

**New York State Department of Health
Public Health and Health Planning Council**

**Ad Hoc Advisory Committee on
Environmental and Construction Standards**



**Final Report and Recommendations
October 1, 2013**

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- David Tepper, AIA - Associate Partner, Ennead Architects

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- Ophelia Roman, Healthcare Lead, Mayor Bloomberg's Special Initiative for Rebuilding and Resiliency
- Maurice LaBonne, Member on Special Initiative for Rebuilding and Resiliency Committee

STATEWIDE CONSTRUCTION AND BUILDING CODES

- Daniel Nichols, P.E., Fire Protection Engineer,
Department of State, Division of Code Enforcement and Administration

OUR LADY OF LOURDES HOSPITAL IN BINGHAMTON –

"A Communities Experience with Major Flooding, Turning Adversity into Opportunity"

- Wayne Mitteer, RN,MS
Vice President of Clinical Services at Our Lady of Lourdes Memorial Hospital
(Recently retired)

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PHHPC Ad Hoc Environmental and Construction Standards Final Committee Report

I. Introduction and Charge to the Ad Hoc Committee:

In May 2013 the New York State Department of Health (“DOH”) announced a statewide moratorium on new construction and major renovation projects of health care facilities located in coastal and flood-prone areas. The primary purposes for imposing the moratorium are to integrate the knowledge and experience gained as a consequence of recent severe weather and flooding events, such as river flooding and flash flooding in Central New York, Hurricanes Irene and Lee and Superstorm Sandy, and make recommendations to amend New York State Hospital Code.

The Public Health and Health Planning Council (“PHHPC”) was directed to establish an Ad-Hoc Committee on Environmental and Construction Standards (the “Committee”). The Committee was charged to examine current building, construction and physical plant codes appearing in Title 10 of the Official Compilation of the Rules and Regulations of the State of New York (“NYCRR”) (the “Code”) and make recommendations to the PHHPC for revisions to the Code including mitigation and resiliency initiatives as well as dissemination and voluntary adoption of best practices by the health care provider industry. The Committee was composed of PHHPC members, experts in code development and enforcement, emergency preparedness and representatives from various sectors of the health care industry.

In meeting its charge the Committee was able to rely on an extensive number of recent studies and reports that not only summarized the impact of severe weather events but also formulated recommendations for code revisions and identified mitigation best practices. Of particular value to the Committee was the New York City Hurricane Sandy After Action Report and the activities of the Health Care Special Initiative for Rebuilding and Resiliency (“SIRR”). The Committee also benefitted from a discussion of state-of-the-art engineering and design challenges currently confronting the construction of two projects proximate to the East River; the \$2 billion NYU Langone replacement hospital and Memorial Sloan Kettering’s \$1 billion Ambulatory Cancer Center. Similarly, the Committee’s work was also enhanced by the experiences of Our Lady of Lourdes Hospital of Binghamton. This facility experienced the equivalent of three “500-year” river floods within a six year period from 2005 to 2011. A 2006 flood resulted in the evacuation and short-term closure of the hospital. In the years which followed, the hospital, with the assistance and guidance of the Federal Emergency Management Agency (“FEMA”), undertook effective multiple mitigation and resiliency investments which permitted the hospital to maintain operations in 2011 even though flood waters crested at a higher level than they had in the preceding years. (See photo on report cover.)

This report summarizes the observations and deliberations of the Committee which not only resulted in recommendations to revise the current Code for new facilities, but also identified a number

of collateral recommendations with respect to adoption of mitigation and resiliency initiatives into long-term capital planning of existing facilities which would not otherwise be impacted by the proposed Code revisions. In addition, the Committee commented upon the importance of emergency preparedness, both institutional and regional.

II. Public Expectations of Access to Critical Health Facilities

New Yorkers statewide have access to a full range of health care providers and facility types to obtain needed medical services. During times of crisis, whether a family member experiences an injury or the sudden onset of serious symptoms requiring emergency treatment, New Yorkers expect health care facilities, particularly hospital emergency departments, to remain open and continue to be available to serve the public. Access and capacity are even more critical during mass emergencies when a large number of casualties appear for treatment. Unfortunately, severe weather events have exposed the vulnerability of the State's critical health care infrastructure. These events have disrupted operations and in several instances disabled facilities for an extended period of time. Although access to critical services was available during these events because of excess system capacity and a coordinated response between government and health care providers, the public may not be able to depend on that capacity to be available in the future. Without adequate planning and protection of critical operating systems, the adverse effects of these disruptions, at key health care facilities, may have catastrophic personal and public health results.

Therefore, from the perspective of the public, it is of great importance that when operators of critical health facilities undertake multi-million dollar investments in rebuilding or major renovation of their facilities that they be strongly encouraged to incorporate best practices for design and construction of those facilities. This is needed to protect the public's investment and increase the probability that these facilities will remain in operation or promptly resume operations when a community experiences a severe weather event or natural disaster. Operators of existing facilities will benefit by voluntarily implementing consensus recommendations of design/engineering best practices when their physical plant and critical operating infrastructure is being expanded, renovated or upgraded. In the following section of this report, the Committee has outlined several recommendations which include regulatory changes as well as a series of best practice design enhancements.

Over the past two decades, New York State has experienced a significant growth in specialized ambulatory care facilities while the number of hospitals and number of inpatient beds needed by New Yorkers had declined. Much of this growth has been fueled by advances in safety and quality which has increased the number of treatments and procedures which can be successfully provided without an overnight stay in a hospital. The number of free-standing ambulatory surgery centers, diagnostic and treatment centers and imaging centers has grown substantially in recent years, providing New Yorkers with more health care access and choice; however, this growth diminishes the role of traditional hospitals in the process.

There is also recognition that the nature of critical health facilities is changing. A significant portion of access to critical health care services is no longer met in the hospital but through other community-based specialized ambulatory facilities such as dialysis and cancer centers. The public, particularly those with chronic illness, relies on these facilities for timely and critical access to treatment and, therefore, they must also be built at a higher standard to withstand severe natural events and resume operation quickly. In addition, New Yorkers have also seen the rise of large ambulatory care

centers providing primary care and specialty physician services serving thousands of patients annually. More recently the Department of Health approved the operation of off-campus emergency departments, a new critical component of the health care access infrastructure for communities who had historically relied on local hospitals which have now been closed or transformed.

When a chronically ill or symptomatic patient loses access to their physician(s) and care provider(s) an urgent situation can quickly escalate to emergent. Therefore, when ambulatory facilities are affected by disasters and are unavailable for extended periods of time patients converge on the hospital through the emergency department. This further constricts access to the community's front door to health care which is opened and staffed 24 hours, seven days a week. Recent past experience has demonstrated that when a disaster strikes it affects the fabric of access for an entire community. The critical and non-critical persons seeking care do so in the remaining facilities which are open, which are already under great stress, to respond to public health needs. The ability of those non-critical facilities to return to normal operation quickly is also important to restoring a community's health access equilibrium. The Committee believes that attention must also be paid to those "non-critical" facilities as well.

In addition to the ambulatory care facilities there is great concern about long-term patients who reside or are receiving care in skilled nursing or sub-acute care facilities as well as residents in adult care facilities. These facilities may not be considered as critical to the overall health of a community as a hospital and its emergency department, but, when these "residential facilities" are unable to shelter in place and must evacuate or are closed for extended periods of time, a significant burden is placed on remaining health care providers. This burden on the health care system is secondary to the burden imposed upon the frail, sometimes disoriented, individuals who are least likely to remain medically stable during disruptive events such as an evacuation or relocation into a shelter or another facility.

New York State will most likely continue to experience significant growth in primary care, specialized facilities and free-standing emergency departments. The Affordable Care Act will incentivize managing the health of covered populations which will further decrease inpatient hospital utilization while promoting ambulatory care facilities. This emphasizes the critical role that ambulatory care facilities will play in the future health care delivery system of New York. These trends may bode well for achieving the "Triple Aim" of higher quality, lower cost and increased patient satisfaction, but it also underscores the importance of improving the probability that those fewer hospitals and other critical health care facilities in flood-prone areas can "ride out the storm" and maintain community availability and access to essential services.

The Committee heard from presenters and they discussed the definition of a critical health facility and how that definition is changing. There was clear consensus that all hospitals with 24 hour availability of emergency care and particularly those facilities which are designated trauma care are critical facilities. However, the probability of communities in coastal or river flood zones having access to hospital or emergency care during a natural disaster is also a function of how many other hospitals are nearby, their surge or excess capacity to accommodate a concentrated spike in demand for services and the overall resiliency of each facility.

For example, during Super Storm Sandy, six of NYC's hospitals were closed or evacuated resulting in an 8% loss of the total bed complement in NYC. The reason the NYC hospitals were able to weather the storm was due to the sufficient capacity (actual or created) in neighboring hospitals which absorbed an influx of patients, on a temporary short-term basis. The same coordinated effort occurred

in Binghamton in 2006 when two other hospitals were able to accommodate acute care patients from Lourdes when it was forced to evacuate.

The Committee raised concern about what would have happened had those neighboring facilities not had surge capacity or if other nearby facilities were also forced to cease operations had a series of highly improbable events all converged and created a devastating reality where the majority of hospitals serving a community suspended operations. These concerns underscored the challenge of the Committee's charge; it is not sufficient to only establish a new standard for newly constructed facilities, but there also must be a concerted effort by the health care industry to make phased investments over a period of years to harden the resiliency of existing facilities through the adoption of best mitigation practices on a voluntary basis. The Committee is hopeful that recent experiences and this report encourage the leaders entrusted with the stewardship of the public's health care infrastructure and assets to do so.

III. Defining At-Risk Areas – Definition of Flood Zones and Related Terms

There are several terms that are used throughout this report which are important to understand. The first set of terms is typically encountered during risk assessments and identification of methods to reduce the risk of loss. These terms are defined as follows:

Mitigation: Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. Mitigation is taking action now – before the next disaster – to reduce human and financial consequences later (analyzing risk, reducing risk, insuring against risk).

Preparedness: Preparedness is achieved and maintained through a continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action. Ongoing preparedness efforts among all those involved in emergency management and incident response activities ensure coordination during times of crises. Moreover, preparedness facilitates efficient and effective emergency management and incident response activities.

Prevention: Prevention encompasses activities designed to provide permanent protection from disasters. This includes engineering and other physical protective measures, as well as legislative and regulatory measures controlling land use, planning, and mandated construction / engineering standards.

Resilience: Resilience is the ability of systems, infrastructure, government, business, communities, and individuals to resist, tolerate, absorb, recover from, prepare for, or adapt to an adverse occurrence that causes harm, destruction, or loss.

Risk: Risk is Hazard & Vulnerability. Risk is the potential impact to people, environment, and economy of a community. Vulnerability is measured by identifying exposure, sensitivity, and ability to cope. Hazard is a natural process with the potential to harm people or property.

The second set of terms relate to the definition of areas which are at-risk of flooding and located in a FEMA defined flood zone. The current regulations around construction in regard to flood zones were enacted by Executive Order 11988--Floodplain management in 1977. In order to provide detail

regarding geography and flood zones, FEMA and the National Flood Insurance Program (NFIP) created maps in 1983 designating zones for varying risk stratifications. These maps, which historically have been hand drawn, are referred to as Flood Insurance Rate Maps (“FIRMs”). These maps are currently being updated and digitalized due to the recent flooding and storm surge activity.

The following are terms used in association with FIRMs and to geography as it relates to flood risk:

1. Flood Zone

Flood zones are land areas identified by the Federal Emergency Management Agency (FEMA). Each flood zone describes that land area in terms of its risk of flooding. Everyone lives in a flood zone—it's just a question of whether you live in a low, moderate, or high risk area. The Precise definitions of FEMA’s flood zone designations appear in Appendix B.

2. Flood Insurance Rate Map (FIRM)

A FIRM is a map created by the NFIP for floodplain management and insurance purposes. Digital versions of these maps are called DFIRMs. A FIRM will generally show a community's base flood elevations, flood zones, and floodplain boundaries.

Flood Insurance Rate Map



3. Special Flood Hazard Area (SFHA)

An SFHA refers to an area of land in the flood plain within a community subject to a 1 percent or greater chance of flooding in any given year. The 1-percent annual chance flood is also referred to as the base flood or **100-year flood**. SFHAs are labeled as Zone A or Zone V.

4. Evacuation Zone

These zones represent varying threat levels of coastal flooding resulting from storm surge. In New York City, Hurricane contingency plans are based on these zones. Prior to Superstorm Sandy, NYC had a three section evacuation system. Post Sandy, NYC expanded its system into six evacuation zones (1 to 6) for support more precise emergency management procedures. Long Island and Westchester have a three zone system. North of Westchester, FEMA flood zones define risk and are used in evacuations and emergency management planning.

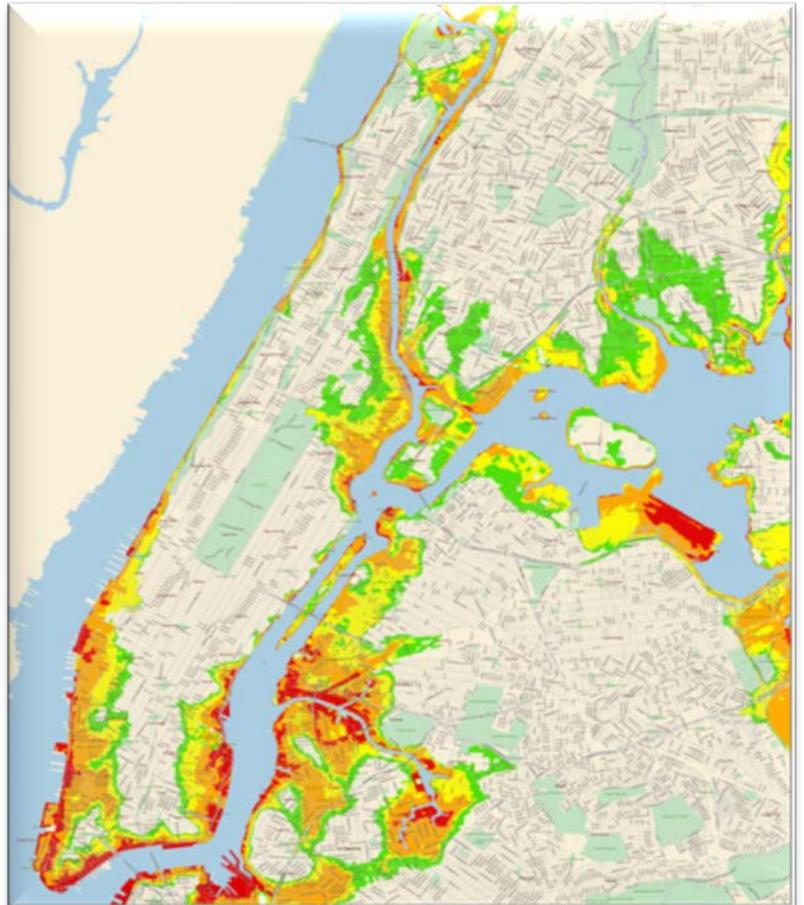
5. Inundation Zone

This term is often synonymous with term “Flood Zone”, see definition above

6. SLOSH Zone- (Sea, Lake, and Overland Surges from Hurricanes)

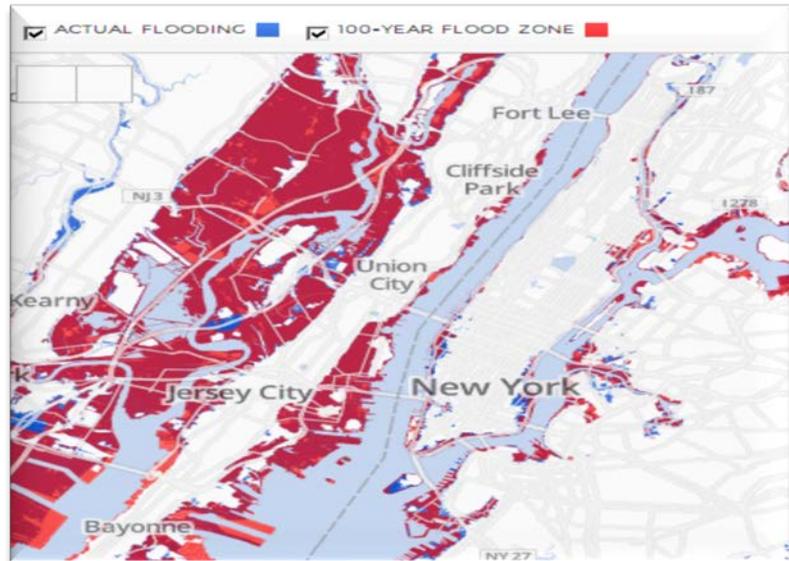
The SLOSH model calculates surge based on storms moving in different directions and with varying strengths. The SLOSH model analyzes storms moving northeast, northwest (the direction that will have the greatest impact), and varying in strength from Category 1 to Category 4.

The SLOSH calculations are based on the storm surge above the mean tide and the strongest potential winds for each category storm. The error is +/- three feet. Additionally, the SLOSH model calculates inundation levels for each location as if the hurricane hit that particular location head-on. The culmination of these factors results in a “worst-case” scenario for storm surge in the SLOSH model.



7. Base Flood Elevation (BFE)

The Base Flood Elevation is the peak elevation of the one hundred-year flood, better thought of as the flood that has a one percent or greater chance of occurring in any given year. It has been the basic standard for floodplain development, used to determine the required elevation of the lowest floor of any new or substantially improved structure.



Base Flood Elevation / 100-Year Flood Zone

8. Design Flood Elevation.

The elevation of the "design flood," including wave height, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the design flood elevation shall be the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm).

