A pathway to a more resilient future
Overview of Massport

- Massport is an independent authority governed by a board of directors, appointed by the state’s governor.
- Massport owns and operates:
  - Boston-Logan International Airport
  - Hanscom Field, Bedford, MA
  - Worcester Airport
  - Conley Container Terminal
  - Black Falcon Cruiseport
  - Various real estate assets
Secure and Resilient Massport on Boston Harbor
Port of Boston

- Oldest continually active port in Western Hemisphere (400 years)
- New England’s maritime hub
- Supports 34,000 jobs
- $2 billion to local, regional, and national economies
• Serves three of the world’s top 10 container lines.
• Handles nearly 1.5 million metric tons of cargo each year.
• Privately owned petroleum and liquefied natural gas terminals
• Supplies more than 90% of Massachusetts’ heating and fossil fuel needs.
• Two ship repair yards,
• Public and private ferry operations,
• Marinas,
• Coast Guard’s Sector Boston
Cruiseport Boston
Context for our resiliency work
A City Built on Fill
Drivers for Action
Monitoring

• Massport essential personnel
  – Fire
  – Safety
  – Operations
  – Resident Engineers

• Term-contractors on-site
  – Roofing
  – Electrical
  – Mechanical
  – Pumping
  – Cleaning
Hazardous Waste

Hazardous waste moved inside

Hazardous waste moved inside
Assessing Damage

- Solar panels destroyed
- Terminals flooded
- Standards and signs blown over
- Vehicles destroyed
- Roofing membranes peeled off
Possible Impacts

• **Airports**
  – Logan Airport prolonged closure – regional/national, international transportation/economic impacts
  – Passenger, business, critical goods, and commerce disruption
  – Lack of ability to serve area-wide storm recovery efforts

• **Maritime**
  – Major facility and equipment loss leading to long term closure
  – Loss of cruise & container business

• **Real Estate**
  – Financial risks associated with tenant disruptions/recovery
  – Disruptions to local/regional transportation system

• **Agency-wide**
  – Loss of human resources
  – Greater recovery cost
Reducing Impacts Through Sustainability

Massport Resiliency

Addressing Impacts

- Hardening critical Infrastructure, retrofitting existing facilities
- Providing redundant facilities
- Incorporating resiliency into new projects
- Workforce cross training

Reducing Impacts Through Sustainability

- GHG reduction - Leading by Example
- Sustainability Management Plan
- Sustainable Design Guidelines
- MEPA/NEPA compliance and project mitigation
- Collaboration with agencies and institutions
First position of its kind at Massport and possibly at any national port authority.

Directs and coordinates resilience assessment and adaptation preparedness activities of Massport.

Pursues two complementary objectives:
- Making the resilience plan and its principles part of business strategy and operations everywhere;
- Facilitating cooperation among internal staff;
- External stakeholders promoting partnership & collective action.
“Resiliency is the ability of a system to withstand a major disruption within acceptable degradation parameters, recover within an acceptable time, and balance composite costs and risks.”

• How to protect Massport facilities against long-term sea-level rise, storm surges, intense storm events, other unplanned events and threats?
• How to maintain and restore operational capabilities during and after disruptive events?
• How to implement a balanced composite cost and risk plan?
Resiliency Program Goals

• Become an innovative and national model for resiliency planning and implementation within the port authority.
• Take responsibility for improving our overall infrastructure and operational resilience.
• Increase our business value and (contextual community responsibilities) through improved resiliency.
• Engage our stakeholders to better understand and address their concerns.
• Incorporate resilient design and construction practices in the development of our airports, maritime systems, and real estate.
• Monitor, measure, and adapt/modify our progress.
OUR PROCESS
Resiliency Working Group

- Logan
- Maritime
- Worcester
- Hanscom
- Corporate
• Identification
  – Threat event
  – Threat level
  – Impacted facilities
  – Effect of impact
  – Critical facilities needing protection

• Devise a Plan
  – Avoid, minimize, recover
  – Short term
  – Long term
Modified DHS Threat and Hazard Identification and Risk Assessment (THIRA) Model

**Methodology**

1. **Identify Threats and Hazards**
   - Natural
   - Technological
   - Human Caused
   - Based on historical occurrences and probability models.
   - Assess Probability and Impact of each threat/hazard

2. **Identify Critical Infrastructure and Key Resources (CI/KR)**
   - What the CI/KR is required to do
   - Identify dependencies and interrelationships

3. **Assess Vulnerabilities**
   - Functionality
   - Structural Integrity
   - Environmental Considerations
   - Accessibility

