M I T I G A T I O N   A S S E S S M E N T   T E A M   R E P O R T

HURRICANE
SANDY
IN NEW JERSEY
AND NEW YORK

1 Introduction

When Hurricane Sandy made landfall on the coast of New Jersey in October 2012, it was 1,000 miles wide and one of the largest diameter hurricanes on record (NOAA 2013b).

Hurricane Sandy caused an estimated 147 fatalities and damage in 24 States, from Florida to Maine and as far west as Wisconsin (NOAA 2013a). The hurricane heavily damaged portions of the Caribbean and the Mid-Atlantic and northeastern United States, where New Jersey and New York were the hardest hit. The Centers for Disease Control and Prevention conducted an analysis of fatalities using data from the Red Cross and published a report on the causes and locations of deaths that were directly related to Sandy (CDC 2013). As part of the response to the disaster, the Federal Insurance and Mitigation Administration (FIMA) of the U.S. Department of Homeland Security's (DHS's) Federal Emergency Management Agency (FEMA) deployed a Mitigation Assessment Team (MAT) composed of national and regional building science and other types of experts to assess the damage in New Jersey and New York (see Section 1.2.3).

The MAT began to deploy on December 4, 2012, and completed its field investigative work in February 2013. The mission of the MAT was to assess the performance of residential buildings and representative infrastructure affected by Hurricane Sandy in New Jersey and New York and to describe the lessons learned to help communities, property owners, and others more successfully mitigate damage from future natural hazard events.

The primary purpose of this MAT report is to improve the natural hazard resistance of buildings by evaluating the key causes of building damage and failure and recommending solutions. This report describes the MAT's observations during the field investigations in New Jersey and New York and the conclusions and recommendations that are based on the observations. The purpose of this report is to provide information that will assist communities, businesses, design professionals, and individuals to rebuild safer, more robust structures, thereby minimizing loss of life and injuries, and reducing property damage resulting from future natural hazard events.

This MAT report focuses on several construction and floodplain issues not previously observed in other MAT damage investigations. These issues include:

- The effect of the storm on a heavily urbanized area
- The damage to buildings where continuous load path systems were not present, either because of the age of the building or because of additions to the original structure
- The interconnectivity of buildings through underground spaces and how those spaces affected the movement of floodwater
- The effect of saltwater intrusion, which heavily damaged electrical transmission systems in buildings throughout Lower Manhattan
- The protection provided by manmade shoreline erosion control structures and wide beaches and high dunes, which reduced the effect of storm surge on properties located behind them in portions of New Jersey and New York

1.1 Organization of Report

This chapter recounts events and damage caused by Hurricane Sandy, describes the MAT background and process, and summarizes flood hazard information. Floodplain management regulations and building codes and standards that affect construction in New Jersey, New York City, and New York State are discussed in Chapter 2. Chapter 3 contains a basic assessment and characterization of the structural and envelope performance of low-rise buildings affected by Hurricane Sandy. Chapter 4 provides a similar assessment as in Chapter 3, but focuses on mid- and high-rise buildings affected by the event. Chapter 5 presents damage to and functional loss of critical facilities and key assets affected by Hurricane Sandy. Chapter 6 discusses damage to historic structures. Chapter 7 presents the MAT's conclusions and recommendations intended to help guide the reconstruction for hurricane-resistant communities. Chapter 8 presents the references used in developing this report. In addition, the following appendices are included:

Appendix A: Acknowledgements

Appendix B: Glossary

Appendix C: Recovery Advisories and Fact Sheets for Hurricane Sandy

Appendix D: Mapping and Geographic Information System Data

Appendix E: History of Sandy and Hurricanes in the Northeast

Appendix F: Background of the National Flood Insurance Program (NFIP), the International Code Series (I-Codes), and Referenced Standards

Appendix G: Background on Floodplain Management and Building Codes in New Jersey, New York State, and New York City

Appendix H: Facility-Specific Descriptions of Critical Facilities and Key Assets

Appendix I: Definitions of Critical Facilities and Risk Categories

Appendix J: Crosswalk of Recommendations with National Disaster Recovery Framework Goals

1.2 Background

This section presents background information, including:

- The meteorological events that led to the formation of Hurricane Sandy (Section 1.2.1)
- Regional preparedness actions taken in New Jersey and New York (Section 1.2.2)
- Information on the FEMA MAT and its process, including selection of damaged areas and buildings to be visited by the MAT, team composition and the involvement of State and local agencies, structure types assessed by the MAT, and deployment (Section 1.2.3)

1.2.1 Hurricane Sandy – The Event

Hurricane Sandy formed as a ***tropical wave*** that emerged off the west coast of Africa on October 11, 2012.[1] On October 27, as Sandy moved over the Gulf Stream, the radius of maximum winds extended over 100 nautical miles from the center, making Sandy one of the largest hurricanes ever recorded in the Atlantic. By 5 p.m. Eastern Daylight Time on October 29, Sandy was approximately 45 nautical miles southeast of Atlantic City and was declared post-tropical. The center of post-tropical cyclone Sandy made landfall at Brigantine, NJ, with estimated sustained winds of 80 miles per hour (mph) and a minimum pressure of 945 millibars. The pressure at landfall was typical of Category 3 hurricanes, but the observed wind speed was on the lower end of Category 1 hurricane intensity. For more information on the timeline and history of Hurricane Sandy, refer to Appendix E.

