

Resiliency in Urban Waterfront Environments and Impacts to Healthcare Facilities

*Extreme Weather Preparedness for Critical Assets
Connecting Social and Physical Infrastructure*

*SAME Jets – Savannah
June 26, 2024*

INTRODUCTION



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BOSTON – SEAPORT DISTRICT





Winter Storm Grayson



Winter Storm Riley



Assessing Risk & Vulnerability | A Boston



Flood Characteristics

Flood depth, Flood velocity, Flood duration, Rate of rise, Debris/Ice flows, **Wave action (coastal)**, Floodway, Other(?)

Site Characteristics

Location, Soil type, Topography, Site size, Urban/Rural, Interdependencies

Building/Structure Characteristics

Type of construction, Foundation, Condition of the building, Building Occupancy, Lower levels (Basement), **Historical Significance**, Other(?)

Other Considerations

Building Codes, Zoning Ordinances and Local Restrictions, Other Agencies (Local / State / Federal), Aesthetics, Public Health/Safety/Welfare, Other(?)

NEW YORK CITY



Hurricane Sandy, 2012

Physical Disruption



Social Disruption



FAILING UTILITY, INFRASTRUCTURE AND URBAN ASSETS

An aerial night photograph of New York City, showing the dense urban landscape and the surrounding water. The image is overlaid with several red callout boxes, each containing a label for a specific urban asset. The labels are: 'Holland Tunnel' (pointing to the tunnel under the Hudson River), 'NYCT - Subway' (pointing to the subway system in the city center), 'Hospital' (pointing to a hospital in the city center), 'Power Generation' (pointing to a power plant in the city center), 'Telecommunication' (pointing to a telecommunications tower in the city center), 'High Rise Offices' (pointing to a cluster of skyscrapers in the city center), 'Data center' (pointing to a data center in the city center), and 'Brooklyn Battery Tunnel' (pointing to the tunnel under the East River).

