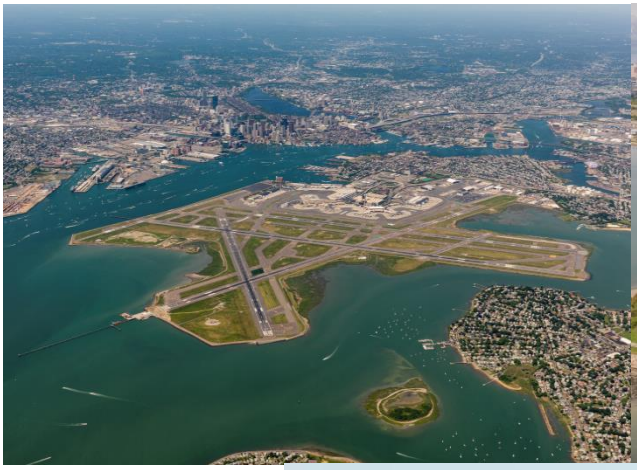
MASSACHUSETTS PORT AUTHORITY

FLOODPROOFING DESIGN GUIDE

January 2025



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Summary of Revisions

January 2025 Update

Revision No.	Date	Revision Description
1	4/15/2015	Updated to reflect newer modeling information and the use of a new datum that aligns Massport's resiliency efforts with other agencies.
2	11/02/2018	Updated with Climate Mitigation & Resiliency Manager's information.
3	1/1/2025	Updated to reflect newer modeling information and new construction.

1. Letter from the Massport Senior Resiliency Manager

Massport's Resiliency Program, begun in 2013, is both progressive and adaptive. We base our analyses and recommendations on sound science, emerging technology, and the latest proven best practices. In an effort to keep the Floodproofing Design Guide relevant and up-to-date, we actively seek best available information and, when appropriate, responsibly change our standards. Revisions in this January 2025 Floodproofing Design Guide reflect newer modeling information shared by the Massachusetts Office of Coastal Zone Management (CZM). Previous revisions completed in 2018 included the use of a new datum that better aligns our resiliency efforts with those of other transportation agencies. It is our sincere hope that the Floodproofing Design Guide will help enable the built environment to "withstand a major disruption system within acceptable degradation parameters, recover within an acceptable time, and balance composite costs and risks" - our definition of resiliency. Please feel free to contact the Resiliency Program at Massport with questions/comments.

Sincerely,

Kathleen Ledoux AIA, CCM, LEED AP, ENV SP
Senior Resiliency Manager
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2. INTRODUCTION

2.1 SCOPE AND INTENT

Massachusetts Port Authority (Massport) facilities and properties, including Logan International Airport, Conley Terminal, Fish Pier, Flynn Marine Park and Cruiseport, Laurence G. Hanscom Field, and other Massport-owned properties in South Boston, East Boston, and Charlestown, are increasingly susceptible to flooding hazards caused by extreme storms and rising sea levels and extreme precipitation as a result of climate change. Massport is incorporating this Floodproofing Design Guide into its capital planning and real estate development processes to make its infrastructure and operations more resilient to these anticipated flooding threats.

2.1.1 Flood Resiliency Objectives

Incorporation of this Floodproofing Design Guide is intended to help Massport achieve the following flood resiliency objectives:

- Protect the safety of passengers, occupants, workers, and first responders.
- Minimize flood damage to critical Massport facilities, whose destruction or loss of service will have a debilitating effect on the security, economy, safety, health and welfare of the public.
- Enhance business resiliency, and expeditiously recover and restart critical services with minimum delay and damage to public safety and health, economy and security.
- Provide for operational continuity to the greatest extent possible.
- Minimize losses of electrical power, communications, security and other critical services facility wide and to individual critical assets.
- Prevent structural and property damage to the maximum extent possible.
- Maintain capacity to support regional emergency response and disaster recovery at Logan International Airport, Laurence G. Hanscom Field, and Maritime facilities during, and immediately after, an extreme storm event.

2.1.2 Applicability

This Design Guide shall be used by Massport staff, tenants, third party developers, design professionals and contractors during planning, design and construction of the projects at Logan International Airport, Conley Terminal, Fish Pier, Flynn Marine Park and Cruiseport, Laurence G.

Hanscom Field, and other Massport-owned properties in South Boston, East Boston, and Charlestown:

(a) New structures and additions, including subsequent work to such structures.
(b) Work classified as substantial repair or substantial improvement[1] of an existing structure.
(c) Retrofit of an existing structure or facility with the explicit objective to make it resilient to flooding.

The provisions of this Design Guide do not apply to routine maintenance and repair projects, unless otherwise directed by the Massport Director of Capital Programs.

The provisions of this Design Guide may only be waived by written authorization from Massport's Director of Capital Programs.

2.2 Background

In 2013, Massport launched a comprehensive resiliency initiative to maximize business continuity in the midst of various human and natural threats. Extreme storms, such as Tropical Storm Irene (2011), Hurricane Sandy (2012) and winter storm Nemo (2013), demonstrated the link between climate hazards and the resiliency of the built environment, including air and maritime transportation infrastructure. As part of its broader resiliency initiative, Massport retained Kleinfelder Northeast (Kleinfelder) to perform a *Disaster and Infrastructure Resiliency Planning Study (DIRP)* focused on the risks associated with climate change, primarily coastal flooding from extreme storms and sea level rise. DIRP included climate hazard analyses, vulnerability assessments for critical infrastructure, and resiliency intent recommendations for capital improvements and programming. One of the high priority recommendations was for Massport to develop and adopt design guidelines for flood resiliency, including establishing design flood elevations possibly more stringent than required by current building codes to account for future flood scenarios.

[1] Substantial repair and substantial improvement are defined as any repair, reconstruction, rehabilitation, addition, or other improvement to a structure, the cost of which equals or exceeds 50% of its pre-improvement market value, or equals or exceeds a smaller percentage established by the Massport Capital Planning Department.

2.2.1 Extreme Storms and Coastal Flooding Hazards at Massport

Flood modeling, utilizing the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model developed by the National Weather Service, was carried out as part of the DIRP climate hazards analysis to predict the worst-case flooding conditions that might occur at Massport facilities under a wide range of hurricane scenarios. The resulting flood maps were analyzed to determine the maximum possible extent and depth of coastal flooding across Logan Airport and Maritime facilities in South Boston. The modeling methodology used for the DIRP study, including the underlying scenario parameters (i.e., hurricane intensity, tidal condition), were developed through a consultative process between Massport Capital Programs leadership and Kleinfelder. Results from MassDOT's Boston Harbor Flood Risk Model (BH-FRM) and Mass CZM's Massachusetts Coast Flood Risk Model (MC-FRM) were later reviewed and compared with SLOSH results from DIRP. Results of the MC-FRM, most recently updated in 2023, were used as the basis for the 2025 updates to reflect the most recent climate science and updated modeling. Sample flood extents predicted for maritime facilities in South and East Boston are shown in Figure 1 using updated results from the MC-FRM.