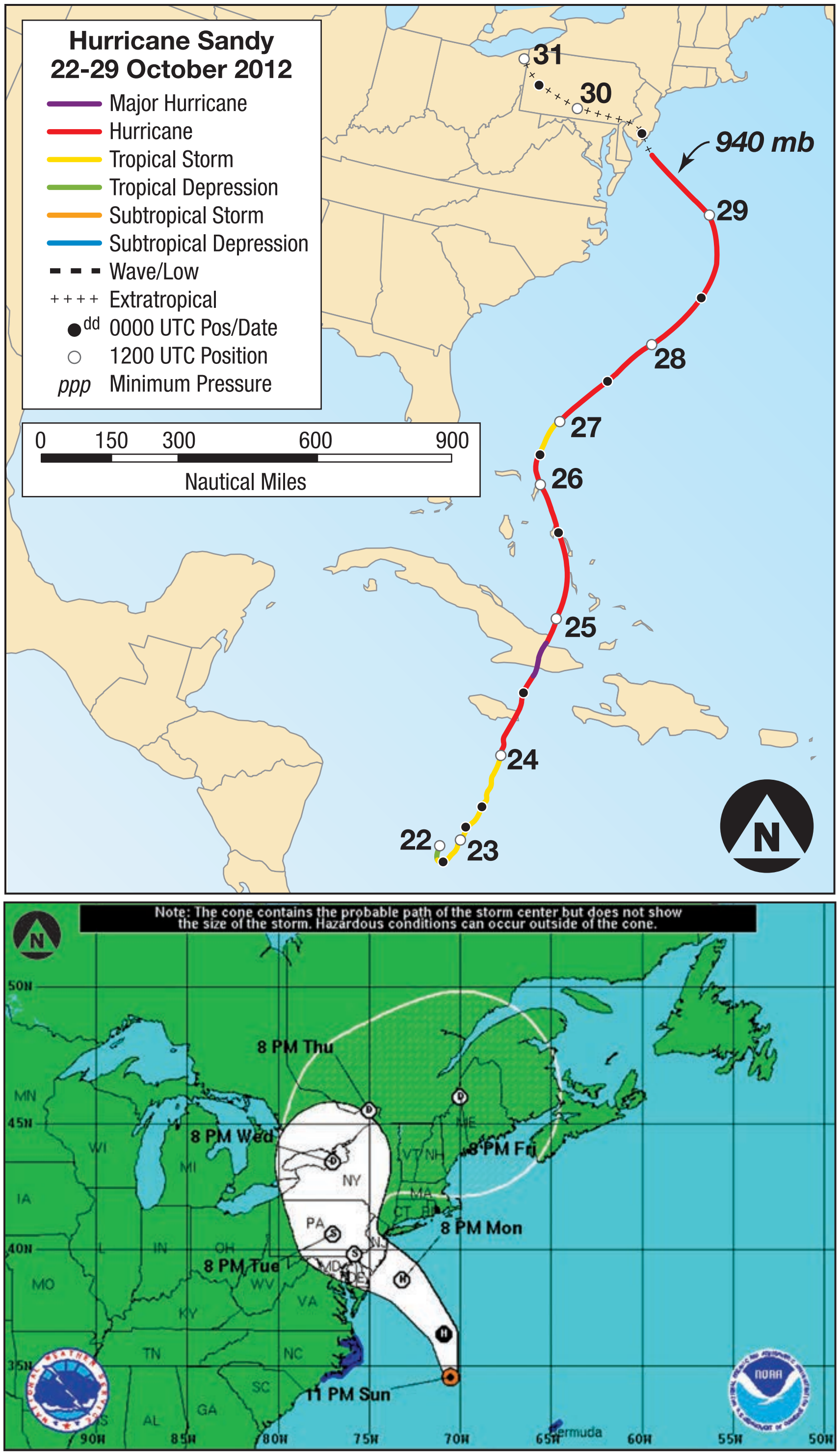
Sandy's Track

The track of Hurricane Sandy was unusual for an East Coast storm. It is uncommon for a tropical or extratropical cyclone to make landfall nearly perpendicular to the eastern coast of the United States above 35°N latitude, as depicted in Figure 1-1. The tracks of 20 recorded hurricanes prior to Sandy passing within 100 nautical miles of Atlantic City, NJ, are depicted in Figure 1-2. Since 1870, only one other hurricane has made a direct landfall in New Jersey without previously encountering land; all other hurricane tracks have paralleled the coastline.

1 All information about the life cycle and evolution of Hurricane Sandy was obtained from The Hurricane Sandy Tropical Cyclone Report from the National Hurricane Center (NHC 2013b).

