



T R A C I E
HEALTHCARE EMERGENCY PREPAREDNESS
INFORMATION GATEWAY

Access speaker bios here:

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Access the transcript here: [https://files.asprtracie.hhs.gov/
documents/healthcare-resilience-webinar-transcript-final.pdf](https://files.asprtracie.hhs.gov/documents/healthcare-resilience-webinar-transcript-final.pdf)

Healthcare Facility Extreme Weather Resilience and Mitigation

June 5, 2024



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Rachel Lehman
Acting Program Director, ASPR TRACIE



ASPR Key Priorities



ASPR TRACIE: Three Domains



- Self-service collection of audience-tailored materials
- Subject-specific, SME-reviewed “Topic Collections”
- Unpublished and SME peer-reviewed materials highlighting real-life tools and experiences



asprtracie.hhs.gov



- Personalized support and responses to requests for information and technical assistance
- Accessible by toll-free number (1844-5-TRACIE), email (askasprtracie@hhs.gov), or web form (ASPRtracie.hhs.gov)



1-844-5-TRACIE



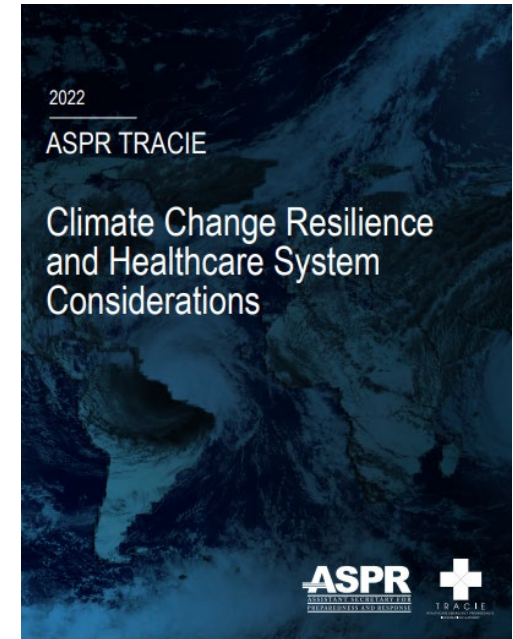
- Area for password-protected discussion among vetted users in near real-time
- Ability to support chats and the peer-to-peer exchange of user-developed templates, plans, and other materials



askasprtracie@hhs.gov

Select Relevant ASPR TRACIE Resources

- [Climate Change Resilience and Healthcare System Considerations](#)
- [Climate Change and Healthcare System Considerations Topic Collection](#)
- [Hurricane Resources Page](#)
- [Major Hurricane Potential PH and Medical Implications](#)
- [Major Earthquakes & Cascading Events: Potential Health and Medical Implications](#)
- [Natural Disasters TC](#)
- [The Exchange Issue 6: Evacuating Healthcare Facilities](#)
- [The Exchange Issue 10: Preparing for and Responding to Wildfires and Planned Outages](#)
- *The Exchange Issue 19: Extreme Weather and Healthcare (Coming Soon)*





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Aparna Bole, MD
HHS Office of Climate Change & Health Equity (OCCHE)
Moderator



Climate Resilience for Health Care

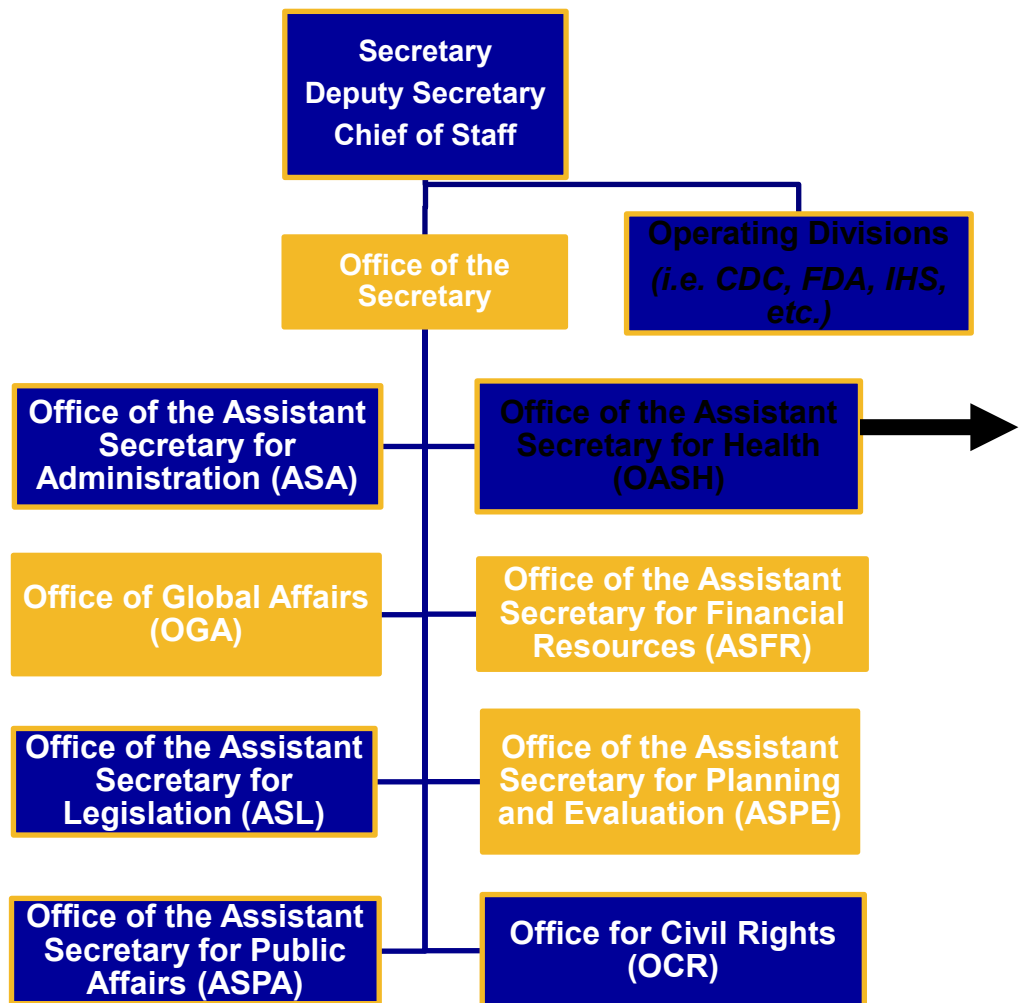
Aparna Bole, MD

**Agency for Healthcare Research & Quality/
Office of Climate Change and Health Equity**



Office of
Climate Change
and Health Equity

Office of the Assistant Secretary for Health



Assistant Secretary for Health
Admiral Rachel L. Levine



Office of Environmental Justice - Est. 2022
Dr. Sharunda Buchanan
Interim Director



Office of Climate Change and Health Equity - Est. 2021
Dr. John Balbus
Director

Air Pollution & Increasing Allergens

Asthma, allergies, cardiovascular and respiratory diseases

Extreme Heat

Heat-related illness and death, cardiovascular failure

Drought

Water supply impacts, dust storms, Valley Fever

Environmental Degradation

Forced migration, civil conflict, loss of jobs and income

Wildfires & Wildfire Smoke

Injuries, fatalities, loss of homes, cardiovascular and respiratory diseases

Degraded Living Conditions & Social Inequities

Exacerbation of racial and health inequities and vulnerabilities, loss of employment

Changes In Vector Ecology

Lyme disease, West Nile Virus, hantavirus, malaria, encephalitis

Food System Impacts

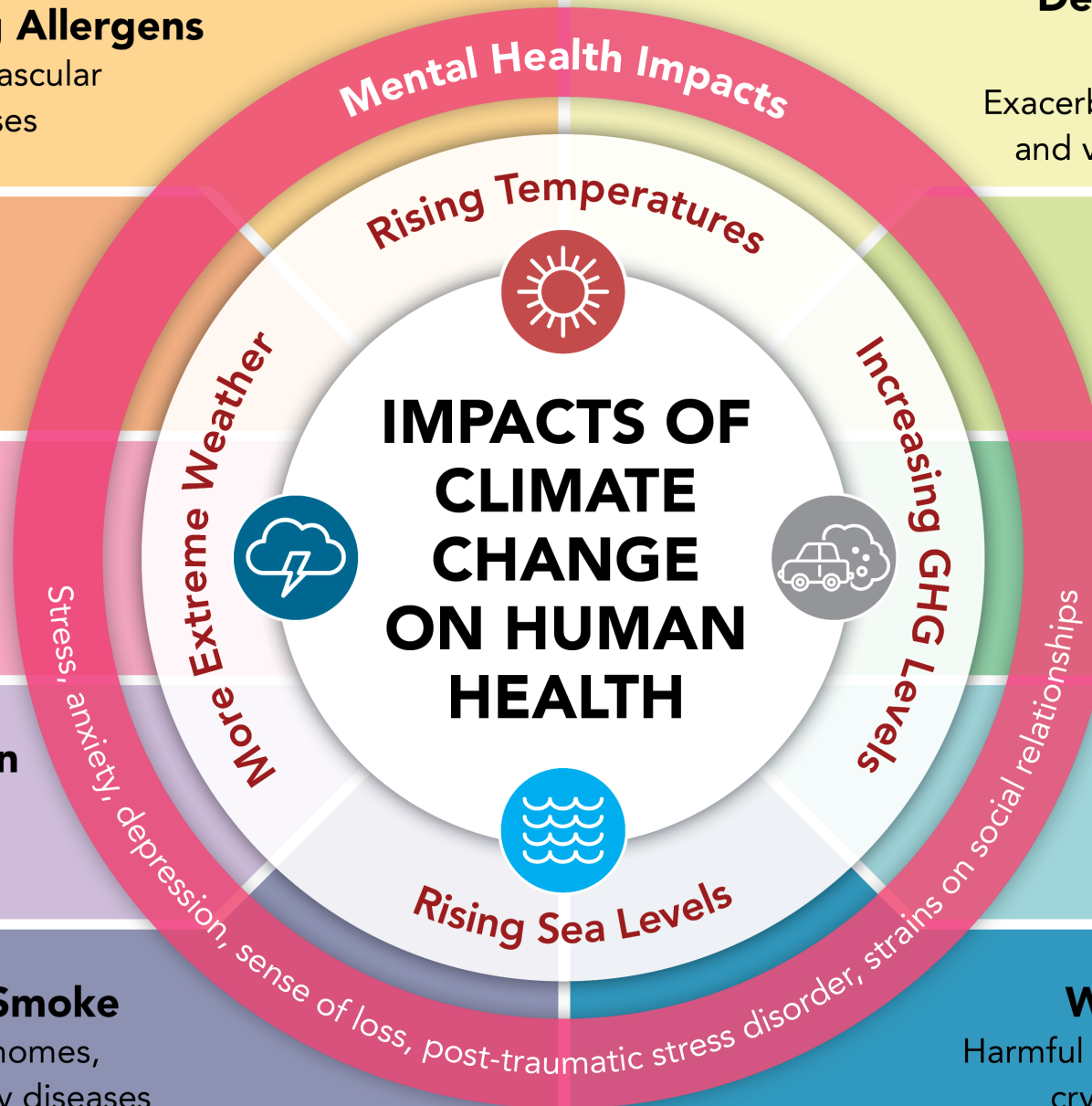
Malnutrition, food insecurity, higher food prices, foodborne illness