Holland Tunnel

Hospital

Power Generation

NYCT - Subway

Telecommunication

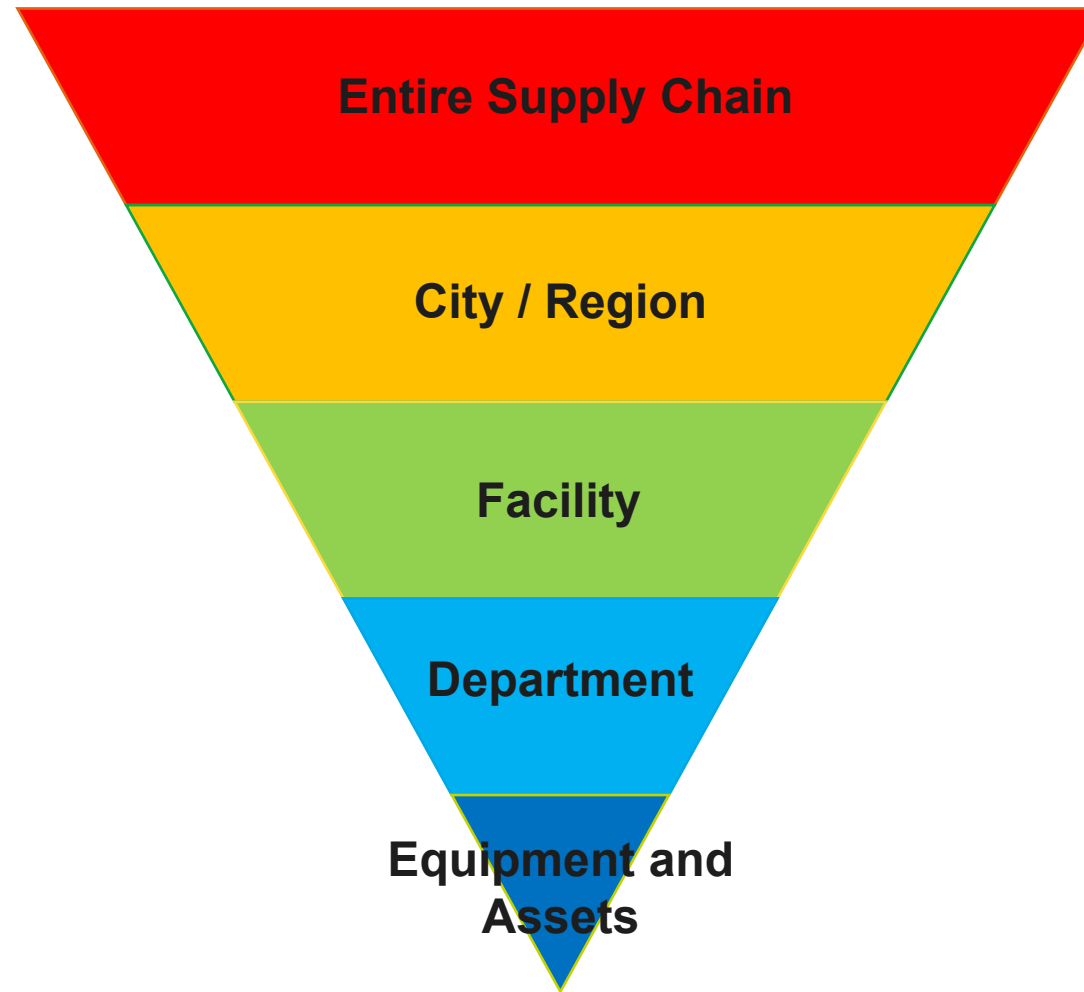
High Rise Offices

Data center

Brooklyn Battery Tunnel

Assessing Risk & Resilience

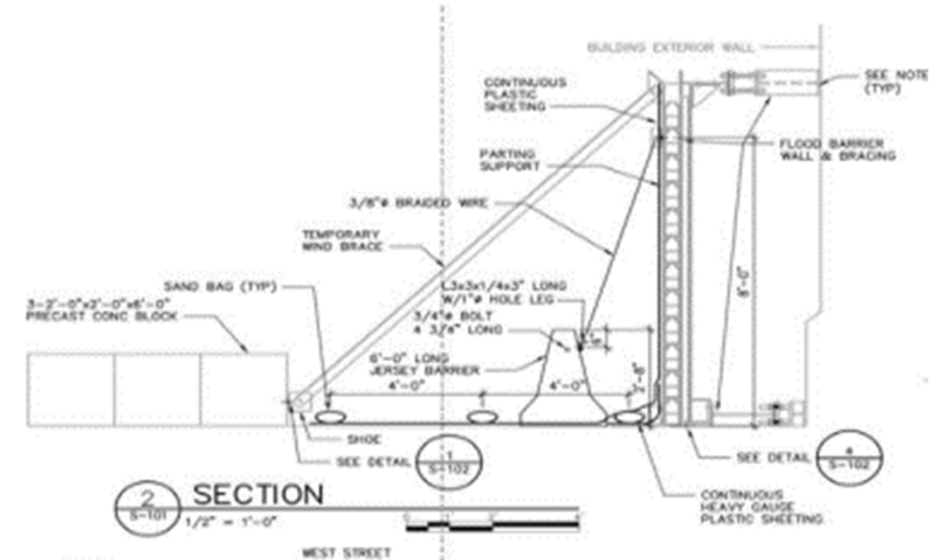
Interdependency, cascading impacts



Always look at least one scale up from the level of interest

Immediate Response: Protection of Critical Assets

Telecommunication Centers



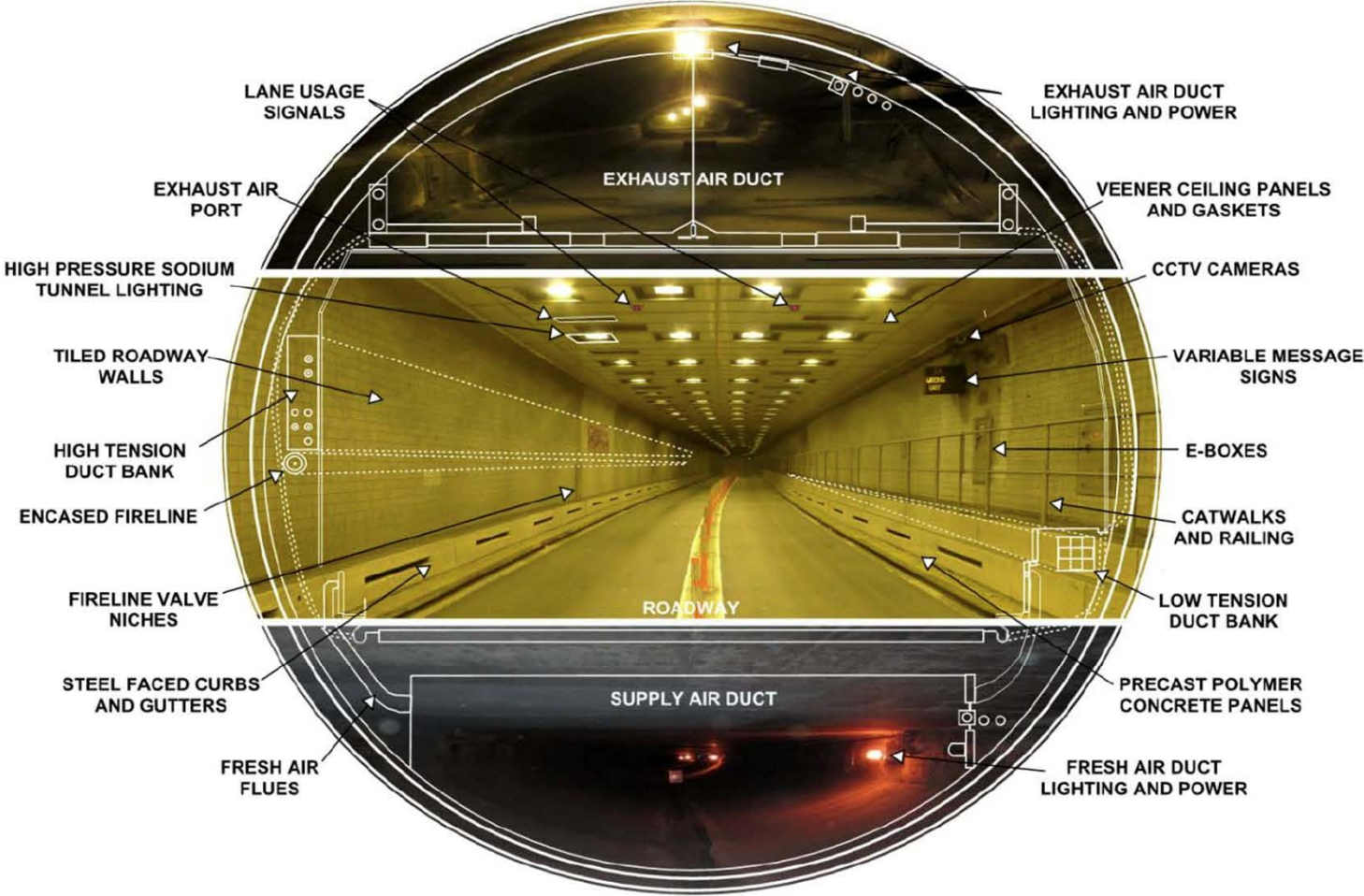
Full Perimeter Protection Of Landmark Buildings | Design, Permitting, Construction & Testing

Protecting Critical Connections

Brooklyn Battery Tunnel



Tunnel Elements and Systems Affected by Sandy



A Systems Approach to Climate Robust Water Management

Connect all scales and build the business case



Built Asset Management



Digital/Cyber



Operations



Organization Culture



Regulatory Framework



Policies and Standards



Roles, Responsibilities
and Authorities



Financial Resources



Human Resources



Emergency and Risk
Management



Long-Term Strategic
Planning



Stakeholder
Coordination

Depth of Inundation for
100 Year Event with 2050
90th Percentile SLR (feet)