Figure 1-1: National Oceanic and Atmospheric Administration's (NOAA's) National Hurricane Center, Hurricane Sandy's track (top) and Hurricane Sandy's track as it approached the United States (bottom)

SOURCE: TOP IMAGE, MODIFIED FROM NOAA; BOTTOM IMAGE, NOAA



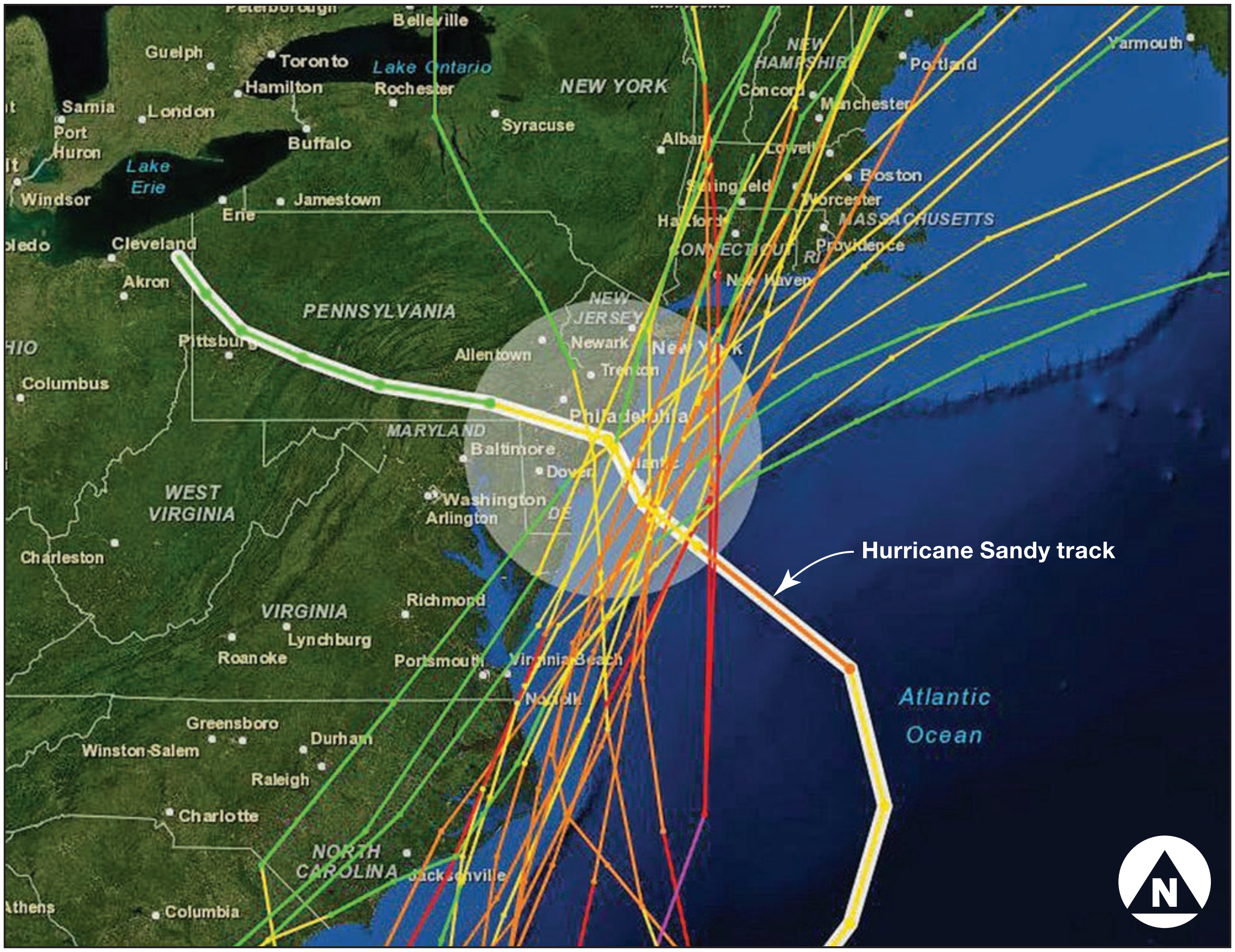


Figure 1-2: Historical hurricane tracks passing within 100 nautical miles of Atlantic City, NJ

SOURCE: DATA FROM THE NOAA COASTAL SERVICES CENTER HURRICANE TRACK DATABASE AT HTTP://CSC.NOAA.GOV/HURRICANES

Meteorological Hazards

The large size of Sandy resulted in a relaxed pressure gradient over a large storm diameter. The maximum sustained winds decreased, though the wind field at or near hurricane force (74 mph) was very wide.

The most prevalent damage associated with Sandy came from ***storm surge***. Sandy was a very large hurricane/post-tropical cyclone, with a very rapid forward speed of over 20 knots just before landfall. However, the surge associated with Sandy behaved more like that associated with a slow-moving, large hurricane with

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Storm surge: An abnormal rise of water, over and above the astronomical tide, caused by a severe storm such as a tropical cyclone or nor'easter.

Storm surge is one of the main causes of coastal inundation. Large waves also raise coastal water levels and ride on top of the storm surge, and can cause extreme damage.

Storm surge is expressed in terms of feet above predicted astronomical tides.

localized areas of peak surge. The highest surge values were recorded well north of the storm center, near the New York City lower bay and harbor. This phenomenon can be partially attributed to the concave shape of the shoreline there, the direction of the storm landfall, and the timing of the storm, which coincided with a spring high tide that was higher than normal because of a full moon.

In and adjacent to New Jersey, surge levels of 5.16 feet in Cape May, 6.29 feet at the Delaware River, and 5.82 feet in Atlantic City were recorded. In New York, a surge level of 12.65 feet above tidal predictions was recorded at King's Point on Long Island Sound, 9.56 feet on the northern end of Staten Island, and 9.4 feet at the Battery in Lower Manhattan.