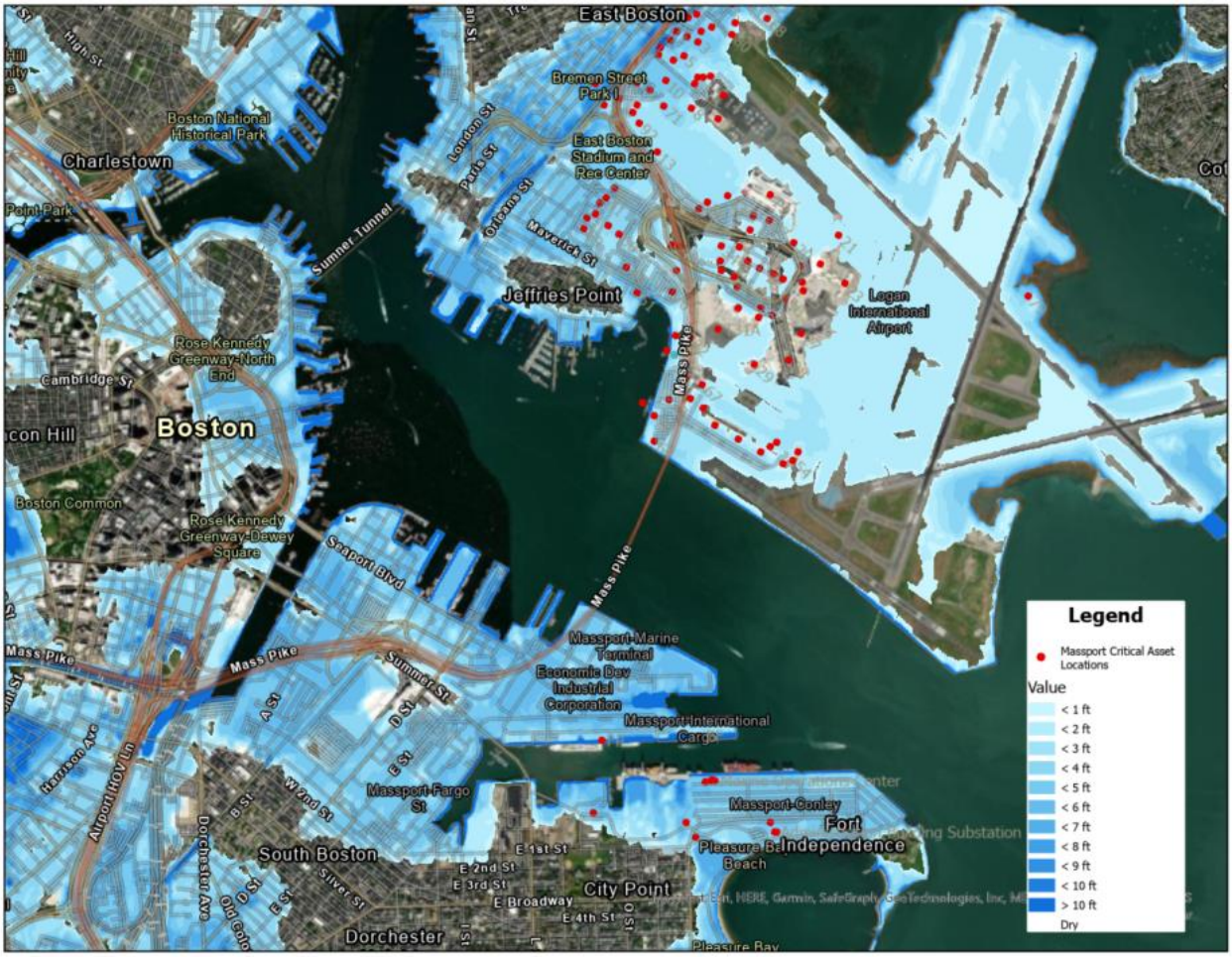

Figure 1: Sample Flood Depths from Updated MC-FRM (2070 1% Probability Event)

In the January 2025 revision of this document, Flynn Marine Park was identified as a distinct subarea within Massport's maritime properties due to the higher wave crest elevations simulated across all storm scenarios for the area. The peak elevations from the MC-FRM were along the northern edge of the Reserve Channel, as well as on the harbor coastline of the marine park (shown as contours in Figure 2). These areas were grouped together as a subset of the South Boston facilities to indicate the higher-risk nature of the area and allow for more reasonable flood estimates to be used for the remainder of South Boston.

Figure 2: MC-FRM Modeled Wave Crest Elevations for 2070, 0.2% AEP – South Boston Facilities

Flood results from the latest MC-FRM data were compiled across a variety of annual probability storm events for Logan Airport in East Boston, the South Boston Maritime Facilities, and the subarea identified within Flynn Marine Park that presented additional coastal flood risk. Peak still water and wave crest elevations are shown in Figure 3 for new and existing construction on Massport properties. Peak elevations for 2070 climate change projections consistently exceed the elevations shown in the 2018 version of this document across all storm events when looking at the Flynn Marine Park subarea, indicating the need for updated design flood elevations as discussed in Section 3 of this design guide.

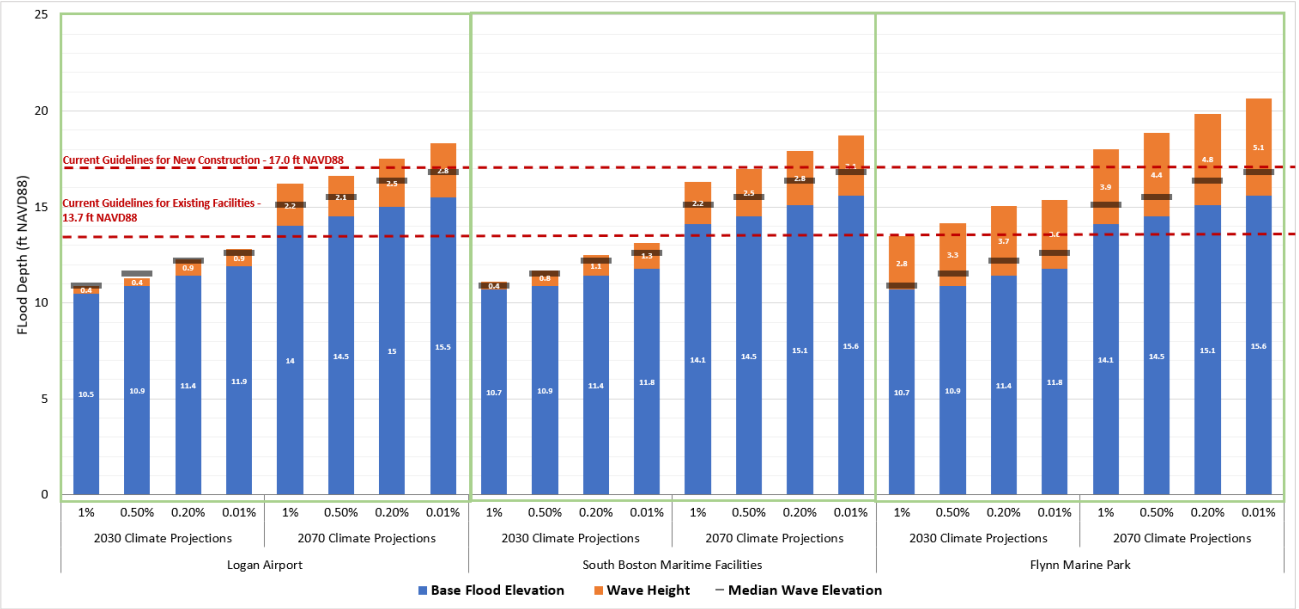

Figure 3: Comparison of maximum Water Surface Elevations (WSE) with and without significant wave action

The latest flood modeling results for Logan Airport, Flynn Marine Park and Cruiseport, and the Maritime facilities in South Boston based on the MC-FRM model are included in Tables B-1 and B-2, in Appendix B. These tables report the estimated maximum flood elevations (NAVD88 datum) for existing critical infrastructure at Logan Airport and Maritime facilities in South Boston under the different scenarios modeled. Elevations are reported as both still-water elevations (Table B-1) and peak wave crest elevations (Table B-2). Both tables indicate at what elevations interior flooding is likely to occur (orange cells), based on the MC-FRM flood modeling results. First floor or lowest critical flood elevations for each facility were derived from sources that were readily available at the time of the DIRP study (e.g., from engineering plans or the Massport Survey Department). More details on sources of data and methods used are provided in the DIRP final draft report.

The flood modeling results and subsequent vulnerability assessments revealed that a number of existing critical infrastructure assets are at risk of coastal flooding from storm surge, particularly under more severe scenarios which may become more likely in the future due to climate change and sea level rise. The costs of infrastructure damage and business interruption, if such an event were to occur, represent a strategic risk that must be managed by increasing current levels of

flood protection and preparedness. A number of the most critical assets have already been floodproofed using either permanent or deployable floodproofing measures.

Laurence G. Hanscom Field is located inland outside of the influence of tides, coastal flooding and sea-level rise. MC-FRM modeling results are not applicable to Laurence G. Hanscom Field. For this January 2025 revision, an Interim Design Flood Elevation (DFE) was established for Laurence G. Hanscom Field based on the flood of record at the Civil Air Terminal from a major rain event on July 11, 2017. Based on this flood of record and adding an additional freeboard of 1.25 feet, the recommended interim DFE for Laurence G. Hanscom Field is 126.5 ft NAVD88. This recommendation might be amended after more detailed hydrologic and hydraulic modeling for Laurence G. Hanscom Field is completed.

3. DESIGN FLOOD ELEVATIONS

3.1 GENERAL

Design flood elevations are indispensable tools for managing the risks of flooding in flood hazard areas and are already widely incorporated in building codes, zoning regulations, and engineering standards. The Design Flood Elevation (DFE) corresponds to the maximum level of water that an engineered structure has been designed to resist, being a foundational input for the calculation of design flood loads, which then set the parameters for structural design. DFEs are also used as a vertical threshold above which the lowest floor of the lowest enclosed area, important utilities, life-safety systems, and other critical equipment must be elevated, unless other floodproofing measures are utilized to protect critical infrastructure.

If elevating above the DFE is not feasible, floodproofing critical areas below the DFE may be permitted. **Floodproofing** is any combination of structural or nonstructural adjustments, changes, or actions that reduce or eliminate flood damage to a structure, contents, and attendant utilities and equipment. **Dry floodproofing** renders a structure envelope substantially impermeable to the entrance of floodwater, resulting in a space free of through-cracks, openings, or other channels that permit unobstructed passage of water and seepage during flooding, and prevents accumulation of more than 4 in. of water depth in such a space during a period of 24 hours (see Section 5.1). **Wet floodproofing** relies on the use of flood-damage-resistant materials and design/construction techniques to minimize flood damages to areas below the DFE of a structure that are intentionally allowed to flood (see Section 5.2). Through these applications, DFEs can help limit the exposure of occupants and property to the damaging effects of flooding and ensure that basic functions can be maintained during a flooding event or quickly restored thereafter.

