Storm Preparedness for Small Businesses

REDUCE THE IMPACT
Welcome & Opening Remarks

- Mr. David Meade, Executive Director, Southwest Brooklyn Industrial Development Corporation
- Hon. Ms. Nydia Velasquez Congresswoman, NY 7th Congressional District
- TBD Port Authority of New York and New Jersey
Agenda

- **Morning General Session**
  - Hazard identification and mitigation concepts
  - Preparedness Planning
  - Brooklyn post-Sandy case studies

- **Afternoon Break-out Sessions**
  - Preparedness planning workshops

- **Afternoon General Session**
  - Lessons learned during workshops
  - Closing Remarks
Agenda – Morning

- 9:30–10:45 Natural Hazard Risks and Mitigation
- 10:45–11:00 BREAK
- 11:00–11:15 Preparedness Planning Introduction
- 11:15–11:55 Red Hook Business Case Studies
- 11:55–12:00 Directions to Afternoon Workshops
- 12:00 – 1:00 Lunch with Workshop Groups
Agenda – Afternoon

- 1:00–2:30   Developing Your Preparedness Plan
- 2:30 – 2:45   BREAK
- 2:45–3:15   General Session: Review Planning Lessons Learned during Workshops
- 3:15–3:30   Closing Remarks
Emergency Exits
Restrooms
Please mute cell phones and pagers
Please answer phones, e-mails, etc. outside meeting rooms
Keys to Disaster Preparedness Planning

- **KNOWLEDGE** Understand hazards and mitigation techniques
- **PREPARE** Design a readiness and response action plan using standardized templates
- **CONNECT** Network with other businesses to strengthen neighborhood disaster resiliency
Step 1: Know your Hazard Risks & Consequences

- Step 1: What are my Hazards and Consequences?
- Step 2: What is my Recovery Strategy?
- Step 3: Develop My Plan
- Step 4: Test My Plan

Exploring Mitigation Solutions

Revise in June/December and after Activation

Storm Preparedness Plan Cycle
Know Your Hazard Risks & Consequences

Flood

Wind
Know Your Hazard Risks & Consequences

- **Flood Sources**
  - Intense rain storms
  - Coastal storms
    - Hurricanes
    - Nor’easters
Know Your Hazard Risks & Consequences

- Hurricane Sandy Small Business Impacts
  - Extended and widespread power outages
  - Erratic response in some New York neighborhoods
  - No central source for recovery information or assistance
Guidance for determining flood hazard
- National Flood Insurance Program (NFIP)
  - Establishes requirements for floodplain management for facilities in the floodplain
- Flood Insurance Rate Maps (FIRMS)
  - FEMA published maps showing Special Flood Hazard Zones and Base Flood Elevations
- Base Flood Elevation (BFE)
  - Flood elevation having a probability of occurrence of 1% in any given year (aka “100-year flood”)
Flood Risk is constantly changing
- Development
- Mitigation efforts

Methods to identify risk are improving

Manhattan at European Settlement

Manhattan today
Hurricane Sandy made landfall in New York on October 29, 2012

Advisory Base Flood Elevations (ABFEs) were released after Hurricane Sandy to provide communities and property owners with the best available data at the time for rebuilding and recovery

The ABFEs were built on data that FEMA and New York City gathered through October 2012
Preliminary Flood Hazard Maps: Benefits to New York City

- Assist the City and property owners in understanding the current flood risk
- Inform rebuilding and recovery actions as Best Available Data
- Inform decisions to protect people and property through appropriate mitigation actions
- Inform public investment process
NYC Evacuation Zones

NEW YORK CITY HURRICANE
EVACUATION ZONES

KNOW YOUR ZONE*

1. Determine whether you live in an evacuation zone by using the Hurricane Evacuation Zone Finder at nyc.gov/hurricanezones or calling 311 (for NYC residents) or 1-800-634-8010 (for non-NYC residents) or by consulting the map. If your address is in one of the City’s hurricane evacuation zones, you may be required to evacuate if a hurricane threatens New York City.

2. Evacuees should be prepared to stay with friends or family members or in the hurricane evacuation zone for up to 72 hours, as directed by the Council. If you cannot stay with friends or family, use the Finder, call 311 (for NYC residents) or 1-800-634-8010 (for non-NYC residents), or use this map to identify which evacuation center is most appropriate for you.

* Evacuation information is subject to change. For the latest information, please check nyc.gov/hurricanezones or call 311 (for NYC residents) or 1-800-634-8010 (for non-NYC residents).

HURRICANE EVACUATION ZONES**

When a coastal storm is approaching, the City may order the evacuation of neighborhoods in danger of flooding from storm surges, starting with Zone 1 and adding more zones as needed depending on the severity of the forecast. Zones will be evacuated progressively, beginning with those most at risk.

