NEW YORK – NEW JERSEY HARBOR AND TRIBUTARIES COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

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NYC Mayor's Office of Recovery & Resiliency

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STUDY AUTHORITY

Public Law 71 CHAPTER 140

AN ACT

June 15, 1955
[S. 414]

To authorize an examination and survey of the coastal and tidal areas of the eastern and southern United States, with particular reference to areas where severe damages have occurred from hurricane winds and tides.

Hurricanes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in view of the severe damage to the coastal and tidal areas of the eastern and southern United States from the occurrence of hurricanes, particularly the hurricanes of August 31, 1954, and September 11, 1954, in the New England, New York, and New Jersey coastal and tidal areas, and the hurricane of October 15, 1954, in the coastal and tidal areas extending south to South Carolina, and in view of the damages caused by other hurricanes in the past, the Secretary of the Army, in cooperation with the Secretary of Commerce and other Federal agencies concerned with hurricanes, is hereby authorized and directed to cause an examination and survey to be made of the eastern and southern seaboard of the United States with respect to hurricanes, with particular reference to areas where severe damages have occurred.

Survey.

SEC. 2. Such survey, to be made under the direction of the Chief of Engineers, shall include the securing of data on the behavior and frequency of hurricanes, and the determination of methods of forecasting their paths and improving warning services, and of possible means of preventing loss of human lives and damages to property, with due consideration of the economics of proposed breakwaters, seawalls, dikes, dams, and other structures, warning services, or other measures which might be required.

Appropriation.

SEC. 3. There are hereby authorized to be appropriated such sums as may be necessary to carry out the provisions of this Act.

Approved June 15, 1955.

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STUDY NON-FEDERAL SPONSORS

- New Jersey Department of Environmental Protection
- New York State Department of Environmental Conservation, in partnership with the City of New York
- Feasibility Cost Sharing Agreement executed 15 July 2016

STUDY GOAL & PURPOSE

- Manage the risk of coastal storm damage in the New York New Jersey Harbor and tributaries (NYNJHAT) study area, while contributing to the resilience of communities, critical infrastructure, and the environment

Port Newark, NJ in foreground, Lower Manhattan in background (looking east)

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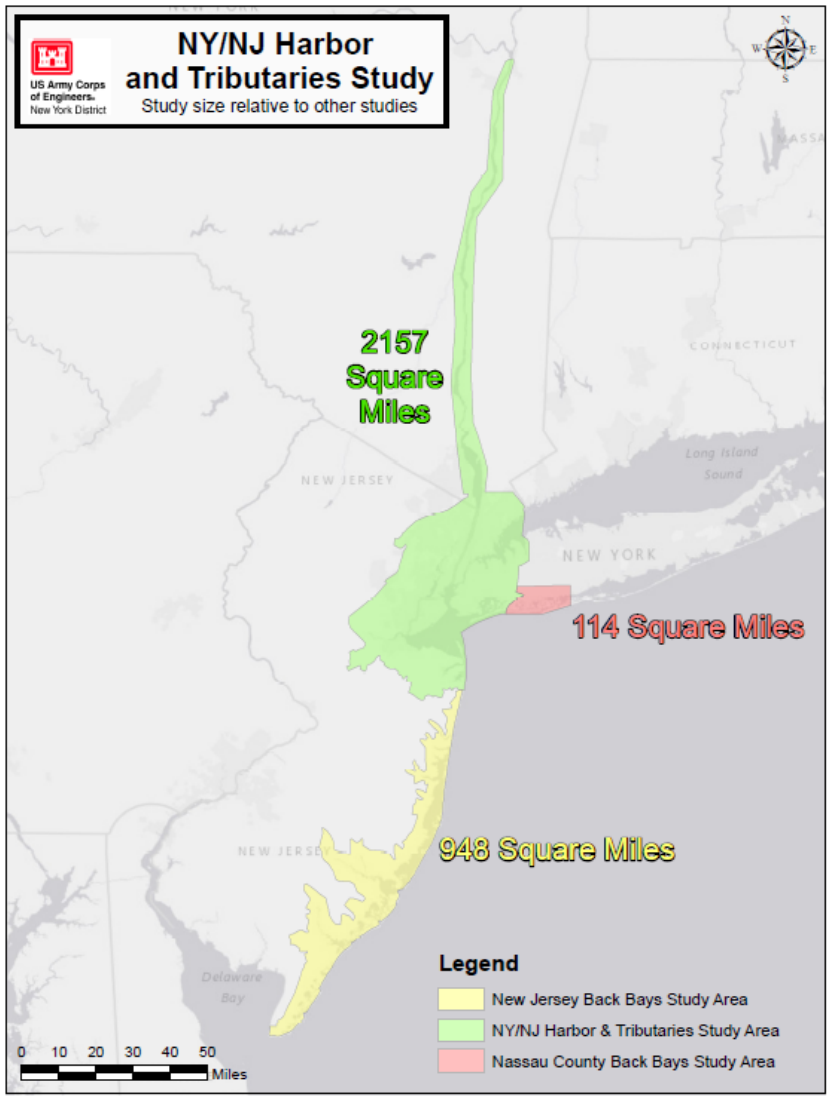
STUDY AREA



- The largest and most densely populated of the 9 high-risk focus areas identified in the USACE North Atlantic Comprehensive Coastal Study (NACCS), released in January 2015
- Area covers 2,150+ square miles and 900+ miles of affected shoreline
- 25 counties in NY & NJ
- Affected population of ~16M, including New York City and the six most populated cities in NJ

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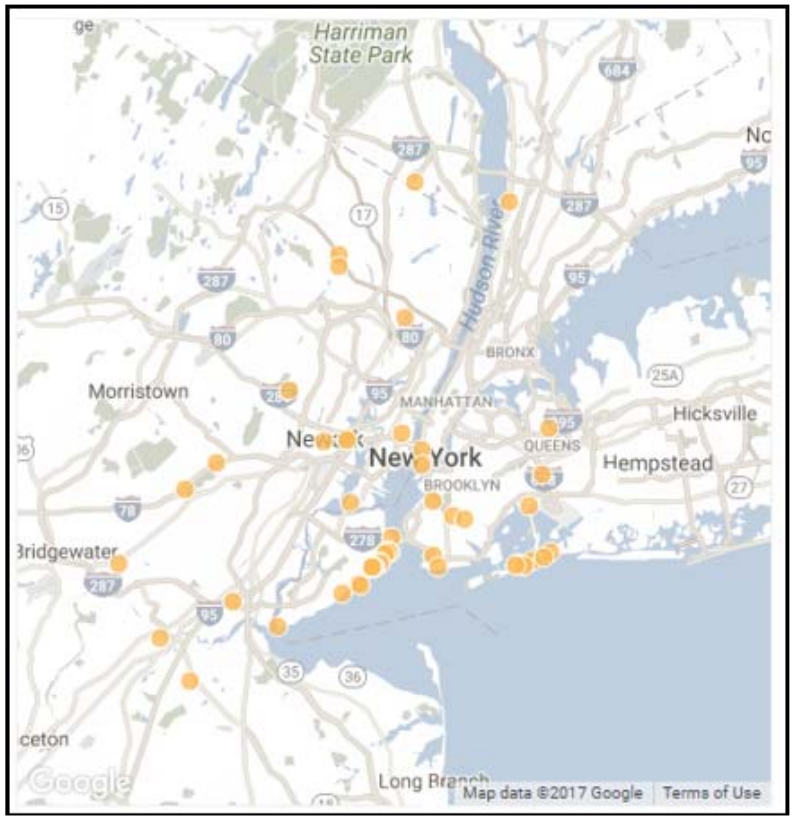
FEDERAL INTEREST