Existing codes and regulations generally set the DFE for a facility based on the latest approved version of the FEMA Flood Insurance Rate Map (FIRM) for the area in which the facility is located. The FIRM indicates the boundaries of flood hazard zones and the base flood elevations (BFEs) within those zones that have a 1% annual probability of being exceeded. It also indicates areas that may be exposed to wave action. The BFE at the location of the facility, plus any additional “freeboard” height required as a safety factor against additional wave action or higher-than-

anticipated flooding, is typically set as the DFE for the facility. However, a property owner may set the DFE higher than the minimum code requirement.

The methodologies used to create FEMA FIRMs and determine FEMA BFEs are based on historical data and do not incorporate sea level rise or other long-term projected climate change impacts. They are therefore likely to underestimate the risk of future flooding, particularly over longer time horizons.

Through a deliberative process involving scientists, engineers, and institutional leadership, Massport has developed Design Flood Elevations (DFEs) that go above and beyond existing code requirements. The initial choice of DFEs at coastal facilities was informed by the results of historical analysis, storm surge modeling, projections of future sea level rise, and review of the latest academic research on climate change's influence on storm frequency and intensity. Subsequently, MassDOT completed the development of the Boston Harbor - Flood Risk Model (BH-FRM), which takes these considerations into account probabilistically. The following updates to the BH-FRM, resulting in the Massachusetts Coast - Flood Risk Model (MC-FRM), continued the probabilistic approach to determining flood risk along the coast with the most up-to-date climate projections. MC-FRM results were used as the basis for the revised DFEs set forth in this section. In 2018, datums were modified to NAVD 88 to better align Massport's resiliency efforts with those of other transportation agencies.

The DFEs set forth in this section, along with the floodproofing performance standards that follow, are necessary tools to programmatically address current and future risk from coastal flooding at Logan International Airport, Conley Terminal, Fish Pier, Flynn Marine Park and Cruiseport, Laurence G. Hanscom Field, and any other Massport-owned properties in South Boston, East Boston, and Charlestown. The institutionalization of DFEs will ensure that new facilities on Massport property minimize exposure to flood damage and that existing facilities become more resilient over time through incremental improvements implemented through targeted resiliency investments and as part of other substantial upgrades, renovations, and additions.

Recognizing that future risks of flooding are greater than at present and that existing facilities face greater constraints, such as limited space to modify facility siting and layout arrangements and higher costs and complexities of retroactive floodproofing up to high flood depths, the DFEs for

existing facilities are less stringent and the performance standards more flexible than for new facilities. The DFEs for both new and existing facilities demonstrate Massport's stewardship of their assets. Their implementation is an effective policy development supported at the highest levels of Massport leadership.

3.2 DFE FOR EXISTING FACILITIES

For existing coastal facilities, the DFE is defined by the maximum of the still water elevation with a 0.2% annual probability of exceedance in 2030 (as modeled by MC-FRM) plus 3 ft. of freeboard, and the peak wave crest elevation for the 0.2% annual probability of exceedance in 2030 (as modeled by MC-FRM). This approach differs from the 2015 version where solely the still water flood elevation was used with 3 feet of freeboard. In the 2025 update, the maximum of the peak wave elevation and the still water elevation plus 3 feet of freeboard was used to account for wave action at the coast. This translates to an elevation of 13.7 ft (NAVD88) for facilities and properties at Logan International Airport, Conley Terminal, Fish Pier, and any other Massport-owned properties in South Boston, East Boston, and Charlestown. For the Flynn Marine Park and Cruiseport, this January 2025 revision sets the DFE for existing facilities at 15.1 ft (NAVD88) (Table 1).

For this January 2025 revision, for Laurence G. Hanscom Field, which is not subject to coastal flooding, the DFE was determined based on historic flood elevations with a factor of safety to be Elevation 126.5 ft. NAVD88 for both existing and new construction.

For projects at existing facilities, the DFE shall be used to determine the following design elements:

- Design loads and structural calculations for evaluating and designing dry and wet floodproofing options.
- Minimum effective level of protection provided by dry and wet floodproofing designs.
- Elevation below which Floodproofing Performance Standards in Section 6.1 shall apply.

3.3 DFE FOR NEW FACILITIES AND ADDITIONS

For new coastal facilities, the DFE is defined by the maximum of the still water elevation with a 0.2% annual probability of exceedance in 2070 (as modeled by MC-FRM) plus 3 ft. of freeboard,

and the peak wave crest elevation for the 0.2% annual probability of exceedance in the 2070 (as modeled by MC-FRM). This translates to an elevation of 17.0 ft (NAVD88) for facilities and properties at Logan International Airport, Conley Terminal, Fish Pier, and any other Massport-owned properties in South Boston, East Boston, and Charlestown. For the Flynn Marine Park and Cruiseport, this January 2025 revision sets the DFE for new facilities at 19.9 ft (NAVD88) (Table 1).

For this January 2025 revision, for Laurence G. Hanscom Field, which is not subject to coastal flooding, the DFE was determined based on historic flood elevations with a factor of safety to be Elevation 126.5 ft NAVD88 for both existing and new construction.

For new facilities, the DFE shall be used to determine the following design elements:

- Design loads and structural calculations.
- Elevation of the lowest floor of the lowest enclosed space:
    - Excludes certain access, storage spaces, and areas used solely for parking vehicles which may be wet floodproofed
- Minimum effective level of protection provided by dry and wet floodproofing designs.
- Elevation below which Floodproofing Performance Standards in Section 6.2 shall apply.

Table 1 – Design Flood Elevations (DFE) for New and Existing Massport Facilities and Properties

Location	Existing Facilities	New Facilities
Logan International Airport	13.7 ft. (NAVD88)	17.0 ft. (NAVD88)
Conley Terminal, Fish Pier and other Massport Properties in South Boston, East Boston and Charlestown	13.7 ft. (NAVD88)	17.0 ft. (NAVD88)
Flynn Marine Park and Cruiseport (**)	15.1 ft. (NAVD88)	19.9 ft. (NAVD88)
Laurence G. Hanscom Field (**)	126.5 ft. (NAVD88)	126.5 ft. (NAVD88)

** New DFEs added in January 2025 Revision
* Add 0.81 ft. to NAVD88 elevations to convert to NGVD29 datum elevations
* Add 6.46 ft. to NAVD88 elevations to convert to Boston City Base (BCB) datum elevations
* Add 5.51 ft. to NAVD88 elevations to convert to Mean Lower Low Water (MLLW) datum elevations

The updated design flood elevations are also shown graphically in Figure 4 with green elevations representing the new design standards for Flynn Marine Park. FEMA base flood elevations from 2009 and the 2013 update are shown for the area as a reference.

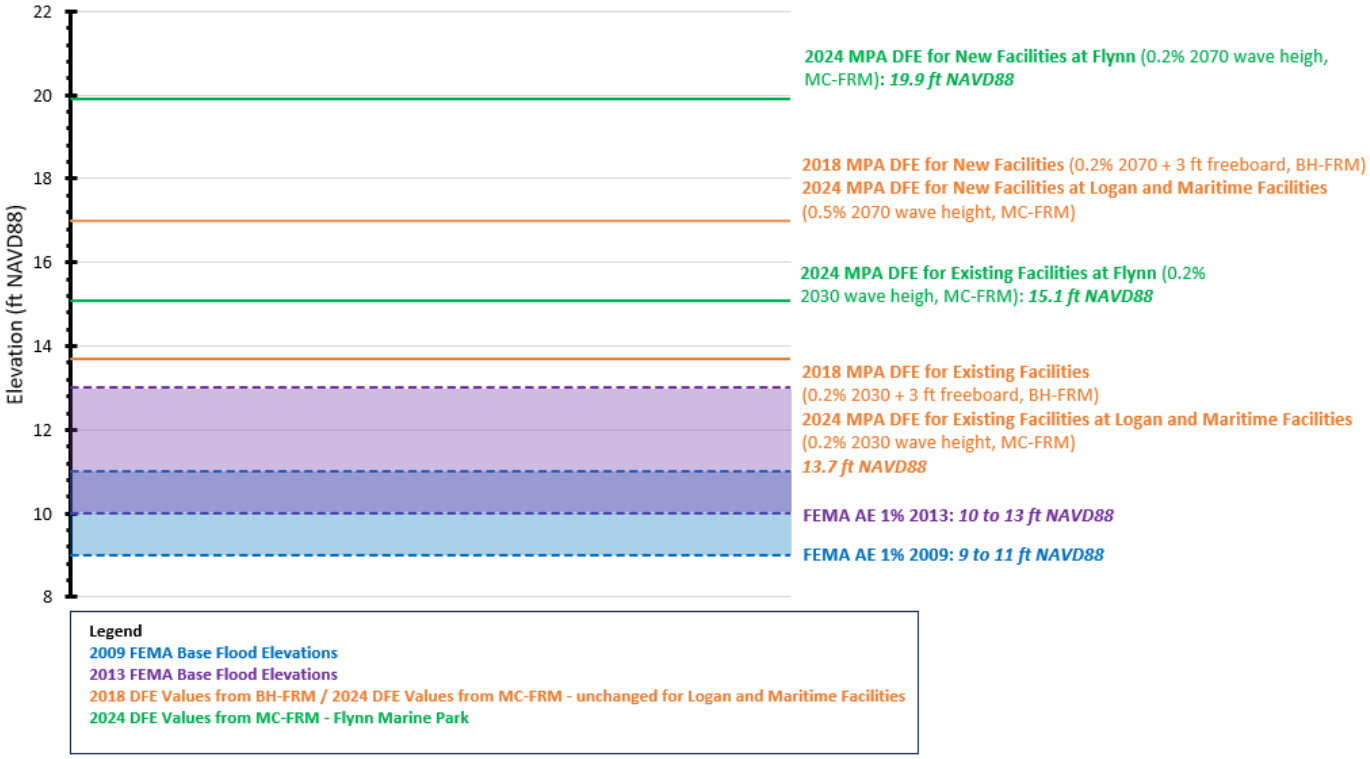

Figure 4: Design Flood Elevations for new and existing facilities using updated Massachusetts Coastal Flood Risk Model results