IV. Health Facilities at Risk

The Department of Health identified hospitals, nursing homes and adult care facilities in New York City, Long Island and Westchester County which are located in an evacuation zone. In these areas approximately 39% hospital facilities accounting for 36% of inpatient bed capacity (13,000 beds) are at risk. For nursing homes, 38% of facilities representing over 25,000 beds are located in a flood zone, and 37% of adult care facilities beds (8,309 beds) are at risk of flooding. However, 53% of these beds, 5,919 beds, are located in a NYC evacuation zone. Data for health care facilities at risk in upstate counties was not available in a similar fashion; however, DOH presented FEMA Flood Hazard Boundary Maps by county indicating which facilities are at risk. A complete listing of facilities and maps can be found in the documents posted on the DOH website of the Ad-hoc Committee:

www.health.ny.gov/facilities/public_and_health_planning_council/environmental_and_construction_committee/

Facilities Located in Evacuation Zones

	Total		Evacuation Zones			
	Facilities	Beds	Facilities	% of Total	Beds	% of Total
Hospitals	99	36,331	39	39%	12,999	36%
NYC	60	25,293	26	43%	9,469	37%
Long Island	23	7,570	13	57%	3,530	47%
Westchester	16	3,468	0	0%	0	0%
Adult Care Facilities	190	22,362	71	37%	8,309	37%
NYC	176	44,696	70	40%	17,689	40%
Long Island	78	16,218	36	46%	6,830	42%
Westchester	42	6,524	5	12%	1,036	16%
Nursing Homes	296	67,438	111	38%	25,555	38%
NYC	76	11,066	42	55%	5,919	53%
Long Island	82	8,261	27	33%	2,223	27%
Westchester	32	3,035	2	6%	167	6%
VA Hospitals	4	1,158	3	75%	847	73%
NYC	3	1,037	2	67%	726	70%
Long Island	1	121	1	100%	121	100%
Westchester	0	0	0	0%	0	0%
Source: NYSDOH						

V. Current NYS Hospital Code – NYCRR Title 10

Health care facilities in general and hospitals specifically contain very complex building systems and technology infrastructure to provide a diverse range of coordinated specialized services and activities within strictly controlled environments. Hurricane Katrina and severe weather events in New York and across the country underscore the fact that many of our nation's hospitals were built at a time when hospital building codes (both Federal and State) did not sufficiently anticipate and protect against hazards or require mitigation of the effects severe weather events.

The Committee learned about the history of building and construction codes from one of its members, Daniel E. Nichols, P.E., who serves with the New York Department of State Division of Code Enforcement and Administration. Since January 1, 1984, New York State has had in effect a Uniform Building Code which all local government jurisdictions have adopted by reference and enforce with one notable exception, New York City, which has adopted its own building code. Buildings, including many

of New York's hospitals, built before 1984 did not benefit from the protections set forth by the Uniform Building Code; however, buildings, including Article 28 facilities, located outside of New York City that were built after January 1, 1984 have been required to meet the standards set forth Uniform Building Code.

In addition to the Uniform Code, current Hospital Code speaks to general flood resistant construction, mitigation and resiliency requirements and specifically mandates these measures when a facility is located in a FEMA designated flood plain. These references appear in 10 NYCRR Sections 711.2 and 711.3 of Part 711-General Standards of Construction which describes general requirements for construction of all new Article 28 facilities and can be found in Appendix A. Additional terminology pertaining to flood mitigation is defined within the NYS Uniform Code and can be found in Appendix B.

10 NYCRR Section 711.2-Pertinent Technical Standards, references the need to comply with the requirements of local zoning safety and construction laws most of which have adopted the Uniform Code described above. The Uniform Building Code and Section 711.2 include identical references to other national codes such as those promulgated by the National Fire Protection Association (NFPA), Underwriters Laboratory (UL), Institute of Electrical and Electronics Engineers (IEEE), to name but a few, which specify design, engineering and construction requirements for specialized building infrastructure or systems. See Appendix A for a copy of Section 711.2. Given the multiple layers and levels of guidance available; it is important to note that if the State adopts a higher standard than the standards defined in a national or local guideline, or regulation, then the facility is required to be compliant with, and construct to, the highest standard.

The New York State Hospital Code also recognizes the complexity of hospitals and other health care facilities and has also adopted by reference national standards in Section 711.2; the *Guidelines for Design and Construction of Health Facilities 2010*, published by the Facilities Guidelines Institute of the American Society for Healthcare Engineering with assistance from the U.S. Department of Health and Human Services.

These standards were developed through a national consensus process not only to provide guidance to state and local government but to also set the minimal standards for hospital construction projects qualifying for federal funding (under the Hill-Burton Program) and also those qualifying to receive Medicare reimbursement. A former NYS DOH Director of Facility Planning, Tom Jung, RA, was recognized by Facility Guidelines Institute ("FGI")

2010 FGI - A1.2-6.5.1 Needs Assessment for Disasters

- **Facility assessment.** Owners of existing facilities should undertake an assessment of their facility with respect to its ability to withstand the effects of regional natural disasters. The assessment should consider performance of structural and critical nonstructural building systems and the likelihood of loss of externally supplied power, gas, water, and communications under such conditions.
- **Facility planning.** Facility master planning should consider mitigation measures required to address conditions that may be hazardous to patients and conditions that may compromise the ability of the facility to fulfill its planned post-emergency medical response.

2010 -FGI - A1.2-6.5 Provisions for Disasters

- **Design for continued operation.** For those facilities that must remain operational in the aftermath of a disaster, special design is required to protect systems and essential building services such as power, water, medical gas systems, and, in certain areas, air conditioning. In addition, special consideration must be given to the likelihood of temporary loss of externally supplied power, gas, water, and communications.
 - Flood protection. In accordance with Executive Order 11988:
 - Possible flood effects should be considered when selecting and developing the site.
 - Insofar as possible, new facilities should not be located on designated floodplains.
 - Where locating a facility on a floodplain is unavoidable, consult the Corps of Engineers' regional office for the latest applicable regulations pertaining to required flood insurance and protection measures.
 - Hospital helipads should be located a minimum of 3 feet above the 100-year flood elevation on campuses constructed on designated floodplains. A path of travel above 100-year flood elevation should be provided between hospital acute care facilities and the helipad to facilitate evacuation.

for the role he and NYS DOH played in the most recent national code revisions which were adopted in 2010.

The 2010 construction guidelines now serve as the definitive code for new hospital construction projects in New York State. The full set of the FGI Guidelines have been incorporated into 10 NYCRR Section 711.2 by reference. Hospitals constructed prior to 2010 had to comply with the guidelines published in 1996. The relevant section of national guidelines for health care facility construction with respect to construction of facilities in flood plains can be found in Section A1.2-6.5 Provisions for Disaster. (see text box) This section explains the need for facilities to be “designed for continued operations” and references design strategies to withstand natural disasters including earthquakes and floods. The “100 year flood elevation” is referenced as part of this design standard.

There is, however, one specific section of the current Hospital Code with respect to the construction of health facilities in a flood plain which does not reference the Uniform Code, other national codes or the 2010 FGI Guidelines. This section appears in 10 NYCRR Section 711.3(e) which addresses the construction of health facilities located in a flood plain. Section 711.3(e) appears in Appendix A in its entirety and an excerpt of the relevant portion is located on this page (see text box) with emphasis added.

Therefore, with respect to construction standards mandated in the New York State Hospital Code, with respect to facilities proposed to be located in a flood plain, there is only one such reference in Section 711.3(e) which could be modified by the Committee.

Both the national FGI code and the Hospital Code mandate construction standards relating to a proposed health facility being located in a flood plain. For obvious reasons, the Ad Hoc Committee did not attempt to suggest changes to the multitude of national codes referenced in 711.2 which guide new construction or major renovation of health care facilities with respect to flood and other natural disasters. If a facility will be located in a flood plain then Section 711.3(e) dictates

Section 711.3 Site requirements.

(e) If a health facility is located in a **flood plain**, the commissioner **may require** that the health facility comply with any, or all of the following:

1. Health facility footings, foundations, and structural frame shall be designed to be stable under flood conditions.
2. A helicopter landing pad shall be located on the facility roof and shall be structurally sound and suitable for safe helicopter evacuations of patients and staff.
3. The health facility shall be designed and capable of providing services necessary to maintain the life and safety of patients and staff if floodwaters reach the **one-hundred year flood crest level** and shall include the following:
 - i. electrical service, emergency power supply, heating, ventilating and sterilizers,
 - ii. main internal communication capability, including nurses' call systems and the fire alarm system;
 - iii. dietary service;
 - iv. an acceptable alternate to the normal water supply system;
 - v. an acceptable emergency means of storage and/or disposal of sewage, biological waste, and garbage;
 - vi. emergency department service; and,
 - vii. X-ray service.
4. No floor level or basement shall be located **below the 100-year flood crest level**, unless specifically approved by the commissioner. On these floor levels or basements that the commissioner approves to be **below the 100-year flood crest level**:
 - i. all new partitions shall be constructed without void such as solid concrete, solid concrete block, or other solid material;
 - ii. no new carpeting shall be installed; and
 - iii. the following services and equipment shall not be provided or located in such area:
 - a) medical records storage area;
 - b) medical records library;
 - c) surgical suite; and
 - d) such other services and fixed equipment that the commissioner may determine, taking into consideration patient safety and cost of replacement.
5. Storage of available building plans of the existing buildings shall be **above the 100-year flood crest level**.

(the commissioner has discretion to waive these requirements) that critical and emergency infrastructure be located above the 100-year flood crest level.

The Committee also learned that the mandated requirements of Part 711 did not differentiate among type of health care facilities. There is no differentiation in adherence to the standards between a hospital, nursing home or ambulatory care facility nor is there any distinction among facilities as critical or non-critical. The requirements appear in Section 711.1 Applicability (a) - this part sets forth minimum construction and physical environment standards applicable to all health facilities subject to Public Health Law Article 28, including, but not limited to, general hospitals, nursing homes and ambulatory care facilities. The construction of hospitals (Part 712); nursing homes (Part 713); ambulatory care/diagnostic and treatment centers (Part 715) all cite Part 711 with respect to referenced codes and construction requirements when a facility is proposed to be built in a flood plain.

Thus, there is no differentiation in the Hospital Code with respect to construction requirements for critical health facilities and “non-critical” health facilities. If any Article 28 health facility proposes to be located in a flood plain it must meet the same facility standards in relation to the location of the 100-year water crest level.

The Committee realized that its charge revolved around these two key terms, “flood plain” and “100-year flood crest level” and their inter-relationship with the events which subsequently caused the closure of critical health care facilities.

As we explored this definition the following questions were asked:

- What is the likelihood of a future event causing the flood water to rise above the 100-year flood crest level noted in the Hospital Code.
- What facilities are currently located in a flood plain?
- What is the risk of a future event?
- How is that determination of the flood plain made?
- Given recent statewide and national experience, what should be the new minimum standards for new health care facilities located in at-risk areas?

VI. Recommendations from Advisory Study Groups

The Committee benefited from the work of two study groups which reviewed the impact of Super Storm Sandy on health care and other facilities and made recommendations for the rebuilding and resiliency of these facilities. One group was the Health Care group of New York City Special Initiative for Rebuilding and Resiliency (SIRR) and the other was a collaborative of planning, design and engineering professional groups spearheaded by the American Institute of Architects New York (AIANY). The highlights of their observation and recommendations are discussed below. A complete set of recommendations proposed for the health care sector are included in the appendices of this report.

The Committee heard a presentation from the leadership of the Health Care SIRR who conducted extensive interviews regarding what happened during Sandy and why, investigated what could happen in the future and made recommendations to address the future risk. A copy of their presentation appears on the DOH website for the Committee. According to the SIRR, in New York City, during or after the storm, the health care infrastructure was placed under a great amount of stress:

- Six hospitals closed (8% of NYC’s bed capacity) and 10+ hospitals used workarounds to remain operational despite outages or some damages. As a consequence of these closures; patients evacuated to other hospitals – many during emergency conditions; elective services and surgeries reduced in many open facilities and city-wide inpatient bed capacity was reduced.
- 26 nursing homes/adult care facilities closed, 5 were partially evacuated and 30 were inundated or experienced power outages but remained open. Patients evacuated to other facilities or special medical needs shelters; many during emergency conditions. The reduction in city-wide capacity restricted the ability of hospitals to transfer patients.
- Approximately 5% of community-based providers (ambulatory care, doctor offices, dialysis, pharmacies, etc.) locations were inundated and about 12% experienced power outages concentrated in certain communities. Some patients delayed care for a few days because they could not see or speak to their providers and had difficulty refilling prescriptions. Patients sought care at ED’s or other open providers.

The SIRR Workgroup prepared an excellent table which summarized the critical system failures, primarily power failures of health facilities which resulted in evacuations, closures or reduced services.

Providers	Impact	Building	Equipment (elevators, Imaging)	Utilities (power, water)	Heating/cooling	Communications/ IT	Staff	Supplies
Hospital EDs	Closures / reduced services	Flooded		Flooded	Back-up failed	Flooded	Carrier-side outages	
Hospital in-patient / elective surgeries	Evacuations	Flooded	Flooded	Back-up failed	Flooded	Carrier-side outages	Staff couldn't travel	Limited deliveries
Nursing homes	Evacuations	Flooded	No back-up power		Back-up failed	No back-up	Phone/ internet outages	
Adult care facilities	Evacuations	Flooded		No back-up power		No back-up	No back-up	Phone/ internet outages
Community-based providers	Closures / reduced services	Flooded	No back-up power	No back-up	No back-up	Phone/ internet outages	Staff couldn't travel	Limited deliveries
Home-based providers	Reduced services	Disruptions in patients' homes/residences, e.g. loss of power, elevators not working	Carrier-side outages	Staff couldn't travel				Delayed deliveries

Red – Primary Reason for closure, Orange – Secondary, Yellow - Tertiary

The SIRR focused on the criticality of building systems and resources, determined how long a facility can operate without those systems functioning properly, estimated the amount of time needed

to repair or restore these systems and identified if there were adequate workarounds to remain in operation. The results of this evaluation were used to address four important planning goals during severe weather events:

- Reduce the risk of emergency evacuations.
- Be able to take on acute emergent patient needs (during and after an event).
- Avoid extended facility outages that strain the system.
- Reduce the number of patients who cannot access their normal provider.

The strategies which form the foundation of SIRR's recommendations to achieve the above goals were to ensure critical operations through system redundancy and the prevention of damage and to reduce barriers to care during and after emergencies. A complete list of SIRR recommendations by building system appear in Appendix E. A summary of those recommendations which have applicability to building code revisions and inform the charge to the Committee appears below:

- Require mitigation to the 500-year flood elevation.
- Require installation of flood resistant emergency generators and fuel supplies, or, pre-connections for external generators.
- Require generators and fuel pumps to be always accessible.
- All emergency generators are to have pre-connections.
- Require pre-connections for temporary boilers and chillers if primary equipment is located below base flood elevation level..
- Require HVAC for inpatient units to be operational during power utility outages by installing extra generator capacity.

The SIRR also commented upon hospital and nursing home retrofit best practices which would focus on a limited set of critical systems that, in the event of failure, would cause emergency evacuation. These include:

- Required elevation and hardening of generators/equipment.
- Protection of fuel tanks and ancillary equipment.
- Require generators and fuel pumps to be always accessible.
- Required pre-connections for external emergency generators.

The AIANY projected that the worsening impact of human induced climate change combined with natural cycles have resulted in rising sea levels and an increase in the frequency of extreme storm events. The AIANY also stressed the importance of designing critical health facilities to survive without structural failure, be able to withstand the effects of a disaster and remain in operation without evacuation. They recommend that all critical building, existing or planned, should:

- Conduct vulnerability assessments of their buildings in anticipation of the likely effects of extreme climate events.
- Identify technical standards and technologies that will allow their buildings to successfully withstand these events.
- Update plans to keep buildings operational during disasters and to quickly recover functionality afterwards.
- Create implementation plans to put in place remedial actions indicated by the three preceding steps.

The AIANY recommended that NYC should enact a law requiring the conduct of vulnerability assessments of all properties with respect to building code. AIANY recommended:

- An updated building code mandating a more robust disaster resistance capability for all new buildings.
- Hardening and retrofitting of existing buildings deemed vulnerable. This will be expensive, and in some cases impossible. The building code should provide a mechanism for permitting non-compliance; in such cases, an alternative strategy of evacuation should be required. Critical-function buildings in vulnerable locations must have a plan for transfer of service to a protected alternate facility, and these alternate facilities should be required to have the additional capacity and equipment to accommodate such a transfer.

With respect to health care facilities, the AIANY used this building type to illustrate the range of changes that can be integrated into code. Their recommendations are similar to those of the SIRR and appear on the following page. Code requirements and best practices for both new and existing facilities are identified.

The AIANY report made a point of the necessity of permitting existing facilities' flexibility in determining the best corrective actions. The adoption of a best practice standard with latitude for equivalent solutions, rather than a proscriptive code requirement, was considered a practical approach to encourage mitigation initiatives for existing facilities. The AIANY Systems Matrix for health Care Facilities has been a useful tool for the Committee. Appendix I Includes the Systems Matrix and the Department of health also added relevant building code references and guidance documents to each utility service listed.

VII. Committee Recommendations

The Committee was charged to make recommendations to the PHHPC to revise the Hospital Code with respect to the construction or major renovations of facilities located in coastal and river flooding areas. The recommendations of the Committee are intended to increase the likelihood that newly constructed critical health care facilities or those undergoing major renovation will be able to withstand the effects of severe weather and national disasters. The primary goal is to secure facilities so they may remain in operation to shelter patients in place and reduce the possibility of being evacuated because of the failure of critical operating infrastructure, utilities and equipment. Health care facilities deemed less critical in nature may temporarily close in advance of such events but should be designed to survive without a critical building / equipment system failure so they can re-open quickly.

There already exists a significant body of knowledge published in numerous reports and studies which examines the vulnerability of buildings in severe weather events and that set forth best practices with respect to mitigation and resiliency initiatives. The Committee, in its brief three month existence, was able to summarize the work of knowledgeable experts and professionals and incorporate their findings and expertise into the following recommendations.

The Committee was extraordinarily impressed with those experts who shared their knowledge with the Committee. Superstorm Sandy, repetitive upstate river flooding, flash flooding and other recent severe weather events clearly illustrate the vulnerability of critical health facilities. There has been a growing awareness in the design community for the need to design above the current Hospital Code. New facilities located in flood-prone areas are being designed with structures that enhance their abilities to shelter in place and continue to provide health care to their communities.

The design teams for the \$2 billion NYU replacement hospital and Memorial Sloan Kettering's \$1 billion ambulatory care building provided the Committee evidence of this new reality. The leaders of these facilities were not waiting for the Committee to conclude its work or for the Hospital Code to change. The design teams for these projects were aware the current code requirement to build at the "100-year flood crest level" was inadequate. They understood the importance of moving their critical operating infrastructure higher up in their buildings and they anticipated the need to invest in state-of-the-art mitigation and resiliency measures to protect their substantial investment of capital, especially when those investments are being made adjacent to a river.

Furthermore, facilities such as Lourdes Hospital didn't wait for another 500-year flood before they solicited the support of FEMA to invest in state of the art technology to hold rising river waters at bay. The Committee therefore concludes that the Hospital Code cannot remain static in the face of a new understanding of the probability of flooding compromising the viability of, and access to, health facilities in New York.