Location of fatalities caused by Hurricane Sandy

- Recurring impacts from coastal flooding has resulted in significant economic, environmental, and community impacts
- One of 9 high-risk focus areas identified in the NACCS
- 60 Hurricane Sandy fatalities
- $15.7B Federal investment in post-Hurricane Sandy recovery and resilience projects
- Critical infrastructure: 3 major airports, 5 major rail systems, largest port on east coast, largest refined petroleum port in U.S., hospitals, police, fire, evacuation routes, rail/subway infrastructure
- Includes New York City metropolitan area, with GMP of over $1.66 trillion (2016)

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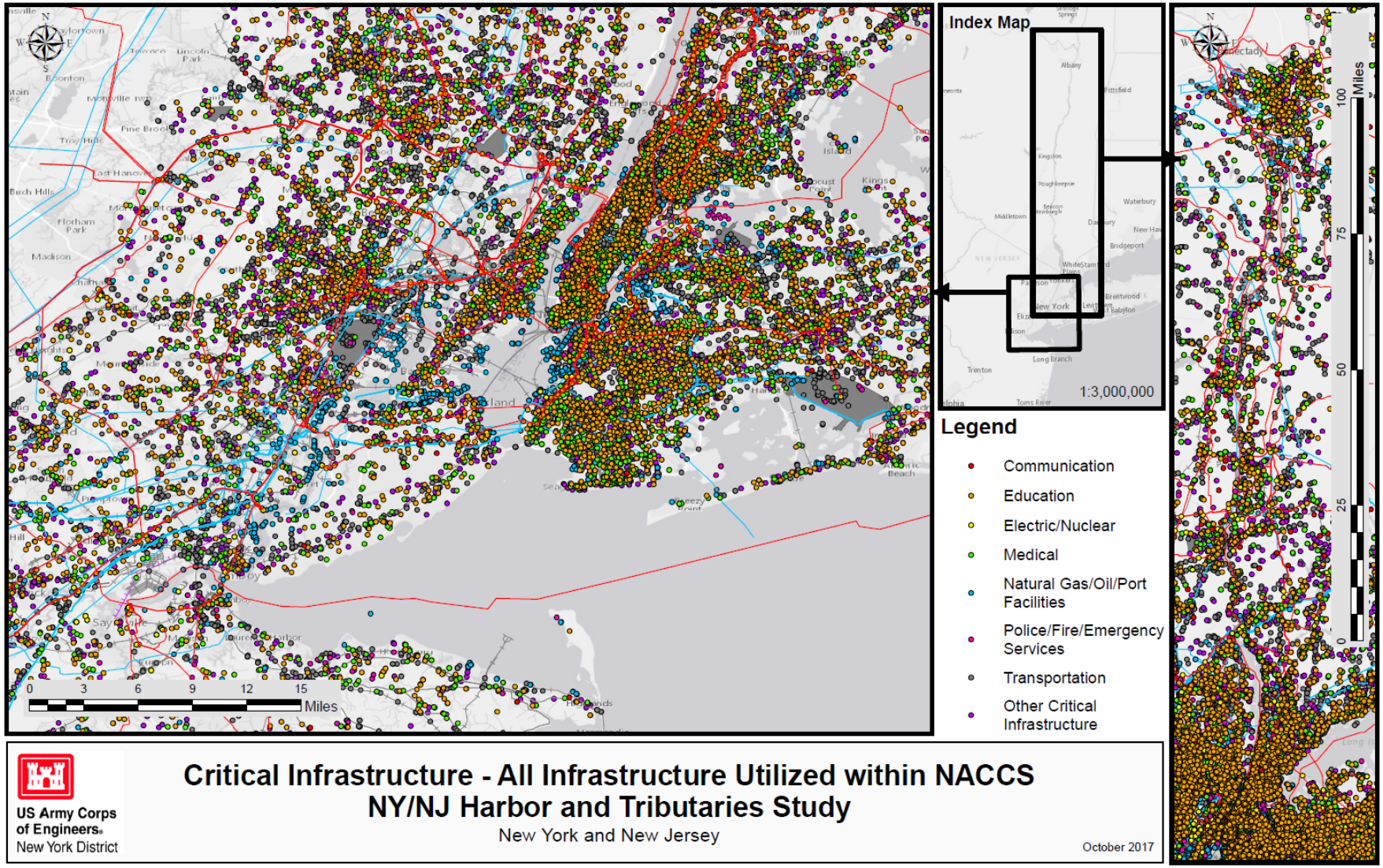
FEDERAL INTEREST – CRITICAL INFRASTRUCTURE



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New York District

Critical Infrastructure - All Infrastructure Utilized within NACCS
NY/NJ Harbor and Tributaries Study
New York and New Jersey

October 2017

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EXISTING CONDITIONS

- Highest metropolitan area population density in the nation
- Includes many critical U.S. infrastructure systems, many of which cannot be relocated
- Includes Federal Navigation channels
- Almost 400 years of shoreline and wetland filling, dredging and hardening
- Area is subject to coastal storm damage from storm surge, wave attack, and erosion as well as intense rainfall-stormwater runoff events, which exacerbate coastal flooding.
- Projections for climate and sea level change indicate increased vulnerability of this area to more frequent and intense future tropical storms, hurricanes and nor'easters

EXISTING CONDITIONS (CONTINUED)

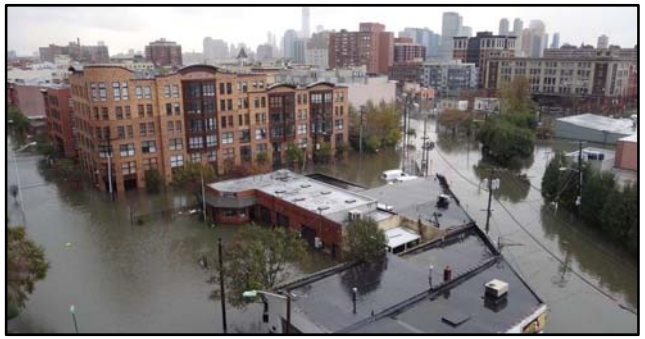
- Intermittent, non-contiguous wetlands provide critical habitat for vulnerable species (aquatic and terrestrial)
- Small islands serve as breeding sites for bird species (ex. Harbor Herons Preserve)
- Talus slope of palisades creates important habitat for vulnerable reptiles
- Over 300 federal- or state-listed species occur (including piping plover, red knot, roseate tern, seabeach amaranth, and several species of sturgeon, sea turtle, bat, and marine mammals)
- Within the Atlantic Flyway for migratory birds
- Spawning area by, among others, winter flounder, one of the most important commercial and recreational fish species present
- New York - New Jersey Harbor and Long Island Sound are estuaries of national significance
- Includes National Historic Landmarks and Historic Districts and State and National Parks (ex. Statue of Liberty, Ellis Island, Sandy Hook Lighthouse and Fort Hancock)
- Shipwrecks dating from the 17th to the early 20th centuries and archaeological sites, including the earliest prehistoric Native American sites
- Includes Superfund and National Priorities List sites (ex. Newtown Creek, Gowanus Canal, Lower Passaic River, Diamond Alkali)

PROBLEMS

- High risk of coastal storm flooding and threat to life safety
- Relative sea level change increases risk

OPPORTUNITIES

- Manage coastal storm flood risk
- Better communicate coastal storm risk to communities
- Restore natural systems in ways that may provide coastal storm risk management benefits
- Contribute to community rebuilding and resilience
- Improve port resilience and navigation maintenance requirements