4. CRITICAL INFRASTRUCTURE SUBJECT TO FLOODPROOFING PERFORMANCE STANDARDS

The equipment and systems listed in Table 2 are considered critical and shall be considered for floodproofing in accordance with Section 6 – Floodproofing Performance Standards. Critical infrastructure subject to flooding applies to both projects undertaken by Massport and projects undertaken by tenants and third-party leases/developments on Massport properties.

Table 2 – Critical Infrastructure Subject to Floodproofing Standards

System	Critical Equipment/Systems
Electrical	Substations, Transformers, Switchgear, Service and Distribution Panels, Emergency Panels, Cable Terminations and Splices, Emergency Generators, Stock and Parts Storage, Meter Centers, Utility Company Connections and Solar Power Generation Equipment
Water and Plumbing	Domestic/Fire Water Pumps and Controls, Sump Pump Non-Submersible Motors and Controls, Plumbing Systems (lavatories, showers, toilets), Ejector and Grinder Pumps, Water Heaters, Pipe Insulation
Mechanical	Air Intake and Exhaust Vents/Louvers, Air Conditioning Units and Condensers, Chilled Water Systems, Pumps, Ventilation Units, Boilers, Unit Heaters, Distribution Duct Work
Telecommunications	Telephone Switches, Network Interface Devices, IDF Closets, Demark Transition Points of Service, Data/Computer Centers/Rooms, Dispatch Rooms, Emergency Communications Centers, Public Announcement System Control Rooms, Radio Systems (incl. personal radio storage areas), Surveillance Systems, Access Control Systems
Emergency and Fire	Fire Alarm Master Boxes, Emergency Operations Centers, Emergency Supplies (medical, food/water, cots/blankets), Emergency Vehicles and Specialized Equipment (medical, fire, rescue, law enforcement)
Hazardous Materials	Waste Oil, Fuel Storage Tanks, Chemical Supplies
Other	Records Storage, Office Space, Parking Garages

5. PERMITTED FLOODPROOFING STRATEGIES

5.1 Dry Floodproofing

Dry floodproofing involves designing or modifying a building, enclosure, or area to render it substantially impermeable to the entrance of floodwaters, thereby lowering the potential for flood damage. Substantially impermeable shall be defined as resulting in a maximum accumulation of 4 in. of water depth in a dry floodproofed space during a 24-hour period.

Applications of dry floodproofing shall not be allowed in the following cases, unless otherwise approved in writing by Massport's Director of Capital Programs:

- When buildings or facilities are located in high-risk flood hazard areas (VE-Zones, as identified on FEMA FIRMs).
- Where flood velocities adjacent to the building or facility are expected to exceed 5 ft./sec. during the design flood.
- When notice of an impending flood is expected to be less than 12 hours, thus allowing insufficient time for human intervention to install any temporary protective devices required for dry floodproofing.
- Where flood depths are expected to exceed 3 feet for existing buildings, unless the structural capacity of the building has been assessed by a qualified structural engineer and found to be capable of resisting the anticipated loads.

Dry floodproofed areas of a building or facility shall:

- Be designed and constructed so that any area below the designated DFE, together with attendant utilities and sanitary facilities, is flood resistant with walls or temporary flood barriers that are substantially impermeable to the passage of water.
- Have walls, floors, flood shields and other temporary flood barriers designed and constructed to resist hydrostatic, hydrodynamic, and other flood related loads, including the effects of buoyancy resulting from the DFE.
- Have any soil or fill adjacent to the structure compacted and protected against erosion and scour.
- Have at least one door satisfying building code requirements for an exit door or primary means of escape, above the designated DFE, and capable of providing human ingress

and egress during the design flood. This requirement of ASCE/SEI 24 is interpreted to apply to buildings that are normally occupied. For buildings or facilities that are not normally occupied, provisions shall be made to remotely monitor water levels within the dry floodproofed area and to remove water from such areas as required to maintain water levels below that which will cause damage to critical equipment.

- Have sump pumps (permanent or temporary) to remove water accumulation due to any seepage of water during the flooding event. Sump pumps shall not be relied upon as a means of dry floodproofing, but rather only to control water levels below critical levels to prevent damage to critical equipment. Sump pumps shall be powered by independent emergency electrical systems raised above the DFE to ensure performance during power outages.
- Be evaluated by a structural engineer to verify that the foundation, exterior wall and floor systems can resist the forces generated by the design flood event.

Dry floodproofing measures may include, but are not limited to the following:

- Installing watertight shields on doors, windows, and louvers.
- Replacing doors and hatches with special flood-resistant doors and hatches.
- Permanently closing or sealing windows and other openings below the DFE.
- Using exterior and interior membranes and sealants to reduce seepage through walls, slabs and foundations.
- Sealing electrical conduits and other utilities entering below the DFE.
- Using aquarium glass or other specialized glazed storefront systems designed to resist floodwater pressures.
- Reinforcing walls, slabs and foundation systems to resist hydrostatic and hydrodynamic loads induced by floodwater.
- Installing drainage collection systems and sump pumps (permanent or temporary) to control water levels within dry floodproofed spaces.
- Installing early warning devices to monitor water levels in dry floodproofed spaces.
- Installing back-flow preventer valves on drainage and sanitary sewer piping located below the DFE.
- Installing pressure relief valves in floor systems to avoid structural damage due to buoyancy forces.

- Exterior perimeter flood walls and barriers (permanent or temporary).

Where removable shields or any other temporary measures are to be used as part of a dry floodproofing system, a Flood Operations Plan and Inspection and Maintenance Plan shall be prepared for the building or facility. Both the Flood Operations Plan and the Inspection and Maintenance Plan shall be drafted and submitted as part of the final design (100%) package.

5.2 Wet Floodproofing

Wet floodproofing involves designing or modifying a building, enclosure, or area to accommodate the entrance of floodwaters while minimizing the potential for flood damage to critical infrastructure and equipment.

Wet floodproofing involves the following:

- Using flood damage-resistant materials below the DFE throughout the building.
- Raising utilities, life-safety systems, important contents and other critical infrastructure above the DFE.
- Installing and configuring electrical, telecommunications, mechanical, and other systems to allow for easy isolation of system components located below the DFE, facilitate repairs, and minimize disruptions due to flood damage.
- Installing flood openings or using other methods to equalize the hydrostatic pressure exerted by floodwaters to prevent structural damage to walls and floors.
- Providing pumps (permanent or temporary) to gradually remove floodwater from basements and non-draining areas.
- Designing tie-down systems for fuel tanks below the DFE to resist buoyant forces caused by submersion.

Wet floodproofing of enclosed areas below the DFE shall be limited to:

- Category I structures as defined by ASCE/SEI 24 (see Table 3)
- Enclosures used solely for parking, building access or storage.
- Structures that are functionally dependent on close proximity to water
- Structures that are otherwise approved by Massport’s Director of Capital Programs.

Table 3 – Classification of Structures (ASCE/SEI 24)

Nature of Occupancy	Category
• Certain temporary facilities • Minor storage facilities	I
• All buildings and other structures except those listed in Categories 1, 3 and 4	II

• Buildings and structures that represent a substantial hazard to human life in the event of failure, including:
  • Buildings where more than 300 people congregate in one area
  • Power generating station and other public utility facilities not included in Category IV
  • Buildings not in Category IV that handle hazardous materials, fuels, etc.
	III

• Buildings and other structures designated as essential facilities including:
  • Fire, rescue, ambulance and police stations and emergency vehicle garages
  • Hurricane emergency shelters
  • Emergency operation and communication centers
  • Power generating stations and other utilities facilities required during an emergency
  • Ancillary structures required for operation of Category IV structures (communication towers, fuel storage tanks, electrical substations, fire water storage tanks or other fire suppression systems, water storage tanks)
  • Aviation control towers and emergency aircraft hangers
  • Water storage facilities and pump structures required to maintain water pressure for fire suppression
  • Buildings having critical national defense functions
  • Facilities handling and storing hazardous fuels
	IV

6. FLOODPROOFING PERFORMANCE STANDARDS

6.1 Substantial Repairs/Improvements to Existing Facilities and Floodproofing Projects

Existing facilities undergoing substantial repairs or improvements or dedicated floodproofing projects for existing facilities shall meet the floodproofing performance standards listed in Table 4. Floodproofing of existing facilities shall meet the requirements of all applicable building codes, standards, and technical guidelines, including those incorporated by reference in this Design Guide.