- Zone 1: Areas with the highest risk of flooding from storm surges.
- Zone 2: Areas with moderate risk of flooding from storm surges.
- Zone 3: Areas with low risk of flooding from storm surges.
- Zone 4: Areas with minimal risk of flooding from storm surges.

- Zone 5: Areas with no risk of flooding from storm surges.

- Zones 6 and 7: Areas that are not part of the evacuation zone.

- Zones 8-12: Areas that are not in the evacuation zone.

Visit nyc.gov/hurricanezones or call 311 to find out if you live in a Hurricane Evacuation Zone.

- ** Evacuation information is subject to change. For the latest information, please check nyc.gov/hurricanezones or call 311 (for NYC residents) or 1-800-634-8010 (for non-NYC residents).

- * Evacuation information is subject to change. For the latest information, please check nyc.gov/hurricanezones or call 311 (for NYC residents) or 1-800-634-8010 (for non-NYC residents).
FEMA Flood Maps

1% annual chance flood zone (100 year flood)

0.2% annual chance flood zone (500 year flood)
Zone AE = High Flood Risk
EL 11 = Base Flood Elevation of 11’ above sea level (not above the ground) during 1% annual chance event (100 year flood)
Southwest Brooklyn
(Zone AE 12)

Zone AE = High Flood Risk
EL 12 = Base Flood Elevation of 12’ above sea level (not above the ground) during 1% annual chance event (100 year flood)
NFIP and Building Codes

NFIP Regulations (44 CFR Parts 59 and 60)

Local Floodplain Management Regulations* or IBC Appendix G*

Building Codes

Hazard Resistant Buildings and Development

ASCE 7

ASCE 24

NFIP – National Flood Insurance Program
Flood hazard exposure risks include potential for:

- Human injury or death
- Structural damage
- Loss of access to critical facilities
- Damage to critical infrastructure

![Hurricane Katrina 2005: Rescue boat searching for stranded residents, New Orleans, LA. FEMA Photo Library (ID #14988)](image-url)
Know Your Hazard Risks & Consequences

Structural damage
- Flood loads exceed strength of structural members
- Undermining of foundations

Hurricane Ike 2008: Structural damage to residence from storm surge and waves (FEMA P-757)
Non-structural damage

- Warping of dimensional elements
- Corrosion of exterior wall systems and connections
- Mold and mildew

Hurricane Katrina 2005: Typical interior flood damage to residential building in New Orleans, showing extensive mold growth (FEMA 549)
Flood Depth

- Increased exposure to hydrostatic force on structure
- Exposure determined by lowest floor elevation relative to the flood water elevation

Midwest Floods 2008: Commercial buildings in Rock Springs, WI were inundated with over 4 feet of water (dashed red line indicates the water line). (FEMA P–765)
Know Your Hazard Risks & Consequences

Storm Surge

- Increased exposure resulting from wind driven storm surge
- Increase exposure to threat of flood-borne debris impact and erosion and scour

Hurricane Katrina 2005 Storm surge carries casino barge (left) into parking deck causing collapse (Biloxi, Mississippi) (FEMA 549)
Wave Action

- Increased hydrodynamic forces
- Most significant damage begins as wave heights approach 1.5 feet or greater

The landward displacement of shore parallel floor joists indicates the onset of wave damage to an elevated floor system (Bolivar Peninsula). (FEMA P-757)
Know Your Hazard Risks & Consequences

- Risk = Hazard Consequences x Probability of Occurrence
  - Probability of a severe storm occurring is currently beyond our control
  - Hazard consequences can be reduced using mitigation methods

- Flood hazard mitigation is the focus of the next discussion

One-story home and neighboring elevated two-story home, post-Katrina New Orleans (J. Klein Sept. 2009)
Mitigation is any sustainable action which:

- Protects people and property
- Supports continued operation of critical infrastructure
- Sustains societal function
- Reduces post-disaster recovery costs
Flood Mitigation Concepts

- Two general flood mitigation concepts
  - Relocation
    - Move out of the floodplain
    - Move up above the Base Flood Elevation
  - Floodproofing
    - Dry floodproofing – Keep water out of building/facility
    - Wet floodproofing – Use flood-damage-resistant materials and construction below the flood protection level
# Flood Mitigation Concepts

<table>
<thead>
<tr>
<th>Effectiveness Most to Least</th>
<th>Cost Least to Most</th>
<th>Residual Risk Least to Most</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relocation</td>
<td>Wet Floodproofing</td>
<td>Relocation</td>
</tr>
<tr>
<td>Elevation</td>
<td>Dry Floodproofing</td>
<td>Elevation</td>
</tr>
<tr>
<td>Dry Floodproofing</td>
<td>Elevation</td>
<td>Dry Floodproofing</td>
</tr>
<tr>
<td>Wet Floodproofing</td>
<td>Relocation</td>
<td>Wet Floodproofing</td>
</tr>
</tbody>
</table>
Flood Mitigation Concepts

Permanent vs. Temporary Floodproofing Measures

- **Permanent measures** do not require active human intervention and are recommended when possible.