Flooding in Hoboken, NJ
October 2012

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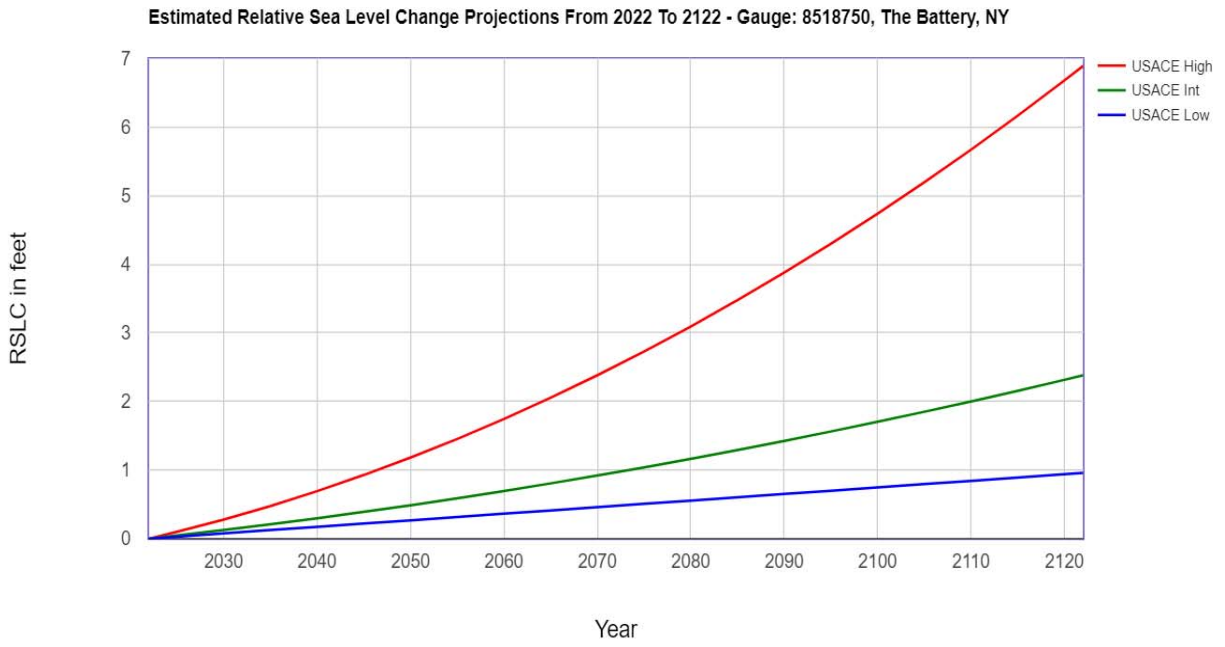
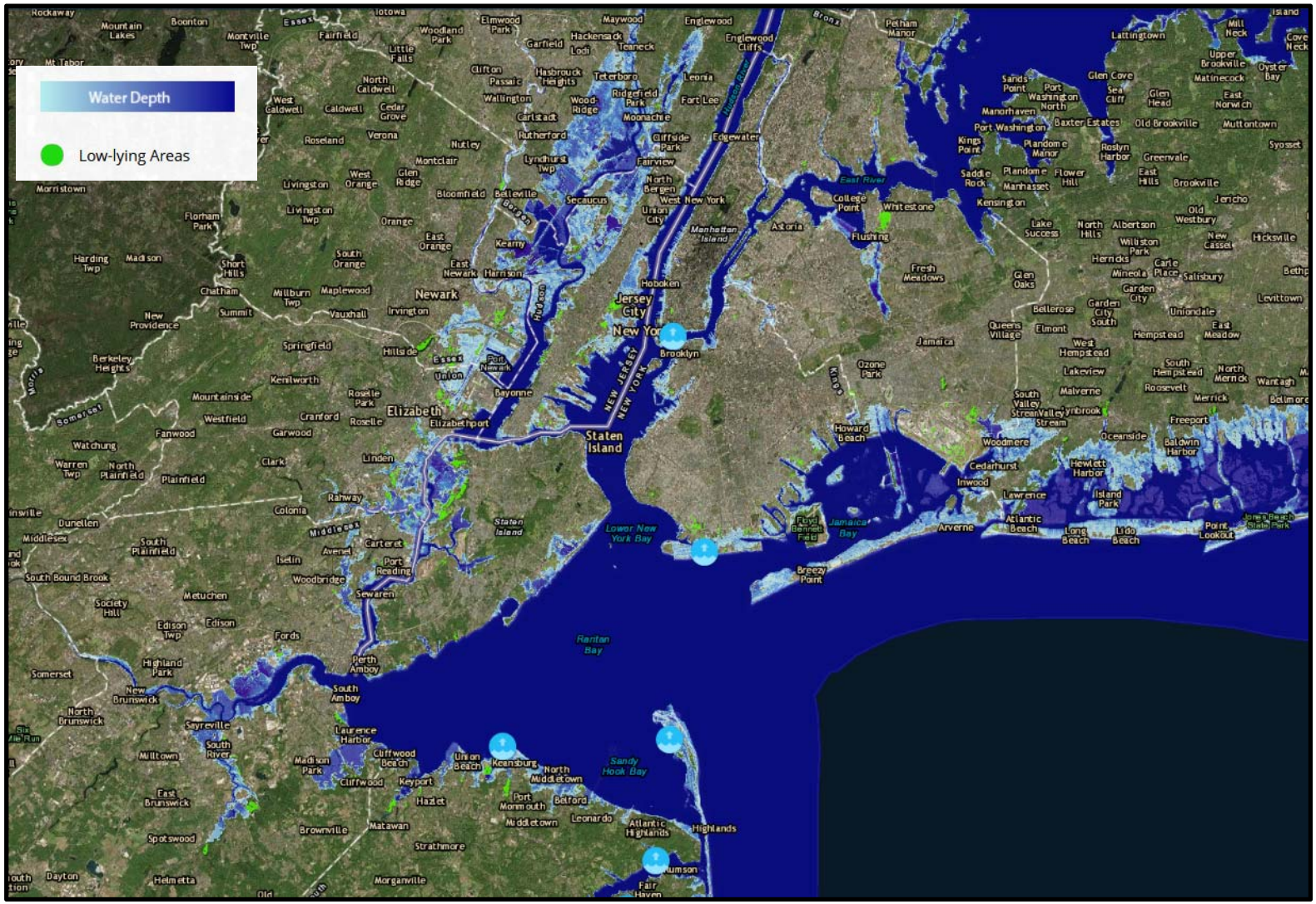
RELATIVE SEA LEVEL CHANGE (RSLC)

Estimated Relative Sea Level Change
from 2022 To 2122 New York - New Jersey Harbor and Tributaries
8518750, The Battery, NY
NOAA's Regional Rate: 0.00958 feet/yr
All values are expressed in feet

Year	USACE Low	USACE Int	USACE High
2022	0.00	0.00	0.00
2025	0.03	0.05	0.10
2030	0.08	0.13	0.28
2035	0.13	0.21	0.48
2040	0.17	0.30	0.69
2045	0.22	0.39	0.93
2050	0.27	0.49	1.18
2055	0.32	0.59	1.45
2060	0.36	0.70	1.75
2065	0.41	0.81	2.05
2070	0.46	0.92	2.38
2075	0.51	1.04	2.73
2080	0.56	1.16	3.09
2085	0.60	1.29	3.48
2090	0.65	1.43	3.88
2095	0.70	1.56	4.30
2100	0.75	1.70	4.74
2105	0.80	1.85	5.20
2110	0.84	2.00	5.67
2115	0.89	2.16	6.17
2120	0.94	2.32	6.68
2122	0.96	2.38	6.89