Table 4 – Floodproofing Performance Standards for Substantial Repairs/Improvements to Existing Facilities and Floodproofing Projects

Critical Equipment	Massport Ownership/Operation			Tenant and Third-Party Lease/Development		
	Elevated Above DFE	Dry FP	Wet FP	Elevated Above DFE	Dry FP	Wet FP
Electrical						
Substations	Yes	Yes		Yes	Yes	
Transformers	Yes	Yes		Yes	Yes	
Switchgear	Yes	Yes		Yes	Yes	
Emergency Panels	Yes	Yes		Yes	Yes	
Emergency Generators	Yes	Yes		Yes	Yes	
Meter Centers	Yes	Yes		Yes	Yes	
Service and Distribution Panels	Yes	Yes		Yes	Yes	
Cable Terminations and Splices	Yes	Yes	Yes	Yes	Yes	Yes
Stock and Parts Storage	Yes	Yes		Yes	Yes	
Water and Plumbing						
Domestic/Fire Water Pumps and Controls	Yes	Yes		Yes	Yes	
Sump Pump Non-Submersible Motors and Controls	Yes	Yes		Yes	Yes	
Ejector and Grinder Pumps	Yes	Yes		Yes	Yes	
Water Heaters	Yes	Yes		Yes	Yes	
Plumbing Systems (lavatories, showers, toilets)	Yes	Yes	Yes	Yes	Yes	Yes
Pipe Insulation	Yes	Yes	Yes	Yes	Yes	Yes
Mechanical						

Critical Equipment	Massport Ownership/Operation			Tenant and Third-Party Lease/Development		
	Elevated Above DFE	Dry FP	Wet FP	Elevated Above DFE	Dry FP	Wet FP
Boilers	Yes	Yes		Yes	Yes	
Air Conditioning Units and Condensers	Yes	Yes		Yes	Yes	
Chilled Water Systems	Yes	Yes		Yes	Yes	
Pumps	Yes	Yes		Yes	Yes	
Air Intake and Exhaust Vents/Louvers	Yes	Yes		Yes	Yes	
Ventilation Units	Yes	Yes		Yes	Yes	
Unit Heaters	Yes	Yes		Yes	Yes	
Distribution Duct Work	Yes	Yes		Yes	Yes	
Telecommunications						
Telephone Switches	Yes	Yes		Yes	Yes	
Network Interface Devices	Yes	Yes		Yes	Yes	
Data/Computer Centers/Rooms	Yes	Yes		Yes	Yes	
Dispatch Rooms	Yes			Yes		
Emergency Communications Centers	Yes			Yes		
Public Announcement System Control Rooms	Yes			Yes		
Radio Systems (incl. personal radio storage areas)	Yes			Yes		
Surveillance Systems	Yes	Yes		Yes	Yes	
IDF Closets	Yes	Yes		Yes	Yes	
Access Control Systems	Yes	Yes		Yes	Yes	
Emergency and Fire						
Fire Alarm Master Boxes	Yes	Yes		Yes	Yes	
Emergency Operations Centers	Yes			Yes		
Emergency Supplies (medical, food/water, cots/blankets)	Yes			Yes		
Emergency Vehicles and Specialized Equipment (medical, fire, rescue, law enforcement)	Yes	Yes		Yes	Yes	
Hazardous Materials						
Waste Oil	Yes	Yes		Yes	Yes	
Fuel Storage Tanks	Yes	Yes	Yes	Yes	Yes	Yes
Chemical Supplies	Yes	Yes		Yes	Yes	
Other*						

Critical Equipment	Massport Ownership/Operation			Tenant and Third-Party Lease/Development		
	Elevated Above DFE	Dry FP	Wet FP	Elevated Above DFE	Dry FP	Wet FP
Records Storage*	Yes	Yes		Yes*	Yes*	Yes*
Office Space*	Yes	Yes	Yes	Yes*	Yes*	Yes*
Parking Garages*			Yes	*	*	Yes*

* Floodproofing recommended but not required for tenants and third-party leases/developments.

6.2 New Construction/Addition Projects

New facilities shall be laid out such that the critical equipment listed in Table 5 is elevated above the applicable DFE, located in areas designed to be dry floodproofed, or protected by an appropriate combination of floodproofing measures. Such designs shall meet the requirements of all applicable building codes, standards, and technical guidelines, including those incorporated by reference in this Design Guide.

Table 5 – Floodproofing Performance Standards for New Facilities

Critical equipment	Massport Ownership/Operation			Tenant and Third Party Lease/Development		
	Elevated Above DFE	Dry FP	Wet FP	Elevate Above DFE	Dry FP	Wet FP
Electrical						
Substations	Yes			Yes		
Transformers	Yes			Yes		
Switchgear	Yes			Yes		
Emergency Panels	Yes			Yes		
Emergency Generators	Yes			Yes		
Meter Centers	Yes			Yes		
Service and Distribution Panels	Yes	Yes		Yes	Yes	
Cable Terminations and Splices	Yes	Yes	Yes	Yes	Yes	Yes
Stock and Parts Storage	Yes	Yes		Yes	Yes	
Water and Plumbing						
Domestic/Fire Water Pumps and Controls	Yes			Yes		

Critical equipment	Massport Ownership/Operation			Tenant and Third Party Lease/Development		
	Elevated Above DFE	Dry FP	Wet FP	Elevate Above DFE	Dry FP	Wet FP
Sump Pump Non-Submersible Motors and Controls	Yes			Yes		
Ejector and Grinder Pumps	Yes	Yes		Yes	Yes	
Water Heaters	Yes	Yes		Yes	Yes	
Plumbing systems (lavatories, showers, toilets)	Yes	Yes		Yes	Yes	Yes
Pipe Insulation	Yes	Yes		Yes	Yes	Yes
Mechanical						
Boilers	Yes	Yes		Yes	Yes	
Air Conditioning Units and Condensers	Yes	Yes		Yes	Yes	
Chilled Water Systems	Yes	Yes		Yes	Yes	
Pumps	Yes	Yes		Yes	Yes	
Air Intake and Exhaust Vents/Louvers	Yes	Yes		Yes	Yes	
Ventilation Units	Yes	Yes		Yes	Yes	
Unit Heaters	Yes	Yes		Yes	Yes	
Distribution Duct Work	Yes	Yes		Yes	Yes	
Telecommunications						
Telephone Switches	Yes			Yes		
Network Interface Devices	Yes			Yes	Yes	
Data/Computer Centers/Rooms	Yes			Yes	Yes	
Dispatch Rooms	Yes			Yes		
Emergency Communications Centers	Yes			Yes		
Public Announcement System Control Rooms	Yes			Yes		
Radio Systems (incl. Personal Radio Storage areas)	Yes			Yes		
Surveillance Systems	Yes			Yes	Yes	
IDF Closets	Yes	Yes		Yes	Yes	
Access Control Systems	Yes	Yes	Yes	Yes	Yes	Yes
Emergency and Fire						
Fire Alarm Master Boxes	Yes			Yes		
Emergency Operations Centers	Yes			Yes		

Critical equipment	Massport Ownership/Operation			Tenant and Third Party Lease/Development		
	Elevated Above DFE	Dry FP	Wet FP	Elevate Above DFE	Dry FP	Wet FP
Emergency Supplies (medical, food/water, cots/blankets)	Yes			Yes		
Emergency Vehicles and Specialized Equipment (medical, fire, rescue, law enforcement)	Yes	Yes		Yes	Yes	
Hazardous Materials						
Waste Oil	Yes			Yes		
Fuel Storage Tanks	Yes	Yes	Yes	Yes	Yes	Yes
Chemical Supplies	Yes			Yes		
Other*						
Records Storage*	Yes			Yes*	Yes*	*
Office Space*	Yes			Yes*	Yes*	*
Parking Garages*			Yes	*	*	Yes*

* Floodproofing recommended but not required for tenants and third-party leases/developments.

7. MASSPORT REVIEWS AND APPROVALS

7.1 Floodproofing Design Implementation Process

Table 6 describes the requirements of the floodproofing design process. This process shall be followed for new construction and additions, substantial repair or improvement projects, or dedicated floodproofing projects. The intent of this process is to identify floodproofing related issues early in the design process to ensure that the proposed floodproofing strategies to be used are adequate and that operational, maintenance and storage requirements are clearly understood by all parties responsible for implementing them.