0 - 2

2.1 - 4

4.1 - 6

6.1 - 8

8.1 - 10

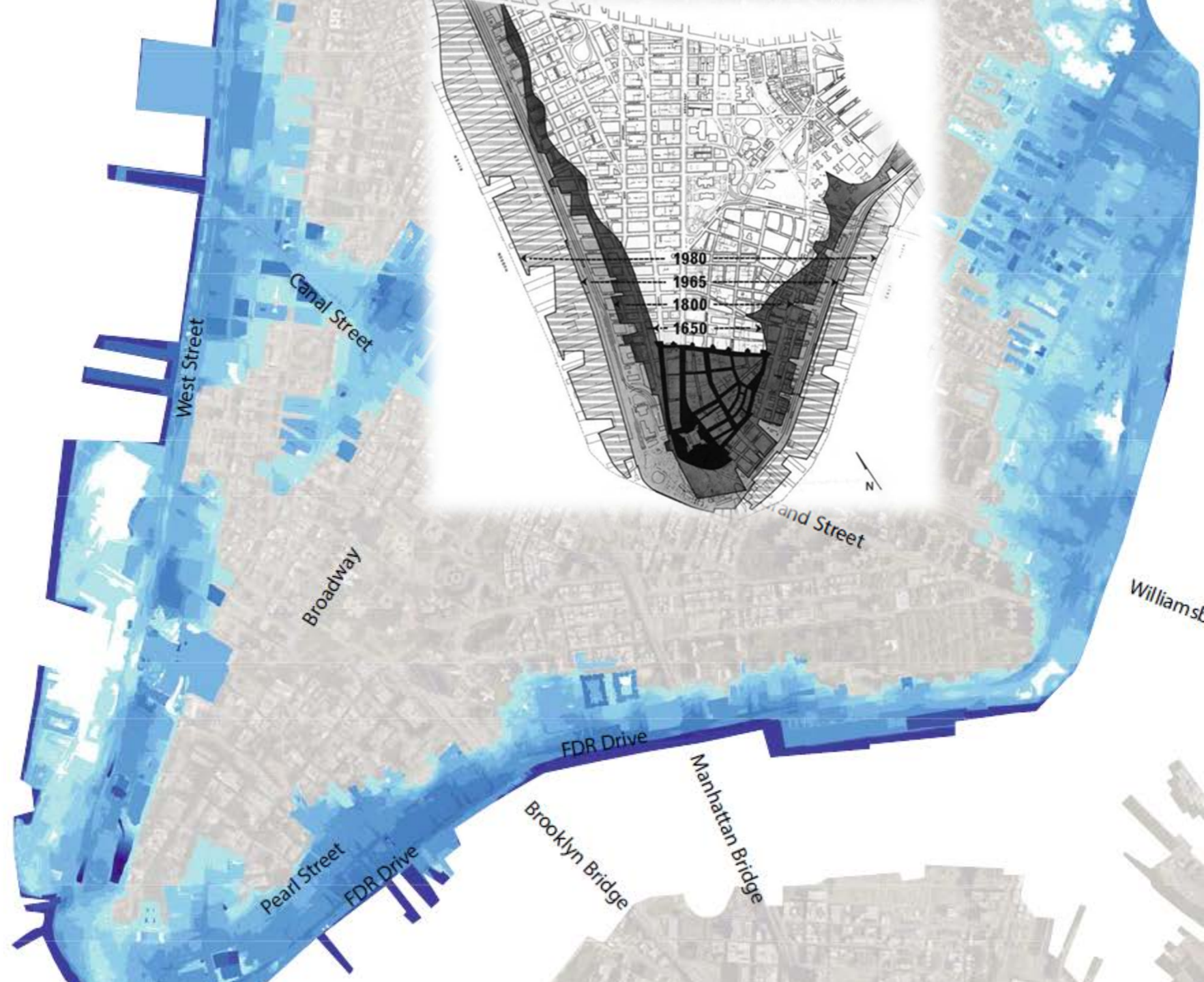
10.1 - 12

12.1 - 14

14.1 - 16

16.1 - 18

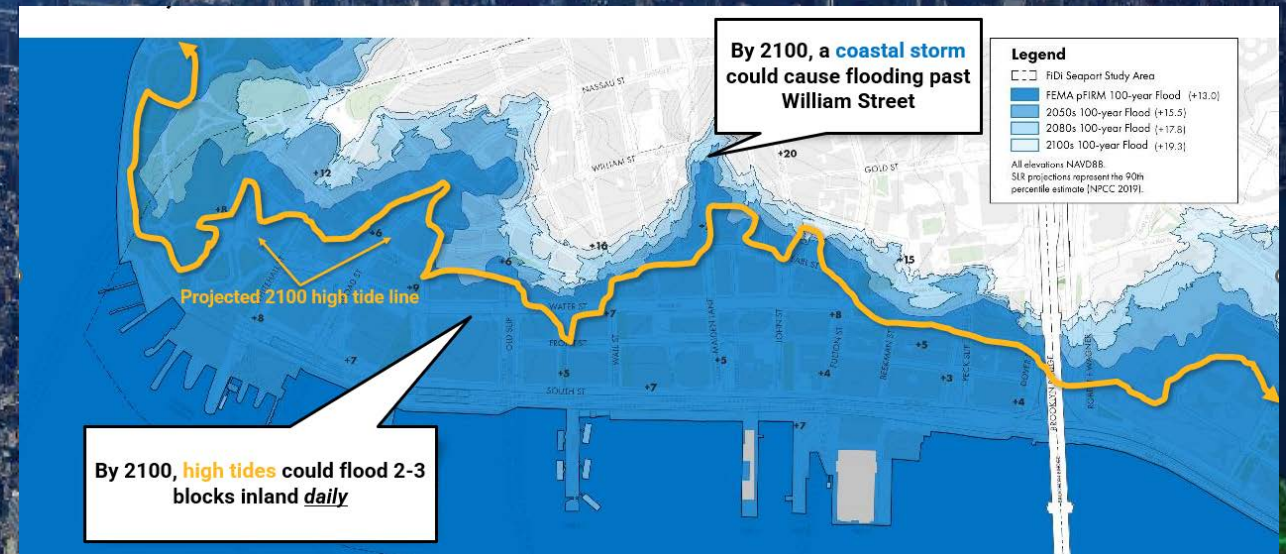
> 18



Manhattan's BIG U Flood Protection Plan

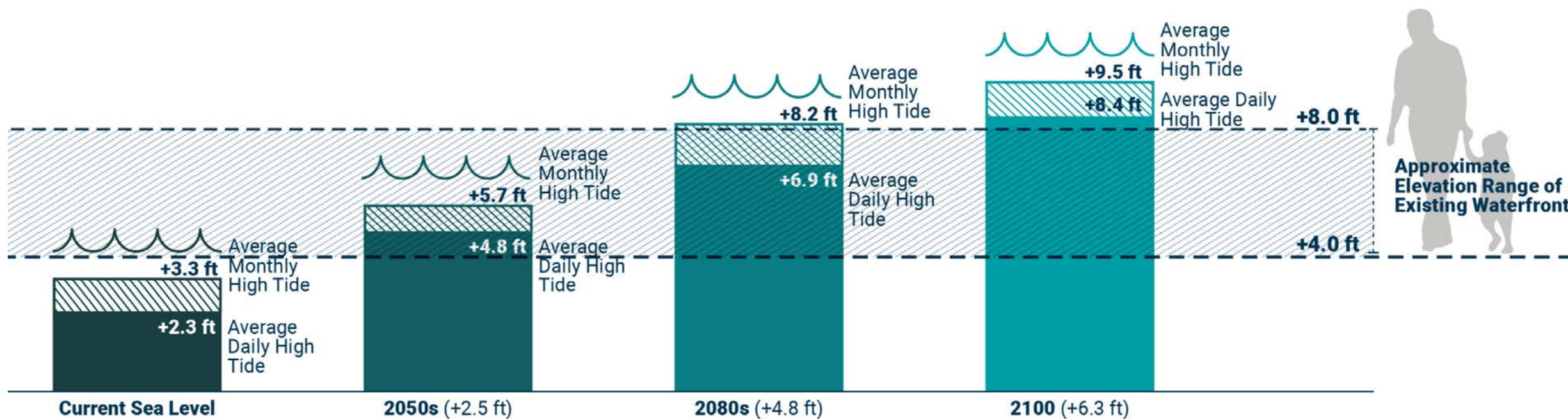


Two types of climate risks - daily tidal flooding and coastal storms, Financial District, Manhattan.



Understanding Current and Future Risk - Sea Level Rise & High Tides

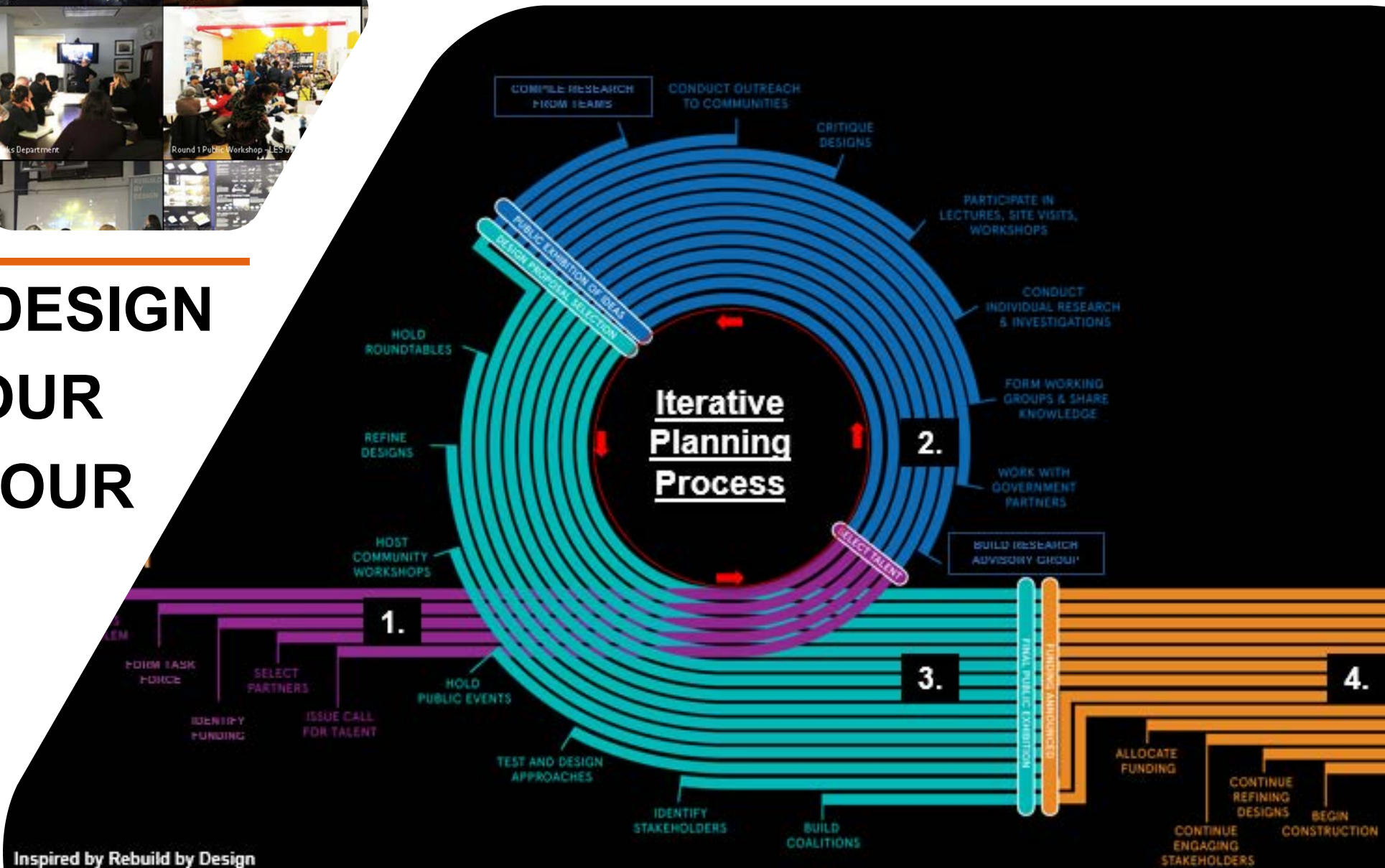
High tide flooding is anticipated to cause up to four feet of flooding by the 2100s, the same height as the storm surge from Hurricane Sandy in this area.