RELATIVE SEA LEVEL CHANGE: 6 FEET OF INUNDATION



Graphics from the NOAA SLC viewer: https://coast.noaa.gov/slr

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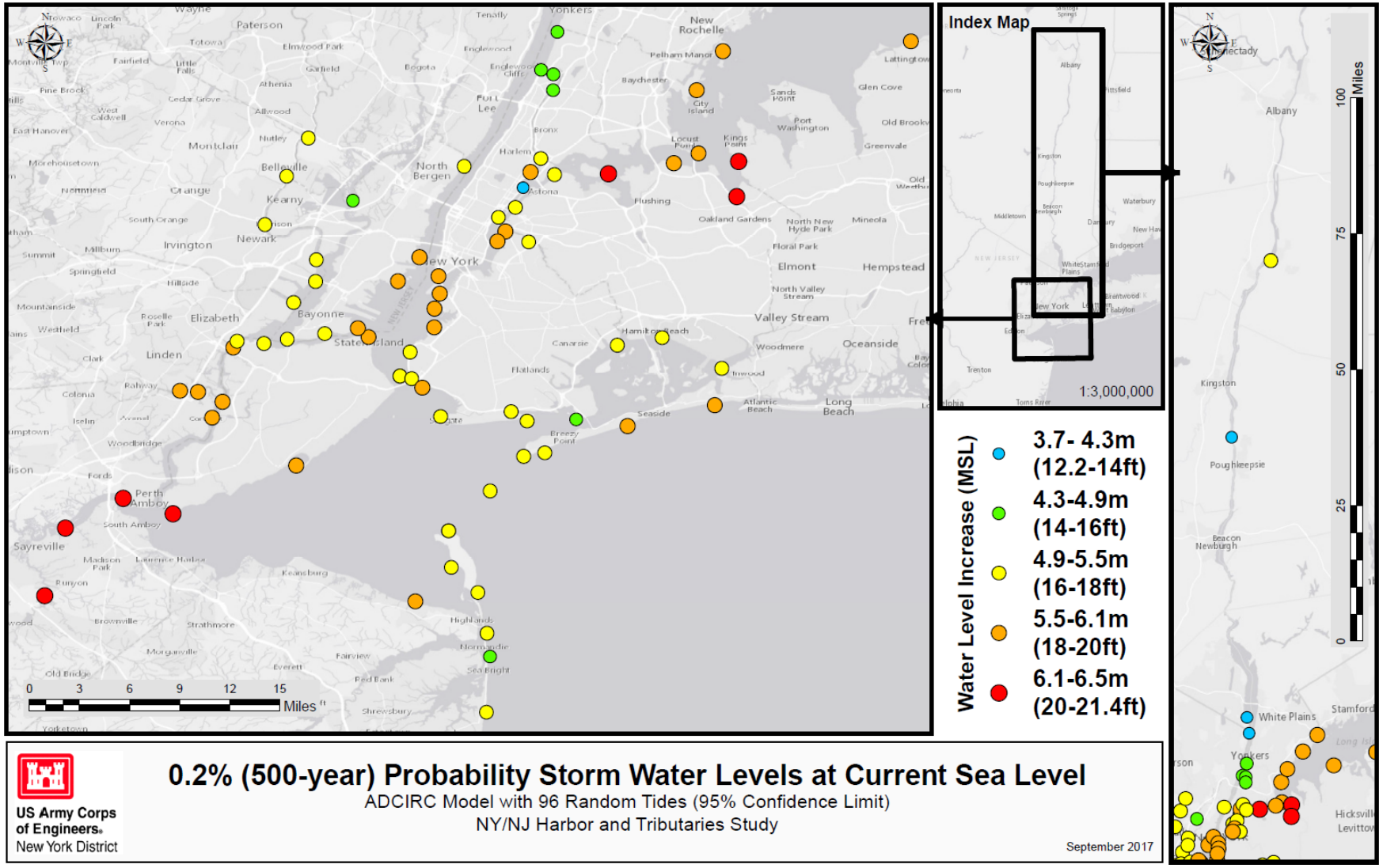
EXISTING CONDITIONS: 0.2% FLOOD ELEVATIONS



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New York District

0.2% (500-year) Probability Storm Water Levels at Current Sea Level

ADCIRC Model with 96 Random Tides (95% Confidence Limit)
NY/NJ Harbor and Tributaries Study

September 2017

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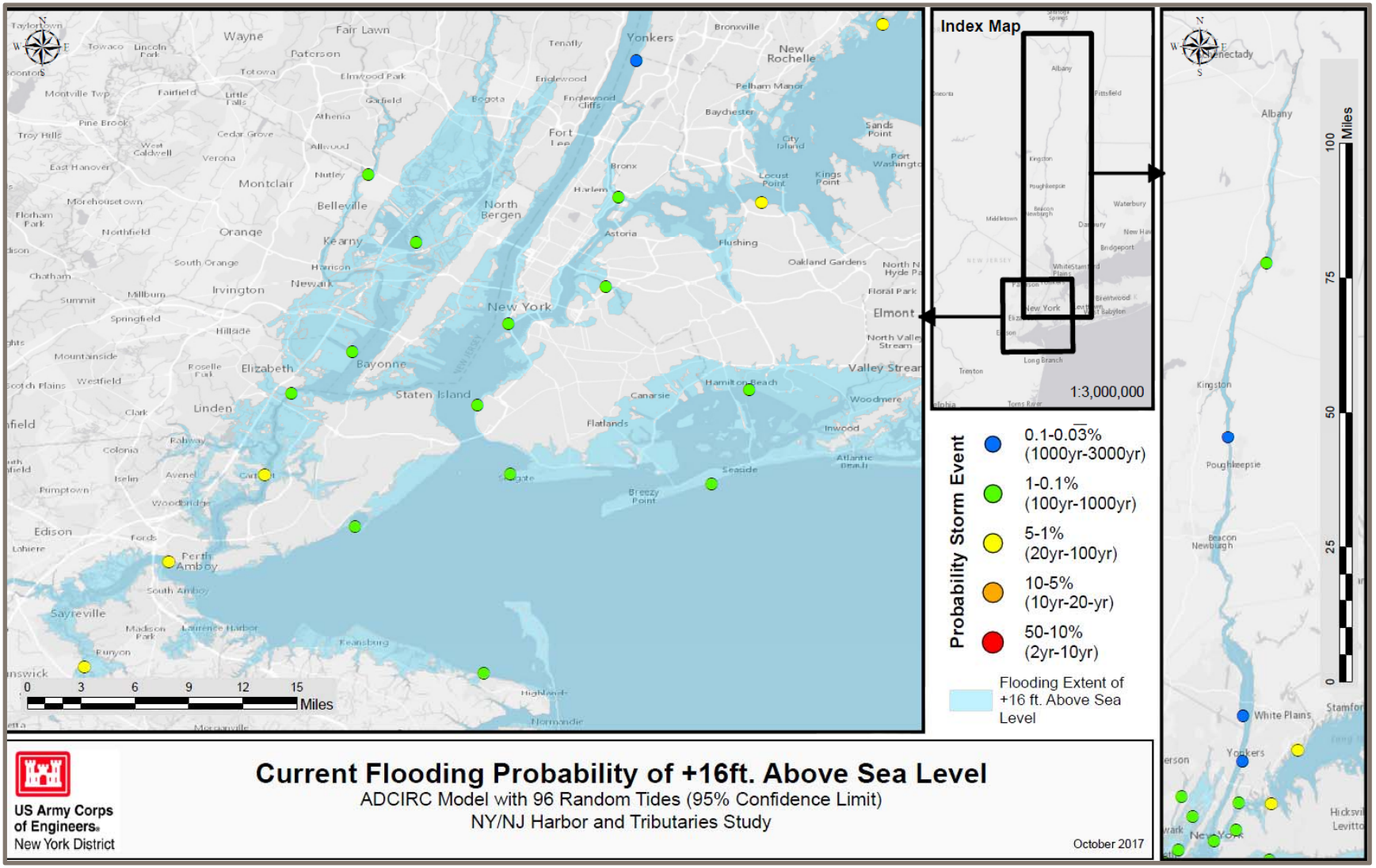
PROBABILITY AT EXISTING SEA LEVEL



