gov/flood-insurance (last visited Sep 10, 2021).
[23] Flood Maps | FEMA.gov, https://www.fema.gov/flood-maps (last visited Sep 10, 2021).
[24] William R. Rath, Christopher P. Kelly, and Kristie A. Beahm, *supra* note 1.
[25] FloodSmart | The National Flood Insurance Program, https://www.floodsmart.gov/ (last visited Sep 10, 2021).
[26] Reducing Flood Losses Through the International Codes, Coordinating Building Codes and Floodplain Management Regulations 5th Ed., *supra* note 16.
[27] FEMA, *Partial Implementation of the Federal Flood Risk Management Standard for Hazard Mitigation Assistance Programs (Interim)*, FEMA POLICY FP-206-21-0003 (2021). https://www.fema.gov/sites/default/files/documents/fema_policy-fp-206-21-0003-partial-mplementation-ffrms-hma-programs-interim.pdf.
[28] FEMA, *Design Guide for Improving Critical Facility Safety from Flooding and High Winds* (2007), https://www.fema.gov/sites/default/files/2020-08/fema543_design_guide_complete.pdf.
[29] AMERICAN SOCIETY OF CIVIL ENGINEERS, ASCE 24: FLOOD RESISTANT DESIGN AND CONSTRUCTION (2014).
[30] FEMA, *supra* note 27.
[31] REDUCING FLOOD EFFECTS IN CRITICAL FACILITIES: HURRICANE SANDY RECOVERY ADVISORY RA2, (2013), HTTP://CORE-ES.COM/WP-CONTENT/UPLOADS/FEMA-RA2-REDUCING-FLOOD-EFFECTS-IN-CRITICAL-FACILITIES.PDF.
[32] CRITICAL FACILITY | FEMA.GOV, HTTPS://WWW.FEMA.GOV/GLOSSARY/CRITICAL-FACILITY (LAST VISITED JUL 14, 2021).
[33] FPM_1_PAGE_CRITICALFACILITIES_AND_HIGHER_STANDARDS.PDF, HTTP://DATA.WVGIS.WVU.EDU/PUB/RA/_RESOURCES/CF/FPM_1_PAGE_CRITICALFACILITIES_AND_HIGHER_STANDARDS.PDF (LAST VISITED JUL 14, 2021).
[34] Reducing Flood Effects in Critical Facilities: Hurricane Sandy Recovery Advisory RA2, *supra* note 34.
[35] Reducing Flood Losses Through the International Codes, Coordinating Building Codes and Floodplain Management Regulations 5th Ed., *supra* note 16.
[36] *Id.*
[37] FEMA, *Highlights of ASCE 24-14 Flood Resistant Design and Construction* (2015), https://www.fema.gov/sites/default/files/2020-07/asce24-14_highlights_jan2015.pdf.
[38] Reducing Flood Losses Through the International Codes, Coordinating Building Codes and Floodplain Management Regulations 5th Ed., *supra* note 16.
[39] FEMA, *supra* note 37. *See* ASCE 24-14 Table 1-1 Flood Design Class of buildings and Structures reproduced on page 5 for detailed Flood Design Class definitions.
[40] *Id. See* table on page 3 for flood height elevation standards by Flood Design Class, flood zone and specific building requirements.
[41] C.G.S. § 25-68.
[42] *Id.* at 25-68b(2).
[43] *Id.*
[44] CT DEEP, *supra* note 7.
[45] *Id.*
[46] NEIWPCC, TR-16 GUIDES FOR THE DESIGN OF WASTEWATER TREATMENT WORKS • NEIWPCC (2016), https://neiwpcc.org/learning-center/tr-16-guides-design-wastewater-treatment-works/ (last visited Sep 18, 2021) stating that "Until FEMA or ACOE flood criteria are amended to include the impact of climate change, a greater level of flood protection may be warranted." And, the level of protection is dependent on how critical a component is to function of facility. Critical equipment should be elevated to 100-yr-flood elevation + 3.
[47] CT DEEP, *supra* note 7.
[48] *Id.*
[49] *Id.*
[50] At this time, the most recent sea level change scenario calls for 20 inches of freeboard which is still encompassed within the statutory minimum of 2 feet. When the sea level rise scenario adopted by CT DEEP becomes greater than 2 feet, the additional freeboard over 2 feet will need to be added to *BFE + 2ft* to calculate the appropriate flood

protection elevation. It should be noted that P.A. 18-82 has sometimes been interpreted as *BFE +2ft +20 in.* We believe this conservative interpretation is not the statutorily correct minimum flood protection elevation, but as has been noted, sites with unique vulnerabilities may necessitate higher than statutorily minimum flood protection elevations.

[51] CT DEEP, *supra* note 7; NEIWPCC, *supra* note 46.

[52] William R. Rath, Christopher P. Kelly, and Kristie A. Beahm, *supra* note 1.

[53] *Id.*

[54] Reducing Flood Losses Through the International Codes, Coordinating Building Codes and Floodplain Management Regulations 5th Ed., *supra* note 16.

[55] Christopher P Jones, William L. Coulbourne, Jamie Marshall, Spencer M. Rogers *Evaluation of the National Flood Insurance Program's Building Standards* (2006). American Institutes for Research, https://www.fema.gov/sites/default/files/2020-07/fema_nfip_eval_building_standards.pdf.

[56] *Id.*at 90.

[57] FEMA, *FEMA Fact Sheet: Building Code Requirements That Exceed or Are more Specific Than the National Flood Insurance Program* (2021), https://www.fema.gov/sites/default/files/documents/fema_building-code-exceed-nfip-complete_2021.pdf.

[58] Note, FEMA fact sheets are considered *guidance documents* and do not have force of law.

[59] FEMA, *supra* note 37.

[60] Flood Building Codes | FEMA.gov, https://www.fema.gov/emergency-managers/risk-management/building-science/building-codes/flood (last visited Jul 31, 2021).