4. **Current and Planned Activities**
   - Vulnerabilities already being addressed
   - External coordination
   - Short–range and Capital Improvement plans

5. **Gap Analysis**
   - Gap between CI/KR requirement and existing or planned capability

6. **Findings**
   - Identify resolutions to minimize or eliminate the gap
     - Resiliency
     - Redundancy
     - Development
## Threats & Hazards to Critical Infrastructure

<table>
<thead>
<tr>
<th>NATURAL</th>
<th>TECHNOLOGICAL</th>
<th>HUMAN-CAUSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resulting from acts of nature</td>
<td>Involves accidents or the failures of systems and structures</td>
<td>Caused by the intentional actions of an adversary</td>
</tr>
</tbody>
</table>

- **Natural**
  - Earthquake
  - *Flood*
  - *High winds*
  - *Hurricane*
  - *Sea Level Rise*
  - Tornado
  - Tsunami
  - Fire
  - *Winter Storm*

  * Addressed in Kleinfelder Study for Logan and Maritime

- **Technological**
  - Data Loss
  - Power Loss

- **Human-Caused**
  - Fire/Accident
  - Sabotage
  - Terrorism Acts (Bomb Blast)
# Critical Infrastructure/Key Resources

<table>
<thead>
<tr>
<th>Utilities</th>
<th>Transportation</th>
<th>Human Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical/Vaults/Sub Stations/Distribution etc.</td>
<td>Parking</td>
<td>Workforce</td>
</tr>
<tr>
<td>Drainage</td>
<td>Surface Roads</td>
<td>HR Functions</td>
</tr>
<tr>
<td>Generators</td>
<td>Elevated Roads</td>
<td>Qualified Maintenance</td>
</tr>
<tr>
<td>Water</td>
<td>Tunnels</td>
<td>Security</td>
</tr>
<tr>
<td></td>
<td>Bridges</td>
<td></td>
</tr>
</tbody>
</table>

**Fuel Systems**

| Aviation Fuel | Workforce |
| Ground Fuel | HR Functions |
| Generator Fuel | Qualified Maintenance |

**IT**

| ATC – Tower | Terminals |
| Telecommunications | Runway/Taxiway |
| Network | Apron |
| Software | Tower |
| Hardware | Security Gates |
| Enterprise | Berths |

**Equipment/Buildings**

<p>| Operating Cranes |
| Processing Gates |</p>
<table>
<thead>
<tr>
<th>Probability</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High Probability/High Impact</td>
<td>Natural</td>
<td>Technological</td>
<td>Human-Caused</td>
</tr>
<tr>
<td>Flood</td>
<td></td>
<td>Data Loss</td>
<td></td>
</tr>
<tr>
<td>High Winds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hurricane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme Temps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Probability/High Impact</td>
<td>Natural</td>
<td>Technological</td>
<td>Human-Caused</td>
</tr>
<tr>
<td>Tsunami</td>
<td></td>
<td>Terrorism</td>
<td>Sabotage</td>
</tr>
<tr>
<td>Tornado</td>
<td></td>
<td></td>
<td>Epidemic</td>
</tr>
<tr>
<td>Earthquake</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Disaster Infrastructure Resiliency Planning (DIRP)

Goals of the project:
- Understand Massport’s vulnerability to climate impacts
- Develop short-term and long-term resiliency strategies

Project approach:
- Climate projections
- Vulnerability and risk assessment
- Adaptation planning & design

![Probabilty of occurrence vs Consequence of impact diagram]
Climate Study Area

Logan Airport

Maritime Facilities
### Historic Occurrence of Hurricanes – Boston (1858-2013)

<table>
<thead>
<tr>
<th>Number of Occurrences</th>
<th>N = 34</th>
<th>P = 0.22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Occurrences</td>
<td>N = 13</td>
<td>P = 0.08</td>
</tr>
<tr>
<td>Number of Occurrences</td>
<td>N = 8</td>
<td>P = 0.05</td>
</tr>
<tr>
<td>Number of Occurrences</td>
<td>N = 2</td>
<td>P = 0.01</td>
</tr>
</tbody>
</table>