Severe Weather & Floods

Injuries, fatalities, loss of homes, indoor fungi and mold

Water Quality Impacts

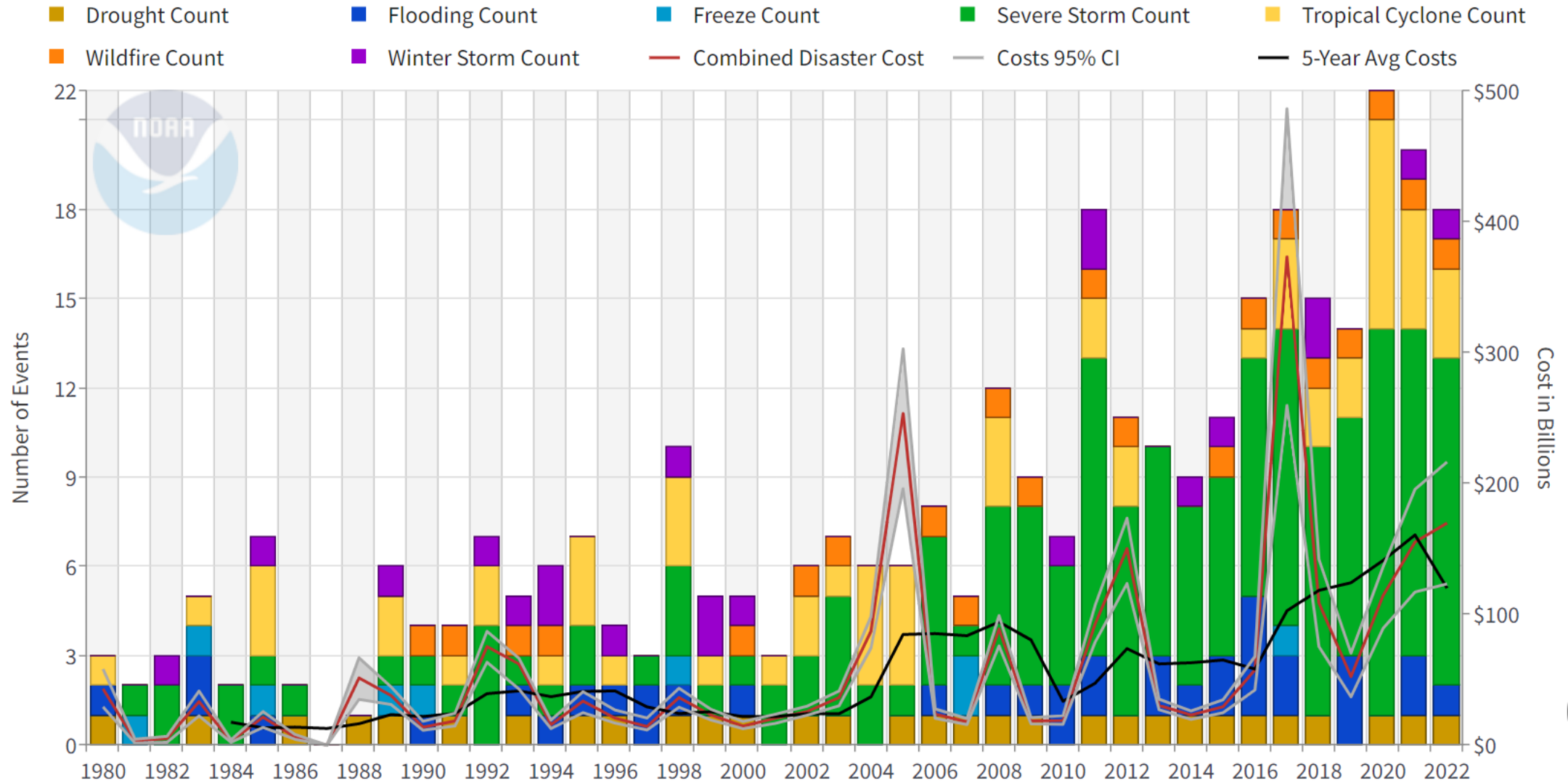
Harmful algal blooms, campylobacteriosis, cryptosporidiosis, leptospirosis



CDPH (Adapted from CDC, J. Patz)

<https://www.cdph.ca.gov/Programs/OHE/pages/CCHEP.aspx>

United States Billion-Dollar Disaster Events 1980-2022 (CPI-Adjusted)





WHO's Operational Framework for Building Climate Resilient Health Systems

- A climate-resilient health system is “capable to anticipate, respond to, cope with, recover from, and adapt to climate-related shocks and stress, so as to bring sustained improvements in population health, despite an unstable climate.”



<https://bit.ly/3lqBJPP>



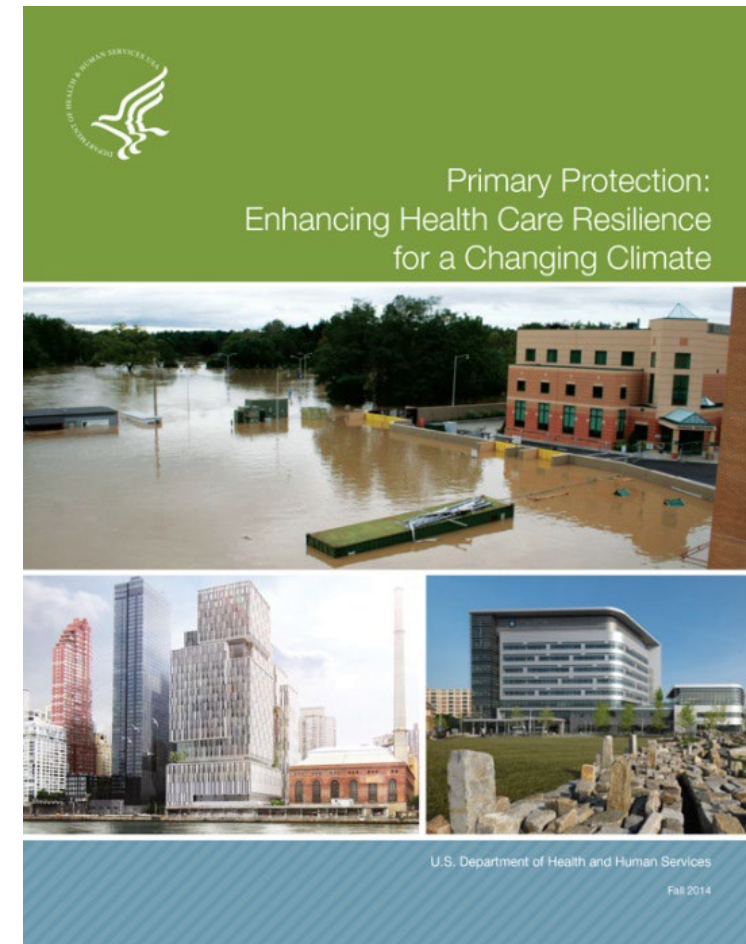
Key Elements of a Healthcare Climate Resilience Plan

1. Prospective risk assessment
2. Health equity and community engagement
3. Assessment and remediation of vulnerabilities in infrastructure and operations
4. Collaboration between healthcare organizations
5. Interdisciplinary planning, oversight, and evaluation



Climate Resilience for Health Care (CR4HC): Updated Toolkit

- Update to “Sustainable & Climate Resilient Healthcare Facilities Toolkit”
- Planned fall 2024 publication
- Alignment with other HHS emergency preparedness tools and guidance
- Primary audience: healthcare emergency management professionals
- More modular, user-friendly content
- Updated case studies, reflecting a diversity of facility types
- Housed within NOAA Climate Resilience Toolkit site



CR4HC Toolkit Structure



Impact of Extreme Heat on Health Care Facilities

1. Prospective Risk Assessment



Extreme heat risk assessments in emergency management plans are traditionally retrospective. Adding forward-facing climate projections to the risk assessment can help healthcare organizations plan for future exposures and vulnerabilities, such as more frequent, severe, and longer heat waves. For example, a study found that New York City's decision in 2008 to lower its threshold for activating the local heat emergency was subsequently associated with a daily reduction of 0.8 heat-related hospital admissions among patients over 65 years (Benmarhnia et al., 2019).

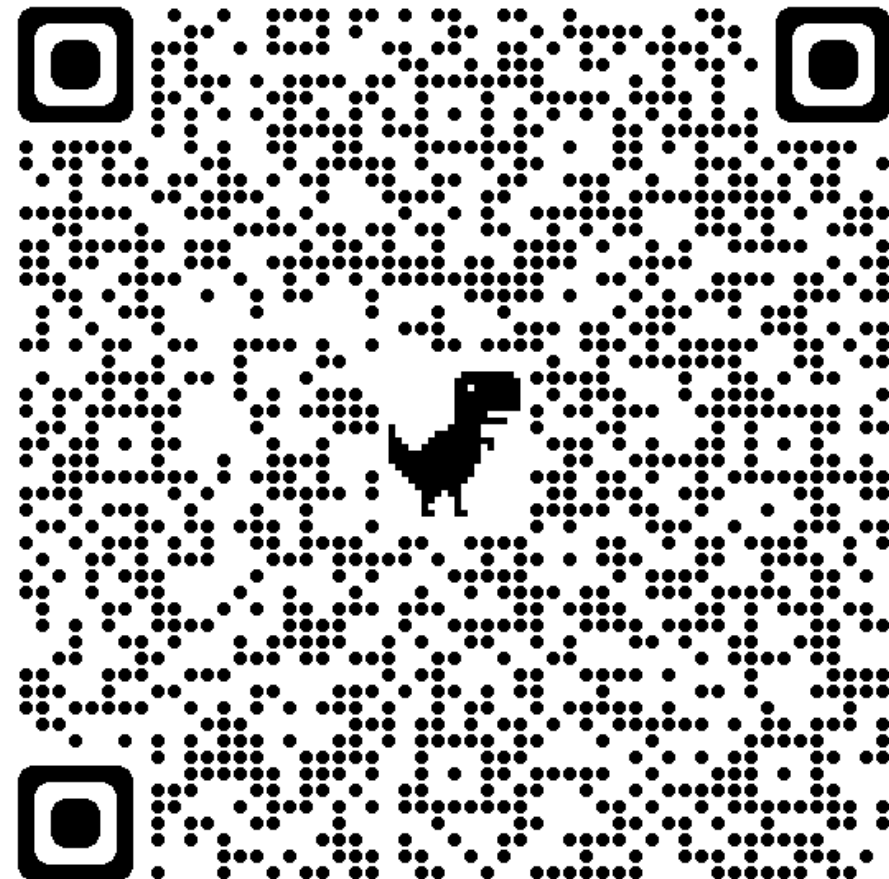
Climate Resilience Actions

Tools and resources relevant to these actions can be found at:
[HEAT: Element 1: Prospective Risk Assessment Tools and Resources](#)

- Collaboration with ASPR to align with updated Risk Identification and Site Criticality (RISC) Toolkit
- Can be navigated online or in downloadable PDFs
- Intro/ resilience strategies + links to tools & resources/ case studies
- Resilience strategies organized around key elements
- All-hazards approach – but content organized around climate-related hazards named in RISC toolkit

Quickfinder for Leveraging the IRA for the Health Sector

1. Background on climate change and health equity
2. Overview of investments and actions potentially facilitated by the IRA
3. Summaries of relevant IRA programs





OASH

Office of
Climate Change
and Health Equity



Thank you!