DESIGN YOUR DETOUR

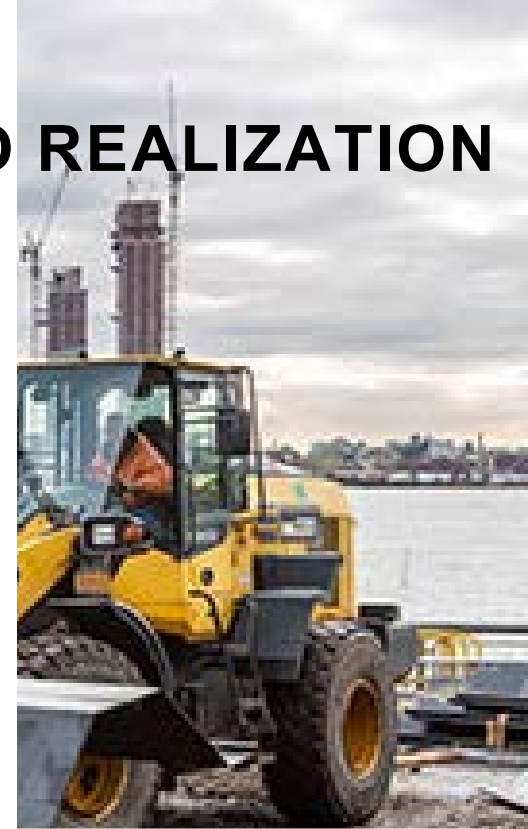
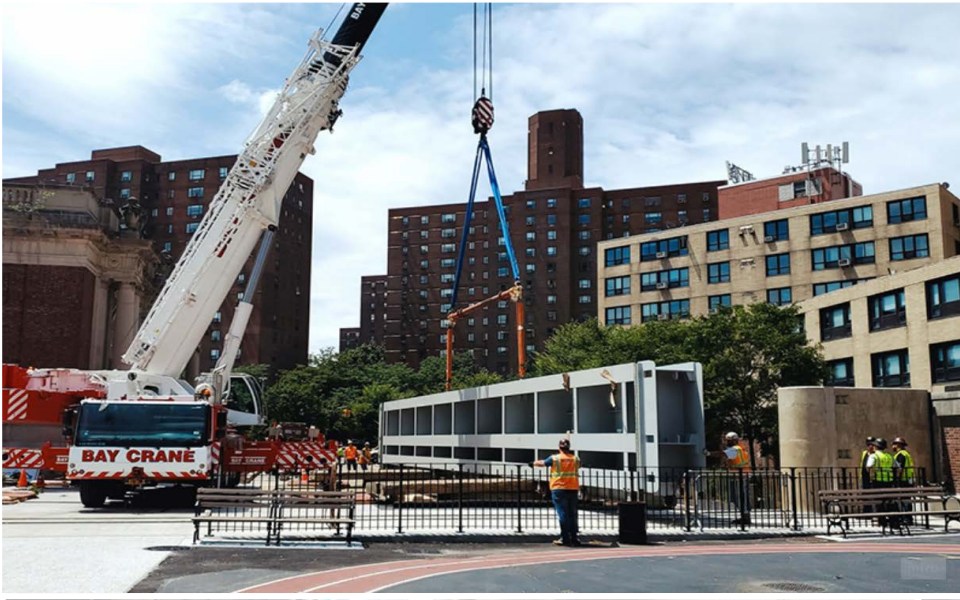
Inspired by Rebuild by Design