Table 6 – Floodproofing Design Implementation Process

Design Stage	Design Flood Parameters and Calculations	Floodproofing Design Narrative and Drawings	Floodproofing Calculations	Flood Operations Plan	Floodproofing Inspection and Maintenance Plan
Project Definition Report*	Identify FIRM Map information and Massport DFE.	Identify proposed floodproofing strategies and performance objectives to be achieved by design	Conduct facility condition assessment and/or site assessment	Identify parties responsible for facility flood emergency response	Identify parties responsible for facility inspection and maintenance
Preliminary Design Submission*	Preliminary design load assumptions and calculations	Identifies specific measures to achieve performance objectives; Review for code compliance, update narrative	Engineering report with structural calculations demonstrating floodproofed facility can withstand design loads	Outreach to parties responsible for implementing active floodproofing measures; Prepare draft plan	Outreach to parties responsible for inspection and maintenance of floodproofing measures; Prepare draft plan
Design Development Submission*	Review design load assumptions and calculations for accuracy; Interpret design load calculations	Review and refine initial design concepts for feasibility, cost, potential risk, and environmental impact	Evaluation/ Review of Engineering report and structural calculations	Refine flood operations draft plan based updated design and on stakeholder input	Refine floodproofing inspection and maintenance plan
Construction Documents*	Finalize	Finalize narrative and drawings. Complete FEMA NFIP floodproofing certificate for non-residential structures signed/ submitted. For new construction with lowest floor elevated above BFE or DFE, complete FEMA NFIP elevation certificate, signed and submitted	Finalize	Final plan and approval memo	Final plan and approval memo

*Project submissions shall conform to the MPA Project Design Submission Standards.

7.2 Floodproofing Design Submittal Form

The Engineer-of-Record for the project shall submit a Floodproofing Design Submittal Form (see Appendix A) to the Senior Resiliency Manager at Massport's Capital Programs Department to document that the floodproofing measures and designs for a project conform to the requirements of this Design Guide. Massport's review of the Floodproofing Design Submittal Form does not relieve the Engineer-of-Record from responsibility that the design conforms to applicable building codes, design standards and meets the standard of professional care for similar projects.

8. REFERENCES

8.1 Applicable Floodproofing Standards

The following consensus standards are incorporated into the Massachusetts State Building Code by reference:

- ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*
- ASCE/SEI 24, *Flood Resistant Design and Construction*

Floodproofing for all Massport buildings and facilities shall conform to the requirements of these two consensus standards, except as modified herein.

8.2 Technical Guidance

The following authoritative technical guidance documents are incorporated in the Massport Floodproofing Design Guide by reference:

- FEMA P-936 (2013), *Floodproofing Non-Residential Buildings*
- FEMA 543 (2007), Risk Management Series: *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*
- NFIP Technical Bulletin 1 (2020), *Openings in Foundation Walls and Walls of Enclosures*
- NFIP Technical Bulletin 2 (2008), *Flood Damage-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas in Accordance with the National Flood Insurance Program*
- NFIP Technical Bulletin 3 (1993), *Non-Residential Floodproofing – Requirements and Certification*
- Resilient Massachusetts Action Team (RMAT) (2022), *Climate Resilience Design Standards Tool**

*Note: RMAT Climate Resilience Design Standards, City of Boston Resiliency Guidelines, and other resiliency guidelines are incorporated as references only. They are not substitutes for nor do they replace this guidance document. Project designers may raise any coordination issues

with other regulations to Massport Capital Program's Senior Resiliency Manager at the time of the design review.

APPENDIX A

Floodproofing Design Submittal Form

January 2025

Massport Capital Programs

Floodproofing Design Submittal Form

Project Number: _____

Project Name: _____

Building Name/Number: _____

Submission: _____ (Project Definition Report / Preliminary Design Submission / Design Development Submission / Construction Documents)

1. Indicate the applicable DFE for the project from the table below:

Location	Existing Facilities	New Facilities
Logan International Airport; Conley Terminal, Fish Pier and Massport Properties in South Boston, East Boston and Charlestown	13.7 ft. (NAVD88)	17.0 ft. (NAVD88)
Flynn Marine Park and Cruiseport (**)	15.1 ft. (NAVD88)	19.9 ft. (NAVD88)
Laurence G Hanscom Field (**)	126.5 ft. (NAVD88)	126.5 ft. (NAVD88)

** New DFEs added in January 2025 Revision
* Add 0.81 ft. to NAVD88 elevations to convert to NGVD29 datum elevations
* Add 6.46 ft. to NAVD88 elevations to convert to Boston City Base (BCB) datum elevations
* Add 5.51 ft. to NAVD88 elevations to convert to Mean Lower Low Water (MLLW) datum elevations

2. Enter the existing or proposed elevation of the lowest floor of the lowest enclosed space, whichever is applicable:

Existing elevation (ft NAVD88)	
Proposed elevation (ft NAVD88)	

3. Describe existing/proposed uses, including occupancy, of spaces below the DFE:

4. **Provide a narrative summary of the proposed floodproofing performance objectives, and strategies and measures proposed to achieve them:**

5. **In the table below, indicate proposed critical equipment protection measures to be in place at project completion**: Indicate whether the following critical equipment will be elevated above the DFE, located in dry floodproofed enclosure (Dry FP), wet floodproofed (Wet FP), protected by other methods, or not protected. Only if the listed equipment will not be present at the existing or proposed facility upon project completion should "not applicable" be selected.

Critical equipment	Elevated Above DFE	Dry FP	Wet FP	Other	Not Protected	Not Applicable
Electrical						
Substations						
Transformers						
Switchgear						
Emergency panels						
Emergency generators						
Meter centers						
Service and distribution panels						
Cable terminations and splices						
Stock, parts						
Water and Plumbing						
Domestic/fire water pumps and controls						
Sump pump and controls						
Ejector and grinder pumps						
Water heaters						
Plumbing systems (lavatories, showers, toilets)						

Critical equipment	Elevated Above DFE	Dry FP	Wet FP	Other	Not Protected	Not Applicable
Pipe insulation						
Mechanical						
Boilers						
Air conditioning units and condensers						
Chilled water systems						
Pumps						
Air intake and exhaust vents/louvers						
Ventilation units						
Unit heaters						
Distribution duct work						
Telecommunications						
Telephone switches						
Network interface devices						
Data/computer centers/rooms						
Dispatch rooms						
Emergency communications centers						
Public Announcement system controls						
Radio systems (incl. personal radio storage areas)						
Surveillance systems						
IDF closets						
Access control systems						
Emergency and Fire						
Fire alarm master boxes						
Emergency operations centers						

Critical equipment	Elevated Above DFE	Dry FP	Wet FP	Other	Not Protected	Not Applicable
Emergency supplies (medical, food/water, cots/blankets)						
Emergency vehicles and specialized equipment (medical, fire, rescue, law enforcement)						
Other						
Records storage						
Office space						
Hazardous Materials						
Waste oil						
Fuel storage tanks						
Chemical supplies						

6. For areas proposed to be dry floodproofed in the table in Section 5, describe assumptions, structural analyses conducted, and conclusions regarding the capability of the structure to withstand design flood forces.

7. **In the table below, list all equipment proposed to be protected by "Other" methods in the table in Section 5, describe the proposed protection measures, and indicate the level of protection the measures are designed to provide:** (if additional space is needed, submit information as an attachment)

Equipment Type	Proposed Protection Measure	Level of Protection (high, medium, low)

8. **In the table below, list all equipment proposed to be "Not Protected" in the table in Section 5, their per unit replacement costs, and their replacement lead time:** (if additional space is needed, submit information as an attachment)

Equipment Type	Units Located Below DFE (number)	Unit Replacement Cost ($)	Replacement Lead Time (days)

9. **Provide additional operational planning information on floodproofing measures requiring human intervention to be effective:** (i.e. temporary installation of protective barriers or relocation of stock/equipment) (if additional space is needed, submit information as an attachment)

Measure	How Much Advanced Time is Needed to Install or Implement (hours)	Staff Requirements Needed to Install or Implement (No. of staff)	Storage Location of Tools and Materials Needed to Install or Implement (e.g., onsite vs. central storage facility)

Submitted by: _____ _____
Engineer of Record — Date

Reviewed by: _____ _____
Massport Project Manager — Date

_____ _____
Facility Manager — Date

_____ _____
Massport Resiliency Program Manager — Date

CC: Massport Director of Capital Programs
Massport Deputy Director of Capital Programs