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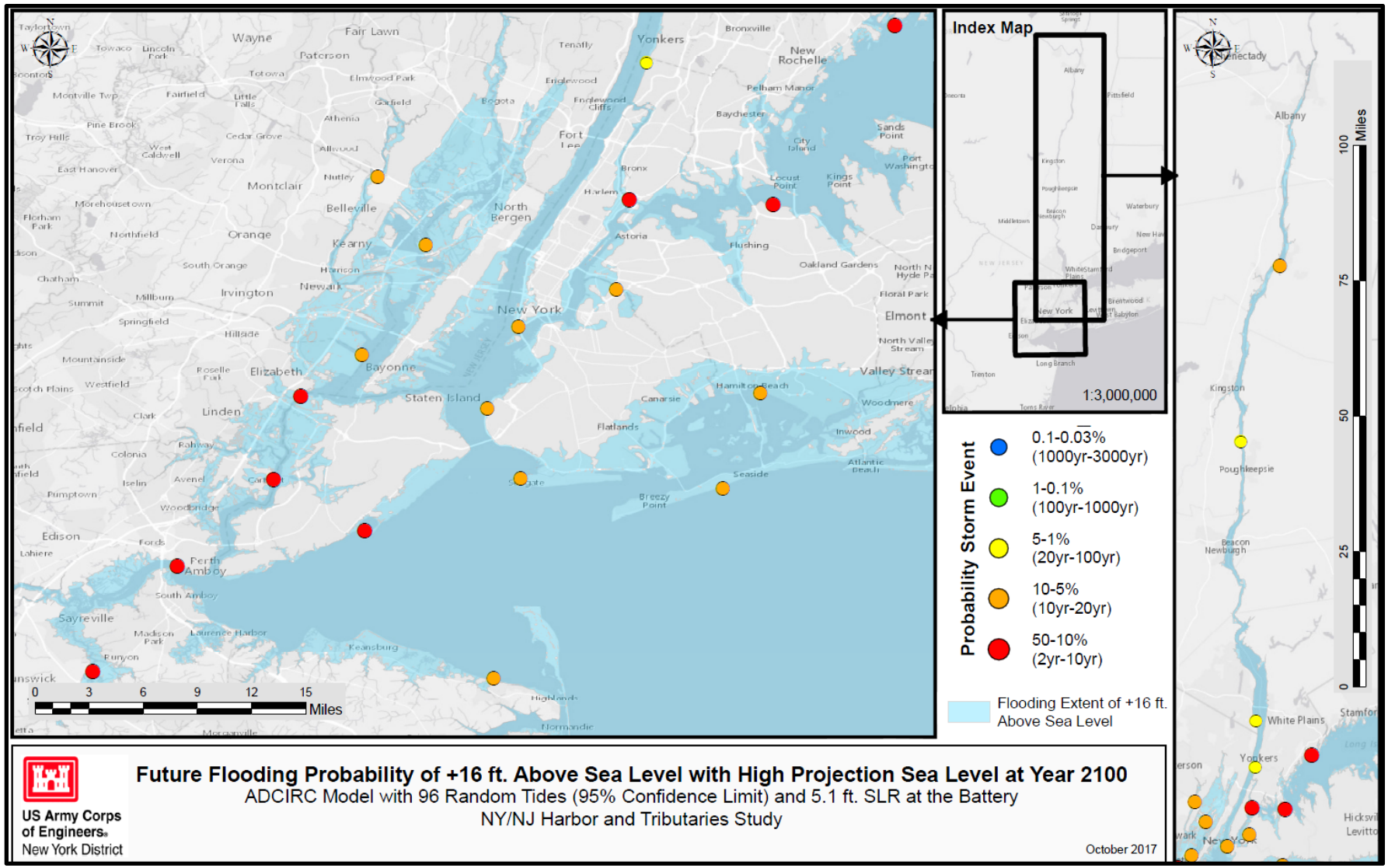
PROBABILITY IN YEAR 2100



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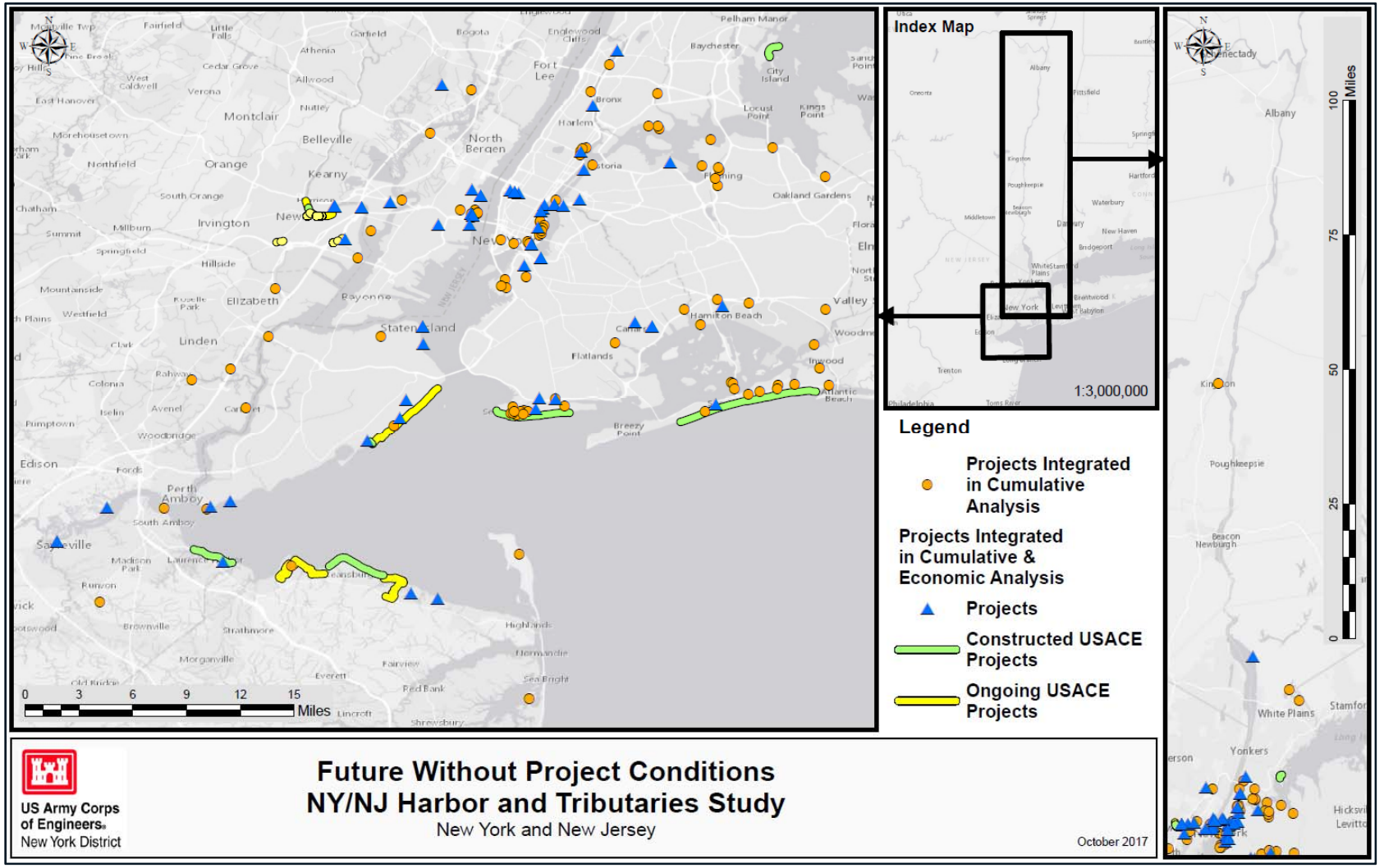
EXISTING AND ASSUMED PROJECTS FOR FUTURE WITHOUT PROJECT CONDITION