- **Temporary measures** require action and can work when there is enough warning time to mobilize the labor and equipment necessary to put into place and safely evacuate.
## Flood Mitigation Concepts

### Floodproofing Considerations

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Issues for Consideration</th>
</tr>
</thead>
</table>
| Building strength          | • Additional hydrostatic and hydrodynamic forces on building  
                              • Structural retrofits to strengthen the building                                    |
| Warning time               | • Warning time required to activate or deploy a floodproofing measure                     |
| Flood characteristics      | • Duration of flooding  
                              • Flood water chemistry                                                               |
| Level of protection        | • Acceptable level of residual risk                                                      |
## Flood Mitigation Concepts

### Floodproofing Considerations

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Issues for Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building location</td>
<td>Is the building in a Coastal A Zone or Zone V?</td>
</tr>
<tr>
<td>Operational considerations</td>
<td>Can considerations for the dry floodproofing measure be added to the maintenance plans?</td>
</tr>
<tr>
<td>Seepage considerations</td>
<td>Are measures to remove water that infiltrates the building necessary?</td>
</tr>
</tbody>
</table>
# Flood Mitigation Concepts

## Floodproofing Considerations

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Issues for Consideration</th>
</tr>
</thead>
</table>
| Utilities | • Alternate power be provided for sump pumps  
             • Discharge location for sump pumps  
             • Sealing above and below ground utility entrances to building  
             • Protection of electrical from floodwaters |
Flood Mitigation Concepts

- New construction and modifications to existing structures must comply with NFIP and New York City building code requirements
- Design plans and specifications must be signed and sealed by a licensed Professional Engineer or architect

NFIP – National Flood Insurance Program
Flood Mitigation Concepts
Dry Floodproofing Historic Buildings

- Flood retrofits of historic buildings should reduce flood risk and preserve the building’s historic integrity
- Examples of flood-proofing measures for historic buildings that provide at least some protection are:
  - Elevate electrical and mechanical systems
  - Relocate contents
  - Use flood damage-resistant materials
  - Fill or wet flood-proof basements
Flood Mitigation Applications

Pedestrian Door
Temporary Floodproofing

Vehicle Door
Temporary Floodproofing
Flood Mitigation Applications

- Temporary sandbag barriers can protect structures from flooding or add height to existing levees.
- Most sandbag barriers are prone to leakage and failure unless emergency placement is planned well in advance and bags are placed under the direction of trained personnel.

Notes:
1. Bags should be 2/3 full and do not need to be tied.
2. Place bags lengthwise parallel to flow direction, with open end of bag facing downstream.
3. Tamp bags in place by walking on them.
Combining wet and dry floodproofing techniques may be useful for:

- Multi-story or split-level buildings where different measures can be applied to different foundation types at different elevations

- Large factories, warehouses, and other industrial facilities constructed of varied materials that respond better to different floodproofing measures

- Groups of buildings on the same site but at different elevations

Interior flood shield, Darlington, WI (D. Mills, June 2006)
Flood Mitigation Applications

Backflow prevention
- Essential in areas with combined sewer system
- Maintenance is necessary
- NYC Code requires dual action backflow prevention
Flood Mitigation Applications

Flood Wrapping Systems

- Plastic or other synthetic waterproof sheeting material used to seal a building to prevent floodwater intrusion
- Rely on existing walls for strength, but typically require temporary reinforcement to bridge openings
Flood Mitigation Applications

“Dry” Floodproofing Basements

Richmond, VA interior basement drainage project (D. Mills, March, 2004)
Flood Mitigation Applications

Dry floodproofing summary

- Adding membranes or shields to prevent floodwater from entering the building
- Backflow preventers to prevent storm and sanitary sewer flooding
- Assess impact of increased flood loads on structure

Flood Hazard Applications

Wet Floodproofing

- Allow water to enter, balancing flood loads on existing structural elements
- All surfaces and services in contact with floodwaters should be retrofitted with flood-damage-resistant materials
# Flood Hazard Concepts

<table>
<thead>
<tr>
<th>Building Mitigation</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Barrier for Doors and Windows</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plywood</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandbag openings</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water tight doors and windows</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Temporary flood barriers</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Retrofit gaskets and seals</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
## Flood Hazard Concepts

<table>
<thead>
<tr>
<th>Building Mitigation</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean and repair masonry wall joints</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Exterior/interior wall membrane</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Interior wall coating</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Sump pumps</td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>
## Flood Hazard Concepts