Contact us: OCCHE@hhs.gov

**Visit us online and sign up for our
listserv at www.hhs.gov/ocche**



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Jenna Agins, MBA, MS
Energy & Sustainability Assistant Director
NYU Langone Health

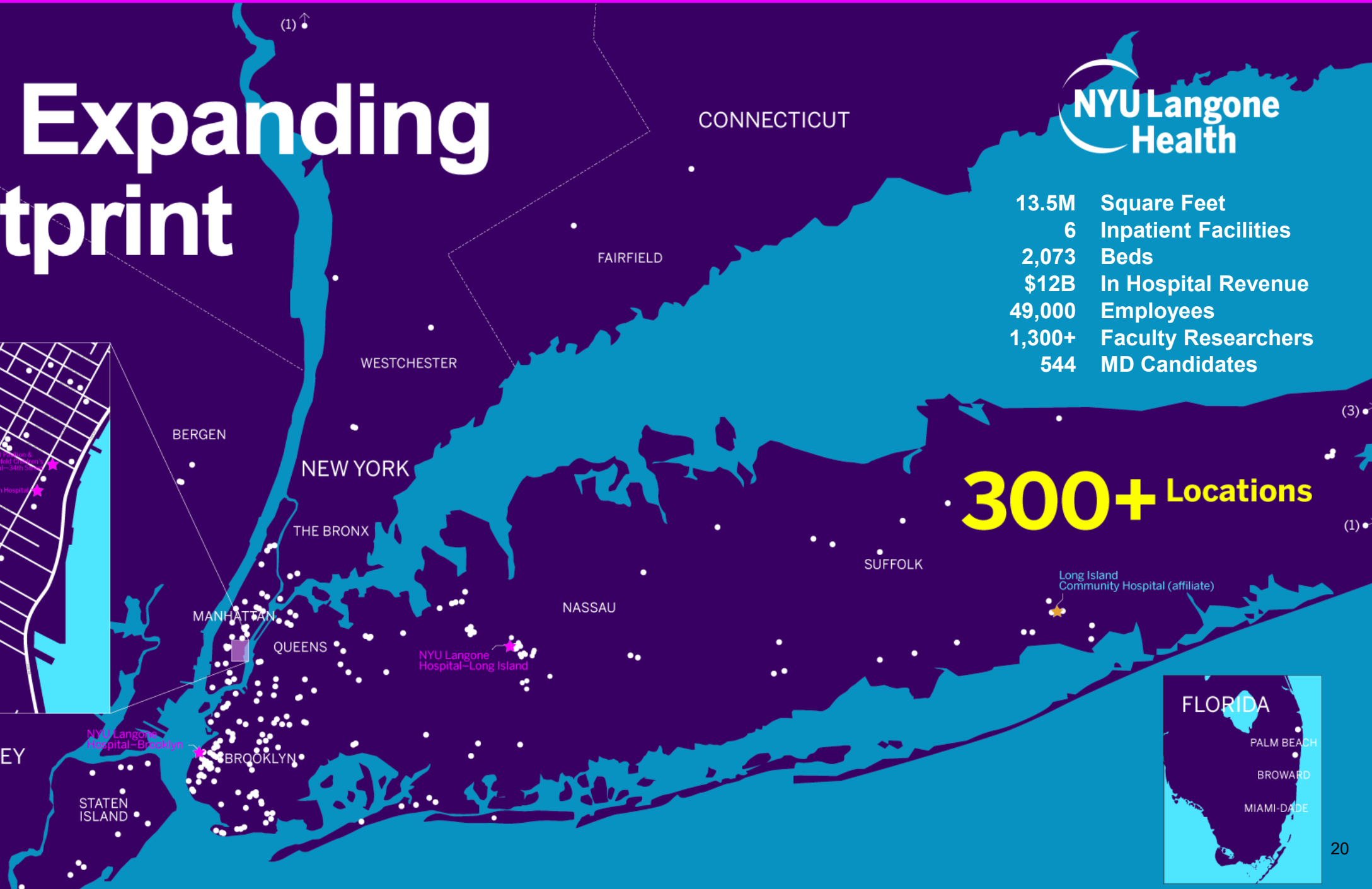


Our Expanding Footprint



13.5M Square Feet
6 Inpatient Facilities
2,073 Beds
\$12B In Hospital Revenue
49,000 Employees
1,300+ Faculty Researchers
544 MD Candidates

300+ Locations



As of April 2024



Key Achievements

1st

Campus in the world to achieve both USGBC PEER & LEED Platinum certification

TOP 25

Hospital for sustainable practices

2022 Practice Greenhealth award

1st

NYC-based member of the US Health Care Climate Council

Joined in 2020

TOP 10

Circles of Excellence – Green Buildings

2024 Practice Greenhealth award



Commitments

National & International

- US Department of Human & Health Services Health Sector Pledge
- US Health Care Climate Council
- Health Care Climate Challenge
- National Academy of Medicine's "Accelerating the National Climate and Health Movement"

City & State

- NYC Carbon Challenge
- Clean Air NY
- NY State Clean Green Campuses

Goals

50% carbon emissions reduction by 2030

Achieve carbon neutrality by 2050

Core Values

“Our experience during Hurricane Sandy and its aftermath prompted us to reimagine resilient and sustainable design”

- Paul Schwabacher, P.E. Senior Vice President, Facilities Management, NYU Langone Health

- Embrace opportunities to change
- Support resiliency and climate preparedness beyond industry standards in healthcare & required by regulation/government/FEMA
- Use a collaborative master planning & design process
- Conduct annual hazard vulnerability assessments that take climate change into account
- Expand commitment to energy efficiency and carbon reduction
- Build a culture of resiliency
- Focus on emergency preparedness and business continuity planning

Approach to Design for Resiliency and Sustainability

- Evidence-based design decisions using forward looking climate projections
- Major investment in infrastructure for resiliency, sustainability and energy efficiency
- Focus on energy conservation, long-term decarbonization, and beneficial electrification
- Elevate critical infrastructure, patient care, research, communications and support functions and add capacity and redundancy
- Explore microgrids with varied DERs like geothermal, cogeneration and renewables + battery
- Increase demand management capabilities with cleaner backup generation
- Harden campuses and protect the perimeter
- Design sustainable, LEED buildings & install green infrastructure
- Plan for flexibility and future requirements for spaces
- Design for emergency management + enterprise resiliency for natural and human based disasters (resilient operations)

Resilient Operations

Climate Change and NYU Langone Health

Future Considerations for Healthcare in a Warming World

There is near-y a unanimous consensus within the scientific community that greenhouse gas emissions generated by human activity will change the earth's climate. Climate change will continue to directly impact the frequency and intensity of natural disasters into the next century and will therefore affect the safety of our communities. Measuring the exact impacts of climate change is difficult due to the complexity of consequences; some aspects contribute to homelessness, hunger and disruptions to education and the economy, all of which can have a profound impact on physical and mental health. Hospitals, as critical infrastructure, will bear the burden of the adverse impacts of climate change on the healthcare system:

- Severe weather incidents (e.g., flooding and power outages) will result in cascading impacts, including disruption to clinical care.
- Increasingly severe storms or environmental conditions (e.g., coastal storms and extreme temperatures) increase the likelihood of mass casualty incidents and exacerbate public health issues.
- Increasing risk for infectious disease transmission and growing vulnerability to certain disease-causing fungi will place stresses on healthcare systems.
- Increasing displacement and migration due to weather-related events will exacerbate men

As temperatures continue to rise, extreme temperature chronic health conditions. Extreme heat is now one of States, causing more fatalities than hurricanes, tornad to milder winters, warmer summers, and fewer days of diseases to spread and infect more people (via mosqu water). These conditions increase the risk of transmissi Fever and have allowed certain disease-causing fungi t for them to survive. Increasing pressure will be place

NYU Langone Health

HVA
Hazard Vulnerability Analysis
2023

NYU Langone Health
Emergency Management@nyulangone.org
212-243-2811

NYU Langone Health

HURRICANE PROTOCOL
5-Day Countdown

Hazard Annex to NYU Langone Health Emergency Operations Plan

August 2020

Version 5.1
Last revised: August 31, 2020

Scan with QR Code Reader to access the latest electronic version of this document.

ELPRG

ULT Freezer (-80 °C) Temperature Data Monitoring

Protect precious irreplaceable biological samples and pharmaceutical products in storage and in transit

Disaster Evacuation in Progress

AUTHORIZED PERSONNEL ONLY

East River Campus Case Study

3.5 million ft² with 10 interconnected buildings

Energy Independent

- 13 MW of cogeneration systems, most dual fuel
- >25 MW diesel backup emergency generation
- 2 backup boilers
- Enhanced black start capabilities
- 6 redundant high tension electrical services with power fed from two different utility substations

Campus Design

- Raised critical infrastructure, IT, programs, & communications above designed flood elevation
- Redundant data centers connected to all buildings
- Building containment & compartmentalization
- Extensive flood protection, walls, gates & doors

- Passive measures like “up-and-over” stairs
- Deployable pumping + permanent piping
- Elevator protection and programming
- Green roofs & green spaces to manage stormwater
- Exterior-accessible, elevated emergency fuel refilling locations

Operations

- Enhanced demand management capabilities
- Automatic emergency operation modes
- Continuous commissioning of systems
- Infrastructure and flood mitigation measure testing
- Staff training, communications and drills