East Side Coastal Resilience – Concept to Realization



MOVING FROM CONCEPT TO REALIZATION



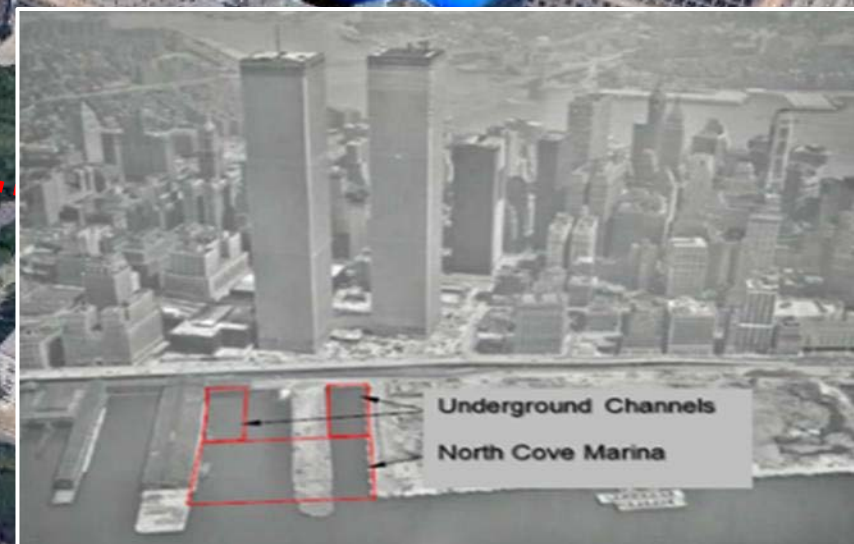
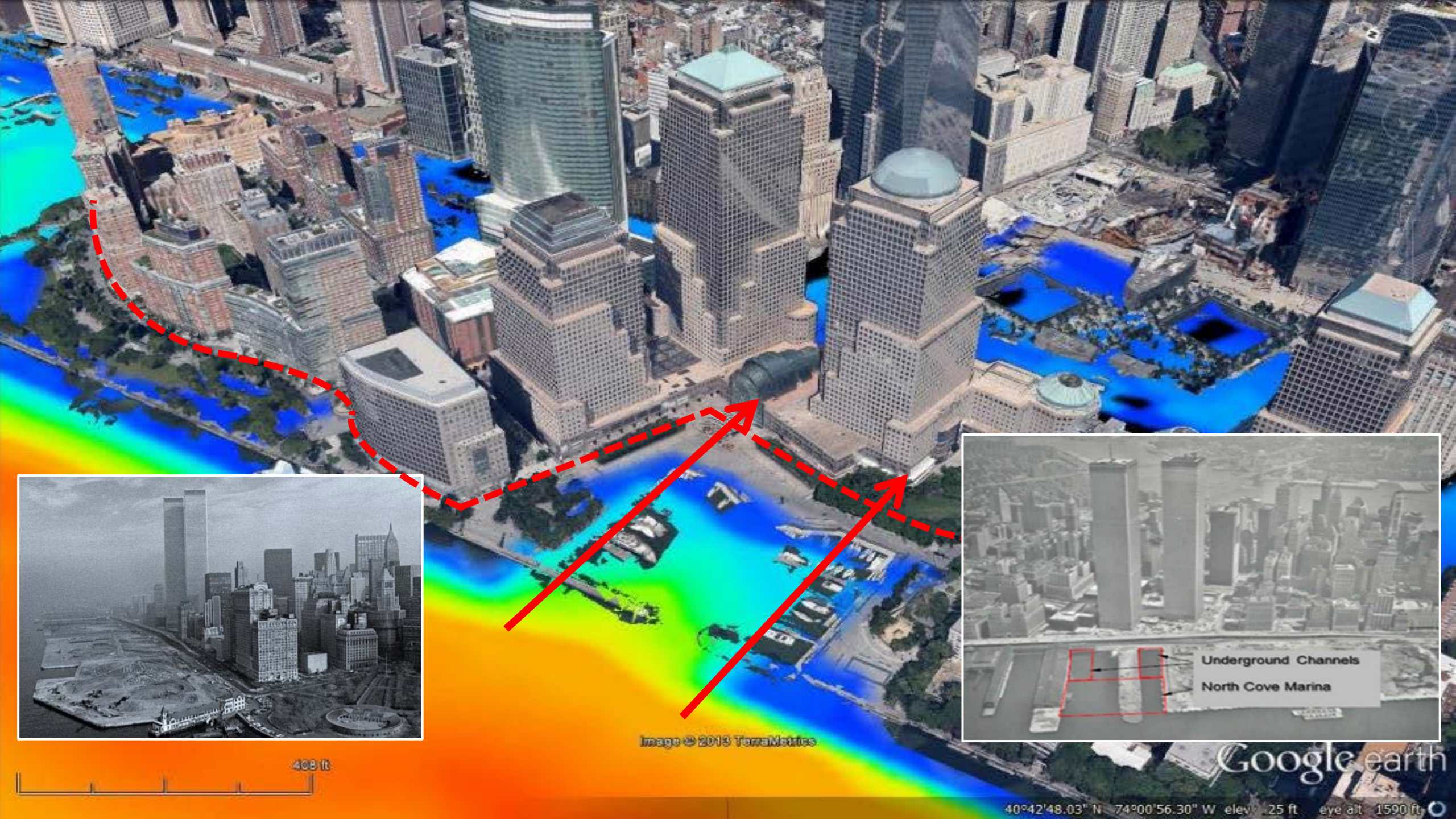