RECOMMENDATION #1: REGULATORY CHANGE

Amend 10 NYCRR Section 711.3. References to the “100-year crest level” should be updated to read “500-year crest level”.

The only reference in the Hospital Code to construction of new facilities in a flood plain appears in 10 NYCRR Part 711.3(e), which makes several references to design and construction of the facility so it is “capable of providing services necessary to maintain life and safety of patients and staff if flood waters reach the 100-year flood crest level.” Based on all the information presented to the Committee and expert presentations, the Committee recommends that the Hospital Code be revised to increase this regulatory threshold to the 500-year flood crest level.

This regulatory change would impact all new health facilities as well as major renovation projects at existing health facilities. For the purposes of this recommendation, the Committee has decided to use a code defined definition for “major renovation” that can be found in NYS Building Code - It is referred to as “Substantial Improvement”. (See text box).

New construction and major renovation projects can be planned and designed, quite effectively, using innovative, tested methods that can reduce the risks associated with severe weather events. Presentations made to the Committee by MSK and NYU demonstrated how relocation and/or fortification of infrastructure systems will bring a substantial level of security to the facility to ensure continued operation during a severe weather event. We also heard in the case of Our Lady of Lourdes in Binghamton, NY, how mitigation investments exceeded returns after Hurricane Lee hit even harder than the previous storm and subsequent flood in 2006. In 2011, the hospital remained open and fully-functional while their 500-year flood wall still had a one foot freeboard to spare.

Substantial Improvement:

For the purpose of determining compliance with the flood provisions of this code, any repair, alteration, addition, or improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure, before the improvement or repair is started. If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed

Although innovative design, technology, hardening equipment and specific mitigation products are readily available, the true challenge is managing the cost. In the case of both MSK and NYU, their mitigation plan will add tens of millions of dollars to the overall project cost. Given the enormous scope of each project, the added costs have been able to be absorbed, but these features are still adding 3% to 5% to each project’s total costs. With projects of smaller scope, mitigation activities will no doubt represent a higher percentage of the overall project costs. In the case of Our Lady of Lourdes, the flood of 2006 devastated the facility -- reconstruction and mitigation project costs were manageable because they were primarily covered by private insurance and assistance from FEMA. The Committee makes this recommendation with the understanding that some of these measures are costly but exceed the cost with the benefit of providing added safety and continued operation of the facility during times of crisis.

It is important to note that accommodating a “100-year flood crest level” has been required for years. However, in New York State, only two completely new hospitals have been built in the past decade; Orange Regional Medical Center and Corning Hospital, and, neither of which were located in a flood hazard area or coastal flood evacuation zone. In the case of all three facilities examined by the committee, storm mitigation designs have been based on the “500-year flood crest level” not the “100-

year flood crest level” currently required. And that design standard was not required by code but driven by best practice.

To better understand the difference between a 100-year flood and 500-year flood we should refer to them in statistical terms where we measure probability. The 100-year flood has a one percent chance (1%) of happening during a single calendar year. Or in insurance terms, a facility has a 26% chance of flooding during the life of a 30-year mortgage ($1 - (0.99)^{30}$). In contrast, a facility located in a 500-year flood zone carries substantially less risk with a .2% chance of flooding in a single calendar year. This is a 6% chance of occurring at least once during the life of a 30-year mortgage.

The Committee also learned that mitigation measures designed to the 500-year level are not substantially more complicated or burdensome compared to the 100-year level. In the case of MSK, their Advisory Base Flood Elevation is 11.35 feet. Their Design Flood Elevation (DFE) is 12.35 feet. This is the current code minimum to accommodate a 100-year flood. The DFE for the 500-year flood is only one foot higher at 13.35 feet. Using a combination of fully sealed utility connections, sewer backflow preventors, pumps and sumps, and dry floodproofing in the foundation in combination with locating critical infrastructure on the second floor they exceed even the requirements for the 500-year flood.

Lastly, as noted earlier in this report, this proposed regulatory change has been recommended by Mayor Bloomberg’s Special Initiative for Rebuilding and Resiliency (SIRR) Committee and under consideration by NYC as it pertains to NYC building codes. The proposed change has also been vetted by the NYS Department of Health Division of Legal affairs and it poses no conflicts or issues with other local, state or federal law.

RECOMMENDATION #2: ADOPT SPECIFIC MITIGATION MEASURES TO ENHANCE THE RESILIENCE OF HEALTH FACILITIES: Amend Hospital Code to require additional mitigation and resiliency measures for new facilities located in flood zones.

The Committee recommends that the Hospital Code be revised to include recommendations of the SIRR and AIANY to regarding additional mitigation and resiliency requirements for the construction of new facilities. The Hospital Code should be revised to include best practices in design and technology. These include but are not limited to the following:

- **Require installation of flood-resistant emergency generators and fuel supplies.**
- **Require generators and fuel pumps to be always accessible.**
- **Require pre-connections in power systems for use in the event of emergency power system failure.**
- **Require pre-connections for temporary boilers and chillers if primary equipment is located below DFE.**
- **Require HVAC for inpatient units to be operational during power utility outages by installing extra generator capacity.**

RECOMMENDATION #3 – CONTINUE TO APPLY THESE REQUIREMENTS TO ALL HEALTH FACILITIES.

The Hospital Code does not differentiate between critical and non-critical facilities proposed to be constructed in a flood plain.

The Hospital Code does not differentiate between critical and non-critical facilities proposed to be constructed in a flood plain nor does the code for new construction differentiate among Article 28 facilities such as hospitals, nursing homes or diagnostic treatment centers with regard to flood-related requirements. 10 NYCRR Section 711.1(a) states that the standards of Part 711 are applicable to, “...all health facilities subject to Public Health Law Article 28...”

One may consider ambulatory care facilities to be non-critical; however, when a disaster strikes it affects the fabric of access for an entire community. The critical and non-critical persons seeking care do so in the remaining facilities which are open and are already under great stress to respond to public health needs. The ability of those non-critical facilities to return to normal operation quickly is important to restoring a community’s health access equilibrium. The Committee believes that non-critical facilities must be held to the same construction standards as critical facilities. However, the Committee recognizes the Commissioner is given latitude in this regard in order to retain some flexibility and ensure access to care.

Therefore, the Committee sees no reason to create a critical/non-critical facility distinction and any changes to Part 711 as amended by the recommendation of the Committee should continue to apply to all Article 28 health facilities.

Recommendation #4 – Require Accessibility of Patient Information **Encourage use and training on eFind Patient Tracking System**

It is important that DOH periodically review the Hospital Code to reflect the new and emerging technologies regarding the interoperability and sharing of medical information among health providers. Particularly, attention needs to be paid to the vulnerability of IT infrastructure within the walls of the facility and the requirements to make patient information accessible if a facility fails and needs to evacuate and transfer patients to neighboring facilities; or, if a health facility is closed and patients are unable to access their information when they are temporarily diverted to another provider.

The PHHPC was recently made aware of the DOH’s development of eFinds which barcodes and registers patients so they can be identified and tracked between evacuating and receiving facilities. The PHHPC commended DOH on their ability to create this critical functionality just seven months after Superstorm Sandy. However, this important phase of work will need to add additional applications in future phases so as to attach important information from a patient’s medical record in the event of an evacuation.

With the launching of a state-wide network of Regional Health Information Organizations (“RHIOs”), the public/private State Health Information Network for NY (SHIN-NY) and NYeHC, the ability for providers to access patient information during a crisis is a reality in many areas of the state and this functionality should be fully operational over the next few years. This would permit many more health providers, not just those involved in an evacuation, to access a patient’s health information.

The Committee recommends that the Hospital Code be revised for all Article 28 providers:

- **DOH should adopt uniform regulations, policies and procedures which govern the consent, collection, sharing and access to patient medical information in the event of an evacuation or temporary closure of a health provider.**
- **Amend 10 NYCRR Section 711.3 to enhance the resiliency of the IT infrastructure of Article 28 providers so that a patient's information is accessible through the SHIN-NY, or other data exchange mechanism, in the event of a disaster which results in evacuation or temporary closure of an Article 28 health provider.**

The Committee's charge was limited to new construction and major renovations of existing facilities, however, the Committee believed it important to comment on improving the resiliency of existing facilities.

Recommendation #5 - Voluntary Adoption of Best Practices by Existing Article 28 Providers

Mitigation activities pose a greater challenge for existing facilities. It is much more difficult and costly to retrofit an existing building as comprehensively as a new building can be designed and constructed. More time is required to implement a mitigation plan that must be done in a phased approach in order to maintain current facility operations. As noted above, mitigation examples include but are not limited to protecting electrical equipment, emergency power systems, communication systems, HVAC and domestic water pumps. The primary options for a facility are to either elevate existing equipment or harden equipment in place.

Mayor Bloomberg's Special Initiative for Rebuilding and Resiliency (SIRR) Committee has recommended that facilities complete retrofitting activities by 2030. This is a reasonable amount of time given the fact that most capital programs at hospitals and health care systems can extend over a 10 year period and are most likely already underway. By allowing compliance by 2030, this will allow facilities to plan well in advance and prepare financially for the investment. It is the recommendation of the Committee to encourage such mitigation and resilience activities.

The Committee heard from presenters and they discussed the definition of a critical health facility and how that definition is changing. There was clear consensus that all hospitals with 24 hour availability of emergency care and particularly those facilities which are designated trauma care are critical facilities. However, the probability of communities in coastal or river flood zones having access to hospital or emergency care during a natural disaster is also a function of how many other hospitals are nearby, their surge or excess capacity to accommodate a concentrated spike in demand for services and the overall resiliency of each facility.

The Committee raised concern about what if those neighboring facilities did not have surge capacity or if other nearby facilities were also forced to cease operations if a series of highly improbable events all converged and created a devastating reality where the majority of hospitals serving a community suspended operations. These concerns underscored the challenge of the Committee's charge; it is not sufficient to only establish a new standard for newly constructed facilities but there also

must be a concerted effort by the health care industry to make phased investments over a period of years to harden the resiliency of existing facilities through the adoption of best mitigation practices on a voluntary basis.

The Committee recommends that each Article 28 provider located in a flood zone be identified and required to:

- **Conduct an assessment of their facilities in anticipation of the effect severe/worse case weather events;**
- **Create a phased plan of investments to increase the probability that their facilities will be successfully operational or quickly recover functionality; and**
- **Present this plan to their Board of Trustees for their consideration as they approve the long-term capital plan for their facilities.**
- **Facility and System mitigation plans should be made available to PHHPC for monitoring purposes.**

The NYC After Sandy Report has recommended the required retrofitting of existing hospitals in the 500-year flood plain and existing nursing homes and adult care facilities in the 100-year flood plain by 2030. These recommendations will be proposed as part of a subset of amendments to the New York City Construction Standards.

The Committee recognizes that existing buildings require flexibility and access to capital for infrastructure projects is a difficult burden for many providers. It is for this reason the Committee is not recommending mandated implementation of these plans but rather is recommending they be prepared and be presented to the Board of Trustees of the provider. The Committee is thus advocating for the voluntary adoption of best-practice standards. The primary challenge for existing hospitals, nursing homes and adult care facilities to implement mitigation strategies is the financing of these investments. The Committee encourages, subject to available funding, DOH and other NYS agencies such as Economic Development and the Dormitory Authority to partner with FEMA, and the federal government to create mitigation grants or loans which could fund these investments.

The Committee is hopeful that recent experiences and the report of the Committee will encourage the leaders entrusted with the stewardship of the public's health care infrastructure and assets to voluntarily incorporate best practice mitigation and resiliency initiatives into their facility investments.

RECOMMENDATION #6: LIFT THE CURRENT HEALTH FACILITY CONSTRUCTION MORATORIUM

The current moratorium should be lifted in its entirety. It is not recommended to retain a permanent moratorium on any particular region or evacuation zone.

The Committee opened its first session with a review of the revised evacuation zones in NYC and an assessment of facilities at risk in NYC, Long Island and Westchester. As noted earlier, the percentage of health care providers located in evacuation zones is substantial. In NYC, 26 out of 34 hospitals are located in evacuation zones with 37% of the total bed capacity. The ratio is even higher for skilled nursing facilities with 40% of the 176 nursing home located in evacuation zones having 40% of the capacity. When other forms of long-term care are included in the assessment, over 17,650 beds are located in evacuation zones.

These statistics led to a frank discussion about the risk to skilled nursing facilities, assisted living and adult care facilities; analyzing the policies of protecting in place vs. evacuation of residents. Can mitigation and resiliency adequately reduce the risk to this vulnerable population? The following questions were considered; “Should the Committee consider extending the moratorium for construction in Zone 1 (or A)? Is it acceptable to have the frail and elderly population of NYC living in evacuation Zone #1 (or A)?”

The discussion included thoughts about downzoning or de zoning which is the practice of limiting the uses for land in flood prone zones. In the text box in this section, you can see the recommendation of the AIANY DfRR Committee.

They are proposing limited use of land in highly flood prone areas (see recommendations in Appendix F).

It is the position of the Committee, echoed by the public commentary of the day, to not consider down-zoning as an option. The Committee felt that if the facility operators were willing to address risks and mitigate, there is no reason to continue to consider restricting land use. There is also a reluctance to promote a statewide position regarding zoning which is a local function.

RECOMMENDATION #7: REGIONAL PLANNING

While physical plant requirements are designed to address risk at the facility level; it is critical regional coordination takes place to ensure an adequate level of “hardened” providers are available in an area to ensure the continuation of services during times of crisis.

Regional planning is currently being conducted through emergency management planning and assessment venues across NYS. The Committee recommends that physical plant standards be a critical component in the process. Local provider coordination needs to take into account risk to key providers and ensure that a critical mass of services will remain available to the general public during future weather events. Hardened providers should be inventoried and assume a primary role in providing services including acute care, dialysis, longterm care, home care and pharmacy services.

**POST SANDY INITIATIVE
Building Better, Building Smarter:
Opportunities for Design and Development
May 2013
AIANY Design for Risk and Reconstruction
Committee (DfRR)**

Zoning for land-uses should appropriately align with new and updated knowledge of flood zones and other risks, which may mean downzoning in some areas; and revisions to zoning and density limits for other areas that may in the future be required to absorb growth previously destined for flood zones and vulnerable waterfronts

RECOMMENDATION #8: PHHPC AND NYS DOH ROLES IN PLANNING AND SURVEILLANCE:

The PHHPC and the Department should proactively monitor and identify facilities and projects at risk once the moratorium has been lifted.

The Committee discussed ways to implement their recommendations. The following measures are recommended:

- **CON Application:**

Update Schedule #7 in the CON application. This schedule identifies project elements pertaining to the State Environmental Quality Review Act. Additional information can help to identify whether or not the project is located in a flood or evacuation zone and the measures included which will specifically address mitigation or resiliency.

- **PHHPC Project Exhibits:**

Add a note to project exhibits to identify if the project is in a flood zone and if the project meets the new recommended standard. It was suggested that the “green sheet” contain this information.

- **PHHPC Oversight:**

Conduct an annual review of mitigation and resiliency efforts made by the provider community and report the results to PHHPC.

Appendix A

Effective Date: 12/29/2010

Title: Section 711.2 - Pertinent technical standards

711.2 Pertinent technical standards. All health facilities shall comply with the pertinent provisions of the standards and codes referred to in this section and with local laws relating to zoning, sanitation, fire safety and construction, where such local laws represent standards in addition to those required by this Part. Reference throughout this chapter to codes and standards shall be those editions listed in this section. If a conflict occurs between the following codes and standards or between them and regulations elsewhere in this chapter, then compliance with the more restrictive regulation is required. If federal regulatory requirements conflict with the codes and standards referred to in this section, the department may waive compliance with such standards and codes, provided that a health facility fully complies with said federal regulatory requirements.

(a) The following National Fire Protection Association (NFPA) Codes and Standards are hereby incorporated by reference, with the same force and effect as if fully set forth at length herein. These codes and standards are available for public inspection and copying at the Regulatory Affairs Unit, New York State Department of Health, Corning Tower, Empire State Plaza, Albany, NY 12237. The codes and standards are published by the National Fire Protection Association, and copies are also available from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, 1-800-344-3555 or www.nfpa.org. The various codes and standards are available from the NFPA either as individual publications or as contained within the Compilation of NFPA National Fire Codes, 1999 edition.

(1) NFPA 101, Life Safety Code, 2000 edition.

(2) NFPA 101A, Guide on Alternative Approaches to Life Safety, 1998 edition.

(3) NFPA 10, Standard for Portable Fire Extinguishers, 1998 edition.

(4) NFPA 13, Standard for the Installation of Sprinkler Systems, 1999 edition.

(5) NFPA 14, Standard for the Installation of Standpipe, Private Hydrants and Hose Systems, 2000 edition.

(6) NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 1998 edition.

(7) NFPA 30-1996--Flammable and Combustible Liquids Code.

(8) NFPA 31, Standard for the Installation of Oil-Burning Equipment, 1997 edition.

(9) NFPA 45-1996-Standard on Fire Protection for Laboratories Using Chemicals.

(10) NFPA 54, National Fuel Gas Code, 1999 edition.

(11) NFPA 58, Liquefied Petroleum Gases Code, 1998 edition.

(12) NFPA 70, National Electrical Code, 1999 edition.

(13) NFPA 72, National Fire Alarm Code, 1999 edition.

(14) NFPA 80, Standard for Fire Doors and Fire Windows, 1999 edition.

(15) NFPA 82, Standard on Incinerators and Waste and Linen Handling Systems and Equipment, 1999 edition.

(16) NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 1999 edition.

(17) NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 1999 edition.

(18) NFPA 91, Standards for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids, 1999 edition.

(19) NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 1998 edition.

(20) NFPA 99, Standard for Health Care Facilities, 1999 edition.

(21) NFPA 110, Standard for Emergency and Standby Power

Systems, 1999 edition.

(22) NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems, 1996 edition.

(23) NFPA 211, Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, 2000 edition.

(24) NFPA 220, Standard on Types of Building Construction, 1999 edition.

(25) NFPA 221, Standard for Fire Walls and Fire Barrier Walls, 1997 edition.

(26) NFPA 241-1996--Standard for Safeguarding Construction, Alteration, and Demolition Operations.

(27) NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 1999 edition.

(28) NFPA 252, Standard Methods of Fire Tests of Door Assemblies, 1999 edition.

(29) NFPA 253, Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source, 2000 edition.

(30) NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials, 2000 edition.