Inundation was another major component of the flood hazard associated with Sandy. Coastal inundation levels were recorded across New Jersey and New York. Coastal inundation levels recorded in New Jersey include 4 to 9 feet in Monmouth and Middlesex Counties, 3 to 7 feet in Union and Hudson Counties, 3 to 5 feet in Ocean County, and 2 to 4 feet in Essex, Bergen, Atlantic, Burlington, and Cape May Counties. Coastal inundation levels recorded in New York include 4 to 9 feet in Staten Island and Manhattan, 3 to 6 feet in Brooklyn and Queens, 3 to 6 feet in Nassau and Suffolk Counties, 3 to 5 feet in the Hudson River Valley, and 2 to 4 feet in the Bronx and Westchester County.

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Inundation: Represents the total water level that occurs on normally dry ground as a result of a storm tide.

Inundation levels are expressed in terms of height above ground level.

1.2.2 Regional Preparedness Actions

News and weather reports provided plenty of advance notice of the arrival of Hurricane Sandy, allowing the region to prepare. Regional pre-event planning was performed by cities, counties, and State emergency management agencies.

In New York, Governor Cuomo ordered evacuations for several areas and announced that public transportation systems in New York City, including subway, bus, commuter rail, and tunnels, would be shut down at 7 p.m. on Sunday, October 28, 2012 (Weisenthal 2012). Evacuation was mandatory for some areas of Suffolk and Nassau Counties and recommended for portions of Westchester and Rockland Counties. Following the Governor's announcement, Mayor Bloomberg of New York City announced a mandatory evacuation of low-lying areas in the city identified as Evacuation Zone A.[2] Evacuation Zone A is the area of New York City that is most prone to flooding; for Manhattan, it begins at 39th Street and 1st Avenue, continues down the East River through the financial district, and then up the West Side Highway to 60th Street (Figure 1-3). After Hurricane

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Despite the advance notice and mandatory evacuations, most of the deaths directly related to Sandy were caused by drowning, with the majority occurring within homes (CDC 2013).

2 In this context, "Evacuation Zone A" is referring to the zone used for New York City inundation and evacuation mapping purposes, not "Zone A" as used on Flood Insurance Rate Maps (FIRMs).

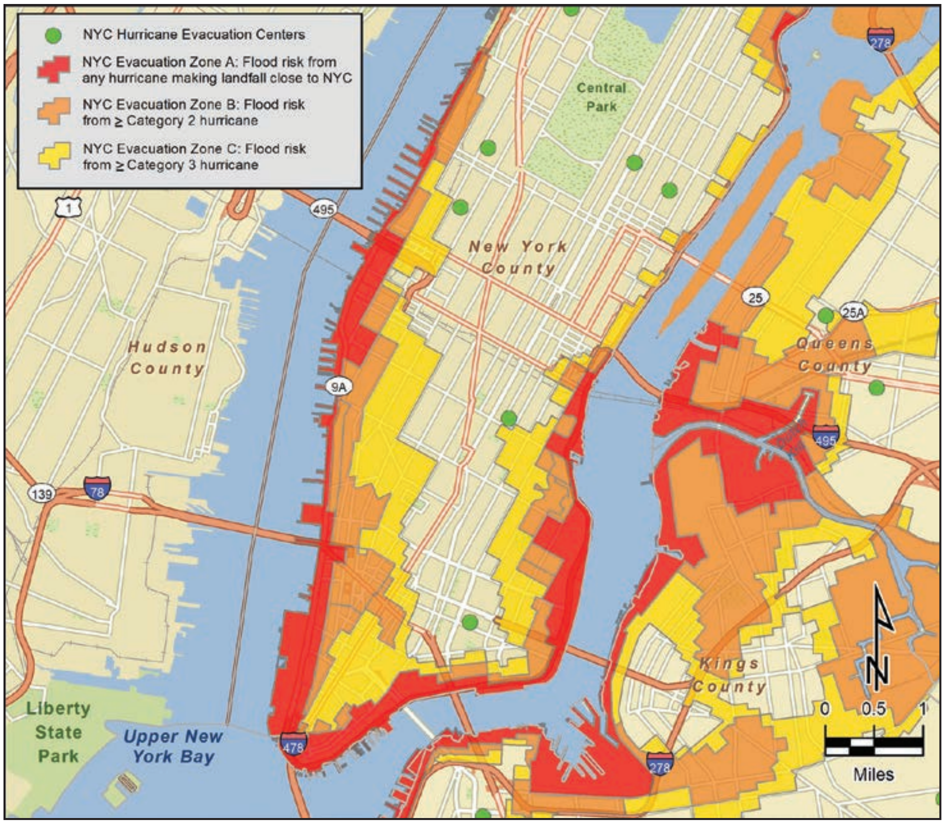

Figure 1-3: Map of New York City Evacuation Zones in effect in Manhattan at the time Hurricane Sandy made landfall

SOURCE: FEMA MOTF FROM HTTP://WWW.ARCGIS.COM/EXPLORER/?URL=HTTP://SERVICES.ARCGIS.COM/OFH668NDRN7TBJH0/ARCGIS/REST/SERVICES/SANDYNYCEVACMAP/FEATURESERVER/0&SOURCE=SD, ACCESSED 10-10-2013

Sandy, New York City updated its evacuation maps.[3] The new maps have extended evacuation areas to reflect the hazard risk.