Image © 2015 TerraMetrics



40°42'48.03" N 74°00'56.30" W elev 25 ft eye alt 1590 ft

Extreme Precipitation – Compound Risk



New York City Health & Hospital Resilience Program

NYC
HEALTH+
HOSPITALS

Bellevue Hospital Floodwall Visualization

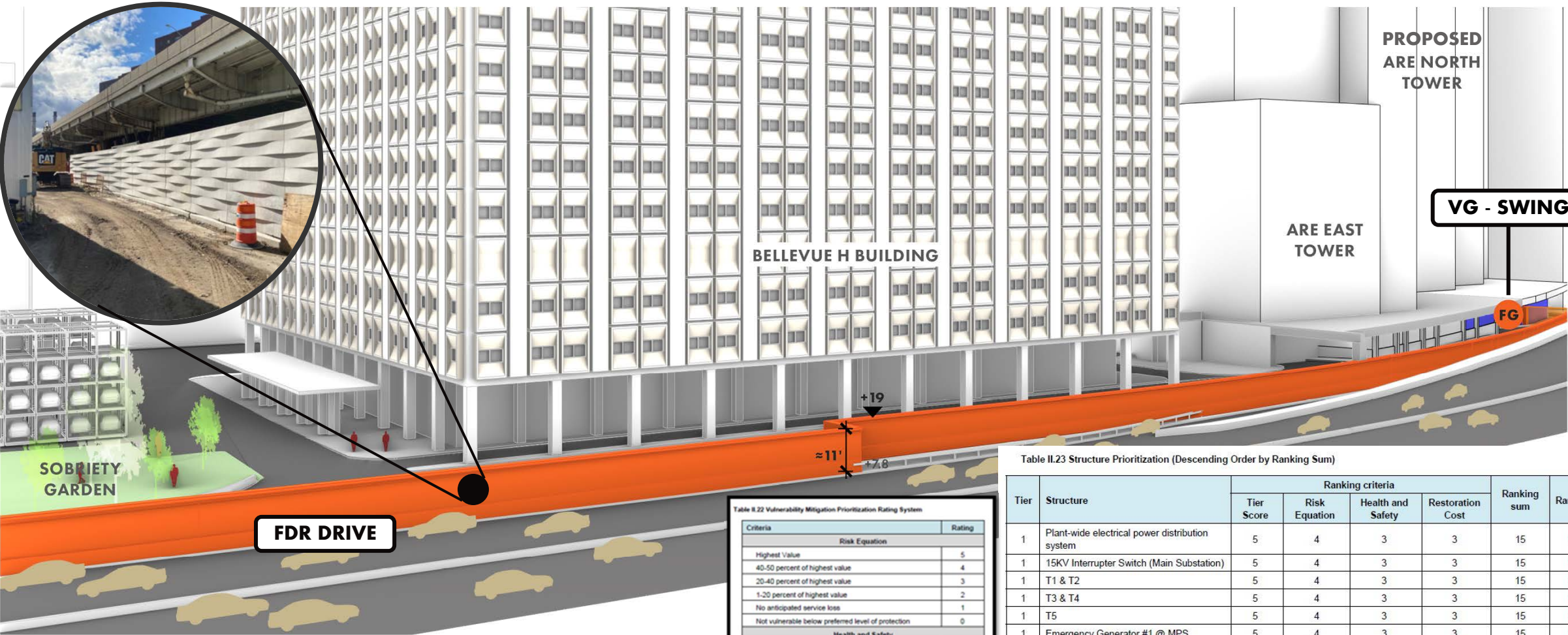


Table 8.22 Vulnerability Mitigation Prioritization Rating System

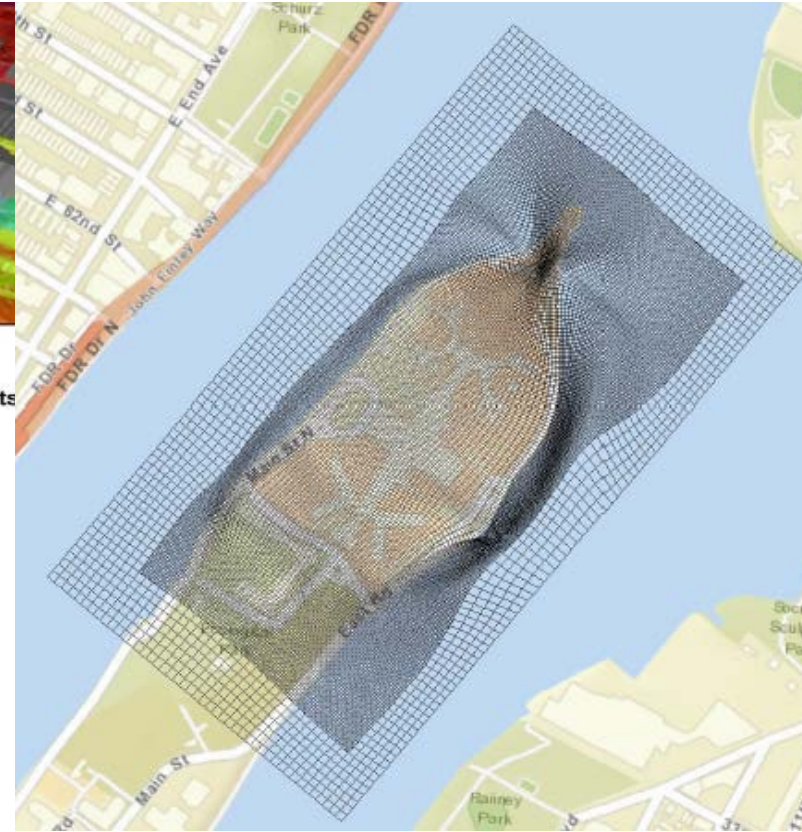
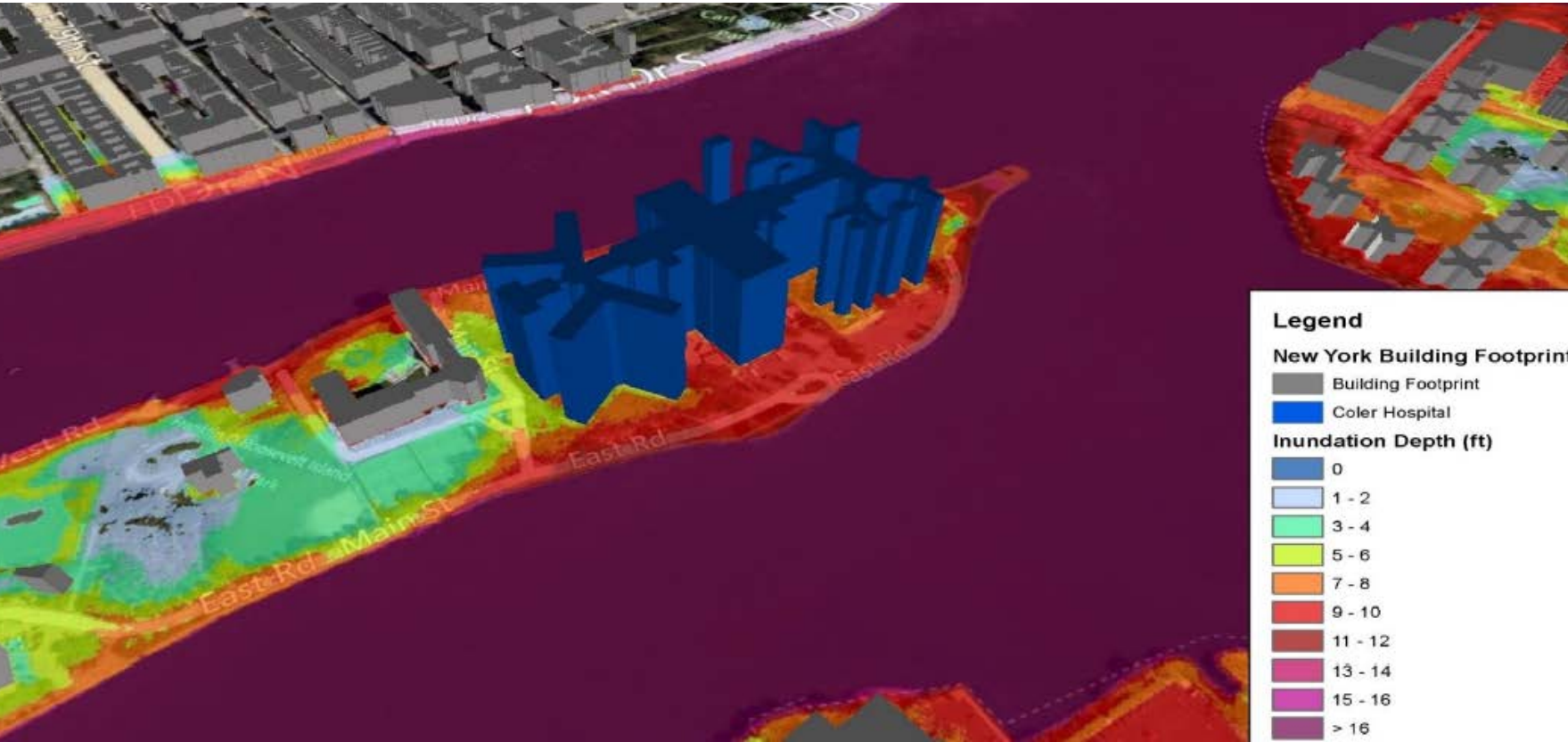
Criteria	Rating
Risk Equation	
Highest Value	5
40-50 percent of highest value	4
20-40 percent of highest value	3
1-20 percent of highest value	2
No anticipated service loss	1
Not vulnerable below preferred level of protection	0
Health and Safety	
Does impact operator health and safety	3
Does not impact operator health and safety	1
Restoration Cost	
High Cost	3
Medium Cost	2
Low Cost	1

Table II.23 Structure Prioritization (Descending Order by Ranking Sum)

Tier	Structure	Ranking criteria				Ranking sum	Rank
		Tier Score	Risk Equation	Health and Safety	Restoration Cost		
1	Plant-wide electrical power distribution system	5	4	3	3	15	1
1	15KV Interrupter Switch (Main Substation)	5	4	3	3	15	1
1	T1 & T2	5	4	3	3	15	1
1	T3 & T4	5	4	3	3	15	1
1	T5	5	4	3	3	15	1
1	Emergency Generator #1 @ MPS	5	4	3	3	15	1
3	Emergency Generator #2	3	5	3	2	13	2
1	Fuel Oil Tank 1 (Emergency Generator #1)	5	2	3	3	13	2
3	Fuel Oil Tank 3 (Incineration Fuel)	3	5	3	2	13	2
3	Fuel Oil Tank 4 (Emergency Generator #3)	3	3	3	3	12	3
3	Emergency Generator #3	3	2	3	3	11	4