Performance
Excellence in
Electricity
Renewal



12,000 SF GREEN ROOF



SCIENCE BUILDING GREY
WATER RECYCLING SYSTEM



IN PROGRESS

SOUTH DATA
CENTER

NORTH DATA
CENTER

Con Ed Utility Service

Cogeneration System & Backup Boilers

Emergency Generators & Switchgear

Linear Accelerators

NYULH DFE (Sandy + 2 feet)
New FEMA 500-Year Elevation
Sandy High Water Level



LOADING DOCK DEPLOYABLE
FLOOD GATE

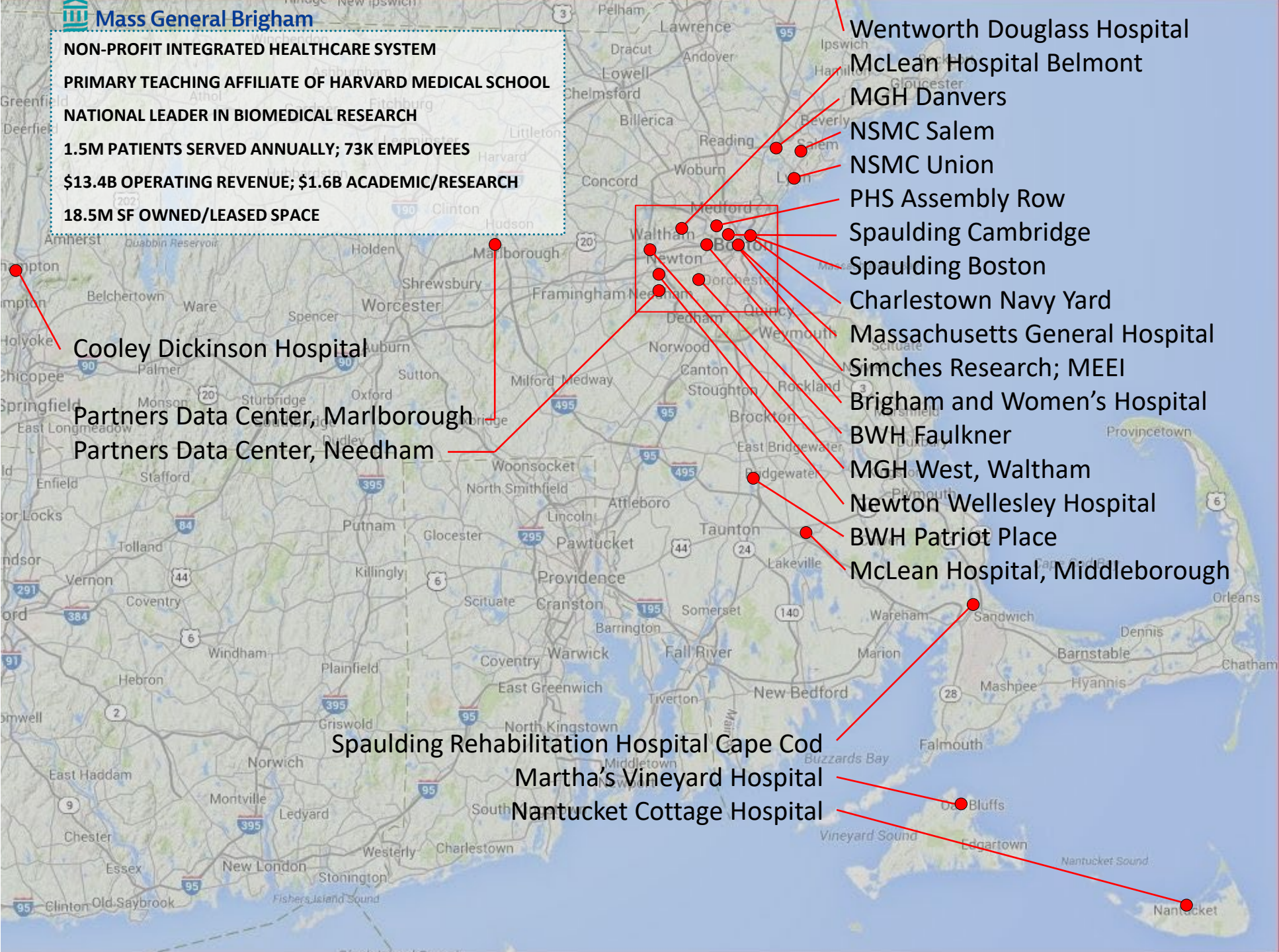


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David Burson, AIA, NCARB
Senior Project Manager, Real Estate and Facilities
Mass General Brigham



NON-PROFIT INTEGRATED HEALTHCARE SYSTEM
PRIMARY TEACHING AFFILIATE OF HARVARD MEDICAL SCHOOL
NATIONAL LEADER IN BIOMEDICAL RESEARCH
1.5M PATIENTS SERVED ANNUALLY; 73K EMPLOYEES
\$13.4B OPERATING REVENUE; \$1.6B ACADEMIC/RESEARCH
18.5M SF OWNED/LEASED SPACE



Cooley Dickinson Hospital

Partners Data Center, Marlborough

Partners Data Center, Needham

Spaulding Rehabilitation Hospital Cape Cod

Martha's Vineyard Hospital

Nantucket Cottage Hospital

Wentworth Douglass Hospital

McLean Hospital Belmont

MGH Danvers

NSMC Salem

NSMC Union

PHS Assembly Row

Spaulding Cambridge

Spaulding Boston

Charlestown Navy Yard

Massachusetts General Hospital

Simches Research; MEEI

Brigham and Women's Hospital

BWH Faulkner

MGH West, Waltham

Newton Wellesley Hospital

BWH Patriot Place

McLean Hospital, Middleborough

MASS GENERAL BRIGHAM SUSTAINABLE INITIATIVES

Leadership and Public Health

To support Mass General Brigham in becoming a leader for promoting a **healthy environment**, optimizing the **care of our patients** and the **well-being of our employees** while **conserving the resources we expend**.

Mass General Brigham cannot be viewed as contributing to the health problems manifested in the patients we are treating.



Resilient Design - Spaulding Rehabilitation Hospital



SPAULDING REHABILITATION HOSPITAL

Statistics

- 378,000 s.f. Rehabilitation Hospital
 - 261,300 s.f. above grade
 - 117,000 s.f. below grade [primarily parking]
- 9 Floors above grade, including Mechanical Penthouse
- 132 Acute Rehab Beds
- Outpatient Clinics & Therapy
- Research and Teaching Hospital
- Opened April 2013
- LEED v2.2 Gold Certification





Boston 1640-2012

from Krieger, Cobb, Turner: *Mapping Boston, 1999*



NEW ORLEANS HOSPITALS: HURRICANE KATRINA 2005

- New Orleans hospitals including the VA, Charity, and Mercy hospitals were **evacuated** due to loss of emergency power, water, sewage treatment and critical infrastructure. **Dozens of deaths** were related to **post storm conditions** in the hospitals.
- The new **Southeast Louisiana Veterans Health Care Service (SLVHCS)** was designed to **“Defend in Place”** for 7 days.
 - Floor **elevations** and **critical functions** set to **withstand future levee breaks**
 - **Provisions and accommodations** for up to **1,000 patients and staff**
 - Energy Plant stores **320,000 gallons of fuel**
 - Storage of over **1,000,000 gallons** of captured **rainwater** and **on-site sewage treatment plant**
 - **Warehouse** for food & emergency supplies



BUILDING RESILIENCY STRATEGIES

- **Design and construct** (or renovate) **buildings** to handle severe storms, flooding, wildfire, and other **impacts** that are expected to result from a **warming climate**.
- Locate **critical systems** to withstand flooding and extreme weather events.
- Create buildings that will **maintain livable conditions in the event of extended loss of power** or heating fuel through **energy load reductions** and reliance on **passive heating and cooling strategies**. (**passive survivability**)
- **Reduce dependence on complex building controls** and systems. Provide **manual overrides** in case of malfunction or temporary power outages.
- Rely on **vernacular design** practices that were prevalent before the advent of air conditioning and central heating. Combine these with **modern materials** to optimize **resilient design**.



Damage at St. John's Regional Medical Center caused by the May 22, 2011, tornado.



Mercy Hospital Joplin, which opened in March 2015. The new hospital is a "storm-hardened" facility with a precast concrete shell, windows that can withstand high winds, and partially buried generators for backup power in an emergency.

PASSIVE SURVIVABILITY

- The decision to “**Shelter in Place**” during extended periods of power outages call for measures to extend critical conditioning systems through emergency power hookups and/ or **passive measures to extend habitable temperatures** for longer periods of time.
- **Enhanced building enclosures** to reduce solar gain or heat loss depending on the exterior conditions to maintain thermal comfort.
- **Daylighting** so that during the day spaces are habitable without electric lights.
- **Operable windows** to mitigate overheating in the event a building remains occupied while patients are awaiting evacuation.
- **Provisions for potable water and water for sewage conveyance** are needed. Hospitals should place a high priority on developing independent, high quality reliable water supplies.



Superdome New Orleans w/ evacuees during Hurricane Katrina



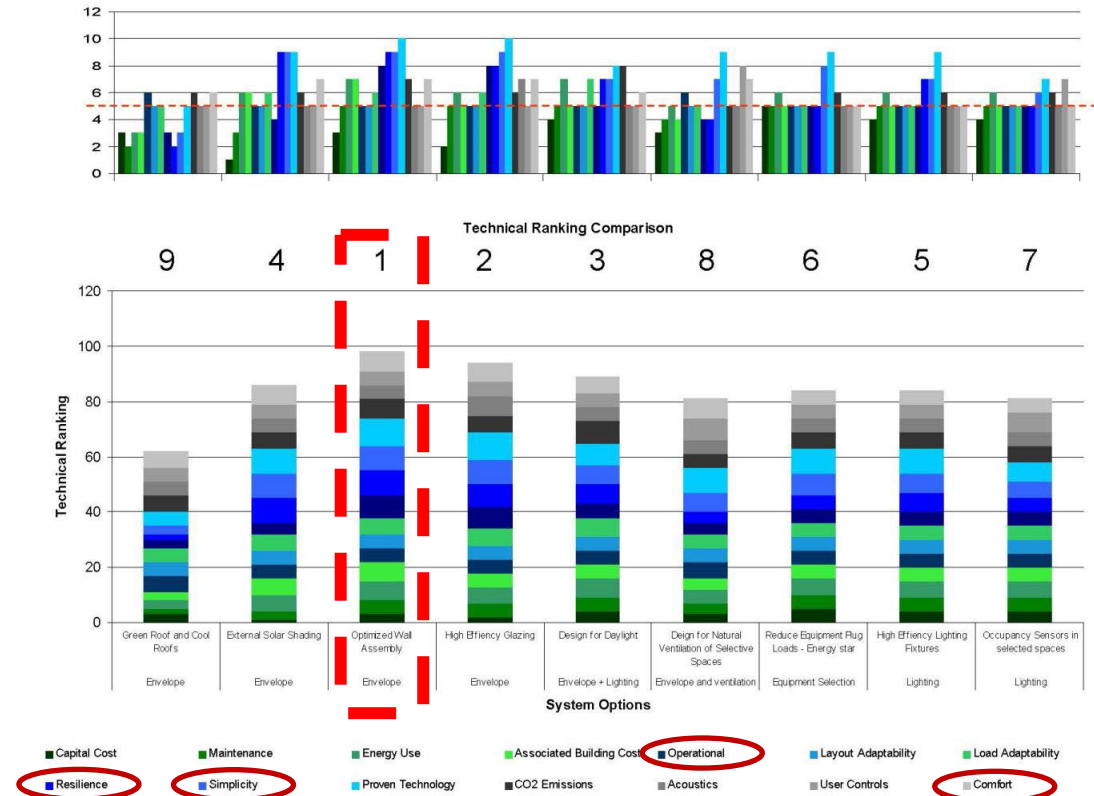
© Anton Grassl /Courtesy Partners HealthCare