In New Jersey, Governor Christie declared a state of emergency in advance of the storm and issued a mandatory evacuation order for the barrier islands, from Sandy Hook to Cape May, by 4 p.m. on October 28, 2012. On October 28, Hoboken Mayor Zimmer and Jersey City Mayor Healy both ordered the evacuation of all basement and street-level residential units. All New Jersey Transit service (bus, rail, and light rail systems) were preemptively closed on October 29, along with most schools throughout the State.

Electric power companies located in areas of expected flooding planned to de-energize their systems before the arrival of the storm surge. This step was taken to allow facilities that rely on utility power to transfer to generator power before the arrival of storm surge.

- In New York, Con Edison preemptively shut down some of their electrical power and steam systems around 7 p.m. on Monday, October 29, 2012, in Lower Manhattan. They also tried to protect their facilities with flood barriers, including sand bags and plywood sheathing. However, the storm surge exceeded predictions by 3 feet, and much of the underground electrical and steam distribution system, including several key substations, was inundated (New York City 2013b).

3 To see the updated evacuation map for New York City, visit http://maps.nyc.gov/hurricane.

- In New Jersey, Public Service Enterprise Group (PSEG) turned off power to facilities between 8 p.m. and 10 p.m. on Monday, October 29, 2012.

1.2.3 FEMA Mitigation Assessment Team

FEMA conducts building performance studies after unique or nationally significant disasters to better understand how natural and manmade events affect the built environment. A MAT is deployed only when FEMA believes the findings and recommendations derived from field observations will provide design and construction guidance that will improve the disaster resistance of the built environment in the affected State or region and will be of national significance to other disaster-prone regions. FEMA bases its decision to deploy a MAT on preliminary information such as:

- Magnitude of the expected hazards
- Potential type and severity of damage in the affected areas
- Pre-storm site conditions, such as the presence of older housing stock and aging infrastructure
- Potential value of study results to the rebuilding effort
- Strategic lessons that can be learned and applied, potentially on a national level, related to improving building codes, standards, and industry guidance
- Possibility that the field investigation would reveal pertinent information regarding the effectiveness of (1) certain FEMA grants and (2) key engineering principles and practices that FEMA promotes in published guidance and best practices documents

The MAT studies the adequacy of current building codes, local construction requirements, building practices, and building materials in light of the damage observed after a disaster. Lessons learned from the MAT's observations are communicated through Recovery Advisories, Fact Sheets, and a comprehensive MAT report available to communities to aid their rebuilding effort and enhance the disaster resistance of building improvements and new construction.

Sandy Team Composition

The Sandy MAT included many experts including:

- FEMA Headquarters and Regional Office engineers and experts
- Other Federal agencies including:
  - Department of Housing and Urban Development
  - National Institute of Standards and Technology
  - National Oceanic and Atmospheric Administration (NOAA)
- Federal Alliance for Safe Homes, Inc.

- International Code Council, Inc. (ICC)
- Association of State Floodplain Managers
- Construction and building code industry experts
- Academia
- Design professionals
- Home builders
- FEMA specialists who joined the New Jersey and New York Joint Field Offices (JFOs)

Team members included structural, civil, mechanical, coastal, and electrical engineers; floodplain management, building code, materials, historical, critical facilities, urban floodproofing, housing, mechanical, electrical, and plumbing (MEP) experts; healthcare specialists; architects and architectural historians; and floodplain mappers. The members of the MAT are listed in the front matter.

The Hurricane Sandy MAT was divided into four units: Coastal; Hospitals and Other Critical Facilities; High-Rise, Police, Fire, and School; and Historical. Each unit visited several locations in New Jersey and New York to assess the performance of specific building and facility types.

Involvement of State and Local Agencies

FEMA encouraged the participation of State, county, and local government officials and locally based experts in the assessment process. Their involvement was critical and resulted in:

- Improving the MAT's understanding of local construction practices
- Encouraging the MAT to develop recommendations that were both economically and technically feasible for the communities involved
- Facilitating communication among Federal, State, and local governments and the private sector
- Improving the State and local understanding of the MAT's observations and recommendations to enable them to better effect change in their communities

The MAT met with local emergency management and government officials in many of the areas they visited. The officials gave an overview of the damage in their area and helped to identify key sites to visit. The MAT also coordinated with the FEMA JFOs that had been set up in the area shortly after Hurricane Sandy. Appendix A lists these and other individuals who assisted with the MAT in its field operations and report development.

Site Selection

Before deploying the MAT, FEMA deployed a reconnaissance team and a Pre-MAT. The reconnaissance visit was conducted on November 6, 2012, in New Jersey coastal communities in Atlantic, Cape May, Ocean, and Monmouth Counties. The reconnaissance team made observations on damage levels to help identify locations for the Pre-MAT and MAT to visit.

Three Pre-MAT subteams were deployed from November 15, 2012, to November 18, 2012. The subteams visited coastal urban areas of New Jersey and New York and heavily urbanized areas of New Jersey and New York City. The members of the Pre-MAT created a list of sites deemed valuable for the MAT to observe. The locations listed by the Pre-MAT included areas with a high concentration of damage and areas with damage not typically observed by previous MATs.