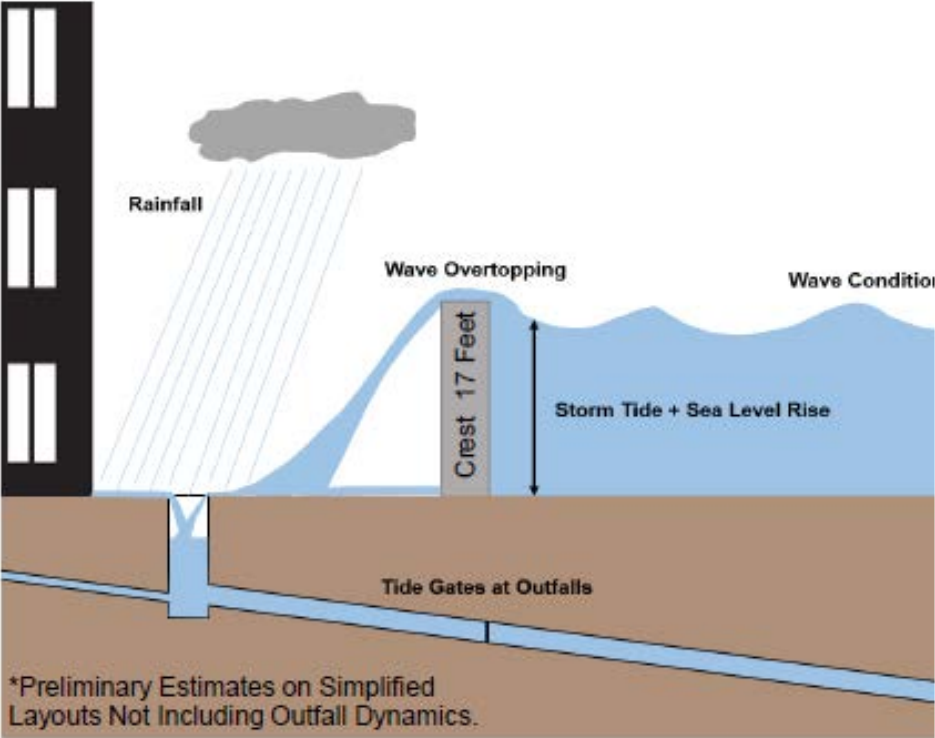
Protecting Critical Assets

Coler Hospital, Roosevelt Island

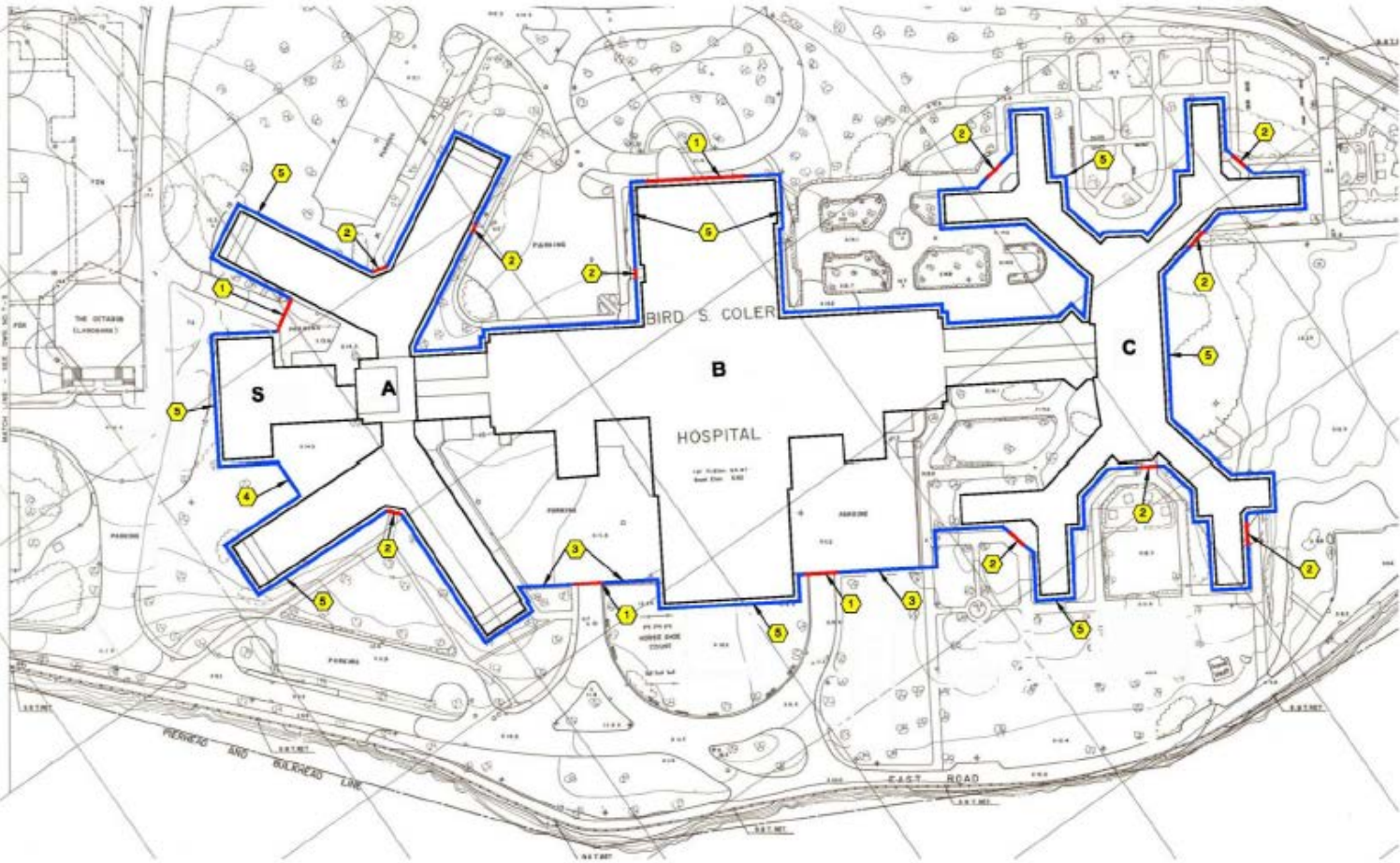


Protecting Critical Assets

Coler Hospital, Roosevelt Island



Sea Level	Interior Ponding * (Feet NAVD88)	Volume Managed * (Million Cubic Feet)
Current-Day	10.5	
2080s 10th	12.0	12
2080s 50th	16.0	32



Coler Hospital: FEMA Hazard Mitigation Plan

Protecting Critical Assets

Coler Hospital, Roosevelt Island



Where VA Hospital and East Side Coastal Resilience meet...



Source: NYC DDC

Lessons learned

- 1) Need for early planning coordination on wall alignment and design standards
- 2) Certification process benefits from 1 comprehensive plan
- 3) What future do we foresee for protecting our critical assets through retrofitted solutions...