APPENDIX B

Maximum Flood Elevations for Individual Buildings and Facilities

January 2025

Table B-1 - Critical Infrastructure and Modeled Flood Elevations

Number	Name	Asset First Floor or Lowest Critical Elevation (ft. NAVD88)	MC-FRM Flood Elevations (ft. NAVD88)							
			2030				2070			
	(*) Indicates Flood Protected Facility		1% (100-YR)	0.5% (200-YR)	0.2% (500-YR)	0.1% (1000-YR)	1% (100-YR)	0.5% (200-YR)	0.2% (500-YR)	0.1% (1000-YR)
Logan International Airport										
79	Fire-Rescue II (*)	10.04	10.5	10.9	11.4	11.7	14.0	14.5	15.0	15.5
4	Facilities III (*)	10.05	NA	10.2	10.8	11.3	13.7	14.1	14.6	15.0
11	State Police/TSA Building (*)	10.59	NA	10.3	10.9	11.4	13.6	14.0	14.6	15.0
06A	MPA Pumping Station (New) (*)	10.26	NA	10.3	10.9	11.3	13.6	14.0	14.6	15.0
85	Marine Fire-Rescure	10.60	NA	NA	10.8	11.8	14.0	14.4	15.0	15.4
3	Facilities II	10.76	NA	NA	10.8	11.2	13.6	14.0	14.6	15.0
41	Porter Street Substation (*)	10.98	NA	NA	NA	11.5	13.9	14.3	14.9	15.3
2	Wood Island Substation (*)	11.15	NA	NA	10.8	11.2	13.6	14.1	14.6	15.0
06B	Electrical/Telecom Building	12.36	NA	NA	11.0	11.4	13.6	14.0	14.6	15.0
15	Large Vehicle Storage Building	11.15	NA	NA	10.8	11.2	13.6	14.0	14.6	15.0
43	Boston EMS Station	11.84	NA	NA	NA	NA	13.8	14.2	14.7	15.1
46	BOSFuel Operations and Control Bldg	12.69	NA	NA	NA	11.9	13.7	14.1	14.7	15.1
65	Logan Office Center	13.28	NA	NA	NA	11.9	14.0	14.4	15.0	15.4
	Fire Training Facility fuel tanks	14	NA	NA	NA	NA	14.0	14.4	15.0	15.4
18	Central Heating Plant/Facilities I	13.68	NA	NA	NA	NA	13.7	14.1	14.7	15.1
21	Terminal C Pier B	13.39	NA	NA	NA	NA	13.6	14.1	14.6	15.0
31	Terminal A Main (landside)	13.44	NA	NA	NA	NA	13.8	14.4	14.7	15.2
T18E	CHP to Terminal E	12.86	NA	NA	NA	NA	13.7	14.1	14.7	15.1
T18C	Intersection to Terminal C (door)	13.84	NA	NA	NA	NA	13.9	14.3	14.9	15.3
T31B	Utility Tunnel between Terminal A and Terminal B (door)	14.01	NA	NA	NA	NA	13.8	14.4	14.7	15.2
44	North Gate	15.34	NA	NA	NA	NA	13.8	14.2	14.7	15.1
52	South Gate	15.8	NA	NA	NA	NA	13.7	14.1	14.6	15.1
19	Terminal E	16.17	NA	NA	NA	NA	NA	NA	NA	15.0
20	Terminal C (Main, Pier B)	13.59-14.63	NA	NA	NA	NA	13.7	14.2	14.8	15.2
21	Terminal C Pier B	13.59	NA	NA	NA	NA	13.6	14.1	14.6	15.0
21	Terminal C Pier B (UAL Baggage)	14.63	NA	NA	NA	NA	13.6	14.1	14.6	15.0
22	Terminal C Main (Jet Blue Baggage)	14.04	NA	NA	NA	NA	NA	14.0	14.6	15.0
22	Terminal C Main	14.59	NA	NA	NA	NA	NA	14.0	14.6	15.0
29	Terminal B (Pier B)	14.37-15.62	NA	NA	NA	NA	NA	NA	NA	15.1
31	Terminal A Main (airside)	15.41	NA	NA	NA	NA	13.8	14.4	14.7	15.2
32	Terminal A Satellite	15.45	NA	NA	NA	NA	NA	14.4	14.9	15.4
32	Harborside Substation	15.5	NA	NA	NA	NA	NA	14.4	14.9	15.4
66	Airfield Lighting Vault	14.61	NA	NA	NA	NA	13.6	14.0	14.6	15.0
67	Bird Island Flats Substation	14.73	NA	NA	NA	NA	13.8	14.2	14.8	15.2
78	Fire-Rescue I	14.3	NA	NA	NA	NA	NA	14.1	14.6	15.1
T18A	Intersection to Terminal A (door)	15.16	NA	NA	NA	NA	13.8	14.2	14.8	15.2
T18B	CHP to Intersection (utility hatch)	15.76	NA	NA	NA	NA	13.8	14.2	14.8	15.2
	Jet Fuel Tank Farm (Containment Wall)	16.4	NA	NA	NA	11.9	14.0	14.4	15.0	15.4
23	Terminal C (Pier C)	14.79	NA	NA	NA	NA	NA	14.0	14.6	15.0
26	Air Traffic Control Tower	11.37	NA	NA	NA	NA	13.7	14.1	14.7	15.2
27	Terminal B (Pier A)	14.66-15.73	NA	NA	NA	NA	NA	14.1	14.7	15.1
27	Terminal B (Pier A)	15.68	NA	NA	NA	NA	NA	14.1	14.7	15.1
27	Terminal B (Pier A)	15.73	NA	NA	NA	NA	NA	14.1	14.7	15.1
T18A	Intersection to Terminal A (utility hatch)	16.35	NA	NA	NA	NA	13.8	14.2	14.8	15.2
T18C	Intersection to Terminal C (ventilation and hatch)	13.43	NA	NA	NA	NA	13.9	14.3	14.9	15.3
T31A	Terminal A Main to Satellite (stair)	15.45	NA	NA	NA	NA	NA	14.2	14.7	15.1
Maritime Facilities in South Boston										
Haul Rd	Haul Road Sump Pump	8.63	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
FP	Berths	9.01	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
FP	Transformer (adjacent to Guard House)(*)	9.41	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
FP	Fish Pier East Building (incl. Massport Police HQ)(*) - Partial	9.94	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Truck Processing Gate (Interchange Facility)	8.79	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
Conley	Reefer yard	9.00	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Rubber Tire Gantry Cranes	10.19	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Vessel Crane 1	10.36	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Vessel Crane 2	10.36	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Berth 11	10.36	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Wharf Switch Houses No. 2 (*)	10.43	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Vessel Crane 3	10.45	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Vessel Crane 4	10.45	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Vessel Crane 5	10.45	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Vessel Crane 6	10.45	10.5	10.9	11.4	11.8	14.1	14.5	15.1	15.6
Conley	Berth 12	10.45	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Gasoline Underground Storage Tank/ Fuel Island (*)	10.68	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Diesel Underground Storage Tank/ Fuel Island (*)	10.77	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Wharf Switch Houses No. 1 (*)	10.87	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Marine Operations Center (*)	10.94	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Administration Building	11.45	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
Conley	Wharf Switch Houses No. 3 (*)	11.65	10.5	10.9	11.4	11.8	14.0	14.5	15.1	15.5
Conley	Reefer substation	11.65	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
Conley	Operations Building	11.66	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
Conley	Administration Building substation	11.72	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
Conley	Massport Police Pro Shop Building	11.82	10.5	10.9	11.4	11.7	14.0	14.5	15.1	15.5
Conley	Administration Building generator	12.31	10.6	10.9	11.4	11.8	14.0	14.5	15.0	15.5
Cruiseport	Berths	11.38	10.5	10.9	11.4	11.7	14.0	14.5	15.1	15.5
Cruiseport	Gangway / FMT	11.38	10.5	10.9	11.4	11.7	14.0	14.5	15.1	15.5
Cruiseport	Main Building	12.96	10.5	10.9	11.4	11.7	14.0	14.5	15.1	15.5

Notes:

- Predicted water elevations (ft. NAVD88) are shown for each critical asset (rows) under each modeled scenario (columns).
- White cells with "NA" indicate that no flooding was predicted at the critical asset in the scenario.
- White cells without "NA" indicate that flooding was predicted at the critical asset in the scenario but did not exceed the first floor or lowest critical elevation.
- Red cells indicate that the critical asset was predicted to be flooded above its first floor or lowest critical elevation in the scenario.