Therapy Gym at Spaulding Rehabilitation Hospital

SPAULDING REHABILITATION HOSPITAL Sustainability/ Resiliency Decision-making Process

- Establish **criteria** by which strategies would be evaluated:
 - Capital Cost
 - Maintenance
 - Energy Use
 - Associated Building Cost
 - **Operational**
 - Layout Adaptability
 - Load Adaptability
 - **Resilience**
 - **Simplicity**
 - Proven Technology
 - CO 2 Emissions
 - Acoustics
 - User Controls
 - **Comfort**
- **Optimized Wall Assembly ranked #1**

Envelope/Lighting



Study and graphics by Buro Happold Inc.
Courtesy of Mass General Brigham



SPAULDING REHABILITATION HOSPITAL

Resiliency Measures

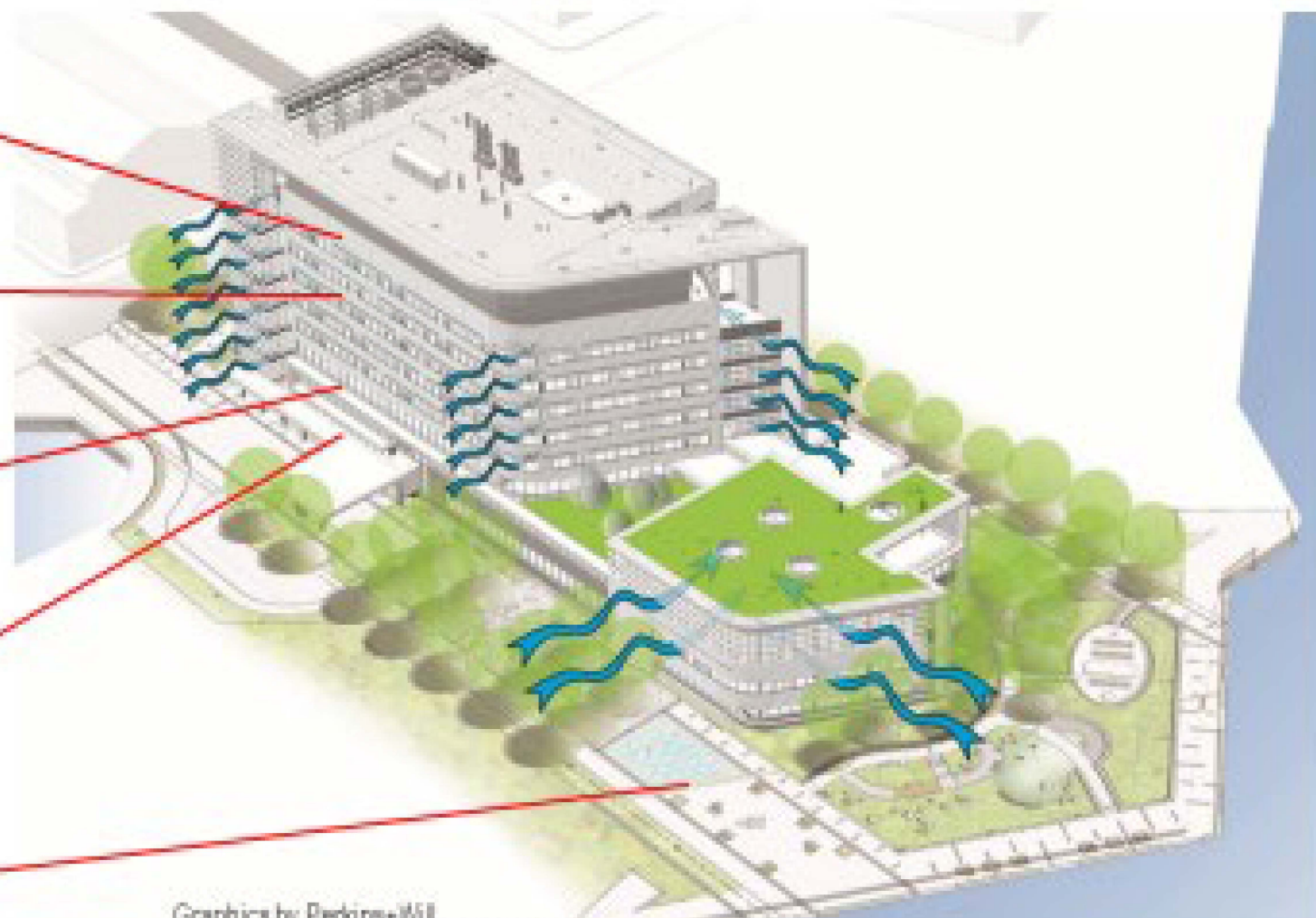
Mechanical, electrical, & emergency generators in penthouse to avoid flooding issues.

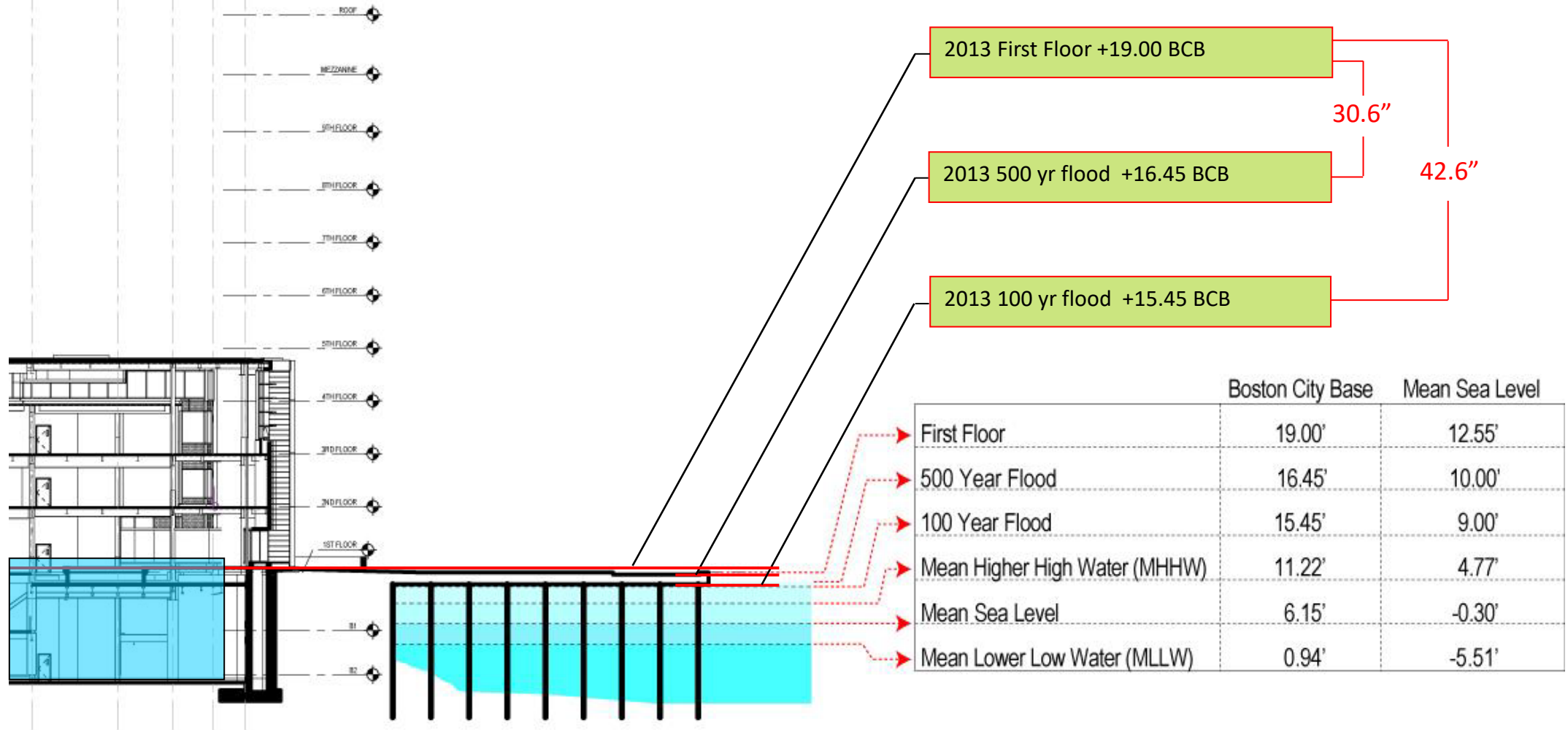
Operable windows in Patient Rooms keyed open in event of systems failure.

Critical patient programs located above the ground floor.

Ground floor and top of parking ramp set 30" above current 500-year flood level.

Berms, retaining walls & plantings act as protective barriers to storm surge.





Spaulding Rehabilitation Hospital, Charlestown Navy Yard, Boston

Architect: Perkins + Will Civil engineer VHB Analytical diagrams P+W / Mass General Brigham

SPAULDING REHABILITATION HOSPITAL

Lessons Learned

- **Staff** must be **trained** in operational procedures in order **to realize** the **design intent** e.g., use of operable windows for patient satisfaction and energy savings as well as passive survivability.
- **Location** of the main **Kitchen** and **food supplies** on the Ground Floor were **driven by other considerations than resiliency**.
- **Rainwater/ other clean water capture not implemented. ROI** proved to be **too long** to be economically feasible.
- **Integration** of the **site** and **ground floor** with the **neighborhood** has **enabled Spaulding** to act as a **catalyst** for community **social resilience** as a means to address adaptation to climate change.





10/29/2012

SPAULDING REHABILITATION HOSPITAL

The Business Case for Resiliency

- The **premium for resiliency measures** was roughly \$1.5 million out of a construction cost of \$160 million. Utility rebates paid for roughly half of these additional costs.
- Investments in the high performance building enclosure and energy efficiency measures have a **5 – 8 year payback**.
- Many of the **resiliency measures** also provide **direct benefits to patients**, for example the landscape design which helps to mitigate storm surge is part of a therapy garden. This has **increased demand for Spaulding's services**.