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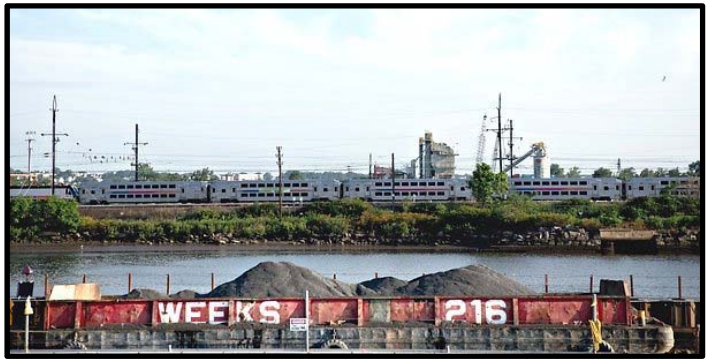
PLANNING OBJECTIVES

- Reduce the risk of coastal storm damage to communities, critical infrastructure, important societal resources, and the environment
- Improve the community's ability to recover from damages caused by storm surges by reducing the duration of interruption in services provided by man-made and natural systems.
- Enhance human health and safety by improving the performance of critical infrastructure and natural features during and after coastal storms.
- Restore natural coastal features that have ability to reduce coastal storm risk for communities and ecosystems.

CONSTRAINTS

- Avoid impact to navigation & waterborne commerce
- Avoid impact to constructed and planned resilience projects
- Avoid induced coastal flooding in adjacent communities, and flooding from rainfall or overwhelming of existing interior drainage systems
- Avoid impacts to critical infrastructure (emergency vehicle access, evacuation routes, etc.)
- Avoid impacts to the environment, historic properties, HTRW sites and public access

Refinery and storage infrastructure, Arthur Kill, NY and Newark, NJ



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CONSIDERATIONS

- Local sensitivity to certain measures (e.g., acquisition, unintended adverse impacts to communities or the environment)
- Enhancing sustainability by incorporating resilient features
- Complement other post-Hurricane Sandy resilience projects and planning efforts

"The Big U" – Initial Rebuild by Design Concept Lower Manhattan

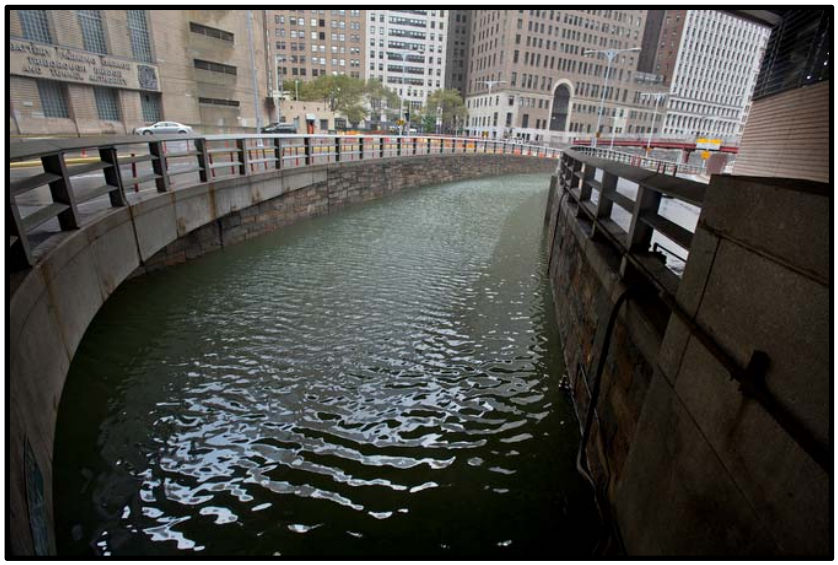
PRELIMINARY ENVIRONMENTAL CONSIDERATIONS

- Changes to tidal range/regime, flow velocity, salinity concentrations, sedimentation rates, scour, and elevation
- Water quality, dissolved oxygen, nutrients, and phytoplankton biomass (i.e. eutrophication) and pathogenic bacteria
- Anadromous/catadromous fish migration and aquatic species
- Marsh inundation
- Air quality
- Transportation (marine vessels, etc.)
- Aesthetics and recreation
- Historic Properties
- Listed species and critical habitat
- Noise and vibration
- Bay bottom impacts, as well as landside impacts
- Location of Superfund, National Priority List and other contaminated sites

Jamaica Bay, New York City

PLAN FORMULATION STRATEGY

- Guided by overarching values:
  - Reduce flood damage to property and infrastructure
  - Contribute to the resilience of critical infrastructure systems, communities, and ecosystems
  - Systems approach
- Use existing data and tools: NACCS Integrated Strategy Document, CHS, state and local datasets, results of public outreach
- Complement other Federal, state, and local resilience projects