Table B-2 - Critical Infrastructure and Modeled Wave Crest Elevations

Number	Name (*) Indicates Flood Protected Facility	Asset First Floor or (ft. NAVD88)	MC-FRM Flood + Wave Height Elevations (ft. NAVD88)							
			2030				2070			
			1% (100-YR)	0.5% (200-YR)	0.2% (500-YR)	0.1% (1000-YR)	1% (100-YR)	0.5% (200-YR)	0.2% (500-YR)	0.1% (1000-YR)
Logan International Airport										
79	Fire-Rescue II (*)	10.04	10.9	11.3	12.2	12.6	15.5	16.0	16.9	17.4
4	Facilities III (*)	10.05	NA	11.3	12.3	12.8	15.2	15.6	16.2	16.9
11	State Police/TSA Building (*)	10.59	NA	10.7	11.7	12.2	14.7	15.1	16.1	16.5
06A	MPA Pumping Station (New) (*)	10.26	NA	11.1	12.0	12.4	15.5	15.9	16.9	17.3
85	Marine Fire-Rescue	10.60	NA	NA	NA	12.0	15.1	15.8	16.5	17.3
3	Facilities II	10.76	NA	NA	11.6	12.0	15.3	15.9	16.5	17.3
41	Porter Street Substation (*)	10.98	NA	NA	NA	12.3	16.2	16.6	17.5	18.3
2	Wood Island Substation (*)	11.15	NA	NA	11.6	12.0	14.7	15.2	15.7	16.3
06B	Electrical/Telecom Building	12.36	NA	NA	11.4	12.1	15.1	15.5	16.5	16.9
15	Large Vehicle Storage Building	11.15	NA	NA	10.8	11.5	14.7	15.5	16.1	16.5
43	Boston EMS Station	11.84	NA	NA	NA	NA	14.6	15.0	15.8	16.6
46	BOSFuel Operations and Control Bldg	12.69	NA	NA	NA	11.9	14.5	14.9	15.8	16.2
65	Logan Office Center	13.28	NA	NA	NA	11.9	14.8	15.5	16.5	16.9
	Fire Training Facility fuel tanks	14	NA	NA	NA	11.9	14.8	15.5	16.5	16.9
18	Central Heating Plant/Facilities I	13.68	NA	NA	NA	NA	14.1	14.9	15.5	16.2
21	Terminal C Pier B	13.39	NA	NA	NA	NA	14.0	14.9	15.4	16.1
31	Terminal A Main (landside)	13.44	NA	NA	NA	NA	14.0	14.7	15.1	15.9
T18E	CHP to Terminal E	12.86	NA	NA	NA	NA	14.1	14.5	15.5	15.9
T18C	Intersection to Terminal C (door)	13.84	NA	NA	NA	NA	14.3	15.1	16.0	16.8
T31B	Utility Tunnel between Terminal A and Terminal B (door)	14.01	NA	NA	NA	NA	13.8	14.4	15.1	15.6
44	North Gate	15.34	NA	NA	NA	NA	14.2	15.0	15.8	16.2
52	South Gate	15.8	NA	NA	NA	NA	14.1	14.5	15.4	16.2
19	Terminal E	16.17	NA	NA	NA	NA	NA	NA	NA	15.0
20	Terminal C (Main, Pier B)	13.59-14.63	NA	NA	NA	NA	13.7	14.6	15.6	16.0
21	Terminal C Pier B	13.59	NA	NA	NA	NA	14.0	14.9	15.4	16.1
21	Terminal C Pier B (UAL Baggage)	14.63	NA	NA	NA	NA	14.0	14.9	15.4	16.1
22	Terminal C Main (Jet Blue Baggage)	14.04	NA	NA	NA	NA	NA	14.0	15.0	15.8
22	Terminal C Main	14.59	NA	NA	NA	NA	NA	14.0	15.0	15.8
29	Terminal B (Pier B)	14.37-15.62	NA	NA	NA	NA	NA	NA	NA	15.1
31	Terminal A Main (airside)	15.41	NA	NA	NA	NA	14.0	14.7	15.1	15.9
32	Terminal A Satellite	15.45	NA	NA	NA	NA	NA	14.8	15.3	16.2
32	Harborside Substation	15.5	NA	NA	NA	NA	NA	14.8	15.3	16.2
66	Airfield Lighting Vault	14.61	NA	NA	NA	NA	14.4	15.1	15.7	16.5
67	Bird Island Flats Substation	14.73	NA	NA	NA	NA	14.2	15.0	15.9	16.3
78	Fire-Rescue I	14.3	NA	NA	NA	NA	NA	14.5	15.4	15.9
T18A	Intersection to Terminal A (door)	15.16	NA	NA	NA	NA	14.6	15.3	16.1	16.7
T18B	CHP to Intersection (utility hatch)	15.76	NA	NA	NA	NA	13.8	14.6	15.2	16.0
	Jet Fuel Tank Farm (Containment Wall)	16.4	NA	NA	NA	11.9	14.8	15.5	16.5	16.9
23	Terminal C (Pier C)	14.79	NA	NA	NA	NA	NA	14.0	15.0	15.8
26	Air Traffic Control Tower	11.37	NA	NA	NA	NA	14.1	14.9	15.5	16.3
26	Control Tower Substation	12.45	NA	NA	NA	NA	14.1	14.9	15.5	16.3
26	MPA Generator - Control Tower	13.30	NA	NA	NA	NA	14.1	14.9	15.5	16.3
27	Terminal B (Pier A)	14.66-15.73	NA	NA	NA	NA	NA	14.2	15.1	15.9
27	Terminal B (Pier A)	15.68	NA	NA	NA	NA	NA	14.2	15.1	15.9
27	Terminal B (Pier A)	15.73	NA	NA	NA	NA	NA	14.2	15.1	15.9
T18A	Intersection to Terminal A (utility hatch)	16.35	NA	NA	NA	NA	14.6	15.3	16.1	16.7
T18C	Intersection to Terminal C (ventilation and hatch)	13.43	NA	NA	NA	NA	14.3	15.1	16.0	16.8
T18C	Intersection to Terminal C (hatch at Old Tower)	14.16	NA	NA	NA	NA	14.3	15.1	16.0	16.8
T31A	Terminal A Main to Satellite (stair)	15.45	NA	NA	NA	NA	NA	14.6	15.5	16.2
Maritime Facilities in South Boston										
Haul Rd	Haul Road Sump Pump	8.63	11.0	11.3	12.2	12.6	15.1	15.6	16.5	17.0
FP	Berths	9.01	11.1	11.7	12.4	13.1	16.3	17.0	17.9	18.7
FP	Transformer (adjacent to Guard House)(*)	9.41	11.1	11.7	12.4	13.1	16.3	17.0	17.9	18.7
FP	Fish Pier East Building (incl. Massport Police HQ)(* Partial)	9.94	11.1	11.7	12.4	13.1	16.3	17.0	17.9	18.7
Conley	Truck Processing Gate (Interchange Facility)	8.79	11.0	11.7	12.5	12.9	15.1	15.6	16.5	17.0
Conley	Reefer yard	9.00	11.1	11.7	12.4	13.1	16.3	17.0	17.9	18.7
Conley	Rubber Tire Gantry Cranes	10.19	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Vessel Crane 1	10.36	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Vessel Crane 2	10.36	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Berth 11	10.36	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Wharf Switch Houses No. 2(*)	10.43	10.9	11.7	12.2	12.9	15.5	16.0	16.6	17.4
Conley	Vessel Crane 3	10.45	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Vessel Crane 4	10.45	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Vessel Crane 5	10.45	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Vessel Crane 6	10.45	10.5	11.5	11.4	11.8	15.6	16.0	17.0	17.9
Conley	Berth 12	10.45	10.9	11.7	12.2	12.9	15.5	16.0	16.6	17.4
Conley	Gasoline Underground Storage Tank/ Fuel Island (*)	10.68	10.9	11.7	12.2	12.9	15.5	16.0	16.6	17.4
Conley	Diesel Underground Storage Tank/ Fuel Island (*)	10.77	10.9	11.7	12.2	12.9	15.5	16.0	16.6	17.4
Conley	Wharf Switch Houses No. 1 (*)	10.87	10.9	11.7	12.2	12.9	15.5	16.0	17.0	17.4
Conley	Marine Operations Center(*)	10.94	10.9	11.7	12.2	12.9	15.5	16.0	17.0	17.4
Conley	Administration Building	11.45	11.0	11.3	12.2	12.6	15.1	15.6	16.5	17.0
Conley	Wharf Switch Houses No. 3 (*)	11.65	10.9	11.7	12.4	12.9	15.2	16.0	16.6	17.0
Conley	Reefer substation	11.65	11.0	11.3	12.2	12.6	15.1	15.6	16.5	17.0
Conley	Operations Building	11.66	11.0	11.3	12.2	12.6	15.1	15.6	16.5	17.0
Conley	Administration Building substation	11.72	11.0	11.3	12.2	12.6	15.1	15.6	16.5	17.0
Conley	Massport Police Pro Shop Building	11.82	11.1	11.7	12.4	13.1	16.3	17.0	17.9	18.7
Conley	Administration Building generator	12.31	11.0	11.3	12.2	12.6	15.1	15.6	16.5	17.0
Conley	Gate Switch House	12.48	10.7	11.3	11.8	12.6	16.0	16.4	17.4	17.9
Conley	Massport Police Main Gate Building (Guard House)	12.9	10.6	11.0	11.8	12.6	15.5	16.1	17.0	17.4
Cruiseport	Berths	11.38	13.5	14.2	15.1	15.4	18.0	18.9	19.9	20.7
Cruiseport	Gangway / FMT	11.38	13.5	14.2	15.1	15.4	18.0	18.9	19.9	20.7
Cruiseport	Main Building	12.96	13.5	14.2	15.1	15.4	18.0	18.9	19.9	20.7