Damage observations collected by the reconnaissance team and the Pre-MAT subteams, as well as observations made by two MAT members from an aerial flyover of New Jersey, New York, and New York City on November 26, 2012, were used to establish locations for the MAT to assess in more detail. The FEMA Region II JFOs, State and local government agencies, and the MAT members identified potential sites for the MAT to visit. The potential sites were then compared to other types of data, listed below, in order to select the final site list:

- Depth grids and flood extents produced by the FEMA Modeling Task Force (MOTF)
- Water surface elevation data compiled from the U.S. Geological Survey (USGS), recorded high water marks (HWMs), and surge sensor data
- Homeland Security Infrastructure Program (HSIP) Gold critical infrastructure data[4]
- Data on FEMA Hazard Mitigation Assistance grant projects
- ImageCAT assessment data[5]

Please see Appendix D for more information on how mapping and geographic information system (GIS) data were used during site selection.

FEMA MODELING TASK FORCE (MOTF)

Both the Pre-MAT and MAT relied on GIS products and data developed and provided by the MOTF. The MOTF played an important role in the response and recovery for Hurricane Sandy by coordinating hazard and modeling information from a variety of sources, including other Federal agencies, universities, the National Labs, and State and local agencies, to develop consensus for best estimates of impacts before, during, and after the storm. The MOTF information was used to "ground-truth," verify, and enhance impact assessments.

The MAT received invaluable support from home, business, and critical facility owners and managers in New Jersey and New York. These individuals accompanied the MAT through many of the affected areas and provided valuable insights into local communities and their experiences before, during, and after Hurricane Sandy.

4 More information on the HSIP can be found on the DHS Web site here: http://www.dhs.gov/infrastructure-information-partnerships.

5 More information about ImageCAT assessment data can be found here: http://www.imagecatinc.com/.

Structure Types Selected by the MAT

The structures selected by the MAT for damage assessment included: residential, non-residential, and mixed use low-rise buildings; mid- and high-rise buildings; critical facilities and key assets; and historic structures. Buildings were located in both coastal and riverine floodplains, as well as in urban areas.

Field Deployment

FEMA deployed the four MAT units to New Jersey and New York beginning on December 4, 2012. The MAT units conducted site visits and recorded observations along the New Jersey and New York shorelines, as well as within the urban areas of New Jersey and New York (Figure 1-4). The deployment was staggered to improve the efficiency and effectiveness of the MAT. Staggering the unit deployments allowed certain MAT members with specific skill sets to be assigned to more than one unit, thereby reducing the overall team costs, minimizing the size of each unit, and reducing logistical needs, such as housing, in the disaster area.