(31) NFPA 256, Standard Methods of Fire Tests of Roof Coverings, 1998 edition.

(32) NFPA 257, Standard on Fire Test for Windows and Glass Block Assemblies, 2000 edition.

(33) NFPA 260, Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture, 1998 edition.

(34) NFPA 261, Standard Method of Tests for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes, 1998 edition.

(35) NFPA 265, Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings, 1998 edition.

(36) NFPA 266, Standard Method of Test for Fire Characteristics of Upholstered Furniture Exposed to Flaming Ignition Source, 1998 edition.

(37) NFPA 267, Standard Method of Test for Fire Characteristics of Mattresses and Bedding Assemblies Exposed to Flaming Ignition Source, 1998 edition.

(38) NFPA 286, Standard Methods of Fire Tests for Evaluating Room Fire Contribution of Wall and Ceiling Interior Finish,

2000 edition.

(39) NFPA 418, Standard for Heliports, 1995 edition.

(40) NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, 1999 edition.

(41) NFPA 703, Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials, 2000 edition.

(b) The following codes and standards are hereby incorporated by reference, with the same force and effect as if fully set forth at length herein. These codes and standards are available for public inspection and copying at the Regulatory Affairs Unit, New York State Department of Health, Corning Tower, Empire State Plaza, Albany, NY 12237. Copies are also available from the publisher or issuing organization at the address listed.

(1) ANSI/ASHRAE Standard 52.2-1999, Method of Testing Air-Cleaning Devices for Removal Efficiency by Particle Size, 1999 edition. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle NE, Atlanta, GA 30329.

(2) Compressed Gas Association, Inc. (CGA) Pamphlet E-10, Maintenance of Medical Gas and Vacuum Systems in Health Care Facilities, third edition, 2007. Compressed Gas Association, Inc., 4221 Walney Road, Chantilly, VA, 20151-2923, www.cganet.com.

(3) National Council on Radiation Protection and Measurements (NCRP) Report No. 102--Medical X-Ray, Electron Beam and Gamma-Ray Protection for Energies Up to 50MeV (1989). National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814-3095, www.ncrppublications.org.

(4) National Council on Radiation Protection and Measurements (NCRP) Report No. 147--Structural Shielding Design for Medical X-Ray Imaging Facilities, 2004 edition. National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814-3095, www.ncrppublications.org.

(5) National Council on Radiation Protection and Measurements (NCRP) Report No. 144--Radiation Protection for Particle Accelerator Facilities, 2003 edition. National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814-3095, www.ncrppublications.org.

(6) 1996-97 Guidelines for Design and Construction of Hospital and Health Care Facilities, 1996 edition. The American Institute of Architects Academy of Architecture for Health, with assistance from the U.S. Department of Health and Human Services, the American Institute of Architects

Press, 1735 New York Avenue, N.W., Washington, D.C. 20006. The standards set forth in this paragraph are applicable to construction projects completed pursuant to Subparts 712-2 and 713-2 and other applicable provisions in this Chapter. Such projects must, at minimum, maintain compliance with these standards.

(7) Guidelines for Design and Construction of Health Care Facilities, 2010 edition. The American Society for Healthcare Engineering, with assistance from the U.S. Department of Health and Human Services, One North Franklin Street, Chicago, Illinois, 60606, and at www.ashe.org.

(c) Design standards for the disabled. The Americans with Disabilities Act of 1990 (ADA) extends comprehensive civil

rights protection to persons with disabilities. Health care facilities must comply with the ADA and the regulations which implement it. Title 28 of the Code of Federal regulations, Public Health Parts 35, Non-Discrimination on the Basis of Disability in State and Local Government Services, and Part 36, Non-Discrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities, including Appendix A, "Standard for Accessible Design", 2004 edition. These regulations are published by the Office of the Federal Register National Archives and Records Administration. Copies may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington D.C. 20402.

Appendix B

2010 Existing Building Code of New York State

Definitions from the Building Code of New York State

SUBSTANTIAL IMPROVEMENT. For the purpose of determining compliance with the flood provisions of this code, any repair, alteration, addition, or improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure, before the improvement or repair is started. If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a building required to correct existing health, sanitary, or safety code violations identified by the code enforcement official and that is the minimum necessary to assure safe living conditions, or
2. Any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure.

WORK AREA. That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code.

ALTERATION. Any construction or renovation to an existing structure other than a repair or addition. Alterations are classified as Level 1, Level 2, and Level 3

SECTION 401 GENERAL

401.1 Scope. The provisions of this chapter shall be used in conjunction with [Chapters 5](#) through [12](#) and shall apply to the repair, alteration, addition and change of occupancy of existing structures, including historic and moved structures, as referenced in [Section 101.5.2](#). The work performed on an existing building shall be classified in accordance with this chapter.

401.1.1 Compliance with other alternatives. Alterations, repairs, additions and changes of occupancy to existing structures shall comply with the provisions of Chapters 4 through [12](#) or with one of the alternatives provided in [Section 101.5](#).

401.2 Work area. The work area, as defined in [Chapter 2](#), shall be identified on the construction documents.

401.3 Occupancy and use. When determining the appropriate application of the referenced sections of this code, the occupancy and use of a building shall be determined in accordance with Chapter 3 of the *Building Code of New York State*.

SECTION 403 ALTERATION—LEVEL 1

403.1 Scope. Level 1 alterations include the removal and replacement or the covering of existing materials, elements,

equipment, or fixtures using new materials, elements, equipment, or fixtures that serve the same purpose.

403.2 Application. Level 1 alterations shall comply with the provisions of Chapter 6.

SECTION 601 GENERAL

601.1 Scope. Level 1 alterations as described in Section 403 shall comply with the requirements of this chapter. Level 1 alterations to historic buildings shall comply with this chapter, except as modified in Chapter 11.

601.2 Conformance. An existing building or portion thereof shall not be altered such that the building becomes less safe than its existing condition.

Exception: Where the current level of safety or sanitation is proposed to be reduced, the portion altered shall conform to the requirements of the Building Code of New York State.

601.3 Flood hazard areas. In flood hazard areas, alterations that constitute substantial improvement shall require that the building comply with Section 1612 of the Building Code of New York State.

SECTION 404 ALTERATION—LEVEL 2

404.1 Scope. Level 2 alterations include the reconfiguration of space, the addition or elimination of any door or window, the reconfiguration or extension of any system, or the installation of any additional equipment.

404.2 Application. Level 2 alterations shall comply with the provisions of Chapter 6 for Level 1 alterations as well as the provisions of Chapter 7.

SECTION 405 ALTERATION—LEVEL 3

405.1 Scope. Level 3 alterations apply where the work area exceeds 50 percent of the aggregate area of the building.

405.2 Application. Level 3 alterations shall comply with the provisions of [Chapters 6](#) and [7](#) for Level 1 and 2 alterations, respectively, as well as the provisions of [Chapter 8](#).

SECTION 1612 FLOOD LOADS

1612.1 General. Within flood hazard areas as established in Section 1612.3, all new construction of buildings, structures and portions of buildings and structures, including substantial improvement and restoration of substantial damage to buildings and structures, shall be designed and constructed to resist the effects of flood hazards and flood loads. For buildings that are located in more than one flood hazard area, the provisions associated with the most restrictive flood hazard area shall apply.

1612.2 Definitions. The following words and terms shall, for the purposes of this section, have the meanings shown herein.

BASE FLOOD. The flood having a 1-percent chance of being equaled or exceeded in any given year.

BASE FLOOD ELEVATION. The elevation of the base flood, including wave height, relative to the National Geodetic Vertical Datum (NGVD), North American Vertical Datum (NAVD) or other datum specified on the Flood Insurance Rate Map (FIRM).

BASEMENT. The portion of a building having its floor subgrade (below ground level) on all sides.

DESIGN FLOOD. The flood associated with the greater of the following two areas:

1. Area with a flood plain subject to a 1-percent or greater chance of flooding in any year; or
2. Area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

DESIGN FLOOD ELEVATION. The elevation of the "design flood," including wave height, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the design flood elevation shall be the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm).

DRY FLOODPROOFING. A combination of design modifications that results in a building or structure, including the attendant utility and sanitary facilities, being water tight with walls substantially impermeable to the passage of water and with structural components having the capacity to resist loads as identified in ASCE 7.

EXISTING CONSTRUCTION. Any buildings and structures for which the "start of construction" commenced before the effective date of the community's first flood plain management code, ordinance or standard. "Existing construction" is also referred to as "existing structures."

EXISTING STRUCTURE. See "Existing construction."

FLOOD or FLOODING. A general and temporary condition of partial or complete inundation of normally dry land from:

1. The overflow of inland or tidal waters.
2. The unusual and rapid accumulation or runoff of surface waters from any source.

FLOOD DAMAGE-RESISTANT MATERIALS. Any construction material capable of withstanding direct and prolonged contact with floodwaters without sustaining any damage that requires more than cosmetic repair.

FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a flood plain subject to a 1-percent or greater chance of flooding in any year.
2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

FLOOD HAZARD AREA SUBJECT TO HIGH VELOCITY WAVE ACTION.

Area within the flood hazard area that is subject to high velocity wave action, and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as Zone V, VO, VE or V1-30.

FLOOD INSURANCE RATE MAP (FIRM). An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

FLOOD INSURANCE STUDY. The official report provided by the Federal Emergency Management Agency containing the Flood Insurance Rate Map (FIRM), the Flood Boundary and Floodway Map (FBFM), the water surface elevation of the base flood and supporting technical data.

FLOODWAY. The channel of the river, creek or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

LOWEST FLOOR. The floor of the lowest enclosed area, including basement, but excluding any unfinished or flood-resistant enclosure, usable solely for vehicle parking, building access or limited storage provided that such enclosure is not built so as to render the structure in violation of this section.

SPECIAL FLOOD HAZARD AREA. The land area subject to flood hazards and shown on a Flood Insurance Rate Map or other flood hazard map as Zone A, AE, A1-30, A99, AR, AO, AH, V, VO, VE or V1-30.

START OF CONSTRUCTION. The date of permit issuance for new construction and substantial improvements to existing structures, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement or other improvement is within 180 days after the date of issuance. The actual start of construction means the first placement of permanent construction of a building (including a manufactured home) on a site, such as the pouring of a slab or footings, installation of pilings or construction of columns. Permanent construction does not include land preparation (such as clearing, excavation, grading or filling), the installation of streets or walkways, excavation for a basement, footings, piers or foundations, the erection of temporary forms or the installation of accessory buildings such as garages or sheds not occupied as dwelling units or not part of the main building. For a substantial improvement, the actual "start of construction" means the first alteration of any wall, ceiling, floor or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

SUBSTANTIAL DAMAGE. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

1612.3 Establishment of flood hazard areas. To establish flood hazard areas, the governing body shall adopt a flood hazard map and supporting data. The flood hazard map shall include, at a minimum, areas of special flood hazard as identified by the Federal Emergency Management Agency in the applicable flood insurance study for the region, as amended or revised with the accompanying Flood Insurance Rate Map (FIRM) and Flood Boundary and Floodway Map (FBFM) and related supporting data along with any revisions thereto. The adopted flood hazard map and supporting data are hereby adopted by reference and declared to be part of this section.

1612.4 Design and construction. The design and construction of buildings and structures located in flood hazard areas, including flood hazard areas subject to high velocity wave action, shall be in accordance with ASCE 24.

1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a registered design professional and submitted to the code enforcement official:

1. For construction in flood hazard areas not subject to high-velocity wave action:

1.1. The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 109.3.3.

1.2. For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.6.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.6.2.2 of ASCE 24.

1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement that the dry floodproofing is designed in accordance with ASCE 24.

2. For construction in flood hazard areas subject to high velocity wave action:

2.1. The elevation of the bottom of the lowest horizontal structural member as required by the lowest floor elevation inspection in Section 109.3.3.

2.2. Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.

2.3. For breakaway walls designed to resist a nominal load of less than 10 psf (0.48 kN/m²) or more than 20 psf (0.96 kN/m²), construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

Appendix C FEMA Flood Designations

Definitions of FEMA Flood Zone Designations

Flood zones are geographic areas that the FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area.

Moderate to Low Risk Areas

In communities that participate in the NFIP, flood insurance is available to all property owners and renters in these zones:

ZONE	DESCRIPTION
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. Are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
C and X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level.

High Risk Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

ZONE	DESCRIPTION
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30.
A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

High Risk - Coastal Areas

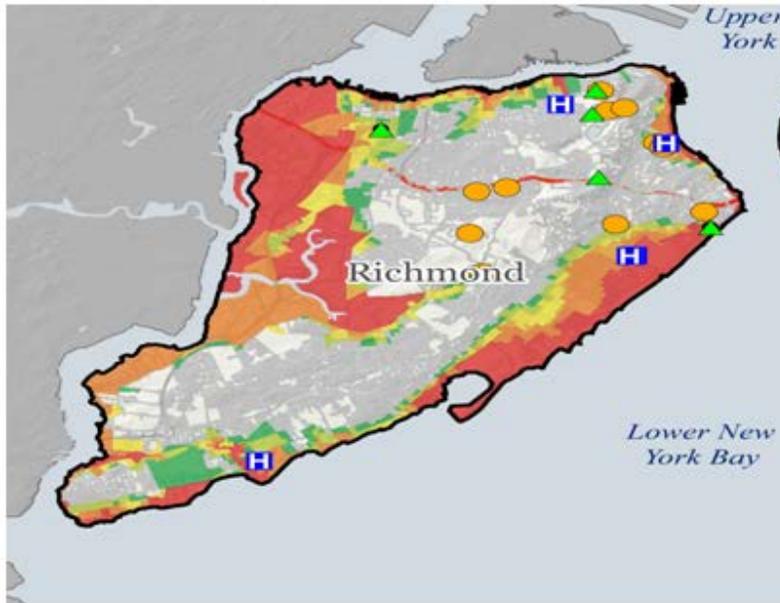
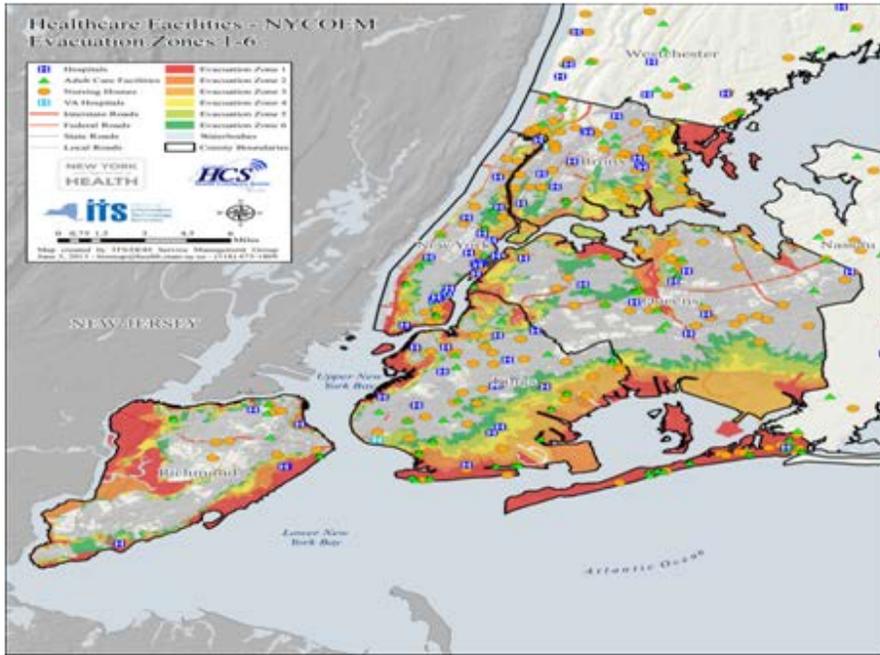
In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

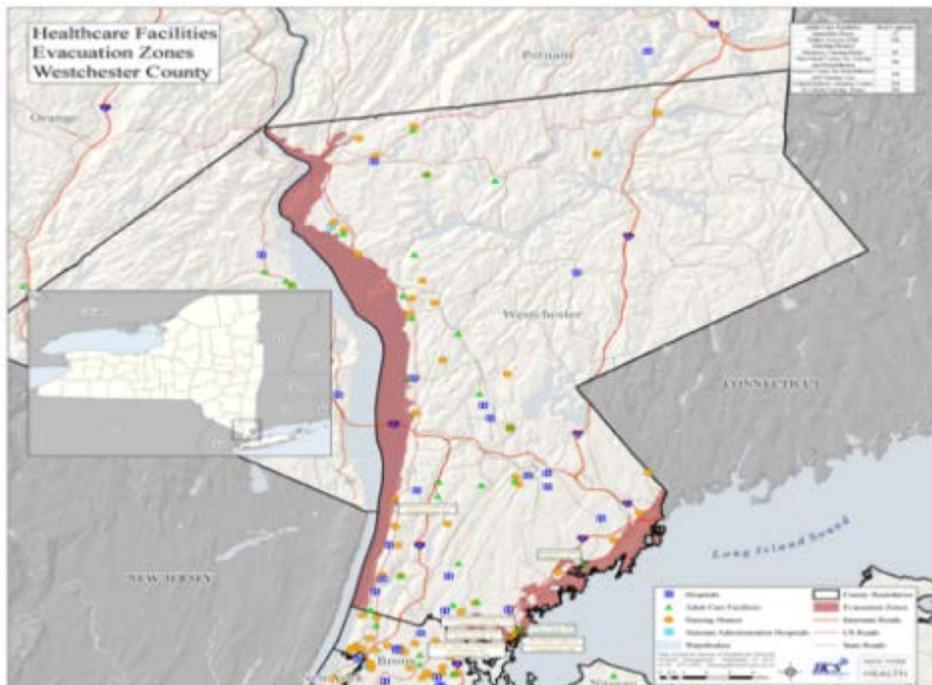
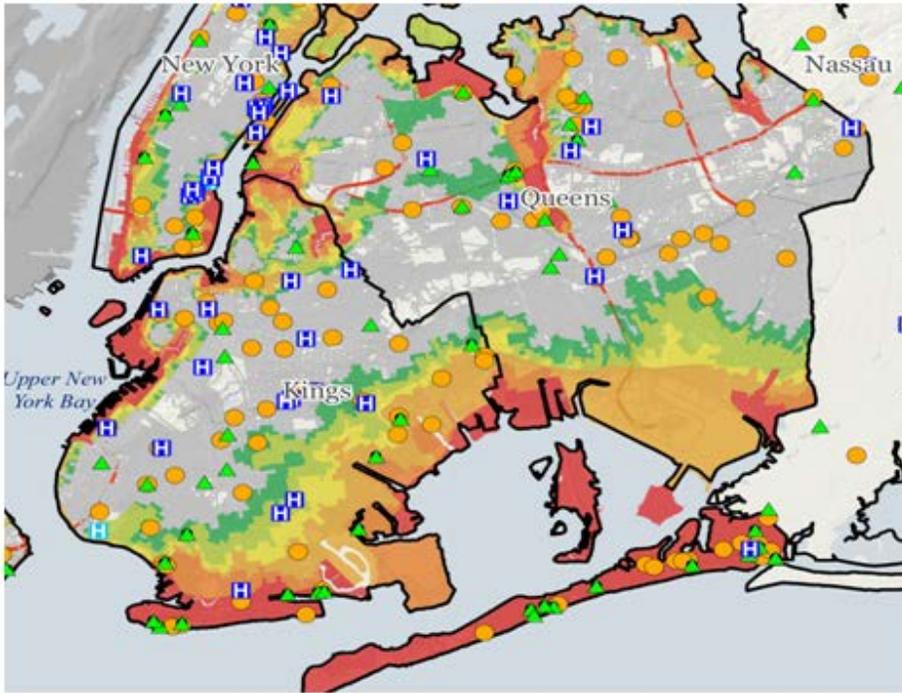
ZONE	DESCRIPTION
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1 - 30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

Undetermined Risk Areas

ZONE	DESCRIPTION
D	Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

Appendix D: Maps of the Coastal Evacuation Zones





Westchester Cty

Appendix E: Mayor Bloomberg’s Special Initiative for Rebuilding and Resiliency (SIRR) Recommendations

BUILDING A STRONGER, MORE RESILIENT NEW YORK IN THE AFTERMATH OF HURICANE SANDY

Sections from Chapter 8 – Health Care Recommendations

New York City’s population of 8.2 million includes people with a wide range of health needs. Many—in relatively good health—see their doctors infrequently, but all count on them to be available if they get injured or become sick. Over 1 million New Yorkers, on the other hand, are in poor health—which could include those who have chronic conditions such as diabetes and high blood pressure—and these individuals depend on regular, ongoing medical care. Furthermore, there are 800,000 New Yorkers under the age of five or over the age of 80 who are more vulnerable to illness and injury and more likely to need life-saving medical care.