Spaulding Rehabilitation Hospital Boston, Massachusetts

PREMIUM
\$1.5 million
\$160 million
\$1.5 million
\$160 million

RESILIENCY
\$1.5 million
\$160 million
\$1.5 million
\$160 million

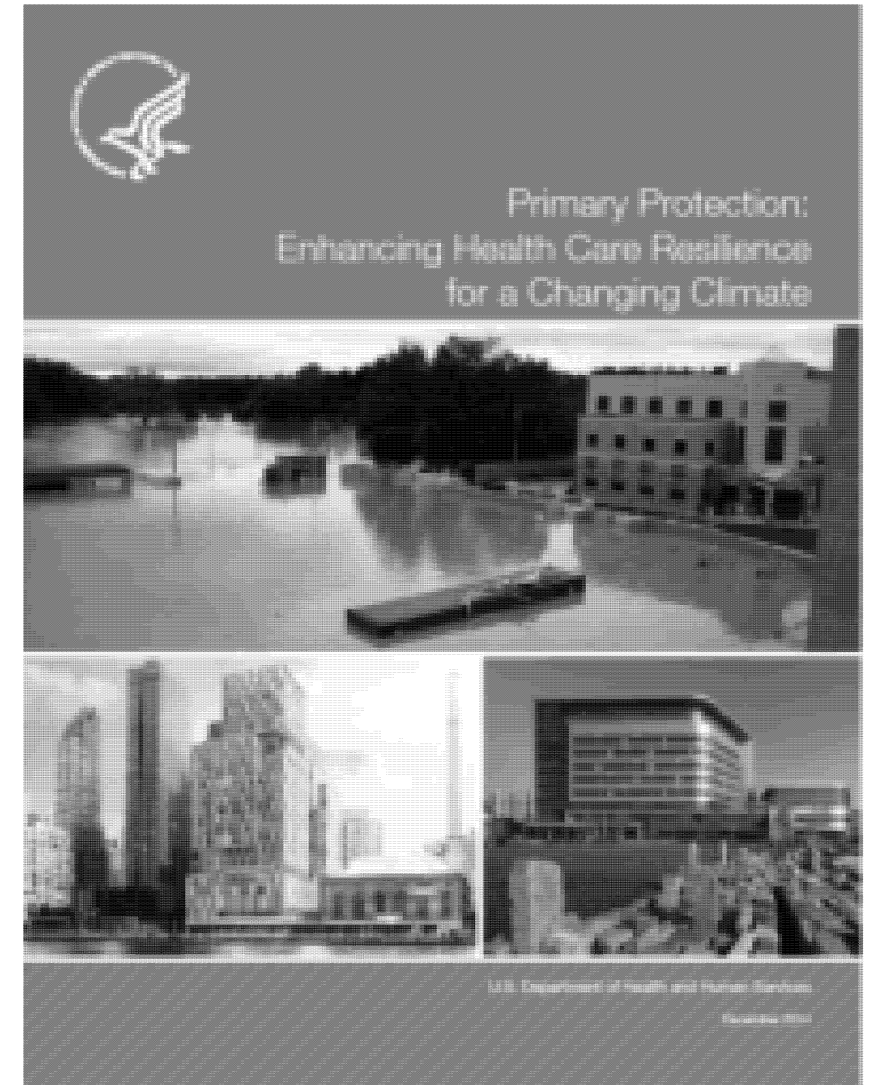
WHEN BOSTON-BASED PARTNERS HEALTHCARE, one of the leading U.S. nonprofit hospital and physicians networks, set out to build the new Spaulding Rehabilitation Hospital a decade ago, it wanted a site on the Boston waterfront because water activities, including kayaking, were key to its rehab program. Just as planning was beginning, however, Hurricane Katrina struck New Orleans, causing deaths because of flooding and systems failures in that city's hospitals.



PHOTO: SPULDING REHABILITATION HOSPITAL

FOUNDATIONAL CONCEPTS OF HEALTHCARE RESILIENCE

1. A **network of coordinated health care services** must remain **operational** during and following extreme weather events.
2. Public Policymakers and healthcare providers must work together to determine the **minimum and recommended infrastructure requirements** for all healthcare delivery settings.
3. Climate change is introducing new threats and **new building design threshold conditions**.
4. Health care organizations play a **key role in community resilience**.
5. **Resilient health care organizations must anticipate extreme weather risks** and transcend limitations of regional public policy, local development vulnerabilities, and community infrastructure challenges as they site, construct, and retrofit health care facilities.
6. **Community engagement** is a key element of health care system resilience.



Resilient Design

Mass General Brigham Administrative Campus, Somerville, MA



Resilient Design

Mass General Brigham Corporate HQ, Somerville, MA



Resilient Design

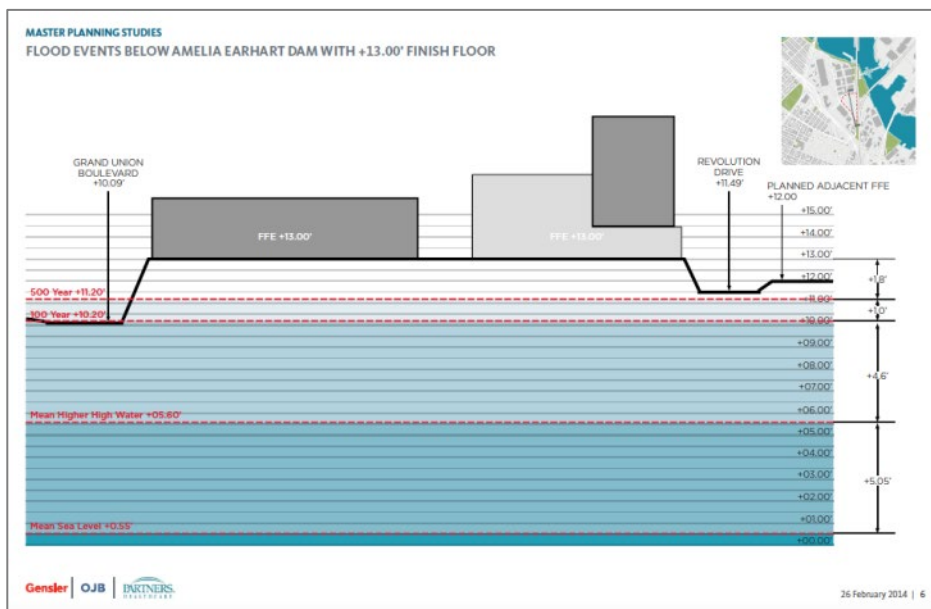
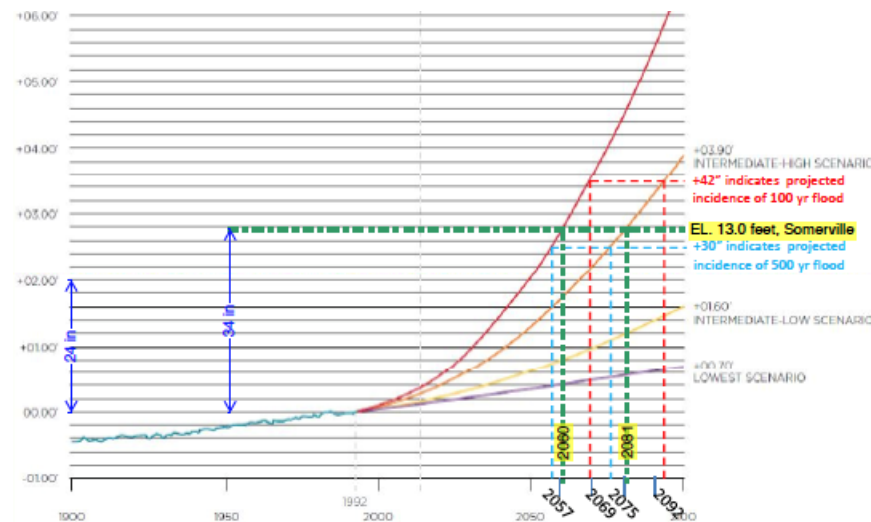
Mass General Brigham Corporate HQ, Somerville, MA

Riverine flooding from Mystic River – above the dam

Ocean flooding from SLR below the dam

- Site datum set 34" above current HHT
- High/intermediate high scenarios
- 500-yr flood vulnerability 2050's – 2070's
- 100-yr flood vulnerability 2060's – 2090's

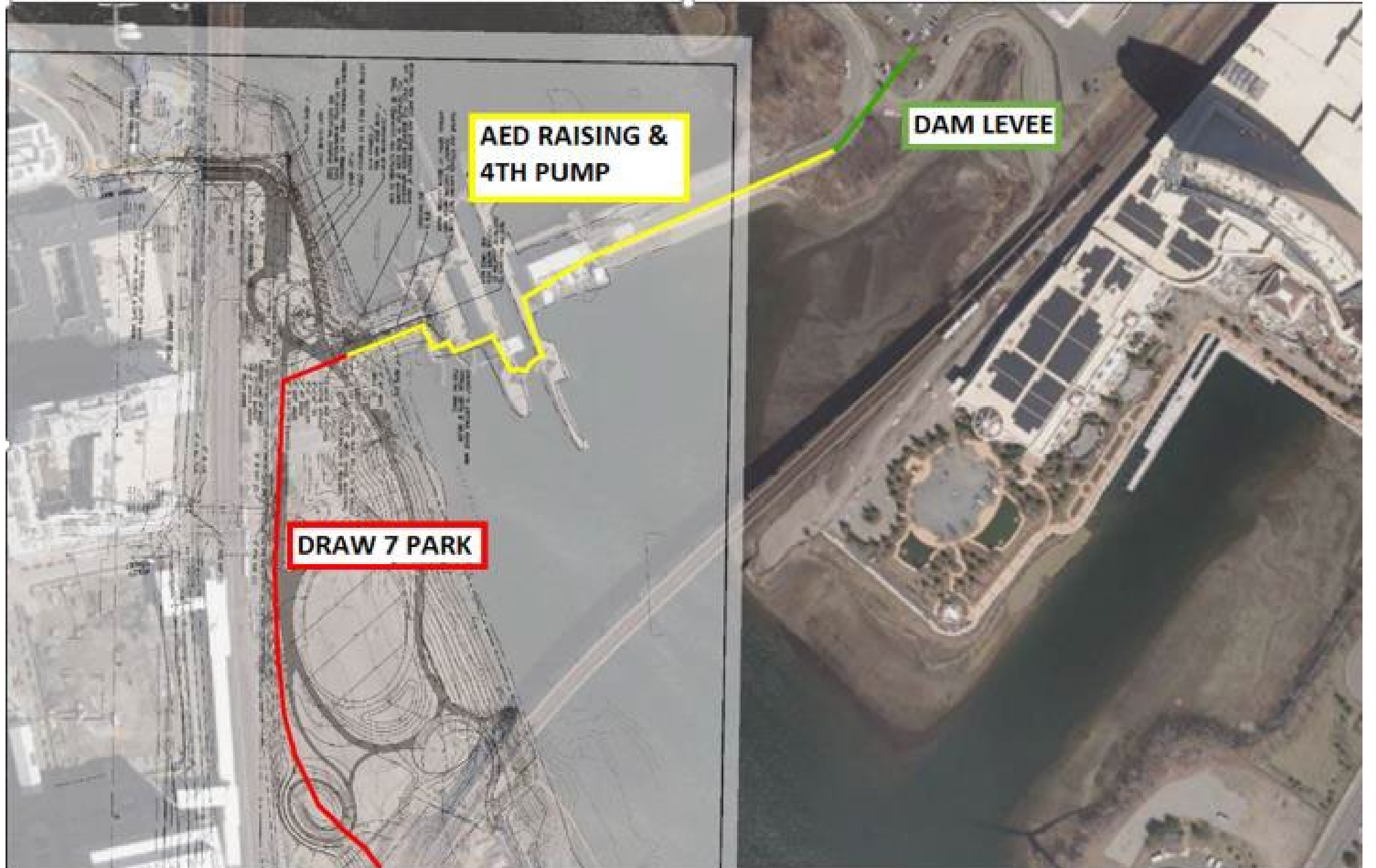
Redundancies for surrounding infrastructure



Flood events above dam (river flooding)



Draw 7 Park, Somerville
March 2, 2018 11:30 am (high tide)







1%-annual-chance storm 2070.