#### Sub/Tropical Storms & Depressions

<table>
<thead>
<tr>
<th>SUB/TROPICAL STORMS &amp; DEPRESSIONS</th>
<th>CATEGORY 1 HURRICANE</th>
<th>CATEGORY 2 HURRICANES</th>
<th>CATEGORY 3 HURRICANES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Atlantic Hurricane of 1944:</td>
<td>Hurricane Sandy (11);</td>
<td>Hurricane Bob:</td>
<td>Hurricane Esther:</td>
</tr>
<tr>
<td>Unnamed (1936):</td>
<td>Hurricane Donna:</td>
<td>Hurricane Edna:</td>
<td></td>
</tr>
<tr>
<td>September 8 - 25, 1936</td>
<td>September 12, 1960</td>
<td>September 11, 1954</td>
<td></td>
</tr>
<tr>
<td>Unnamed (1924):</td>
<td>Hurricane Gloria:</td>
<td>Hurricane Carol:</td>
<td></td>
</tr>
<tr>
<td>September 27 - 30, 1924</td>
<td>September 27, 1985</td>
<td>August 31, 1954</td>
<td></td>
</tr>
<tr>
<td>Hurricane of 1916:</td>
<td>Hurricane of 1869:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 10 - 22, 1916</td>
<td>Hurricane Edna:</td>
<td>September 7 – 9, 1869</td>
<td></td>
</tr>
<tr>
<td>Unnamed (1904):</td>
<td>Great New England</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 8 - 15, 1904</td>
<td>Hurricane:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed (1896):</td>
<td>September 21, 1938</td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 30 - September 11, 1896</td>
<td>Unnamed (1924):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed (1894):</td>
<td>August 16 - 28, 1924</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October 1 - 12, 1894</td>
<td>Unnamed (1869):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed (1893):</td>
<td>October 4 - 5, 1869</td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 15 - 26, 1893</td>
<td>Unnamed (1858):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed (1888):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 23 - 27, 1888</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed (1885):</td>
<td>Unnamed (1879):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 17 - 23, 1885</td>
<td>August 13 - 20, 1879</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnamed (1858):</td>
<td>September 14 - 17, 1858</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[1] All storms listed above tracked within 150 miles of Boston, except Hurricane Sandy.
### Tide Levels at Peak Hurricane Storm Surge - Boston (1923-2013)

<table>
<thead>
<tr>
<th>Category</th>
<th>MLW</th>
<th>MSL</th>
<th>MHW</th>
<th>MHHW</th>
<th>HAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category 2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category 3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

MLW = Mean Low Water (-4.36 ft)  
MSL = Mean Sea Level  
MHW = Mean High Water  
MHHW = Mean Higher High Water  
HAT = Highest Astronomical Tide (7.73 ft)

*All tidal elevations are in NGVD29 datum*

Sandy made final landfall near Atlantic City, NJ on 10/30/2012 00:00 GMT as a Category 1 hurricane at MHW (NOAA, 2013)
Sea Level Rise Projections

Global mean sea level rise scenarios provided by NOAA as part of the National Climate Assessment report published in December 2012.
South Boston - Flooding from Category 2 Hurricane at MHHW
South Boston - Flooding from Category 3 Hurricane at MHHW
Storm Climatology

- Includes both tropical and extra-tropical storm sets
- Present and future climate change scenarios

Source: Woods Hole Group
Flood Risk Model

- 2030
- 2070
Design Flood Elevations (Probabilistic Model)

OLD - Logan DFE New Facilities: Cat 3 MHW = 19.5 ft (SLOSH)
OLD - Maritime DFE New Facilities: Cat 3 MHW = 19.3 ft (SLOSH)

NEW – MPA DFE New Facilities: 0.2% 2070 +3 ft freeboard = 17 ft (BH-FRM)

OLD - Logan DFE Existing Facilities: Cat 2 MHW = 15.4 ft (SLOSH)
OLD - Maritime DFE Existing Facilities: Cat 2 MHW = 15 ft (SLOSH)

NEW – MPA DFE Existing Facilities: 0.2% 2030 +3 ft freeboard = 13.7 ft (BH-FRM)
AE 1% 2013 = 10 to 13 ft (FEMA*)

AE 1% 2009 = 9 to 11 ft (FEMA)

(Feet NAVD88)
Floodproofing Design Guidelines

Floodproofing Design Guide:

• Design Flood Elevations
  – New Facilities
  – Existing Facilities

• Floodproofing Strategies
  – Wet Floodproofing
  – Dry Floodproofing

• Performance Standards

• Reviews and Approvals
New Construction
New Construction
Real Estate and tenants
## Consequence: Criticality Score

<table>
<thead>
<tr>
<th>Description</th>
<th>Criticality Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets required for <strong>bare-bones functionality</strong> for disaster preparedness, response, and recovery</td>
<td>3</td>
</tr>
<tr>
<td>Assets required for <strong>disaster response</strong> in the immediate aftermath of a flood event</td>
<td>2</td>
</tr>
<tr>
<td>Assets required for facility to recover to acceptable level of service</td>
<td>1</td>
</tr>
</tbody>
</table>
Risk-Based Prioritization

Probability of Flooding

- Determined based on Inundation Model results
- Flooded in more storm scenarios → higher probability, higher priority

Consequence of Flooding

- Criticality Score
  - Based on role in disaster preparedness, response, recovery

- Occupancy Category
  - Based on ASCE/SEI 24-05 Standard for Flood Resistant Design and Construction

- Higher consequence → higher priority

Depth of Flooding

- Further distinguish among assets with same Probability and Consequence
- Higher depth → higher priority
Fish Pier
Fish Pier East – Design Flood Elevations

- All elevations are in NGVD.