A vast, complex healthcare system has evolved to meet the needs of New York’s diverse population, and Sandy caused disruptions across that system. The storm completely shut down six hospitals and 26 residential-care facilities. More than 6,400 patients were evacuated through efforts coordinated by the Healthcare Evacuation Center (HEC). Providers who remained open strained to fill the healthcare void—hospitals repurposed lobbies as inpatient rooms, adult care facilities siphoned gas from vehicles to run emergency power generators, and nursing home staff lived on-site for four or more days until their replacements arrived. Flooding and power outages forced community clinics, doctors’ offices, pharmacies, and other outpatient facilities to close or reduce services in the areas most impacted by the storm.

Sandy not only put unprecedented stress on the provider system; it placed the health of medically fragile individuals at risk. There were an estimated 75,000 people in poor health living in areas that were inundated by floodwaters and an estimated 54,000 more in communities that lost power. These groups faced additional health risks during the storm and were less capable of gaining access to appropriate care. For example, lack of heating in their buildings could have caused new health conditions, and those who lived in high-rise buildings might have been unable to leave their homes if elevators were not functioning. Furthermore, the unpredictable storm conditions increased the risk that any New Yorker could require life-saving medical care.

In keeping with the overarching goals of the Special Initiative for Rebuilding and Resiliency—to minimize the impacts of climate change and enable quick recovery after extreme weather events—the City will make the healthcare system more resilient. To ensure that hospitals, nursing homes, and adult care facilities can operate continuously during extreme weather, the City will require that new facilities be built to higher resiliency standards and existing providers are hardened to protect critical systems. To reduce barriers to care in impacted communities, the City will seek to keep the lines of communication open between patients and their providers and enable affected community-based providers to reopen quickly after a disaster. Making our healthcare system more

resilient will benefit our most fragile populations—and all New Yorkers.

What Happened During Sandy

New York City’s healthcare system is designed to handle fluctuations in demand as healthcare needs vary seasonally. However, the cascading closures of providers during and after Sandy strained the system citywide. Because of the closures, providers that remained open had to operate beyond normal capacity, which was difficult to sustain for extended periods. To ensure they were able to address the most acute medical needs, some providers that remained open reduced certain services they offered—for example, postponing non-emergency surgeries or suspending outpatient procedures.

Disruptions in citywide systems—transportation, fuel, telecommunication, and power—had a noticeable but short-term impact on the healthcare system. Transportation outages and restrictions, as well as fuel restrictions, made it difficult for healthcare staff to travel to workplaces in the first week after the storm. Telecommunication breakdowns meant that impacted providers were unable to communicate with patients, and also made coordination with City and State officials for response efforts more challenging. Power outages closed some community-based providers for up to a week, while flood damage closed a limited number of providers for much longer, necessitating repairs and the replacement of destroyed equipment.

Across the city, five acute care hospitals and one psychiatric hospital closed. This resulted in the emergency evacuation of nearly 2,000 patients coordinated by the HEC, in addition to an unknown number of patients who were transferred within provider networks or were discharged before or after Sandy. Of these, three hospitals closed in advance of the storm: New York Downtown (Manhattan) closed after notice of a potential pre-emptive utility shutdown, while the Veterans Affairs New York Harbor Hospital (Manhattan) and South Beach Psychiatric Center (Staten Island) closed due to concerns about flooding. Three other hospitals—New York University’s Langone Medical Center (Manhattan), Bellevue Hospital (Manhattan), and Coney Island Hospital (Brooklyn)—evacuated during or after Sandy due to the failure of multiple electrical and mechanical systems including emergency power systems. In the immediate aftermath of Sandy, hospital bed capacity was down eight percent citywide.

Meanwhile, 10 hospitals remained open despite power outages and/or limited flooding in basement areas. In the week after the storm, Beth Israel in Manhattan—powered only by back-up generators due to the area-wide power outage—saw a 13 percent increase in ED use. To meet patient demand, the hospital suspended elective procedures and surgeries. Other hospitals used

workarounds in response to communication and information technology (IT) failures. For example, runners on each floor conveyed doctors' orders, paper charts replaced electronic records, and two-way radios were used to communicate with other providers. To handle the influx of patient evacuees, some receiving hospitals turned lobbies into inpatient wards and gave emergency permission for OB/GYNs displaced from other hospitals to deliver babies in their facilities.

Some hospitals narrowly escaped flood damage. For example, Metropolitan Hospital in upper Manhattan just missed having its critical electrical systems flooded, and on Staten Island University Hospital's North Campus, floodwaters came within inches of the hospital entrance.

New York City hospitals incurred an estimated \$1 billion in costs associated with emergency response measures taken during and immediately after Sandy, including the costs of staff overtime, patient evacuations, and emergency repairs of equipment. To return to normal operations, as of the writing of this report, it is projected that damaged hospitals will spend at least another \$1 billion on repairs and mitigation. In addition, permanent revenue loss for hospitals citywide is estimated to have been nearly \$70 million per week in the immediate aftermath of the storm. Hospitals that were closed due to serious damage experienced revenue losses over many months.

Sandy's impact on residential providers was also significant. Sixty-one nursing homes and adult care facilities were in areas impacted by power outages and/or flooding. Half of these providers continued to operate—some because they sustained minimal or no damage, others because they had effective emergency plans. But within a week of the storm, 26 facilities had to shut down, and another five partially evacuated, reducing citywide residential capacity by 4,600 beds and leading to the evacuation of 4,500 residents who had to be transported to other facilities or Special Medical Needs Shelters, which were staffed by personnel from the New York City Health and Hospitals Corporation (HHC) and Disaster Medical Assistance Teams (DMAT). These closures impacted hospitals as well, preventing them from discharging patients to nursing homes, as they normally would have done. Instead, hospital beds that could have been available for new patients remained occupied by existing patients who had nowhere else to recover after treatment.

Power loss was the primary cause of post-Sandy evacuations from nursing homes and adult care facilities, and many providers experienced both utility outages and damage to building electrical equipment. Even providers with generators had difficulties if those generators were located in parts of buildings that flooded or if providers had failed to secure fuel in advance. Without power, other critical systems—lights, heating, elevators, kitchens, and medical equipment—could not function.

Although two nursing homes and one adult care facility evacuated patients in advance of the storm, 28 others evacuated under emergency conditions. These stressful emergency scenarios added significantly to patient risk (though, fortunately, there was no loss of life during any Sandy-related evacuations in the city). Some evacuees were transported without medical records or proper identification, making it difficult for receiving providers to administer appropriate care or notify evacuees' families and caretakers.

Among other residential providers, the majority with fewer than 10 beds, approximately 5 percent of facilities were located in inundated areas, and another 10 percent were in areas impacted by power outages. These disruptions caused some facilities to evacuate patients while others remained safely sheltered in place. Overall, however, these evacuations did not significantly impact the broader healthcare system because many evacuees were safely transferred to other providers.

Community-based providers in over 500 buildings across the city (5 percent of total community-based provider buildings) were located in inundated areas, including 300 buildings with doctors' offices, 100 retail pharmacies, and at least 70 outpatient and ambulatory care centers. Flooding in facilities in low-rise buildings or on the lower levels of taller buildings resulted in damage that often took weeks or even months to repair. Providers on higher floors could not reopen until damaged electrical systems, boilers, elevators, and other building systems were repaired.

An additional 12 percent of community-based providers' buildings were in areas that experienced power outages only. Since most community-based providers occupy buildings without generators, these providers typically remained closed until utilities were restored.

The impact of community-based provider closures was felt most in the areas hardest hit by the storm. In South Queens, for example, 60 percent of provider buildings were in inundated areas, while in Southern Manhattan, 95 percent of providers experienced power outages. Elsewhere in the city, community-based care was only affected if doctors and staff could not travel to their offices. Most providers opened as soon as transportation was restored.

New Yorkers whose providers' facilities closed often were left without a way to see or communicate with their providers. For many without immediate medical concerns, the temporary closures may have had limited impact. However, others with pressing healthcare needs—dialysis patients or those on methadone, for instance—had to seek alternative care immediately, often from hospital emergency departments or mobile medical vans staffed by doctors and nurses from community clinics and other healthcare workers. The longer providers remained closed, the greater the numbers of individuals who had to look elsewhere for care.

Home-based care was impacted primarily by disruptions in the transportation system. The public transportation shutdown, travel restrictions on single-occupancy cars, and gasoline shortages all made it difficult for nurses and aides to reach the homes of patients scattered across the five boroughs. If and when providers finally did reach their destinations, elevators that were out of service—due to power outages or flood damage—often made it challenging for staff to reach patients on upper floors in high-rise buildings. The power, water, and heat outages within patients' homes were also problematic, increasing the likelihood that existing medical conditions would worsen or new ones would develop.

What Could Happen in the Future

Now and over the next 40 years, the primary climate risks facing the healthcare system are expected to be storm surge and heat waves.

Major Risks

Newly released Preliminary Work Maps (PWMs) from the Federal Emergency Management Agency (FEMA) place at least 300 more buildings housing healthcare providers in the 100-year floodplain than were in the floodplain in the 1983 Flood Insurance Rate Maps (FIRMs). Based on high-end projections for sea level rise from the New York City Panel on Climate Change (NPCC), another 200 facilities will be in the 100-year floodplain by the 2020s, and a total of 1,000 healthcare facilities will be in the 100 year floodplain by the 2050s. If the vulnerabilities of healthcare providers to flooding are not addressed, 10 percent of New York City's healthcare buildings will be at risk of damage and closure in the event of a major flood event under this scenario.

Among the vulnerable healthcare facilities are hospitals with 10 facilities—representing 16 percent of hospital beds citywide—in the 100-year floodplain, as indicated by the PWMs, and one more is in the 500-year floodplain. This one facility is expected to be added to the 100-year floodplain by the 2020s, with two more likely to be added by the 2050s. By mid-century, hospitals in the 100-year floodplain are expected to include three psychiatric hospitals and four regional trauma centers

Meanwhile, 37 nursing homes and adult care facilities, representing 14 percent of citywide bed capacity, are in the 100-year floodplain, as indicated by the PWMs, with seven more likely to be in the floodplain by the 2020s. By the 2050s, 33 nursing homes and 25 adult care facilities are likely to be in the 100-year floodplain, many of these (approximately 60 percent) in Southern Brooklyn and South Queens. Among other residential care facilities, approximately 70 are in the floodplain, (7 percent of citywide bed capacity), with another 50 (an additional 5 percent of citywide bed capacity) likely to be added by the 2050s.

Among community-based providers, approximately 5 percent of buildings with providers are in the 100-year floodplain, as indicated by the PWMs. There are approximately 550 buildings with community clinics, doctors' offices, pharmacies, and other outpatient and ambulatory care centers in the 100-year floodplain and nearly 400 more buildings are expected to be in the floodplain by the 2050s.

Other Risks

In addition to storm surge, heat waves pose a serious health risk to New Yorkers. They can cause deaths by exacerbating chronic conditions and inducing heat-related medical conditions, such as heat stroke. Heat waves are particularly life-threatening to elderly and medically fragile individuals who do not have air conditioning in their homes. Even New Yorkers who do have air conditioning will be impacted if heat waves lead to widespread power outages. In addition, power outages from heat waves cause disruptions in the healthcare system citywide. Community-based providers would likely have to shut down until power is restored. Hospitals, nursing homes, and adult care facilities would not need necessarily to evacuate immediately, provided they had backup generators to maintain adequate cooling capacity. However, today the vast majority of these facilities do not have backup power for cooling of their inpatient units.

Sudden downpours and wind are unlikely to have a significant impact on healthcare providers, particularly as facilities with the most vulnerable patients (for example, hospitals) are required to

have greater structural resiliency than regular commercial buildings. However, specific facilities may be at risk depending on their site drainage capacity for heavy rains and their façade, window, and rooftop conditions

INITIATIVES FOR INCREASING RESILIENCY IN THE HEALTHCARE SYSTEM

To preserve the health and well-being of all New Yorkers, the City's healthcare system must maintain sufficient capacity to meet patients' needs during disasters and be prepared to resume normal services as quickly as possible. To this end, the City will require flood-prone hospitals, nursing homes, and adult care facilities to provide redundancies for critical systems and prevent physical damage to equipment. These facilities account for almost 90 percent of all inpatient and residential bed capacity at risk of flooding. If successfully mitigated, they can stay open and ensure that system capacity is not heavily strained during disasters. The remaining residential bed capacity at risk of flooding is spread across many smaller providers citywide. The vulnerability of these providers to climate risks is typically best addressed through emergency planning and other operational solutions, especially because physical protection of these facilities may be too difficult and not cost-effective given building and physical constraints.

Since community-based providers are located citywide, most will not be affected by flooding from extreme weather events. However, those impacted will be highly concentrated in hard hit communities. The City will, therefore, work with clinics and pharmacies to implement targeted mitigation in areas where services may be most needed after a disaster. To further reduce barriers to the restoration of community based care, the City will also call upon outpatient providers to consider technology based mitigation strategies that are appropriate to their scale and allow for faster recovery.

Furthermore, measures to increase the resiliency of citywide power, transportation, and water systems will ensure that community based and home-based providers can recover the resources that they depend on most as quickly as possible.

Strategy: Ensure critical providers' operability through redundancy and the prevention of physical damage

Hospitals, nursing homes, and adult care facilities rely on extensive equipment and utility services to diagnose, treat, and care for patients. Basic utilities (such as power and water supply); building equipment (heating, ventilation, air conditioning, and elevator systems); medical equipment (diagnostic labs, X-ray machines, and medical gas tanks); and other services (such as kitchens and laundry rooms) are all integral to normal patient care. Much of this equipment is located in the facilities' lower levels, which are at risk of flooding during extreme weather events. Fortunately, providers have operational plans and workarounds for many of these systems in case of disruptions.

However, some systems—power, water, heating, and air conditioning—require both operational planning and physical hardening to be made more resilient. These systems are the foundation of a facility's medical infrastructure and are essential for the operation of all other services and equipment, including emergency operations. Without these critical systems, providers cannot ensure safe patient care and may be forced to evacuate.

Furthermore, severe damage to these systems can result in long-term closures as repairs can often take several months.

Therefore, the City will amend its Construction Codes to require new and existing healthcare providers to take actions that ensure critical building systems are physically protected from the impacts of extreme weather, and—to address outages—are supplied with backup systems. The City also will provide financial assistance to support the mitigation projects of providers who have limited funding sources. These new resiliency measures will minimize the risk of evacuating patients and keep important healthcare facilities open for the benefit of all New Yorkers.

Initiative 1: Improve the design and construction of new hospitals

New hospitals that are constructed in the floodplain could experience critical system failures due to storm surge and may be at risk of evacuating patients. To improve the resiliency of any new hospital that is built in the 500-year floodplain, the City will, therefore, amend its Construction Codes to require a higher level of protection and critical systems redundancy.

For example, new hospital buildings will be required to meet construction code standards for flood-resistant construction to the 500-year flood elevation, which is a higher than the 100-year flood elevation to which protection is required today. Protecting utilities and mechanical equipment to this higher flood level will ensure that new hospitals—which are expected to serve the city for many decades—will be protected even as climate change increases flood risk.

In addition, the City will institute new resiliency requirements related to electronic data and communications technologies, which play an increasingly central role in patient care. New hospitals in the 500-year floodplain will be required to increase their IT and telecommunications resiliency by installing two independent points-of-entry for telecom and communication to reduce the risk of outages from a single supplier. Backup options are crucial to ensure that critical systems can function and long-term closures can be avoided. New hospitals will, therefore, also be required to be built with pre-wired electrical connections for external emergency power generators as well as for temporary boiler and chiller connections if the primary equipment is below the 500-year flood elevation.

In addition, new hospitals in the 500-year floodplain will be required to ensure that air conditioning services to their inpatient care areas are available when utility power is disrupted (for example, by placing chiller systems on emergency power). Having an air conditioning solution that is not dependent solely on primary utility power will help avert evacuations. These measures will ensure that providers do not incur high costs later for damages, repairs, or retrofits. The Office of Long-Term Planning and Sustainability (OLTPS) will include the proposed amendments to the New York City Construction Codes in its broader proposal to the New York City Council in the latter half of 2013.