H. L. Carey Tunnel between Manhattan and Brooklyn flooded during Hurricane Sandy, October 2012

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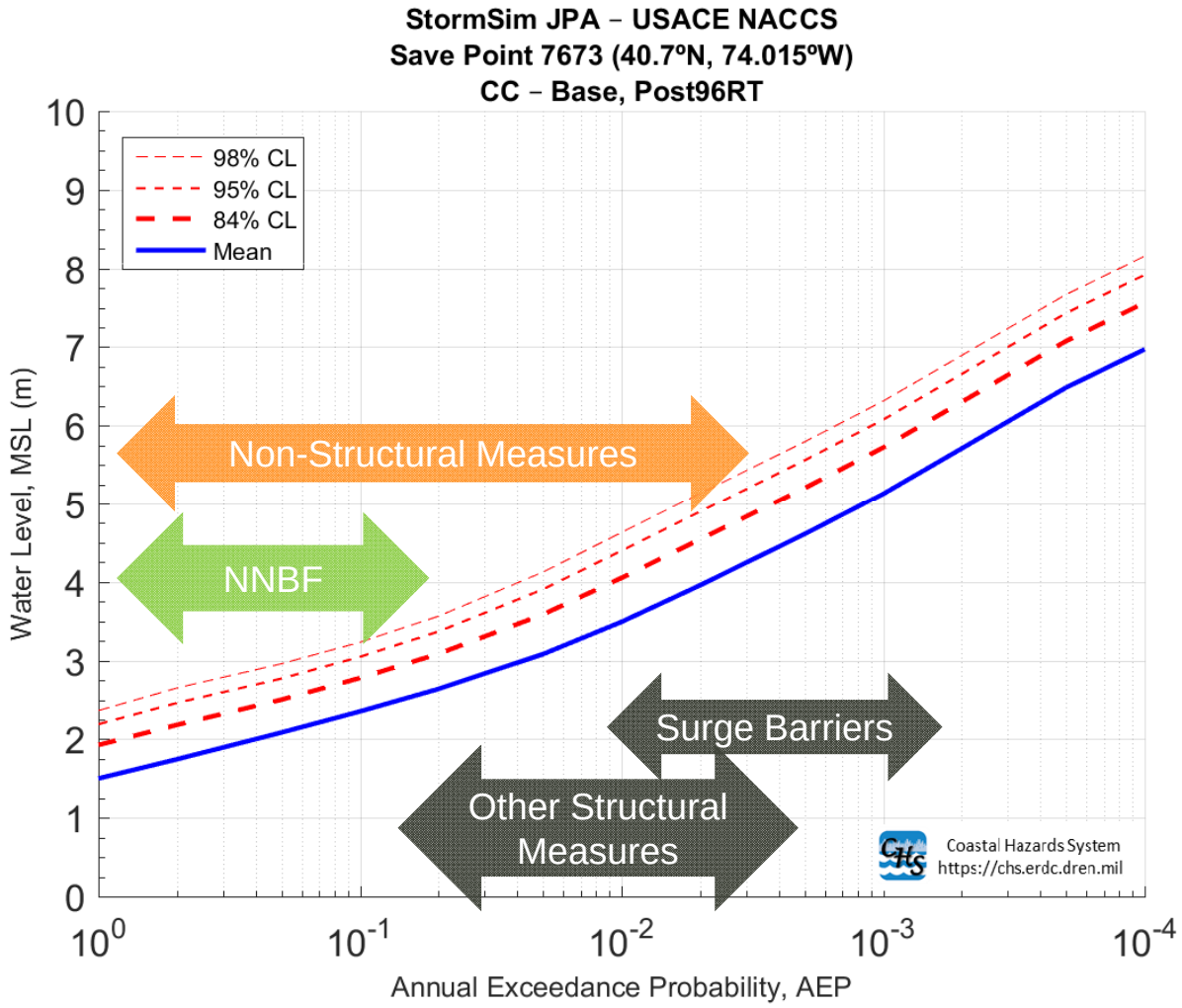
TAILORING MEASURES TO LOCATION & LEVEL OF PERFORMANCE



Location: the Battery

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SCREENING OF MEASURES

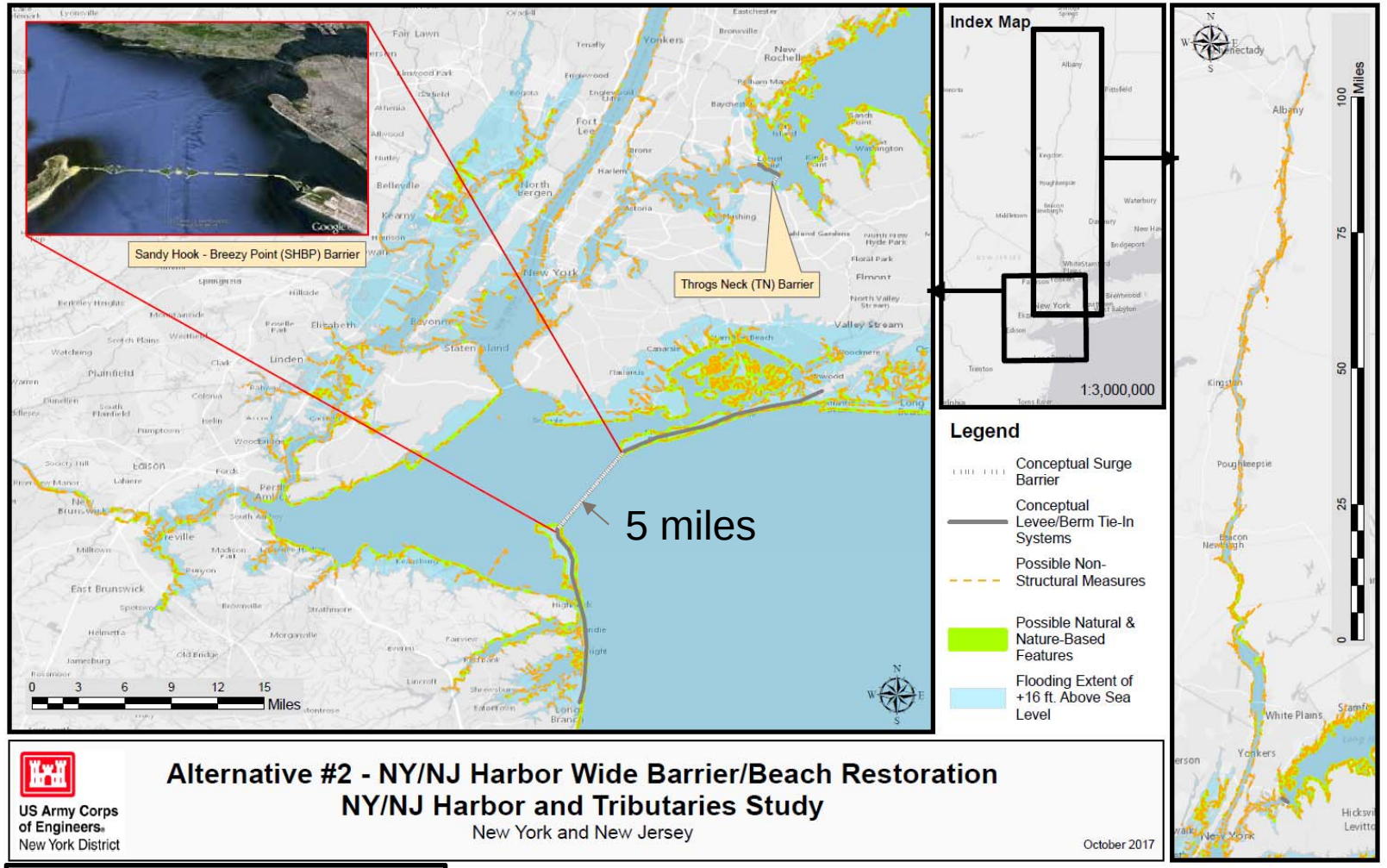
- Screening of measures based on shoreline type
- Offshore barriers, nonstructural actions, NNBF apply to entire study area
- Beach fill limited by shoreline type to Raritan Bay and Sandy Hook Bay, Lower Bay, and Jamaica Bay
- Focus on systems approach

ARRAY OF ALTERNATIVES

All alternatives will be combinations of structural and nonstructural measures, and natural and nature-based features. Names refer to key features.