MYSTIC MALL, MARKET BASKET, STOP & SHOP

REGIONAL FBI HEADQUARTERS

ADDISON ORANGE NEIGHBORHOOD (EJ)

EVERETT COMMERCIAL TRIANGLE

FHWA CRITICAL URBAN FREIGHT CORRIDORS SUPPORTING PORT AND DISTRIBUTION ACTIVITIES

REGIONALLY CRITICAL FOOD PRODUCTION, STORAGE, AND DISTRIBUTION INDUSTRY (ENTIRE EAST WEST FLOOD EXTENT)

MASS GENERAL HOSPITAL CHELSEA

MASS INFORMATION TECHNOLOGY CENTER

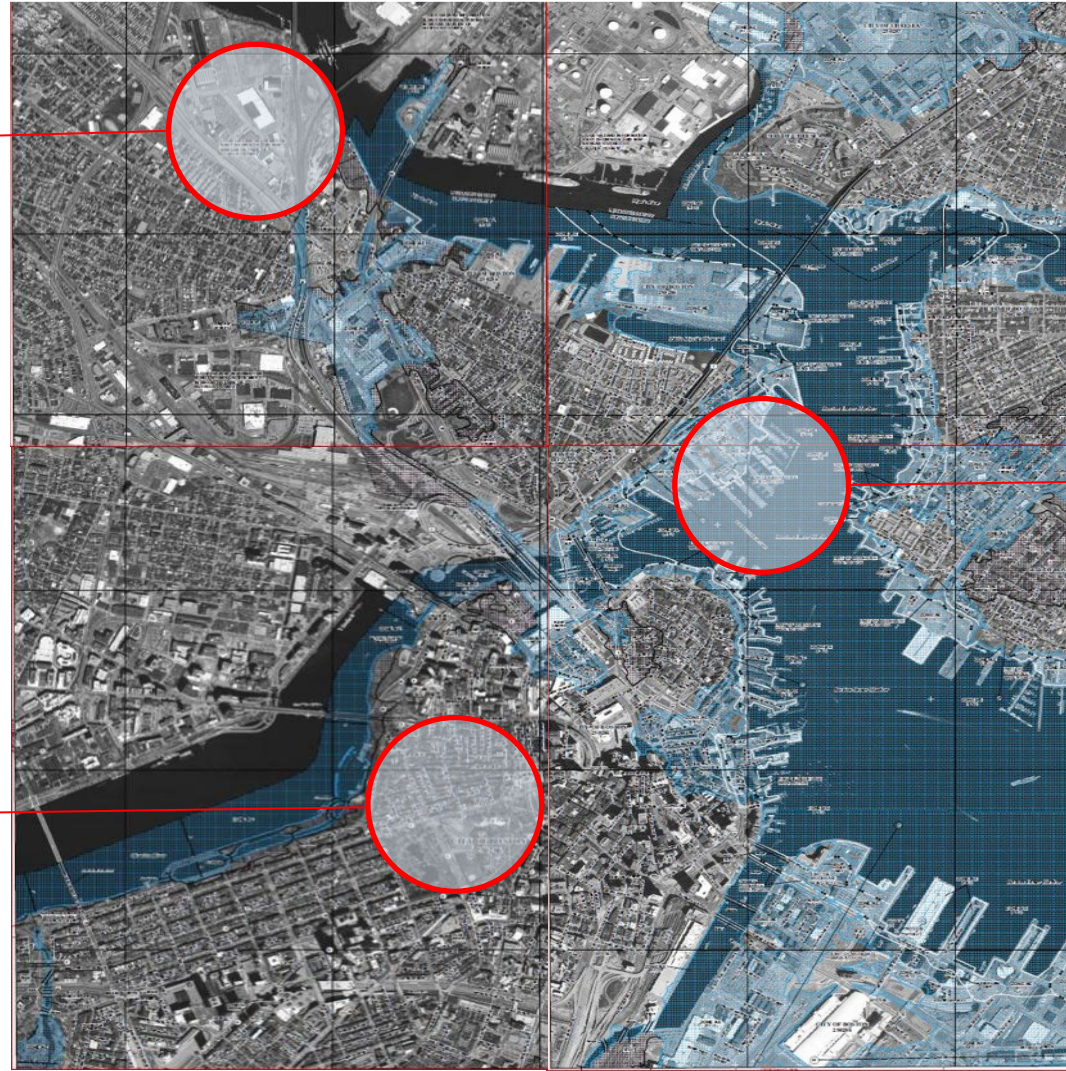
CHelsea WILLIAMS MIDDLE SCHOOL

MBTA COMMUTER RAIL & SILVERLINE STATION, RAMPS TO US RT 1, REVERE BEACH PARKWAY

Vulnerabilities and Risk Management

Mass General Brigham
Assembly Row
1,087,500SF
Administrative
Campus

MGH Main Campus
4,309,811SF
1051 beds
70 OR's
Simches Research
Research Labs
405,900SF



Spaulding Boston
220,339SF
132 beds
Charlestown Navy Yard
Research labs
991,170SF

SUSTAINABLE CLIMATE RESILIENT HEALTHCARE FACILITIES TOOLKIT

FRAMEWORK FOR RESILIENT HEALTHCARE SETTINGS

- **ELEMENT 1:** Climate Risks and Community Vulnerability Assessment
- **ELEMENT 2:** Land Use, Building Design, and Regulatory Context
- **ELEMENT 3:** Infrastructure Protection and Resilience Planning
- **ELEMENT 4:** Essential Clinical Care Service Delivery Planning
- **ELEMENT 5:** Environmental Protection and Ecosystem Adaptations

Vulnerabilities and Risk Management

Mass General Brigham Strategic Climate Resiliency Plan

PHASE 1

Climate Scenarios Hazard Assessment

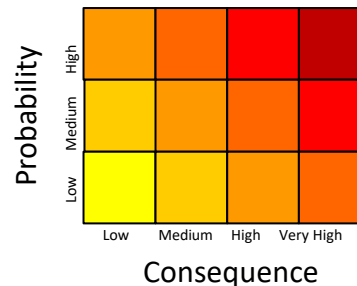


Climate analysis
Hazard priorities

- SLR / Storm Surge
- Precipitation
- Temperature
- Wind
- *Seismic*

PHASE 2

Vulnerability Assessment



- Critical Facilities and Operations
- 5 Elements Checklist Risk Assessment
- Prioritize Needs Across System

PHASE 3

Implementation



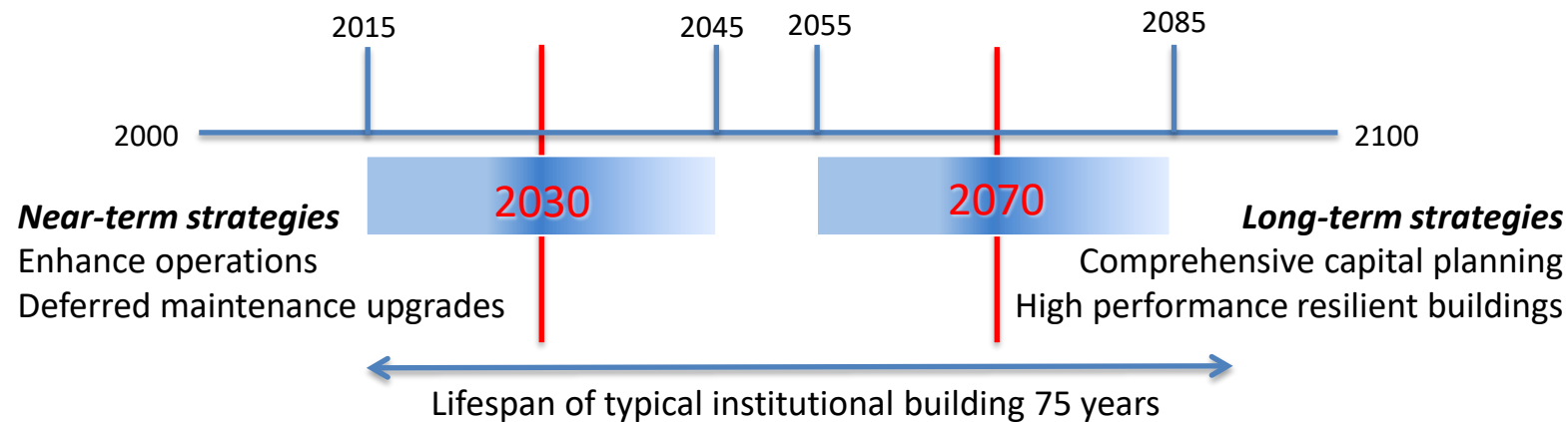
- Facility Resilience
- Capital Prioritization
- Operations enhancement
- Long-term Adaptation

Vulnerabilities and risk management

Mass General Brigham Strategic Climate Resiliency Plan

Climate analysis projections

Value of long view vs. quality of data



Risk = Probability x Consequence

Where to place the emphasis?

Probability based

Informs capital investment cycle

| | |
|-----------|------|
| 10 year | 10% |
| 100 year | 1%* |
| 500 year | 0.2% |
| 1000 year | 0.1% |

Consequence based

'Worst case scenario' for emergency operations management.

Based on 5 storm models.