**FEMA BFE (2009)**
- Flood EL. = 9.81’
- Ground Floor EL. = 11.11’

**FEMA BFE (2013)**
- Flood EL. = 13.81’

**CAT. 2 HURRICANE (HAT)**
- Est. Flood EL. = 18.28’

**CAT. 3 HURRICANE (MHHW)**
- Flood EL. = 20.46’
Fish Pier East – Design Flood Elevations

- All elevations are in NGVD.
Fish Pier – Design Flood Elevations

DESIGN FLOOD
EL. = 17.75’

TOP OF CURB
EL. = 10.22’
Resiliency Performance Objectives:

• Allow the first floors of buildings to flood
• Prevent damage to critical electrical and fire protection systems and building elevator machinery
• Prevent flooding of underground waste storage tanks and associated pump systems
• Prevent structural failure of the building due to flooding
Conley Terminal
Conley Terminal - Vessel Berths

- All elevations are in NGVD.

DESIGN FLOOD
EL. = 17.75’

TOP OF DECK
EL. = 10.76’
Conley Terminal – Vessel Cranes

All elevations are in NGVD.

DESIGN FLOOD
EL. = 17.75’

TOP OF DECK
EL. = 11.26’
Adaptation Planning & Design
2015 Resiliency Work Plan for Critical MPA Assets at Logan and Maritime

- **Task 1 - ADCIRC Model**

- **Task 2 - Re-Review Tier 1 Facilities**

- **Task 3 - Temporary Measures Procurement/Demonstration**

- **Task 4 - A/E Services for the Permanent Flood Control at Tier 1 Facilities**

- **Task 5 - Operational Plan**
Common Adaptation Recommendations – Temporary Flood Walls

<table>
<thead>
<tr>
<th>Inflated Height in Feet</th>
<th>Maximum Controllable Water/Sediment Depth in Inches</th>
<th>Inflated Volume in Gal. per liner Foot</th>
<th>Inflated Width in Feet</th>
<th>Connection Overlap Requirements in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>27</td>
<td>131</td>
<td>7</td>
<td>4.5</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>225</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>352</td>
<td>11.25</td>
<td>7.5</td>
</tr>
<tr>
<td>6</td>
<td>54</td>
<td>506</td>
<td>13.5</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>72</td>
<td>901</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>

* The depth of water represents 75% of the inflated height of a fully inflated Aqua-Banner™. It is required that a minimum 25% freeboard (portion of barrier above water level) inflated capacity be maintained during all phases of a project. Excess slopes and grades, soil composition, moving water, and other related hydrological criteria may increase or decrease the ability of the Aqua-Banner™ to perform as projected.
Procure Temporary Flood Barriers

- AquaFence successful bidder
  - Logan Airport – 4 facilities
  - Conley Terminal - 2 facilities
  - Fish Pier – 3 Facilities
- Ready for deployment in September 2015
• Seal electrical conduits
• Purchase temporary water pump
• Install water level sensors
• Install ground anchors for AquaFence
Permanent AquaFence Layout
A310-S2 Resiliency – Common resiliency

Sealing Electrical Conduits

Water Level Sensors

Temporary Water Pump
A310-S2 Resiliency – Fish Pier East– Fire Pump Room

• Seal electrical conduits
• Purchase temporary water pump
• Install water level sensors
• Install ground anchors for AquaFence
• Waterproof interior CMU wall

Permanent AquaFence Layout
Wall Attachment Bracket to Be Bolted to Wall
- Seal electrical conduits
- Purchase temporary water pump
- Install water level sensors
- Install ground anchors for AquaFence
- Install wall anchors at 4 AquaFence wall brackets
A310-S2 Resiliency – Ground anchors

Typical AquaFence Panels

AquaFence Pavement Anchors
• Seal electrical conduits
• Purchase temporary water pump
• Install water level sensors
• Install ground anchors for AquaFence
Permanent AquaFence Layout