Initiative 2: Require the retrofitting of existing hospitals in the 500-year floodplain

Many existing hospital buildings in the floodplain remain vulnerable to the impact of storm surge. To improve the resiliency of these buildings, the City will require existing hospital buildings in today's

500-year floodplain to meet, by 2030, a subset of the amended New York City Construction Codes standards through building retrofits.

This mandate will apply to the eleven hospitals that are, as indicated by the PWMs, in the floodplain. They will be mandated to protect their electrical equipment, emergency power systems, and domestic water pumps to the 500-year flood elevation by elevating the equipment, hardening equipment in place (for example, through the use of submarine doors), or dry flood-proofing basements and lower floors. They will also be required to ensure that emergency power systems—generators and fuel pumps—are accessible to building staff at all times, so that emergency power can be maintained continuously, even during flood conditions.

As with new hospitals, existing hospitals will also be required to install by 2030: Backup air conditioning service for inpatient care areas in case of utility outages (for example, chillers on emergency power); pre-connections for temporary boilers and chillers if primary equipment is not elevated; and pre-connections for external generators as a backup power source in case the hospital must run on emergency power for extended periods. These redundancies will provide an additional level of protection for hospitals' most critical services, and thus, will help avert evacuation in the event that primary equipment is breached or permanently damaged.

Many providers have already met several of these requirements. For example, many hospital generators are elevated today. In addition, providers generally acknowledge that power, emergency power, and water are necessary for them to remain operational, and investments in flood mitigation are needed to minimize future evacuation risk. Accordingly, many providers already have made plans to address these risks. To avoid placing an undue financial burden on providers, hospitals will not be mandated to retroactively protect other critical systems and services (such as emergency departments, elevators, lab equipment, telecommunications, IT, and medical equipment) for which other workarounds can be implemented. Never the less, protection for these systems still will be encouraged as a best practice especially since they could be essential for some facilities to remain in operation, depending on their layout and unique risks.

OLTPS will include these retrofit requirements in its broader proposal to the New York City Council in 2013. The City will enforce compliance with this mandate by 2030 (recognizing compliance to be voluntary for hospitals owned by the State or Federal government). As part of this process, by the end of 2020, hospitals will be required to submit an interim report certifying that they have complied with the requirements or to submit an affidavit describing a plan to achieve such compliance by 2030. Hospitals added to the floodplain in future versions of flood maps will have 15 years from the release of such new maps to implement retrofits.

Initiative 3: Support the Health and Hospitals Corporation's (HHC) effort to protect public hospital emergency departments from flooding

Emergency departments (EDs) are critical access points for patients in need of hospital services. Three public hospitals' EDs are at risk of flooding due to storm surge. Subject to available funding, the City will aim to ensure these EDs are protected and available to care for New Yorkers. Bellevue Hospital (Manhattan), Metropolitan Hospital (Manhattan), and Coney Island Hospital (Brooklyn) are operated by the New York City HHC, which serves all New Yorkers, regardless of their ability to pay. With EDs located below the 500-

year flood elevation, direct flood damage would cause the EDs to be closed for months, as equipment, walls, and floors would need to be replaced. Extended closures would require patients to travel longer distances to receive care, and other providers to accommodate additional volume.

Bellevue Hospital has the only designated regional trauma center below 68th Street in Manhattan. The City will pursue a coastal protection pilot project, subject to available funding, which includes measures to address the flood risk to Bellevue's ED.

Mitigation options under consideration include floodwalls and ramps. The City will also support HHC's on-going efforts to work with the State and Federal governments to identify mitigation solutions and funding sources that allow its other EDs to be protected from flooding. Current options being explored include elevating Coney Island Hospital's ED and other critical building systems above the 500-year flood elevation and installing temporary or permanent floodwalls around Metropolitan Hospital's ED and campus

Initiative 4: Improve the design and construction of new nursing homes and adult care facilities

New nursing homes and adult care facilities are at risk of power service failures due to storm surge, which could result in patient evacuations. To address this risk, the City will amend its Construction Codes to require that new facilities be constructed with additional resiliency measures for their emergency power systems, which are essential to allow staff and patients to shelter in place safely during a disaster. Power in these residential facilities is needed not only for standard operational requirements—such as lighting, elevators, use of medical equipment, and communications—but also for essential emergency operations such as pumping floodwater out of basements if flood protection fails.

New nursing homes are already required to have emergency generators, but because generators can fail when used for an extended period of time, facilities will now be required to have in place an electrical pre-connection for an external stand-by generator. The ability to switch electrical systems over quickly to a stand-by generator can reduce significantly the likelihood of emergency evacuations during or after a disaster.

Meanwhile with respect to adult care facilities, they are not currently required by the State or City to have any emergency power systems. Their residents are more ambulatory and less fragile than nursing home patients but, nevertheless, require care and living assistance that is dependent on working electricity. For this reason, the City will require new facilities to install either an emergency generator that is adequately protected or pre-connection to an external stand-by generator. OLTPS will propose these requirements for new nursing homes and adult care facilities to the City Council in the latter half of 2013.

Initiative 5: Require the retrofitting of existing nursing homes in the 100-year floodplain

Among all the critical systems that nursing homes rely on for normal operations, power and water are the most essential during emergency conditions because they are required for so many other services such as heating, air conditioning, sanitation, and elevator services.

The City will therefore require existing nursing homes in the 100-year floodplain which, as indicated by the PWMs, includes 18 facilities (11 percent of the citywide bed capacity), to meet standards by 2030 for the protection of electrical equipment, emergency power systems, and domestic water pumps (if applicable) retroactively pursuant to changes in the City's Construction Code. These systems will be protected to the 100-year flood elevation, in accordance with specifications already in the New York City Construction Codes.

OLTPS will propose these requirements to the City Council in the latter half of 2013. The City will enforce compliance with this mandate. As part of this process, by the end of 2020, nursing homes will be required to submit an interim report certifying that they have complied with the retrofit requirements or to submit an affidavit describing a plan to achieve such compliance by 2030.

Because it may be difficult for some nursing homes to secure the financial capital needed for retrofit projects, a financial assistance program will be launched by the City, subject to available funding (see Initiative 7). Nursing homes that are added to the floodplain with the release of future flood maps will be required to comply within 15 years of such new flood maps going into effect.

Initiative 6: Require the retrofitting of existing adult care facilities in the 100-year floodplain

Over 25 percent of citywide adult care facility bed capacity is in the 100-year floodplain (within 19 facilities) and is at risk of power outages due to storm surge. Many of these facilities have their electrical equipment in lower levels where it is vulnerable to flooding. Furthermore, these facilities are also at risk of power outages during heat waves. In either case, power outages would increase the risk of emergency evacuations. The City will, therefore, require existing adult care facilities located in the 100-year floodplain to elevate or protect their electrical equipment to the 100-year flood elevation, in accordance with the specifications applicable to new buildings in the New York City Construction Codes. In addition, these providers will be required to install an emergency generator that is adequately protected in their facilities. Alternatively, they may install an electrical pre-connection to an external generator provided they have an operational plan in place that allows them to access an external generator quickly during an emergency (through, for example, regular contracts with suppliers).

OLTPS will propose these requirements to the City Council in the latter half of 2013. The City will enforce compliance with this mandate. As part of this process, by end of 2020, adult care facilities will be required to submit an interim report certifying that they have complied with the retrofit requirements or an affidavit describing a plan to achieve such compliance by 2030. As with nursing homes, adult care facilities will be eligible for financial support, subject to available funding, to comply with the mandate (see Initiative 7). Moving forward, facilities that are added to the floodplain with the release of future flood maps will be required to comply within 15 years of the new flood maps going into effect.

Initiative 7: Support nursing homes and adult care facilities with mitigation grants and loans

The primary obstacle for most nursing homes and adult care facilities in implementing mitigation measures is financing the investment.

Subject to available funding, the City, through DOHMH and the New York City Economic Development Corporation (NYCEDC), will, therefore, administer competitive grants and subsidized loans to assist providers with the upfront costs of certain mandated retrofit projects.

Most nursing homes and adult care facilities receive the majority of their revenue from publicly funded programs such as Medicaid, Supplemental Security Income, or Safety Net Assistance. Typically, reimbursement rates from these programs are not sufficient to enable nursing homes and adult care facilities to invest in costly mitigation projects that do not impact day-to-day care directly. If any capital investments are made, some nursing homes may receive Medicaid reimbursements for a portion of their mitigation costs; while other providers may not be reimbursed.

To qualify for the program, nursing homes and adult care facilities will be required to demonstrate financial need, emergency preparedness planning, and an operational commitment to remain safely open during disasters or reopen quickly thereafter. Eligible mitigation will include retrofits to meet amended building codes (see Initiatives 5 and 6) and wet flood-proofing of walls and floors below the 100-year flood elevation to limit damage from mold. The goal is for NYCEDC and DOHMH to launch the program, capped at \$50 million citywide, when the proposed building code amendments for nursing homes and adult care facilities go into effect.

Initiative 8: Increase the air conditioning capacity of nursing homes and adult care facilities

Nursing homes and adult care facilities today typically do not have enough emergency power capacity to run their air conditioning systems. Thus, some providers could be forced to evacuate during power outages that occur in hot summer months. To reduce this risk, the City will seek a sales tax waiver for 100 nursing homes and adult care facilities citywide to install emergency power solutions for their air conditioning systems. This benefit, which will be capped at \$3 million citywide, will only be available to those facilities eligible for such benefits under state law. Eligibility criteria for this program will be announced over the next year and will, among other things, include demonstrated financial need.

Strategy: Reduce barriers to care during and after emergencies

Additional initiatives, spearheaded by the City in collaboration with healthcare associations and providers, will ensure that community-based providers in the healthcare system can provide limited but critical services under emergency conditions and restore normal services as quickly as possible after a disaster. The City's goal is to improve the resiliency of the community-based provider network so that even in the hours and days immediately after a disaster, when other local businesses are still recovering, healthcare providers can offer essential services to New Yorkers with the greatest need for care.

Initiative 9: Harden primary care and mental health clinics

In communities that are at risk of extensive flooding, the accessibility of primary care and mental health services may be compromised for weeks after a disaster due to extended facility

closures. Ensuring that local clinics can reopen quickly to provide primary care, mental health counseling, and other medical services in high-need communities is important for the health and safety of residents and will address the concentrated impact of storm surge.

Subject to available funding, the City, through DOHMH and a fiscal intermediary, will therefore disburse grants and interest-free loans to five to six providers that serve large outpatient populations in communities where medical services may be reduced significantly because of extreme weather events. These capital investments will enable faster recovery of services—for example, via installation of emergency power systems, protection of other critical building systems, and wet flood-proofing of facilities. The goal is to launch an application process during the next year. The selection process will prioritize clinics that offer a broad scope of medical services, and demonstrate adequate emergency operations plans.

Initiative 10: Improve pharmacies' and other medically necessary power resiliency

Pharmacies dispense life-saving drugs. However, without power, pharmacists cannot access the necessary patient records or insurance information to dispense these drugs. For retail pharmacies that do not sustain structural building damage, generators allow providers to restore the most critical building services they need to reopen. With an emergency power supply, pharmacies can access patient records, receive calls from doctors about new prescriptions or refills, and communicate with insurers and payers for billing purposes. To reopen with emergency power, pharmacies also will need to have robust emergency operations plans ensuring staff transportation and the delivery of supplies to the facility. For New Yorkers who depend on regular prescriptions, quick restoration of pharmacy services is critical.

DOHMH will, therefore, work with other agencies, including Office of Long-Term Planning and Sustainability, the Office of Emergency Management, the Department of Transportation, the Department of Buildings, the Department of Environmental Protection, and pharmacies to assist pharmacies to reopen quickly after a disaster. DOHMH will explore issues such as installing pre-connections for external generators, identifying a central emergency point of contact, permitting, and emergency operations planning. By the end of 2013, DOHMH will launch an emergency preparedness website for pharmacies.

Initiative 11: Encourage telecommunications resiliency

In the aftermath of a disaster, it is important that New Yorkers be able to speak to their doctors for guidance on needed medical care. While in-person visits are ideal for diagnosing and treating health concerns, a phone consultation can be extremely valuable in addressing many patients' needs after a disaster.

For example, a telephone conversation allows a trusted doctor who is familiar with a patient's medical history and specific health conditions to help with post-disaster anxiety, answer health-related questions, perform initial triage of medical concerns, refill prescriptions, or direct patients to alternative providers and medical resources. Telecommunications resiliency is especially important for mental health providers who may need to support patients during the extremely stressful period after a disaster.

To this end, DOHMH is developing a best practice guide and outreach plan to help community based providers understand the

importance of telecommunications resiliency as well as the options they might consider and questions to ask when evaluating solutions. Resiliency solutions could include using backup phone systems (such as a remote answering service that would not be affected by local weather hazards), Voice over Internet Protocol (VoIP) technology that allows office phone lines to be used off-site, and pre-disaster planning to inform patients of available emergency phone numbers. DOHMH will continue to develop the informational materials through the remainder of 2013.

Initiative 12: Encourage electronic health record-keeping

Doctors rely on patients' medical records to provide and track care, but these important records may be compromised or destroyed due to flooding. Damage to paper records results in the loss of valuable patient information, which may impact care. In addition, the specialized disposal of this sensitive material once damaged can result in high waste removal costs.

Electronic Health Records can help prevent the permanent loss of data and allow for quick restoration of services after a disaster. However, even EHR systems need to be implemented with operational resiliency in mind. For example, providers might want to ensure that they can still access patient information even if they cannot occupy their offices. In addition, providers must ensure that computers and servers are not located on floors where they may be flooded. Their vendors' servers must also be protected from flood risk.

DOHMH's Primary Care Information Project (PCIP) sponsors numerous initiatives to help primary care and mental health providers citywide with EHR technical assistance for their practices. Moving forward, PCIP programs will highlight the ways in which EHR can be used to prevent permanent loss of data and quickly restore services after a disaster. PCIP will target providers, in the floodplain, that can benefit significantly from transitioning to EHR, with specific guidance on how EHR should be implemented for maximum effectiveness in flood hazard mitigation.

POST SANDY INITIATIVE

Building Better, Building Smarter: Opportunities for Design and Development May 2013 AIA Design for Risk and Reconstruction Committee (DfRR)

Sections from the Recommendations with emphasis on the Critical and Commercial Buildings Chapter

Since October 2012, numerous initiatives are under way at local, regional, and federal levels to determine how to respond to future impacts from such storms, which are anticipated to happen with even greater frequency and intensity.

Sandy's unexpected power and breadth created a need for realistic standards to protect communities in the way of future storms—which may be even more powerful in terms of wind, rain, and potential damage. This unprecedented challenge, complicated by estimates of rising sea levels and increasing frequency of events, will define how we plan and regenerate the inundated areas and the regional context. Even as people and buildings suffered terrible direct impacts, the City and region as a whole suffered massive indirect impacts of the storm. Adverse effects to economic vitality, communications infrastructure, and connectivity networks were widespread.

The initial step in any disaster is **response**, preserving life and critical property in the midst and immediate aftermath of the event (ideally preceded by effective pre-planning for evacuation and staging of needed resources). This is followed by **recovery**, returning to as much normalcy as possible, in turn followed by organized and deliberate rebuilding. The overarching long-term objective is **resilience**—modifying buildings and land-use patterns over time, and infrastructure where significant investment prevents physical relocation, and waterfront edges that transition between the shore and upland areas—hardening and/or softening as relevant to mitigate the impact of future events.

In order to deal with these challenges, Mayor Michael Bloomberg's Special Initiative for Rebuilding and Resiliency (SIRR) program is engaged in preparing an integrated strategy to address how we rebuild New York City to be more resilient in the wake of Hurricane Sandy, but with a long-term focus. The City will use its first allocation of federal Community Development Block Grant (CDBG) funds to support recovery from Sandy and to build in resilience to the challenges of climate change, including programs to build and support housing, businesses, infrastructure, and other city services. This process, undertaken through the coordination of numerous governmental agencies and multidisciplinary advisors, relies heavily on community outreach to define issues and priorities. As planning and design professionals, our intent is to support that process through our parallel volunteer efforts.

But as we step back from the immediate shock and imperative response to emergency conditions, we must recognize that much of the problem lies in our own culpability as a client society—the way we have helped over the years to create a susceptible built environment:

- Land-use patterns that encourage fragile dwelling units and critical facilities in the most vulnerable locations;

- Transportation and utility systems that fail more and more frequently in the face of natural events;
- Storm water management and development policies that increase rather than decrease the impact of runoff;
- Existing buildings that are barriers to sustainability—and that, in NYC, use 94% of electrical production and produce 75% of greenhouse gas emissions.

Overall, sea levels are rising and extreme storm events are becoming more frequent, both because of natural cycles and the worsening impact of human induced climate change. By building back better and smarter—moderating our past poor decisions through careful planning, becoming more energy-independent, and setting in motion new, sustainable design and construction practices—we can begin to mitigate or reverse the effects of centuries of misguided development policies.

The Post-Sandy Initiative

The Post-Sandy Initiative, the collaboration that produced this summary report, is structured as the planning and design community's response to this challenge. Initiated by the American Institute of Architects New York (AIA) in the weeks that followed the storm and in collaboration with a wide range of other professional organizations and concerned individuals, it has been supported by the participation of a variety of local, regional, state, and national public agency participants. At publication time, still only months after Sandy swept through our region, this report is a slice in time of our efforts as of April 2013—a definition of issues, an analysis of options and opportunities, and the establishment of a framework for next steps. As our community continues to explore these issues and develop ideas for building better and building smarter, progress reports will be issued online at www.postsandyinitiative.org

As part of this Initiative, many professionals have given their time to explore important issues about Sandy and the response to date, both in terms of shorter-term recovery efforts and longer-term resiliency considerations. It is clear that we can, and need to, do better in the face of future extreme weather events.

CRITICAL & COMMERCIAL BUILDINGS

The challenges of adapting the vast inventory of existing critical buildings to withstand the effects of extreme climate events are distinct from the relatively easier task of designing new structures for resiliency.

With substantial parts of the New York City metro area's power grid down and with Superstorm Sandy's floodwaters disabling emergency power, at least 4 major NYC hospitals (Bellevue, Coney Island, Manhattan VA, and NYU Langone) were forced to evacuate all patients and to completely shut down. Coler at the north end of

Roosevelt Island transferred some patients to its sister Goldwater at the south. The same level of vulnerability took down four major data centers supporting the telecommunications networks in Lower Manhattan. A police station was abandoned when it flooded and a wall collapsed. In Brooklyn and Queens, 29 nursing homes were severely damaged; despite receiving instructions to shelter their populations in place, they were unprepared to endure the storm and its desolating aftermath. Individual buildings, as well as city- and region wide systems, were also unready. They still are.