* 1% probability of an event occurring in any one year
 = 26% in 30 years
 = 39% in 50 years

Risk Management - A Systemwide Strategy



Deliverables

- **Individualized Climate Scenarios** for 30 campuses
SLR, Storm Surge, Precipitation, Temperature, Wind and Seismic
- **Standardized Vulnerability Assessment**
Alignment with current risk criteria informed by lessons learned
- **Compilation of Vulnerabilities** per campus/building
- **System-wide Risk Assessment**
Identification of key vulnerabilities and need for redundancy
Impact on critical functions and business continuity
- Identification of **key external dependencies**
Strategies for addressing operational dependencies
- **Insurance implications** and preliminary recommendation on incentives

Risk Management - A Systemwide Strategy

Hazards analyzed per campus

| Location Name | City / Town | SLR | Surge | Precip | Temp | Wind | Seismic |
|--------------------------------|-------------|-----|-------|--------|------|------|---------|
| BWH Faulkner Main Campus | Boston | | | | | | |
| BWH Main Campus | Boston | | | | | | |
| BWH CHC Brookside | Boston | | | | | | |
| BWH CHC Southern Jamaica Plain | Boston | | | | | | |
| BWH/MGH ACC Patriot Place | Foxborough | | | | | | |
| Cooley Dickinson Hospital | Northampton | | | | | | |
| McLean Main Campus | Belmont | | | | | | |
| MGH Main Campus | Boston | | | | | | |
| MGH 125 Nashua Street | Boston | | | | | | |
| MGH Simches Research Center | Boston | | | | | | |
| MGH West ACC | Waltham | | | | | | |
| MGH CHC Charlestown | Boston | | | | | | |
| MGH CHC Chelsea | Chelsea | | | | | | |
| MGH CHC Everett | Everett | | | | | | |
| MGH CHC Revere | Revere | | | | | | |

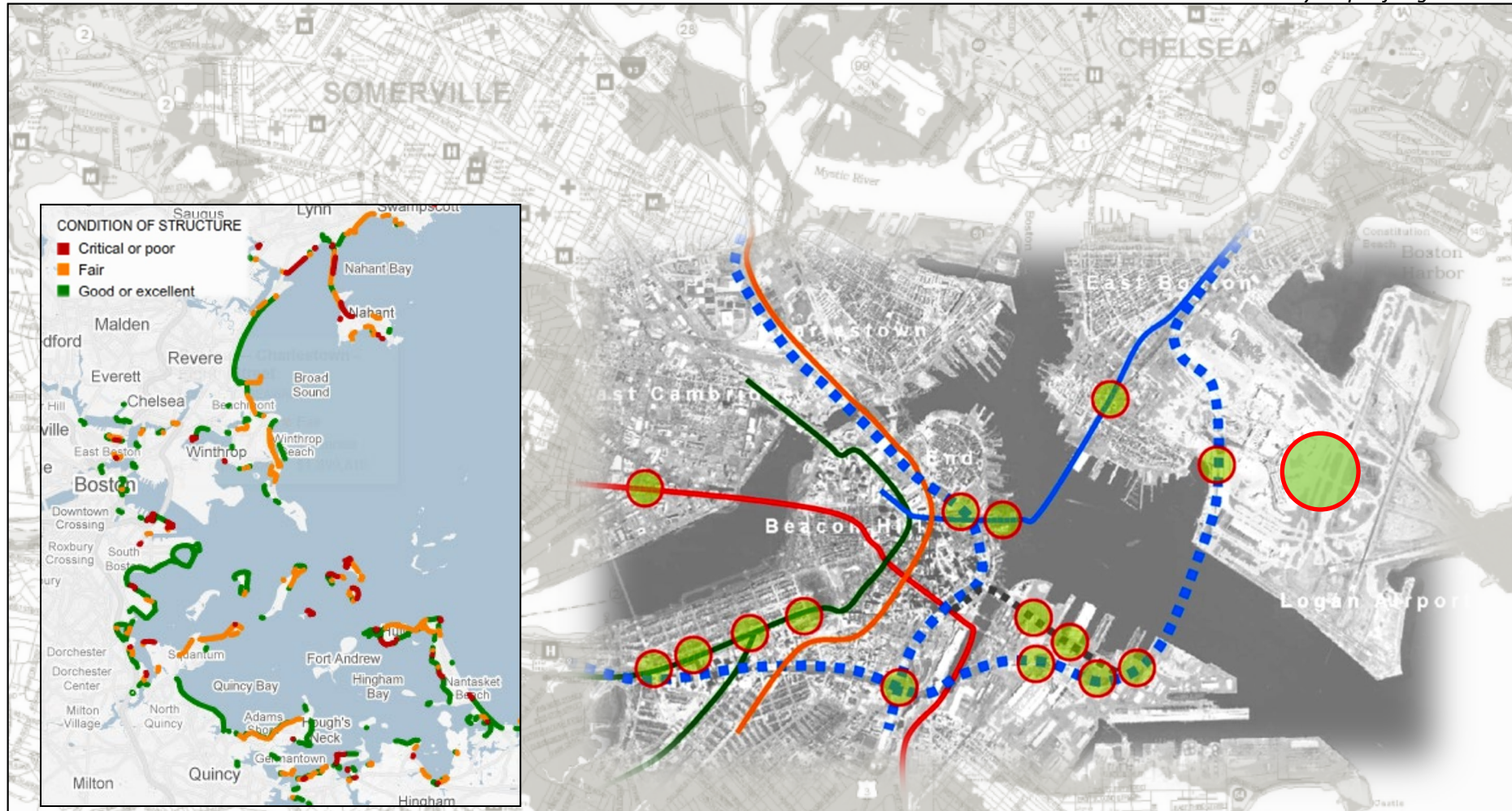
Project prioritization

| Priority | Type of Service | Facility Type |
|----------|---|---|
| 1 | <ul style="list-style-type: none">• Core Inpatient Services• Emergency Department• Dialysis• Infusion• Primate/Transgenic Animal Facility• Irreplaceable Research Samples• Data Center Services | <ul style="list-style-type: none">• Hospital/Inpatient Building• Data Center |
| 2 | <ul style="list-style-type: none">• Elective Inpatient Services• Core Outpatient Services• Rodent/Other Animal Facility | <ul style="list-style-type: none">• Community Health Center/ACC• Research Building |
| 3 | <ul style="list-style-type: none">• All Other Clinical• All Other Research/Lab Equipment | <ul style="list-style-type: none">• Medical Office Building• Administrative Building |
| 4 | <ul style="list-style-type: none">• Administrative Services• Parking & Site Impacts | |

System Vulnerabilities

Urban and regional dependencies

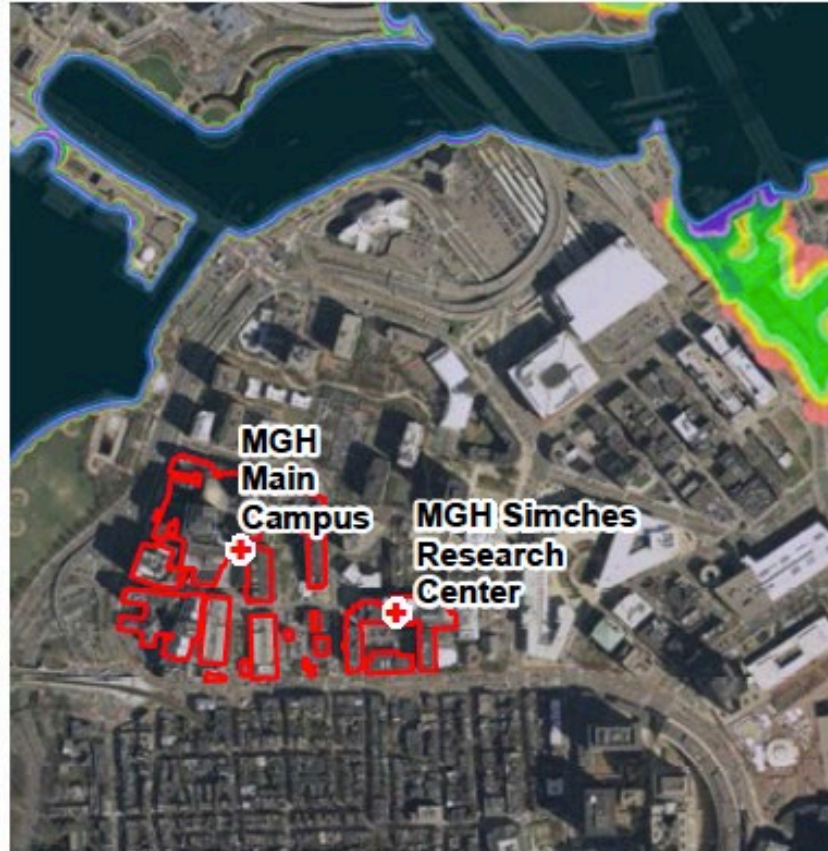
US Army Corps of Engineers 2000



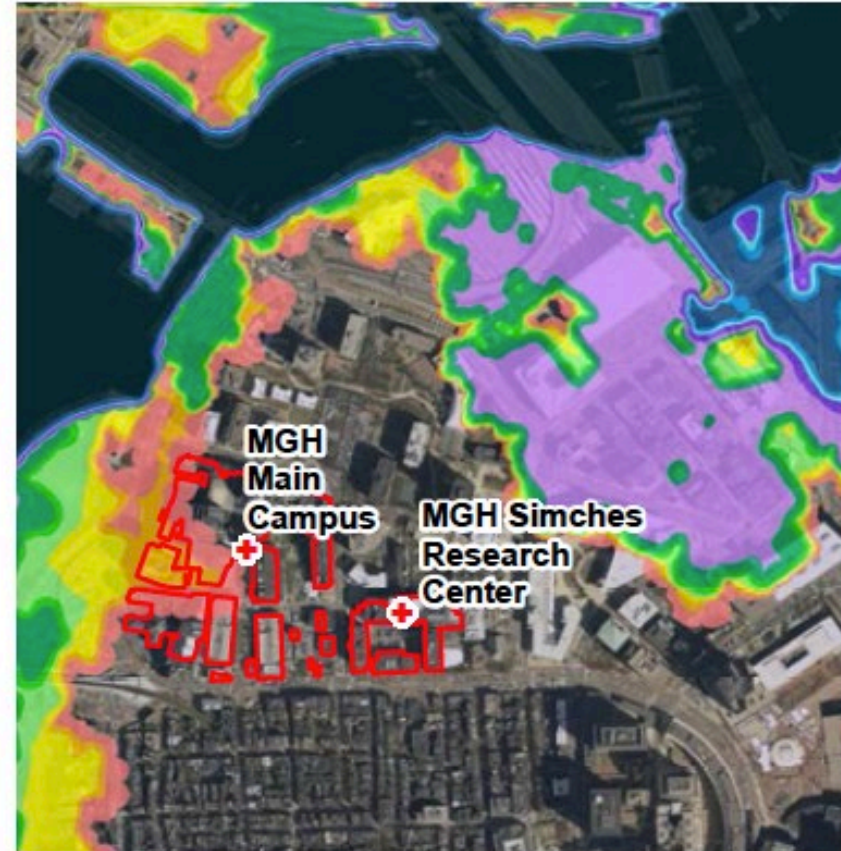
Capacity Redundancy (85-90% occupancy) Equivalence (ICU vs. Rehab.)
Access Roads - interstate and local Tunnels and Subways
Infrastructure Power / Gas / Water / Sewers etc. Shoreline protection

Sea Level Rise and Storm Surge

Probability-based Flooding



2030 Probability
0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%



2070 Probability
0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%



MGH CAMPUS EXPANSION

- 18 mo. permitting
- 2020 construction start
- 1M GSF; 12 stories
- 6 floors inpatient; 450 beds
- New campus services center
- 6 levels underground parking



MGH CAMPUS RESILIENCY PROJECT

- Place of refuge for patients and staff across campus
- Capacity to shelter in place for up to four days
- Flood-proofing existing buildings and infrastructure



T R A C I E
HEALTHCARE EMERGENCY PREPAREDNESS
INFORMATION GATEWAY

Panel Roundtable



Question & Answer



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