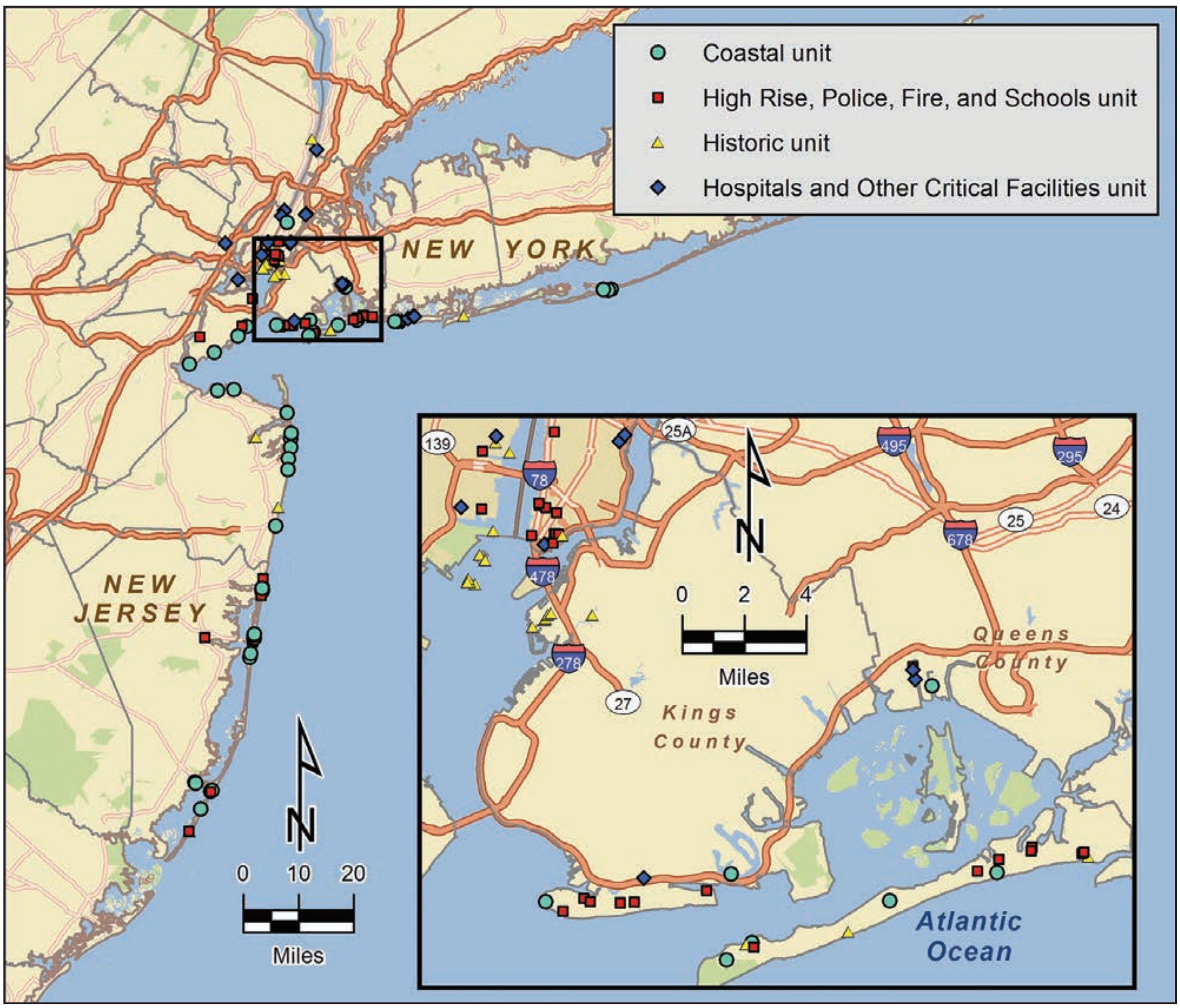

Figure 1-4: Locations visited by the four MAT units after Hurricane Sandy

- The ***Coastal*** unit observed low-rise structures located along coastal and riverine areas of New Jersey and New York. The buildings observed were primarily residential, low-rise buildings, though some schools and fire and police stations were also included.

- The ***Hospitals and Other Critical Facilities*** unit observed healthcare facilities, senior care centers, police and fire stations, schools, transportation centers, data centers, and municipal facilities across New Jersey and New York.

- The ***High-Rise, Police, Fire, and School*** unit observed mid- to high-rise residential and commercial buildings located in urban areas of New Jersey and New York.

- The ***Historical*** unit observed historic buildings across New Jersey and New York.

When possible, building or facility owners were interviewed to gain insight into how their buildings and/or facilities withstood Hurricane Sandy and how their recovery efforts were progressing. The MAT spent considerable time assessing partially damaged buildings to determine why certain buildings performed better than others. The MAT took note of any technique used that they considered a ***best practice***.

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Best practice: A construction technique that, though not required by the building code in the area, has proven to minimize damage from natural hazards.

1.3 Summary of Damage Observed

Hurricane Sandy caused widespread damage to buildings across the entire affected area, as well as widespread power outages and interruptions in utility service. Hurricane Sandy brought large-scale flooding to coastal and riverine residential and urban areas, particularly concentrated along the New Jersey and New York coastlines. Although the effects of Sandy were felt along much of the northeast coast, New Jersey and New York sustained the worst impacts from the storm and are the focus of this report. Most of the damage observed was caused by flooding (hydrostatic, hydrodynamic, buoyancy, and wave loads). Observations of damage caused by wind were rare, and wind damage was much less significant than the flooding damage.[6]

The flood damage observed was a result of inundation, erosion and scour, and wave action. Although inundation alone was a significant source of damage, some of the more dramatic structural failures observed were a result of the added force of wave action. Many buildings, both residential and non-residential, were inundated at the basement and first floor levels, which disrupted operations and damaged utilities, causing significant repair costs and extensive loss of income. The MAT noted:

- Many of the low-rise and residential buildings in coastal areas were of older construction that pre-dates the NFIP.

6 This does not include the consequential effects of wind damage, such as tree fall, which in turn caused extensive power outages and damages to the electrical distribution grid.

- Many of the high-rise buildings and hospitals had underground vehicle access and subgrade tunnels between buildings to distribute utilities that were inundated during the storm, commonly resulting in damaged utility systems and power outages.

- Flood damage to many of the high-rise and critical facility structures was typically a result of inundated mechanical, electrical, plumbing, and other utility systems where these systems were located below the base flood elevation (BFE).

- Most of the damaged historic buildings were in areas subject to inundation and wave impact and had first floor elevations below the BFE.

1.4 Flood Zones and Issuance of Updated Flood Hazard Information

Congress requires FEMA to update the Nation's Flood Insurance Rate Maps (FIRMs) periodically so they remain current and accurately reflect local flood hazards. FIRMs delineate special flood hazard zones (e.g., Zone VE, Zone AE) and BFEs that reflect the nature of the flood conditions expected during the base flood (see Section 1.4.1). Flood risk can change over time. Natural changes, such as beach erosion, subsidence, accretion within floodways, climate change, sea level rise, and manmade structures, such as bridges or sea walls, may affect flood hazards for a given area.

The New Jersey/New York coast is one of the most highly populated and developed coastlines in the United States, and the area has undergone heavy development since it was last mapped by FEMA. The coastal flood studies underway use the best available data and the most current and accepted methods for modeling storm surge and coastal flood hazards.

ELEVATIONS

Unless otherwise noted, all elevations in this report are relative to mean sea level and reported as North American Vertical Datum of 1988 (NAVD88) elevations.

1.4.1 FIRMs and Flood Zones

FIRMs delineate flood hazard zones (e.g., Zone VE, Zone AE) that reflect the nature of the flood conditions expected during the base flood. The base flood is the flood that has a 1 percent annual chance of occurrence (frequently referred to as the 100-year flood). FIRMs show the base flood elevation, or BFE. The area designated as subject to inundation from the 1-percent-annual-chance flood is called the Special Flood Hazard Area (SFHA).