<table>
<thead>
<tr>
<th>Building Mitigation</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevate electric service entrance and meters</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floodproof electric meters</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency generators</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Backflow prevention device</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Elevate HVAC equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Floodproof HVAC equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Isolate air handler below BFE</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
## Flood Hazard Concepts

<table>
<thead>
<tr>
<th>Essential Business Equipment/Assets</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reposition equipment to above BFE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Temporary elevation of equipment</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reposition critical small tools and supplies to above BFE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
## Flood Hazard Concepts

<table>
<thead>
<tr>
<th>Information Technology/Data Systems</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store critical paper documents above BFE or off-site</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scan critical paper documents</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Place network servers above BFE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Place voice and data communication routers above BFE</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Back-up critical electronic data off-site</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Relocate critical documents in advance of storm</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

49
Flood Mitigation Concepts: Information Resources
Flood Mitigation Concepts: Information Resources

Protecting Building Utilities From Flood Damage
FEMA P-348, Edition 1 / November 1999

Floodproofing Non-Residential Buildings
FEMA P-936 / July 2013
Wind Hazard
Know Your Hazards & Consequence

Wind

[Map of the United States with regions highlighted for wind and hurricane-prone areas.]
Know Your Hazard Risks & Consequences

Based on NOAA, Storm Prediction Center Statistics
Know Your Hazard Risks & Consequences

- Design Standards for wind are more rigorous than flood
  - Design wind speeds vary as a function of building use and occupancy

<table>
<thead>
<tr>
<th>Structure Category</th>
<th>Maximum Recurrence Interval for Design Wind Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural and minor storage</td>
<td>300 Years</td>
</tr>
<tr>
<td>All buildings included in another Category</td>
<td>700 Years</td>
</tr>
<tr>
<td>Building with a substantial hazard to human life in event of failure</td>
<td>1700 Years</td>
</tr>
<tr>
<td>Buildings designated critical facilities</td>
<td>1700 Years</td>
</tr>
</tbody>
</table>

Maximum recurrence interval for BFE = 100 Years
Know Your Hazard Risks & Consequences

Wind – Structure interaction a function of both:

- Aerodynamics
- Atmospheric effects

Source: FEMA 488
Aerodynamics Components and Cladding

- Drag forces can result of failure of cladding to frame connections

- Partial cladding failure can increase internal pressure on other components

Cladding failure of pre-engineered metal building column to roof beam due to Hurricane Charley winds, Arcadia FL 2004
Know Your Hazard Risks & Consequences: Wall Covering

Brick Veneer
Know Your Hazard Risks & Consequences

Exterior-Mounted Equipment

Hurricane Ivan 2004: Sheet metal access doors and covers blow off and damage roof membrane (FEMA 489)
Fully adhered single ply membrane struck by large number of wind borne objects acting like “missiles.” (FEMA 543)

Wind Borne debris through exterior wall (FEMA 488)
Mitigation Concepts

- **New Construction**
  - Design a continuous load path sufficient to transfer wind loads to the supporting ground
  - Special attention to building attachments
  - Use materials not susceptible to damage by wind borne debris

- **Retrofit Construction**
  - Reinforce structural connections
  - Install “hurricane shutters” to protect building openings from wind borne debris damage

Installing hurricane shutters prior to storm landfall
Mitigation Concepts

Connection reinforcing for critical load path nodes

Reinforcing straps for complex load path connection
Mitigation Concepts

Window Shutters

Hurricane shutters installed in school used as an emergency shelter (FEMA 543)

Double glazed window damaged by wind borne debris
# Wind Hazard Concepts

<table>
<thead>
<tr>
<th>Building Mitigation</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforce Load Path Connections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber to timber</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Timber to masonry</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Timber to concrete</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Masonry to concrete</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
# Wind Hazard Concepts

<table>
<thead>
<tr>
<th>Building Mitigation</th>
<th>$0 – $500</th>
<th>$500 – $1500</th>
<th>Over $1500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hurricane Shutters – Temporary</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plywood</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Steel</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Hurricane Shutters – Permanent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel – swinging</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel – roll-down</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Steel – architectural</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ballistic fabric screen*</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

* Ballistic fabric screens designed to protect the opening but not the window glass
Wind Hazard Technical Resources

Taking Shelter From the Storm:
Building a Safe Room For Your Home or Small Business
Includes Construction Plans and Cost Estimates
FEMA P-320, Third Edition / August 2008

Design and Construction Guidance for Community Safe Rooms
FEMA P-361, Second Edition / August 2008
Wind Hazard Technical Resources

Wind Retrofit Guide for Residential Buildings
FEMA P-804 / December 2010

Coastal Construction Manual
FEMA P-55 / Volume I / August 2011
Mitigation Concepts

Open Discussion/Questions
Please take a 15 minute break

Reconvene in Plenary Session at 11:00 am for Preparedness Planning overview briefing.