Building owners have a four-fold responsibility when climate-driven disasters strike:

- Protecting occupants and users from death, injury, and suffering;
- Avoiding the evacuation of occupants if possible;
- Protecting buildings and their contents from damage;
- Ensuring that buildings can operate during and after the event.

Current building technologies offer the ability to construct new buildings and retrofit existing ones to better withstand the anticipated impacts of climate change. However, the challenges of adapting the vast inventory of existing buildings to those standards are distinct from the relatively easier task of designing new structures for resiliency. There exists a vast body of technical standards that can be put in place, or adapted for the local situation as it is coming to be understood. But a sobering aspect of the new paradigm is the rapid increase in dangerous conditions, such as rising sea levels and more powerful storms, as well as the ever-deepening science of the likely effects of climate change. Building standards and disaster planning will need to be revisited and updated frequently.

The Critical & Commercial Buildings Working Group consisted of 18 professionals, representing the main disciplines of the design profession including architects, planners, mechanical engineers, structural engineers, and hospital administrators. The group conducted six evening workshops over the course of two months. The Working Group incorporated five sub-groups: Vulnerability Assessment, Structural/Façade, Building Infrastructure, Operational Planning, and Implementation. Each sub-group produced a report on its assigned topic, which was incorporated into the final report.

KEY CONCEPTS AND FINDINGS

Owners of all commercial and institutional buildings—existing, in construction or planned—can begin now on a four-part process to meet their responsibilities in response to climate disasters. Owners should:

- Conduct vulnerability assessments of their buildings in anticipation of the likely effects of extreme climate events;
- Identify the specific technical standards their buildings must meet, and the technologies and products available to do so;
- Update operational plans to keep their buildings working during disasters, and to quickly recover functionality afterwards;
- Create implementation plans to put in place the remedial actions indicated by the three preceding steps.

Assessing Vulnerability

First, the specific impacts buildings might experience during climate-driven disasters should be determined. The potential effects on a given location can be inferred from published flood-zone and wind maps, as well as historical and modeled future weather data. As noted in the Introduction, however, the increasing severity of recent and anticipated climate events reveals much existing data to be inadequate, and highlights an urgent need to update and reach consensus on such standards.

Second, the critical roles of specific buildings should be established. A building, or a portion of one, should be considered a critical facility if it is required to withstand the effects of a disaster and remain in operation, whether to safeguard the activity conducted within it, or the lives and wellbeing of its occupants, other disaster victims, or emergency-services personnel. Critical facilities include, for example, hospitals, police and fire stations, data centers, evacuation shelters, and buildings or portions of buildings that provide essential support to them. Other vulnerable buildings should be required to withstand a climate disaster without failure of structural components, including façade elements, though they need not remain functioning and are likely to be evacuated during the disaster; these should be considered protected facilities rather than critical.

Third, survey building systems. Essential building systems comprise the design features, technologies, and equipment necessary to support continued operations. For critical facilities, for example, these include emergency power systems, water and ventilation systems, vertical transportation systems, and food storage and preparation facilities. For critical facilities, the survey should assess the ability of essential building systems to continue functioning during a disaster. For protected facilities, the survey should evaluate the ability of the building structure and façade to survive intact.

Meeting Updated Technical Standards

Two building components—structure/facades and internal systems—are key to resisting climate-driven threats whether from flooding, wind, snow, or extreme temperatures. Simply put, the goal is to assure that a building's physical structure remains intact and relatively undamaged by the forces of a disaster, especially the structural system and the building envelope, including fenestration.

Façade and structure: Current New York City and State codes specifying design requirements for snow resistance and flood resistance do not require changes. For wind load design, however, requirements should be upgraded to ASCE/SEI 7-10; this code provides ultimate wind speed values and introduces maps that incorporate the risk categories. For example, for Occupancy Category III and IV buildings, which include those posing a substantial hazard to human life in the event of failure, such as schools, hospitals, and critical facilities as defined above, this code requirement corresponds to wind speeds with only a 3% probability of being exceeded in 50 years.

Systems: We studied a range of building system and utility issues, including the vulnerability points of electricity, IT, gas, water, and steam services as they enter a building; the location and protection of mechanical equipment; emergency equipment to provide for and back up supplies of water and power; fire alarm and firefighting systems; and elevators. We reviewed these in the context of three facility types—commercial and institutional; healthcare; and other mission-critical buildings—and for both new and existing structures. Examples of options for making these systems more resilient are shown here.

In general, a new critical building must meet higher performance standards than a commercial building, since its services are to be available before, during, and after a climate-driven event; new critical buildings should comply fully with new standards. Existing buildings demand more flexibility in determining the best corrective action. A realistic approach for an existing building is generally a best-practice standard, with some latitude in offering equivalent solutions. In some cases for existing buildings, even those deemed critical in function, evacuation may be the only feasible action to permit compliance.

Developing Operational Plans

While many New York City-area agencies and institutions have disaster plans in place, in general these need to be updated to reflect the increased risks our region is now understood to face. Moreover, disaster planning should always consider buildings and their particular vulnerabilities and requirements.

Before An Event

Not all disasters can be foreseen, but for some—in particular, weather events—there may be substantial warning and the ability to anticipate specific effects like flooding. Building owners' advance operational plans should address a range of issues, including the evacuation and relocation of occupants, building shutdowns, and the possible extended relocation of occupants afterwards. For critical facilities, emergency equipment and supplies should be accommodated, temporary relocations should be envisioned, and advance arrangements should be made with the NYC Office of Emergency Management for disaster zone access for essential personnel.

During An Event

Planning should consider the provision of security for evacuated buildings; in Class E high-rise buildings, the risk of a fire-detection system failure requires particular attention. Hospitals by definition are both especially vulnerable and uniquely essential during disasters, and disaster planning for them creates distinct obligations. For example, hospitals should plan for surge capacity for emergency and inpatient departments, the capability to house and feed stranded staff, and provisions for "passive operational survivability," such as natural ventilation during power failures and electric generation capabilities independent of the City's grid.

After An Event

Plans for continuing or resuming operations in the wake of a disaster should consider that normal transportation and supply routes will most likely be disrupted. Therefore, back-up supplies and the on-site storage capacity for them are necessary. Emergency supply agreements made in advance with vendors may be advisable. Portable emergency trailers housing heating or electrical generators, water or oxygen supply, and sewage or waste containment may need to be accommodated as well.

Clean-up and decontamination may require, for example, pre-negotiated arrangements with specialized contractors or vendors for mold removal, fuel or sewage overflows, debris removal, disposal of floodwater and the like, and environmental waivers for removing contaminated water and debris to disposal points. Restoration of normal operations may require post-storm inspections of floor and façade walls; testing and remediation of mechanical, electrical, plumbing, and communications systems; drying out of flooded areas; prioritizing of repairs and/or demolition; and even a strategy for abandonment or managed retreat, if a facility is found to be damaged beyond repair.

Implementing a Plan

Determining a Building's Risks, Strengths, and Weaknesses

Conducting a vulnerability assessment of a building and evaluating it against updated technical standards will indicate what must be done to make it disaster ready. This process will also illuminate relative priorities among the risks a building faces and the available solutions, and create a sense of sequence for how to proceed.

Calculating Available Resources

Implementation of a plan requires evaluating both capital and human resources. Capital resources could be funds from internal sources, such as operating budgets and borrowing; or from external sources, such as grants, tax incentives, and philanthropy. Human resources include the personnel who will be expected to follow the operational procedures developed for withstanding and recovering from an extreme event. They also include a building's stakeholders who may be potential allies or opponents in preparedness planning.

Reconciling Needs and Resources

Arriving at a realistic plan will mean reconciling needs with resources. Typically, needs outstrip resources, so that strategic trade-offs and deferments are necessary. These can be arrived at by:

- Developing a detailed plan;
- Conducting cost-benefit analyses of its elements;
- Determining a timeframe and budget;
- Assembling a team responsible for implementation.

Keeping On Track

- A progress-monitoring system, and honest assessments of progress, should be part of establishing a building's preparedness.
- Deviations from a plan must be corrected.
- Standards may change, our understanding of the risks may change, and available funding may change, so periodic re-examination and re-calibration will be necessary. Intervals of four and eight years are realistic to stay up to date.

POLICY CONSIDERATIONS AND REGULATORY IMPLICATIONS

Because vulnerability assessments are the necessary first step in making buildings resilient, and because no obstacles exist to undertaking them immediately, the City Council should enact a law requiring building owners to conduct vulnerability assessments of their properties. A great number of specific changes to current zoning and building codes will be called for if the City and its buildings are to withstand repeated climate-driven and other disasters. In general, these include:

- An updated building code mandating a more robust disaster resistance capability for all new buildings.
- Hardening and retrofitting of existing buildings deemed vulnerable. This will be expensive, and in some cases impossible. The building code should provide a mechanism for permitting non-compliance; in such cases, an alternative strategy of evacuation should be required. Critical-function buildings in vulnerable locations must have a plan for Transfer of Service to a protected alternate facility, and these alternate facilities should be required to have the additional capacity and equipment to accommodate such a transfer.

- Zoning for land-uses should appropriately align with new and updated knowledge of flood zones and other risks, which may mean downzoning in some areas; and revisions to zoning and density limits for other areas that may in the future be required to absorb growth previously destined for flood zones and vulnerable waterfronts.

OPPORTUNITIES AND NEXT STEPS

Long Term

Innovation in the development of disaster-resistant building design strategies, technologies, and materials is essential. Where applicable, such innovations that already exist or are being implemented in other countries where resiliency planning is more advanced should be adopted or adapted. New York City's particular vulnerabilities call for:

- Policies that move toward elimination of non-compliant existing buildings that cannot be hardened, and their replacement—with an exception path for buildings deemed of significant historic or cultural value.
- Regional protective systems that enhance, or eliminate the need for, individual building responses. These should involve making utility, data, and security networks redundant and resilient, and finding regional strategies for maintaining essential services and supplies, such as public transport, food, and fuel, during disasters. In particular, regional networks for maintaining essential healthcare services must be established.

Medium Term

Numerous scientific, governmental, and professional organizations and collaborative are exploring the potential impacts of climate

change on natural and built environments; these include the Federal Emergency Management Agency, the National Academy of Sciences, the National Oceanic and Atmospheric Administration, the U.S. Conference of Mayors, C40 Cities Climate Leadership Group, and many others. The specific challenges that extreme climate events pose for buildings, cities, and in particular for densely populated areas, illuminated by our experience of Sandy and explored by this and other initiatives in the storm's aftermath, must be brought to the attention of these research bodies. The goals should include:

- Better simulation models of water and wind behavior on built structures;
- New national reference code for building construction;
- Zoning and planning approaches that bring patterns of development into line with present and emerging knowledge of disaster-prone areas.

Short Term

Advisory bodies have been established at the City and state levels, and among professional associations, to develop recommendations for changes to codes and zoning, façade and structural systems, building systems, and operational requirements. Similar groups focused on disaster-response planning will also have recommendations relevant to the design and operation of buildings. Their valuable findings will need to be aligned and reconciled. In the meantime, building owners should begin assessment programs to determine their risks; undertake voluntary upgrades to their properties; and update operational plans for disaster events.

A collaborative, integrated design approach to assessing and upgrading critical and commercial buildings will enable these important facilities to remain in operation when we most need them.

Appendix G: Urban Green Recommendations

URBAN GREEN REPORT New York City's leading advocate for urban sustainability

Urban Green Council is the New York Chapter of the U.S. Green Building Council (USGBC). Their mission is to lead in advancing the sustainability of urban buildings through education, advocacy and research.

A non-profit organization established in 2001, Urban Green is funded by contributions from foundations, its 900+ members, and over 40 corporate sponsors. Our in-house experts and a dedicated network of volunteers are helping to transform the built environment in New York City with models that can be replicated in urban centers nationwide.

Urban Green provides a wide range of educational and networking events for our members and the green building community at large; conducts research; and advocates for change that will make cities more sustainable. Our website and newsletter (circ. 6,500+) reach an audience comprised mostly of professionals working in architecture, engineering, design, construction, real estate development and management, product development and manufacturing, government, and other related fields.

1 Prevent Storm Damage to Homes

Issue:

Flooding, precipitation, high winds, storm surge, wave action, and wind-/water-borne debris can damage homes. Much of this damage can be prevented with targeted design and construction measures.

Recommendation:

Require new and replacement windows to be wind-resistant. Recommend anchoring framing to foundations and strengthening foundations and basements in existing homes. Develop custom requirements for attached homes that present unique challenges.

2 Launch a Design Competition for Raised Homes

Issue:

New York City has 71,000 buildings located in the new 100-year flood zone. New buildings in these areas will have to build above the flood line, and other homeowners may decide to voluntarily raise their homes. This will impact the city's architecture, streetscapes, and accessibility.

Recommendation:

Launch a competition to design a streetscape of attractive raised homes that fit the character and aesthetic of existing neighborhoods and remain accessible to people with disabilities. The competition should address both detached and attached homes.

3 Relocate & Protect Building Systems

Issue:

The first and lower floors of many existing buildings are at risk because they are below flood level, and essential building equipment is often located on these lower floors.

Recommendations:

Building owners should consider relocating equipment above the flood level and follow best practices when flood-proofing. Require fire protection equipment to be raised in new construction and enhance standards for hospitals.

4 Remove Barriers to Elevating Buildings & Building Systems

Issue:

Building owners may wish to elevate buildings or building systems, but are restricted by building regulations and zoning height limitations.

Recommendation:

Allow building owners to raise telecommunications rooms and to store more fuel above the flood line. Consider allowing zoning relief for buildings elevating to the 500-year flood line.

5 Remove Barriers to Sidewalk Flood Protection

Issue:

Building owners may wish to install flood barriers on sidewalks, but are deterred by codes that limit sidewalk use and that assume buildings are fully occupied during floods.

Recommendation:

Allow underground sidewalk attachments for temporary flood barriers. After evacuation, allow nonresidential buildings to maintain a single entrance/exit for emergency personnel so that flood barriers can be installed.

6 Add Backup Fire Safety Communication

Issue:

Loss of power to telecommunications systems and flooding that damages underground phone and data lines can cut off communication between buildings and the Fire Department.

Recommendation:

All large buildings in flood zones should consider having a backup wireless fire communication system, and new large critical buildings must have backup phone and data connections. Mandate the use of storage batteries with a life of at least eight hours to serve buildings' fire and life safety communication systems.

7 Safeguard Toxic Materials Stored in Flood Zones

Issue:

The NYC Department of Environmental Protection requires facilities that store hazardous chemicals to file a risk management plan, but it does not require special protection for chemicals stored in flood zones.

Recommendation: Require toxic materials in flood zones to be stored in a flood-proof area.

8 Prevent Sewage Backflow

Issue:

During floods, sewage can backflow into buildings.

Recommendation:

Require valves on building sewage lines to prevent sewage from entering the building.

9 Plant Wind and Flood Resistant Trees

Issue:

People, property, buildings, and utility lines can be at risk from trees damaged by high winds and flooding.

Recommendation:

In waterfront areas accessible to the public, require wind and salt-tolerant trees and regular tree pruning. Encourage private owners to follow the same practices.

10 Clarify Construction Requirements in Flood Zones

Issue:

City regulations for new construction and substantial renovations provide for resiliency in flood zones. However, the requirements are not always clear to design professionals and contractors.

Recommendation:

Clarify flood zone construction requirements in code and through a Department of Buildings Bulletin. Allow more flexibility in requirements for enclosures below the flood line.

11 Prevent Wind Damage to Existing Buildings

Issue:

High winds can cause walls, windows, doors, and building equipment to come loose. Loose stones on rooftops can become small missiles. While new buildings must meet strong wind standards, new installations on existing buildings do not.

Recommendation:

Require that equipment and structures added to existing buildings meet the same wind standards in effect for installations on new buildings. Require heavy pavers on rooftops and impact-resistant windows in high wind zones.

12 Analyze Wind Risks

Issue:

New York City is in a hurricane-prone region and our building code incorporates modern standards for wind design. However, most NYC buildings were constructed under older codes that did not include the same level of protection. In addition, buildings under construction and climate change impacts are not fully addressed in the new codes.

Recommendations:

Analyze wind effects on existing buildings and those with particular wind vulnerability, such as homes raised on columns and buildings under construction. Study how climate change may affect wind speeds. Recommend changes to code and construction practices to address any vulnerabilities identified.

13 Capture Storm Water to Prevent Flooding

Issue:

Storms can cause localized flash flooding of buildings and streets. The city applies rigorous Storm water standards to buildings that add new sewer connections, but storm water from existing buildings must still be addressed.

Recommendation:

Design sidewalks to capture storm water and continue supporting the NYC Green Infrastructure Plan.

14 Use Cool Surfaces to Reduce Summer Heat

Issue:

Light-colored roofs and surfaces reflect light and heat back into the atmosphere, cooling buildings and cities. City regulations mandate light-colored roof coatings, but only for flat roofs. These coatings also tend to darken over time, losing their effectiveness. Dark, non-compliant coatings are still sold in NYC, increasing unintentional violation of code.

Recommendations:

Expand existing cool roof requirements to include pitched roofs. Prohibit the sale of dark roofing materials and dark “crumb” rubber in synthetic playing fields. Encourage owners to use self-cleaning cool roof coatings and study the longevity of various cool roof options.

15 Choose Reliable Backup Power & Prioritize Needs

Issue:

Few backup power systems are large enough to serve a whole building, forcing most buildings to make difficult choices about what equipment to back up.

Recommendation:

Prioritize which electrical equipment will run on backup power so buildings can remain habitable during extended blackouts. Because cogeneration and solar power systems are always in use, they can be more reliable than generators that are only turned on during emergencies.

16 Use Cogeneration & Solar During Blackouts

Issue:

Many cogeneration and solar power systems are not set up to run during a blackout. Because of this, they cannot provide heat and power to buildings during these emergencies.

Recommendation:

Cogeneration and solar power systems should be designed to run during blackouts.

17 Remove Barriers to Backup & Natural Gas Generators

Issue:

Existing regulations require buildings that voluntarily provide backup, standby generators to supply backup power for at least one elevator in addition to whatever other loads the buildings may want to power. This increases generator size and costs, making backup generators too expensive for some buildings. Other regulations discourage natural gas generators, which are clean burning and can power buildings for extended periods without fuel deliveries.