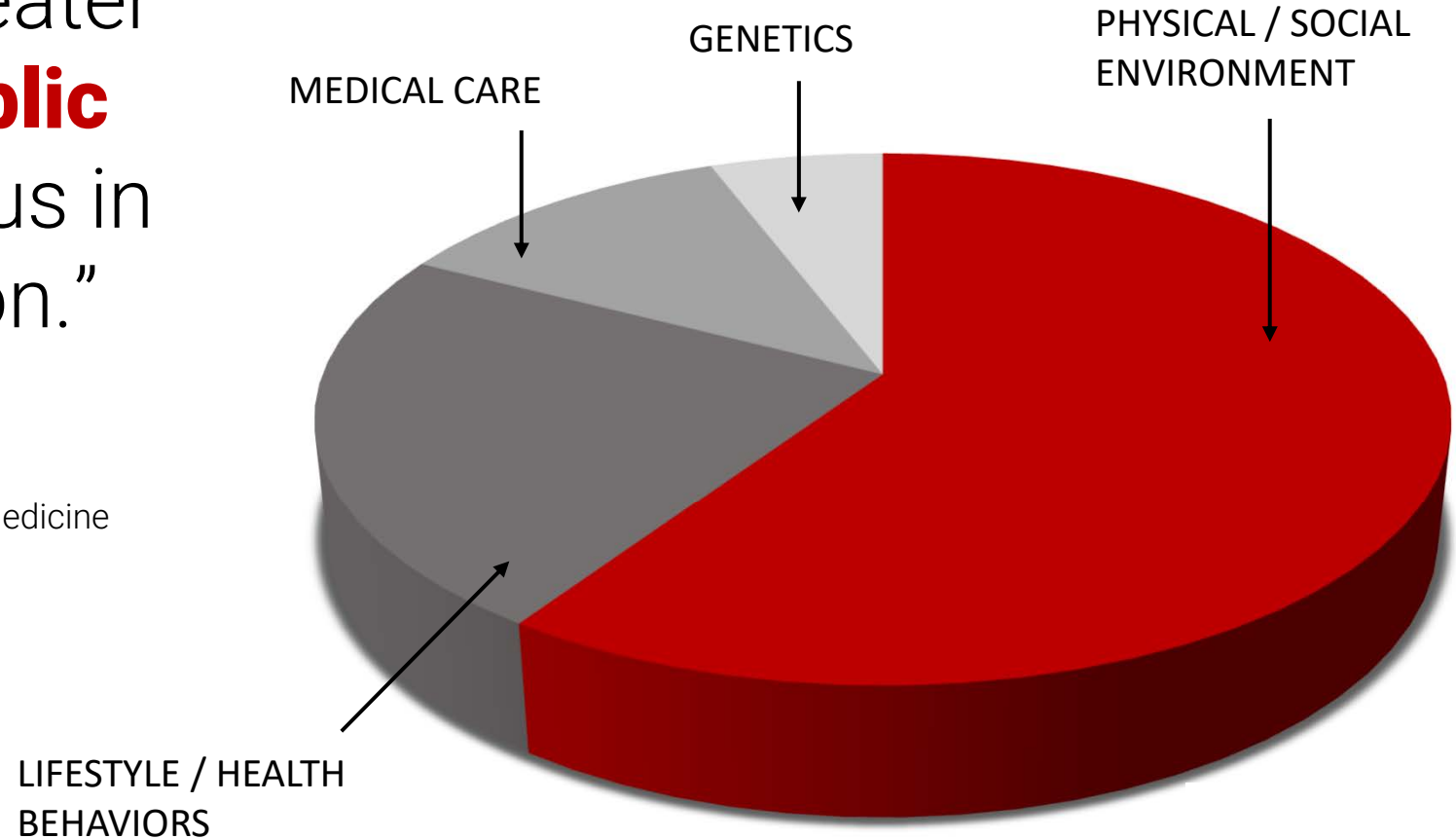


Wellbeing Design

“Architects have a greater ability to **improve public health** than those of us in the medical profession.”

Dr. Claudia Miller, MD
UT School of Medicine, San Antonio
Professor in Environmental & Occupational Medicine

DETERMINANTS OF HEALTH



Planning for Operational Resiliency

“Hospitals can be resilient even if they are unprepared and can be prepared but not resilient.”

Fostering Hospital Resilience—Lessons From COVID-19
Ian J. Barbash, MD, MS; Jeremy M. Kahn, MD, MS

Planning for Resiliency - Operationally

Daily huddles

Improve Communications

Safety and Security Checks

Preparedness

Practice



Know Your Hazards and Risks

Not all locations or building occupancy types have the same hazards and threats

The threat picture is evolving constantly

Design solutions only come after we reach consensus on priorities



Flexibility

Multipurpose every space

Storage considerations



FLEXIBLE SPACE PLANNING sets the stage for resilience by embedding change management into the building program. This keeps organizations resilient by allowing them to adapt to new economic conditions, business priorities, technologies and environmental conditions.

Flexibility



Access

Entries/Screening

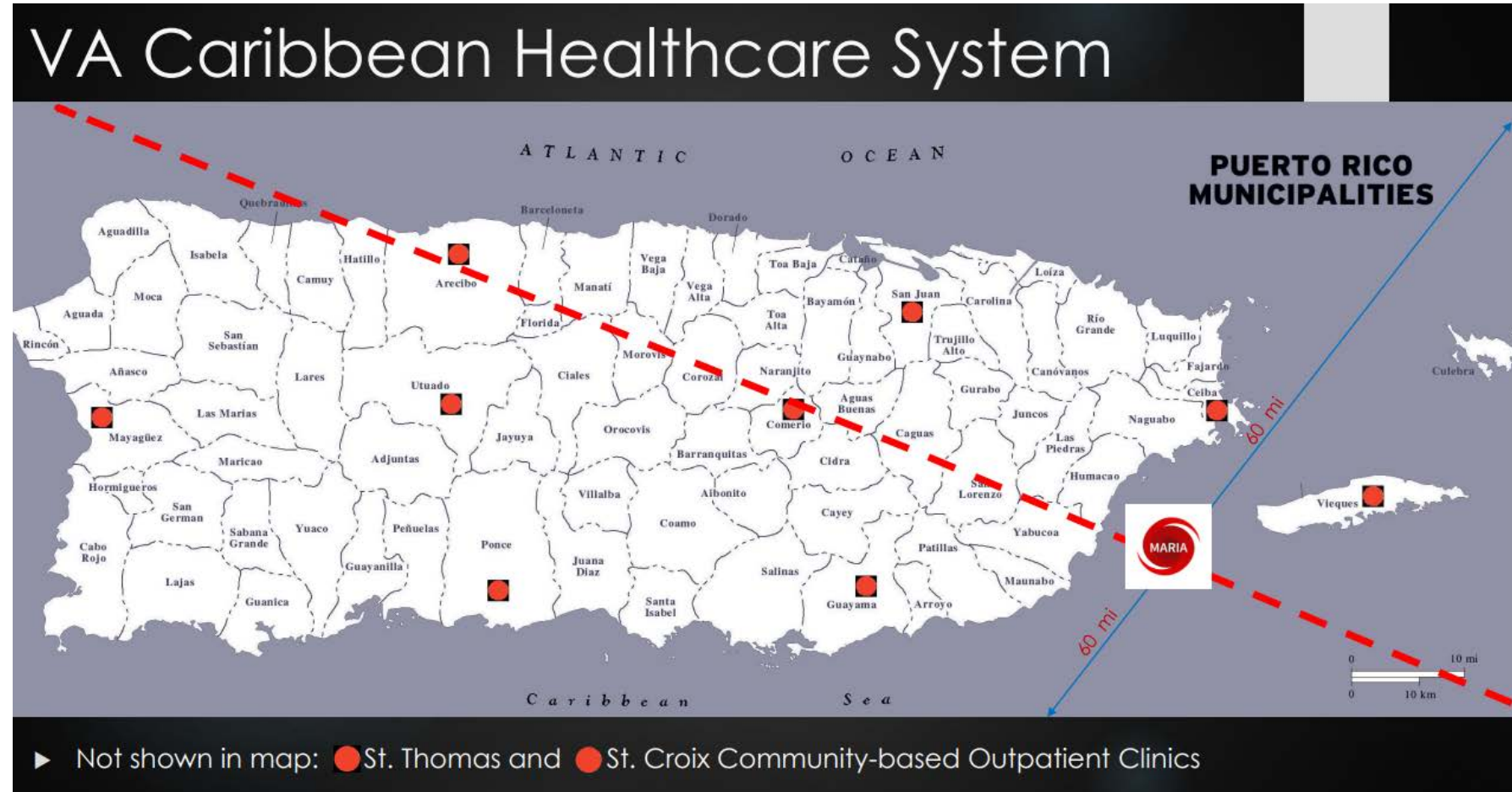
- Campus
- Master Planning
- Reception/Waiting
- Discharge Lounge



Resiliency in Action – Lessons Learned

September 2017

Hurricanes Irma and
Maria



Resiliency in Action – Lessons Learned

Communications with the community

Storage – on-site versus off-site

Water usage – supporting demand beyond hospital usage

Emergency management protocol

Emergency generators – protection of equipment and employees

Flexible use of spaces



A large, stylized orange graphic element on the left side of the slide, consisting of several horizontal bars of varying lengths that overlap each other, creating a sense of depth and movement.

Arcadis

Improving the quality of life

Thank You!

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