- Install water level sensors
- Install ground anchors for AquaFence
- Install sewer shut-off valve
- Seal electrical conduits
- Purchase temporary water pump
## A310-S2 Resiliency – Schedule

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>60% Submission</td>
<td>January 15, 2016</td>
</tr>
<tr>
<td>Final Bid Documents for Bidding</td>
<td>March 3, 2016</td>
</tr>
<tr>
<td>Pre-Bid Conference</td>
<td>March 15, 2016</td>
</tr>
<tr>
<td>Filed Sub-Bid Opening</td>
<td>March 30, 2016</td>
</tr>
<tr>
<td>General Contractor Bid Opening</td>
<td>April 13, 2016</td>
</tr>
<tr>
<td>Contract Award</td>
<td>May 4, 2016</td>
</tr>
<tr>
<td>Notice-to-Proceed</td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Construction Complete (9 weeks)</td>
<td>August 12, 2016</td>
</tr>
</tbody>
</table>
HEAVY WEATHER AND FLOOD OPERATIONS PLAN

FOR MASSPORT’S MARITIME FACILITIES

Logan International Airport
Coastal Flood Operations Plan

November 2015
Guiding Principles

• Safety is #1
• Stakeholder-driven
• Integrated in all-hazards planning
• Minimize disruptions & speed recovery
• Realistically reflect available resources
• More than a document
Airport Coastal Flood Operations Plan - Timelines

**Pre-Flood**
72, 48, 24, 12, 6 hours

**During Flood**

**Post-Flood**
12 hours & 12+ hours
New Flood Preparedness Actions & Timelines

- Flood forecasting and decision framework
- Temporary flood barrier system deployments
- Preventative electrical and IT measures
- Elevating critical stock, equipment, materials
- Relocating fleet out of harms way
- Requiring berthed vessels to leave dock
- Preventative evacuations of at risk buildings
- Debris and waste management planning
Tabletop Exercises

Heavy Weather and Flood Operations Plan for Massport’s Maritime Facilities

TABLETOP EXERCISE

September 29, 2015
Highly Participatory
Tough Questions

• Who is responsible for flood monitoring?
• How soon do we activate?
• Who is the “decider”?
• When do we notify contractors?
• Where do we operate from during the event?
• Where is the safest place to shelter people?
• Where is safest place to move vehicles?
• Do essential employees live in impacted areas?
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>FLOOD FORECAST DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date and time of arrival of flood elevation greater than or equal to 9.0 ft. NAVD88</td>
<td>N/A (^{(2)})</td>
</tr>
<tr>
<td>Maximum flood elevation forecasted (ft. NAVD88 vertical datum)</td>
<td>7.6 ft. NAVD88 (^{(3)}) (a)</td>
</tr>
<tr>
<td></td>
<td>7.5 ft. NAVD88 (^{(3)}) (b)</td>
</tr>
<tr>
<td>Anticipated wave height at time of maximum flood elevation (ft.) (if available)</td>
<td>Harbor: 2-3 ft.</td>
</tr>
<tr>
<td>Date and time of maximum flood elevation</td>
<td>(a) 10/1/15 @ 1400</td>
</tr>
<tr>
<td></td>
<td>(b) 10/2/2015 @ 1500</td>
</tr>
<tr>
<td>Date and time of recession of flood to elevation below 9.0 ft. NAVD88</td>
<td>N/A (^{(2)})</td>
</tr>
<tr>
<td>Duration of predicted flooding above elevation 9.0 ft. NAVD88 from start to recession</td>
<td>N/A (^{(2)})</td>
</tr>
<tr>
<td>Forecasted maximum wind gust speed and direction</td>
<td>NE - Up to 30 kt(^{(4)})</td>
</tr>
<tr>
<td></td>
<td>Small Craft Advisory until 2000 Friday 10/1/2015</td>
</tr>
<tr>
<td>Forecasted maximum sustained wind speed and direction</td>
<td>NE - 15 - 25 kt(^{(4)})</td>
</tr>
<tr>
<td></td>
<td>Small Craft Advisory until 2000 Friday 10/1/2015</td>
</tr>
</tbody>
</table>
TTX to Reality

Hurricane Robbin – Table Top Exercise 9/29/15

Hurricane Joaquin – October 1, 2015
Expect the Unexpected

Hurricane Sandy through the Ocean Prediction Center’s Area of Responsibility
- OPC High Seas Area (Metarea IV)
- OPC Offshore Zones

[Map showing the path of Hurricane Sandy through the eastern United States, with annotations for dates and times of various events.]
Discussion

rpeach@massport.com