Recommendation:

Only require buildings over 75 feet to power an elevator with the standby generator, and reduce the minimum requirements for generator size. For emergency generators, increase the allowed

startup delay from 10 to 60 seconds, making more options available for generators operated by natural gas.

18 Remove Barriers to Cogeneration

Issue:

Onsite cogeneration can be an efficient and cost effective source of heat and power to buildings, but technical and regulatory barriers inhibit its use.

Recommendation:

Con Edison should help facilitate the installation of larger systems by preparing guidelines similar to those for smaller systems, and implement a plan for significant expansion of cogeneration. Cogeneration should be properly sized to maximize economic benefit and energy efficiency.

19 Remove Barriers to Solar Energy

Issue:

Onsite solar power can keep buildings habitable during blackouts, but technical, regulatory, and economic barriers inhibit its use.

Recommendation:

Con Edison, NYSERDA, and other government agencies should continue working together to streamline permitting processes, reduce barriers in project schedules, and increase the allowable roof area for solar power.

20 Add Hookups for Temporary Generators & Boilers

Issue:

Buildings with extended service disruptions can use electricity and heat from temporary emergency generators and boilers. It is much easier to connect this equipment if convenient hookup points are installed in advance.

Recommendations:

Require some existing health care facilities to install external electrical hookups. Recommend these installations as best practice for other buildings, and recommend external hookups for heating and cooling as well.

21 Keep Residential Stairwells & Hallways Lit During Blackouts

Issue:

All buildings are required to have 90 minutes of emergency lighting so they can be safely evacuated. However, during a prolonged blackout, residents in multifamily buildings need lighting in hallways and stairwells throughout the duration of the event.

Recommendation:

Require most new multifamily buildings to provide lighting in hallways and stairwells during extended blackouts; require the same of existing multifamily buildings within two years.

22 Keep Gas Stations Open During Blackouts

Issue:

During blackouts, most service stations are unable to sell gas because the pumps rely on electricity. In the days following Superstorm Sandy, about half of NYC's service stations were not operational, delaying recovery efforts and disrupting work and life for hundreds of thousands of residents and businesses.

Recommendation:

Unless New York State passes an equivalent law, NYC should require all fuel stations to either have a backup generator or be "generator ready."

23 Supply Drinking Water Without Power

Issue:

During a power failure, residential buildings using electric pumps lose their supply of potable water. Water may be present below the sixth floor, but in some cases remains unavailable if a non-operating pump blocks the water supply.

Recommendation:

Require residential buildings to provide drinking water to a common area, supplied directly through pressure in the public water main.

24 Ensure Toilets & Sinks Work Without Power

Issue:

Some toilets and faucets need electricity to function. This presents a sanitation risk during an extended power outage.

Recommendation:

Require that toilets and faucets be capable of operating without grid power.

25 Enhance Building Water Reserves

Issue:

Water towers can provide potable water during power losses. City regulations no longer require water towers for new construction and they allow towers to be removed from existing buildings.

Recommendation:

Encourage building owners to maintain existing water towers and consider using water towers in new construction.

26 Ensure Operable Windows in Residential Buildings

Issue:

Operable windows permit cooling without power, which allows buildings to remain habitable during power outages and saves energy. New windows are often installed with stops that prevent them from opening more than 4.5 inches, reducing their cooling potential.

Recommendation:

Extend the mandate of the Task Force through Fall 2013 to recommend options for regulating windows that address both child safety and the overheating during blackouts.

27 Maintain Habitable Temperatures Without Power

Issue:

Utility failures often disable heating and cooling systems, leaving interior building temperatures dependent on whatever protection is provided by the insulation and air sealing of a building's walls, windows, and roof.

Recommendation:

Extend the mandate of the Task Force through Fall 2013 to develop a multi-year strategy for ensuring that new and existing buildings maintain habitable temperatures during utility failures. Clarify requirements for tightly sealing new windows and doors and upgrading roof insulation during roof replacement.

28 Create Emergency Plans

Issue:

The multiday loss of power and extreme flooding from Superstorm Sandy exceeded most planning scenarios. As a result, few buildings or residents had plans to manage such emergencies.

Recommendation:

The city should work with industry experts to develop emergency preparedness information and instructions for apartment residents and homeowners including model emergency operating procedures and a building contact directory.

29 Adopt an Existing Building Code**Issue:**

Existing building renovations are governed by a complex mix of new and old codes. This complexity discourages upgrades that would improve resiliency, particularly during time-sensitive recovery periods.

Recommendation:

The Task Force supports the Department of Buildings plans to adopt an Existing Building Code, which will simplify regulation of building upgrades and streamline permitting for resiliency improvements. The new code or other regulations should include specific provisions for post-disaster reconstruction.

30 Don't Discourage Buildings From Operating During Emergencies**Issue:**

Buildings need to remain open during many emergencies, but makeshift services that don't meet code standards during normal operations can be a liability risk. Buildings also need clarity about enforcement of various regulations during an emergency, such as those governing heat and stairwell lighting.

Recommendations:

New York State should adopt legislation that limits the liability of building owners and their staff during emergency conditions. The

city should inform owners and tenants how enforcement of regulations may be relaxed during emergencies.

31 Support Good Samaritan Legislation**Issue:**

Architects and engineers often hesitate to volunteer with emergency recovery efforts due to liability concerns.

Recommendations:

Enact New York State "Good Samaritan" legislation protecting architects and engineers from liability for emergency volunteer work.

32 Preapprove Emergency Inspectors**Issue:**

The Department of Buildings has procedures to mobilize large numbers of public and private sector inspectors trained for post-disaster building assessments. There are opportunities to speed implementation and enhance capabilities by formalizing this program.

Recommendation:

The Department of Buildings should formalize its practices by creating a Preapproved Emergency Inspector Program through its "special inspector" program to assist the city during emergencies.

33 Pre-negotiate Emergency Recovery Agreements**Issue:**

Finding service providers and negotiating agreements can delay recovery for damaged buildings.

Recommendation:

As part of emergency planning, building owners and managers should identify service providers and pre-negotiate emergency recovery agreements, reducing the economic and human impact of an emergency.

Appendix H: Healthcare Facilities in Affected by the Construction Moratorium

Hospitals in NYC	Bed Capacity	Evac. Zone	Old Evac. Zone
Bellevue Hospital Center	912	1	B
NYU Hospitals Center	879	1	A
St Johns Episcopal Hospital So Shore	257	1	A
Staten Island University Hosp-North	508	2	A
Coney Island Hospital	371	2	A
Metropolitan Hospital Center	338	2	B
Calvary Hospital Inc	225	2	C
Coler-Goldwater Specialty Hospital & Nursing Facility - Coler Hospital Site	210	2	B
The Heart Institute	0	2	A
Coler-Goldwater Spec Hosp&Nurs Fac - Goldwater Hospital Site	417	3	B
New York Presbyterian Hospital - New York Weill Cornell Center	850	4	N/A
Lincoln Medical & Mental Health Center	347	4	C
Harlem Hospital Center	286	4	C
Hospital for Special Surgery	205	4	C
NYU Hospital for Joint Diseases	190	4	C
Rockefeller University Hospital	40	4	N/A
Beth Israel Medical Center/Petrie Campus	856	5	C
Brookdale Hospital Medical Center	530	5	C
Lutheran Medical Center	450	5	C
Woodhull Medical & Mental Health Center	394	5	C
Beth Israel Medical Center/Beth Israel Brooklyn	212	5	N/A
Staten Island University Hosp-South	206	5	A
New York Downtown Hospital	180	5	C
New York Community Hospital of Brooklyn, Inc	134	5	C
Montefiore Med Center - Jack D Weiler Hosp of A Einstein College Div	403	6	N/A
NY Eye and Ear Infirmary	69	6	N/A

Nursing Homes in NYC	Bed Capacity	Evac. Zone	Old Evac. Zone
Shorefront Jewish Geriatric Center	360	1	A
Sea-Crest Health Care Center	320	1	A
Menorah Home & Hospital for Aged & Infirm	320	1	A
Shoreview Nursing Home	320	1	A
Brookhaven Rehabilitation & Health Care Center LLC	298	1	A
Resort Nursing Home	280	1	A
Horizon Care Center	280	1	A
Neponsit Health Care Center	269	1	A
Haven Manor Health Care Center, LLC	240	1	A
Promenade Rehabilitation and Health Care Center	240	1	A
Rockaway Care Center	228	1	A
West Lawrence Care Center, LLC	215	1	A
Saints Joachim & Anne Nursing and Rehabilitation Center	200	1	A
Queens Nassau Rehabilitation and Nursing Center	200	1	A
Lawrence Nursing Care Center, Inc	200	1	A
Peninsula Center for Extended Care and Rehabilitation	200	1	A
Sheepshead Nursing & Rehabilitation Center	200	1	B
Park Nursing Home	196	1	A
New Surfside Nursing Home, LLC	183	1	A
Bishop Charles Waldo Maclean Episcopal Nursing Home	163	1	A
Bezalel Rehabilitation and Nursing Center	120	1	A
Ocean Promenade Nursing Center	120	1	A
Oceanview Nursing & Rehabilitation Center, LLC	102	1	A
Far Rockaway Nursing Home	100	1	A
Providence Rest, Inc.	200	2	C
Keser Nursing and Rehabilitation Center, Inc.	200	2	B
Coler-Goldwater Spec Hosp&Nurs Fac Coler Nursing Facility Site	815	3	B
Coler-Goldwater Spec Hosp&Nurs Fac Goldwater Nursing Facility Site	574	3	B
River Manor Care Center	380	3	B
Four Seasons Nursing and Rehabilitation Center	270	3	C
Ruby Weston Manor	240	3	C
Crown Nursing & Rehab Center	189	3	B
Spring Creek Rehabilitation & Nursing Care Center	188	3	B
Brooklyn-Queens Nursing Home	140	3	B
Brooklyn United Methodist Church Home	120	3	C
Kings Harbor Multicare Center	720	4	C
Sephardic Nursing & Rehabilitation Center	271	4	B
Haym Solomon Home for the Aged	240	4	B
Rego Park Nursing Home	200	4	C
Greater Harlem Nursing Home Company Inc	200	4	B
Gold Crest Care Center	175	4	C

VillageCare Rehabilitation and Nursing Center	105	4	B
The Robert Mapplethorpe Residential Treatment Facility A.N.	28	4	C
Terence Cardinal Cooke Health Care Center	679	5	C
Cobble Hill Health Center, Inc	520	5	C
Bay Park Center for Nursing and Rehabilitation, LLC	480	5	C
Schulman and Schachne Institute for Nursing And Rehabilitation	448	5	C
Northern Manhattan Rehabilitation and Nursing Center	320	5	C
Cabrini Center for Nursing & Rehab	240	5	C
Grand Manor Nursing & Rehabilitation Center	240	5	C
Cliffside Rehabilitation & Residential Health Care Center	218	5	N/A
Rebekah Rehab and Extended Care Center	213	5	C
Throgs Neck Extended Care Facility	205	5	C
Park Terrace Care Center	200	5	C
Manhattanville Health Care Center	200	5	C
Bridge View Nursing Home	200	5	N/A
Bronx Center for Rehabilitation & Health Care	200	5	C
New Gouverneur Hospital SNF	156	5	C
New East Side Nursing Home	58	5	C
Jeanne Jugan Residence	30	5	C
Daughters of Jacob Nursing Home Company Inc	405	6	N/A
Atlantis Rehabilitation and Residential Health Care Facility	400	6	N/A
Hopkins Center for Rehabilitation and Healthcare	288	6	N/A
Union Plaza Care Center	280	6	N/A
NYS Veterans Home In NYC	250	6	C
Lutheran Augustana Center for Extended Care & Rehabilitation, Inc	240	6	C
Ditmas Park Care Center	200	6	C
Fairview Nursing Care Center Inc	200	6	N/A
St Vincent Depaul Residence	120	6	N/A
Highbridge-Woodycrest Center Inc	90	6	N/A

Appendix I: The AIANY Systems matrix with reference codes added

SYSTEMS MATRIX - HEALTH CARE FACILITIES AND RELEVANT UTILITY SYSTEMS

UTILITY SERVICES	RISK ASSESSED	TYPE	CRITICAL FACILITY	PROPOSED MEASURE	NEW	EXIST	CODES & ISSUES	AHJ	COST IMPACT
ELECTRIC									
High Voltage Electric	Flood	Hospitals & Medical Centers	YES	Protect underground ductbanks, vaults, wiring, transformers and exterior load banks	Req	Rec	National Electric Code (NEC), NFPA	Local Utilities-AHJ such as Con Ed/PSEG	High
Low Voltage Electric	Flood	All	YES	Locate electrical closets, etc above FEMA flood evaluation		Rec	NFPA, NEC and UL	NYS	Medium
Generators	Flood	All	YES	Elevate above FEMA flood plain	Req	Rec	NFPA and Type 1 EES	NYS	Medium
Telephone & Data	Flood	All	YES	Locate underground cables, services and equipment above flood plain elevation or protect with vaults that pump/drain water	Req	Rec	Local Phone Service or Computer Internet Provider	Verizon, ATT, Time Warner et al	Low
Emergency Lighting		All	YES	Extended battery life or generator	Req	Rec	NFPA	NY & Local	Low
HVAC Systems	Flood	All	YES	Controls and alarms on emergency circuits	Req	Rec	ASHRAE /NFPA		Low
Overhead Distribution Wiring, Poles and Transformers	Wind	All	Site Specific	Protect and evaluate fall zone	Req	Rec	NEC	Local Utilities-AHJ such as Con Ed/PSEG	High
All Critical Equipment (Life Support)	Heat	All	YES	Protect with ventilation and air conditioning; use natural ventilation to reduce extended energy uses	Req	Varies	NFPA 99	NYCCR 710	Medium
All Critical Equipment (Life Support)	Flood	All	YES	Provide protection with rooms that are waterproof or storage at elevation above FEMA flood elev	Req	Varies	Disconnect medical gases during emergencies/provide battery back up or dedicated generators	NYCCR 710	Medium
MECHANICAL									

Boiler Rooms	Flood	as per design	Site Specific	Raise boilers and associated systems above flood level	Req	Varies	ASHRAE	NYS Mech Code	Medium
Roof Top Units - Air Handling Units	Wind	as per design	Site Specific	Secure to roof and raise above flood level for flat roofs that pond water	Req	Varies	ASHRAE	NYS Mech Code	Medium
Hot Water Systems	Flood	as per design	Site Specific	Raise all equipment in basement or low level to elevation above FEMA flood level	Req	Varies	ASHRAE	NYS Mech Code	Medium
Chilled Water Systems	Flood	as per design	Site Specific	Raise all equipment in basement or low level to elevation above FEMA flood level	Req	Varies	ASHRAE	NYS Mech Code	Medium
Cooling Towers	Flood	variable	Site Specific	Secure to roof and raise above flood level for flat roofs that pond water; Locate remote equipment above flood level	Req	Varies	ASHRAE	NYS Mech Code	Medium
Ventilation Systems	Flood	All	Yes	Provide redundant systems to assure dangerous fumes, exhaust and gases will operate	Req	Rec	ASHRAE	NYS Mech Code	Medium
Medical Gas Systems	Flood	Hospitals and Medical Centers	Yes	Secure bottles, cylinder & gases above flood level and provide redundant systems as required	Req	Req	ASHRAE, NFPA & NYS	NYS Mech & Plumbing	Variable with qty.
Bulk Gas Tanks	Flood	All	Site Specific	External systems to be located above flood level	Req	Req	NFPA	NYS Mech & Plumbing	Low/Medium
Steam Service	Flood	variable	Site Specific	External piping to be located on piers above flood level; avoid buried piping without drainage provisions	Req	Rec	ASHRAE	NYS Mech & Plumbing	Variable with size
FIRE PROTECTION									
Fire Pump	Flood	as per design	Site Specific	Raise all equipment in basement or low level to elevation above FEMA flood level	Req	Req	NFPA	NYS & Local	Medium
Sprinkler Systems	Flood	All	Site Specific	Raise all equipment in basement or low level to elevation above FEMA flood level	Req	Req	NFPA 13	NYS & Local	Variable with size

Sprinkler Systems	Heat	All	Site Specific	Replace low temperature sprinkler heads with higher temperature type or provide redundant systems	Req	Req	NFPA 13 & Local Fire Authorities	NYS & Local	Medium
PLUMBING									
Gas Service	Flood	as per design	Site Specific	Eliminate breach of piping & access to valves, meters and PRV stations	Req	Req	NFPA Gas Code	Local Gas Supplier	Low
Domestic Water	Flood	All	YES	Isolate piping below grade to assure watertight (double wall piping with drainage); raise all piping and valves above flood level	Req	Req	ASCE/NYS DOH	Local	Medium-High
Sump Pumps & Ejectors	Flood	All	Site Specific	Size systems for flood events with redundant pumps	Req	Rec	NYS Building Code	NYS & Local	Low
Sanitary Waste System	Flood	All	YES	Include backwater valves and adequate separation from combined systems. Separate storm drainage system	Req	Req	NYS Plumbing Code	Local inc. County, City or Town	Low-Medium
Storm Water Systems	Flood	ALL	Site Specific ALL	Evaluate & mitigate ALL potential flooding issues from site, buildings and adjacent areas	REQ	REQ	Federal ACOE, FEMA, IBC, NYS & Local. Also see MSKCC Report by JBB dated 4/15/13	NYS, Local and County	Variable depending on size
OTHER									
Elevators & Conveyance Equipment	Flood	All	YES	Provide sumps and drainage provisions for excessive flooding of shafts per code	Req	Rec	NYS Building Code (Architect to Review)	NYS & Local	Variable

Appendix X: Resources

Resources

A Stronger and More Resilient New York, Mayor Michael R. Bloomberg Special Initiative for Rebuilding and Resiliency (SIRR), June 2013

<http://www.nyc.gov/html/sirr/html/report/report.shtml>

FEMA: Publication 577; Risk Management Series: Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds Providing Protection to People and Buildings, June 2007

<http://www.fema.gov/media-library/assets/documents/8811?id=2441>

Post-Sandy Initiative: Building Better, Building Smarter. Opportunities for Design and Development, American Institute of Architects New York (AIANY), Design for Risk and Reconstruction Committee (DfRR), May 2013

http://postsandyinitiative.org/wp-content/uploads/2013/05/Post-Sandy-Report_Full.pdf

NYSDOH: Healthcare findings briefing, June 2013

Urban Green, Building Resiliency Task Force Report, June 2013

<http://www.urbangreencouncil.org/BuildingResiliency>

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