Areas delineated as Zone V on FIRMs are subject to inundation as well as wave heights of 3.0 feet or higher. The Limit of Moderate Wave Action (LiMWA) that is delineated in new FIRMs occurs in Zone A at the limit of the 1.5-foot base flood wave height. The area of Zone A that is seaward of the LiMWA is known as a Coastal A Zone. Wave heights between 1.5 and 3.0 feet are expected during the base flood in Coastal A Zones.

FIRMs also show shaded Zone X areas that are outside the SFHA but that are subject to flooding with a 0.2 percent annual chance of occurrence (frequently referred to as the 500-year flood). Unshaded Zone X areas are land areas that are at a higher elevation than the SFHA and shaded Zone X areas.

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Coastal A Zone: The portion of the coastal SFHA referenced by building codes and standards, where base flood wave heights are between 1.5 and 3 feet, and where wave characteristics are deemed sufficient to damage many NFIP-compliant structures on shallow or solid wall foundations.

Limit of Moderate Wave Action (LiMWA): A line indicating the limit of the 1.5-foot wave height during the base flood. FEMA requires new flood studies in coastal areas to delineate the LiMWA.

Zone V: Under the NFIP, an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave action from storms or seismic sources. This area is subject to inundation by the base flood, where wave heights or wave runup depths are 3.0 feet or higher.

Zone A: Under the NFIP, area subject to inundation by the 1-percent-annual-chance flood where wave action does not occur or where waves are less than 3.0 feet high.

Zone X: Under NFIP, areas where the flood hazard is lower than that in the SFHA (Zone V and Zone A).

Communities that participate in the NFIP adopt Flood Insurance Studies (FISs) and associated FIRMs, which are then used by the communities to regulate floodplain development. FISs are prepared using specified models and the physical, hydrologic, and climate conditions in effect at the time the studies were conducted. The resulting FIRMs are drawn incorporating the FIS data. FIRMs and FISs are thus a "snapshot" of flood risk at a certain time, and can become outdated as topographic, hydrologic, or climate conditions change, or as engineering methods and models improve. The FIS, FIRM, and associated flood data adopted by the community is referred to as "Effective" until replaced by a new FIRM. Only Effective FIRMs are used for insurance rating and NFIP regulatory purposes.

1.4.2 Advisory Base Flood Elevation Maps

After severe floods, FEMA may issue Advisory Base Flood Elevation (ABFE) maps for areas where the existing FIRMs no longer adequately represent the actual base flood risk. ABFE maps are based on ***in-progress*** or ***approximate*** studies. They are intended to offer guidance to community officials and property owners as they plan reconstruction. ABFE maps do not represent the "Effective" data for insurance rating and regulatory purposes, but they do provide interim information for reconstruction efforts and can be used until the new FISs and Effective FIRMs are adopted by the community. Use of ABFE maps for post-flood reconstruction is mandatory only if the maps are adopted by a State or community. ABFEs are not used for insurance rating or NFIP regulatory purposes. ABFE maps for portions of New Jersey and New York are available at http://www.region2coastal.com/sandy/abfe. For more information about the best available floodplain management data, please see FEMA Floodplain Management Bulletin 1-98 at http://www.fema.gov/media-library/assets/documents/7401?id=2231.

New Jersey ABFE Maps

ABFE maps were released for 10 New Jersey counties (Atlantic, Bergen, Burlington, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, and Union) on December 14, 2012. On January 24, 2013, the New Jersey Department of Environmental Protection (NJDEP) issued an Emergency Rule that adopted the ABFE maps for the purpose of State permits that are issued for new construction, reconstruction, and mitigation. In addition, flood elevations established by the NJDEP will be used to enforce the State's building code.

FEMA GUIDANCE DOCUMENTS

Over the past few decades, FEMA has provided guidance on building practices to improve hazard resistance. FEMA highly recommends that designers, architects, builders, home and business owners, government, and planning and code officials, among others, in hurricane-prone areas refer to these publications. The publications are downloadable for free at the FEMA Web site: http://www.fema.gov/building-science-publications.

New York ABFE Maps

ABFE maps were released for seven New York counties (Bronx, Kings, New York, Richmond, Queens, Rockland, and Westchester). ABFE maps were released for Westchester County and portions of New York City on January 28, 2013. The remaining New York City ABFE maps were released on February 25, 2013. ABFE maps were not produced for Nassau and Suffolk Counties because their FIRMs are up-to-date and based on current models and technical studies.

In New York State, flood maps are adopted at the local level. As of January 31, 2013, New York City requires that reconstruction projects add ***freeboard*** above the Effective BFE for certain building types, but allows relief from this requirement for some reconstruction projects if owners build to the ABFE (if the ABFE is higher than the Effective BFE plus freeboard).

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Freeboard: Under the NFIP, a factor of safety usually expressed in feet above a flood level for purposes of floodplain management.

1.4.3 New FIRMs

The ABFE maps are being superseded by Preliminary FIRMs. The revised preliminary flood hazard information will be posted on FEMA's Geoplatform[7] for public review and use as it becomes available. Preliminary FIRMs will undergo a public review period and statutory appeal period prior to being adopted by communities as the Effective FIRM. The new Effective FIRMs, once adopted, will be used for insurance rating and regulatory purposes. In certain locations, the new FIRMs may result in higher BFEs or higher risk zone designations than are shown on current FIRMs. These new BFEs and flood risk zones will affect the minimum building requirements.

7 Available at: http://www.Region2Coastal.com.