- Alternative 1: No Action
- Alternative 2: NY/NJ Outer Harbor Barrier
- Alternative 3A/3B: Multiple Barriers and Floodwalls & Levee Systems
- Alternative 4: Solitary Bay and River Basin Barriers, Floodwalls & Levees
- Alternative 5: Perimeter Only

ALT 2: NY/NJ OUTER HARBOR BARRIER



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Alternative #2 - NY/NJ Harbor Wide Barrier/Beach Restoration
NY/NJ Harbor and Tributaries Study
New York and New Jersey

October 2017

0 0.75 1.5 3 4.5 6
Miles

N

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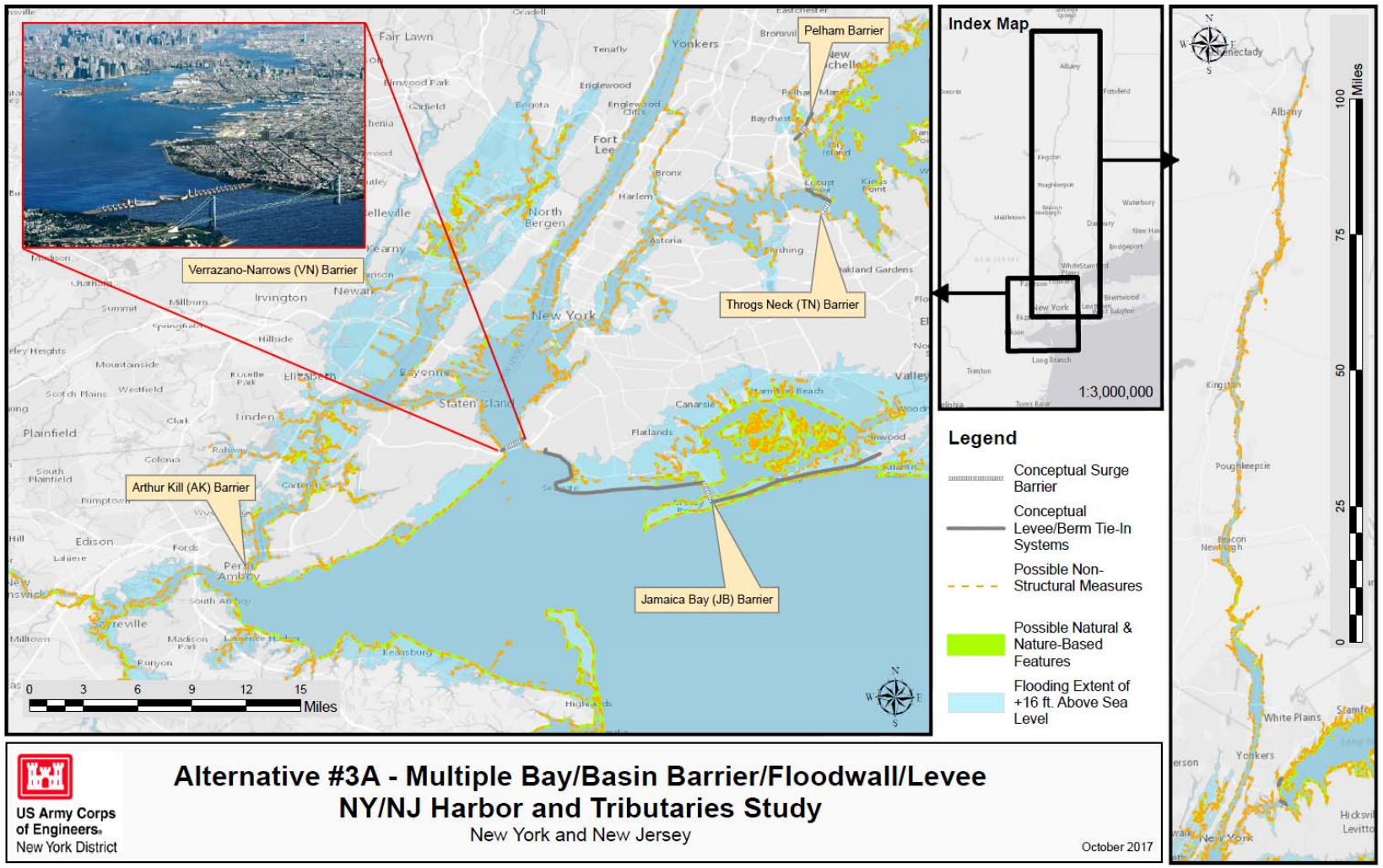
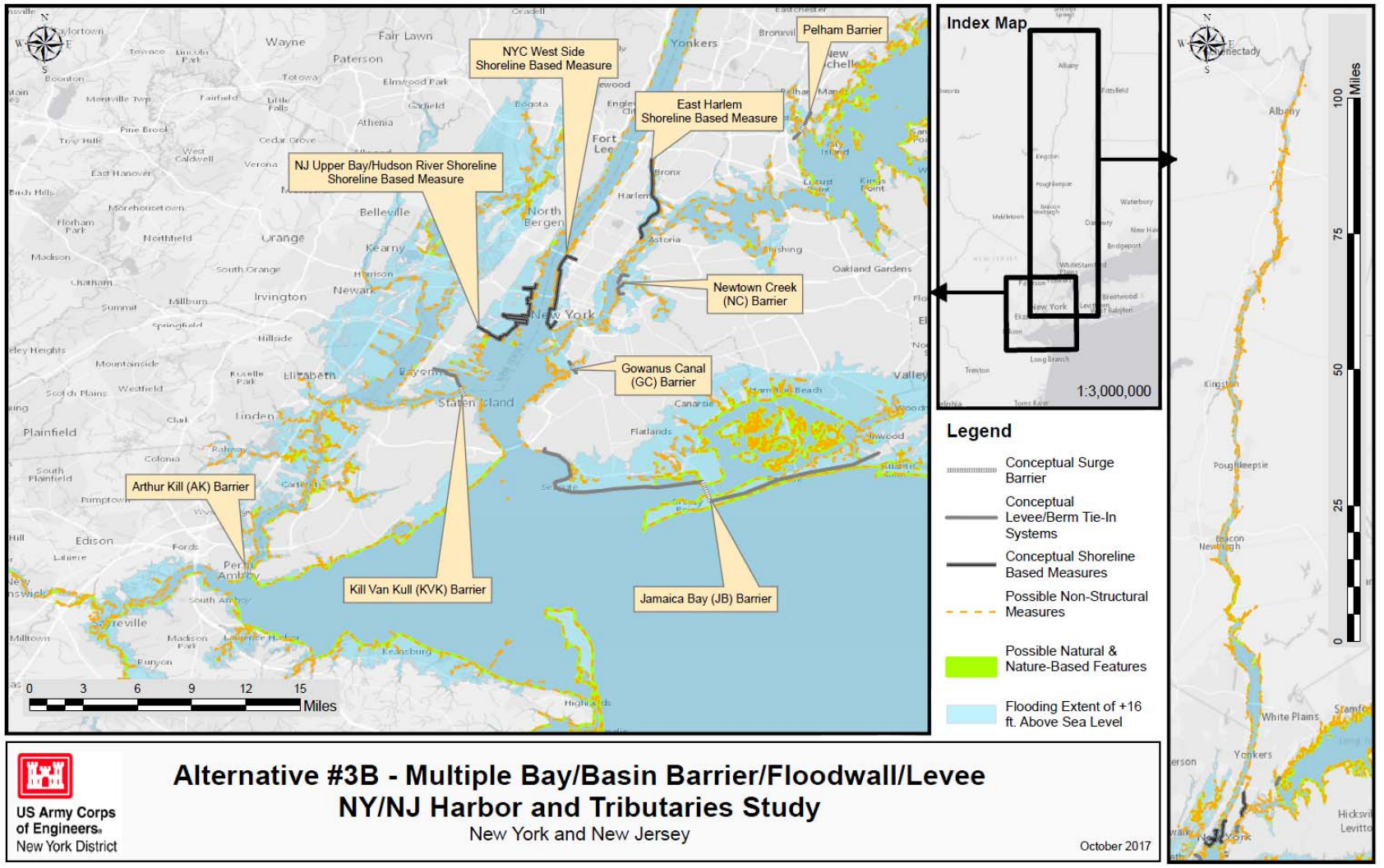
ALT. 3A: MULTIPLE BARRIERS & FLOODWALLS/LEVEES



ALT. 3B: MULTIPLE BARRIERS & FLOODWALLS/LEVEES



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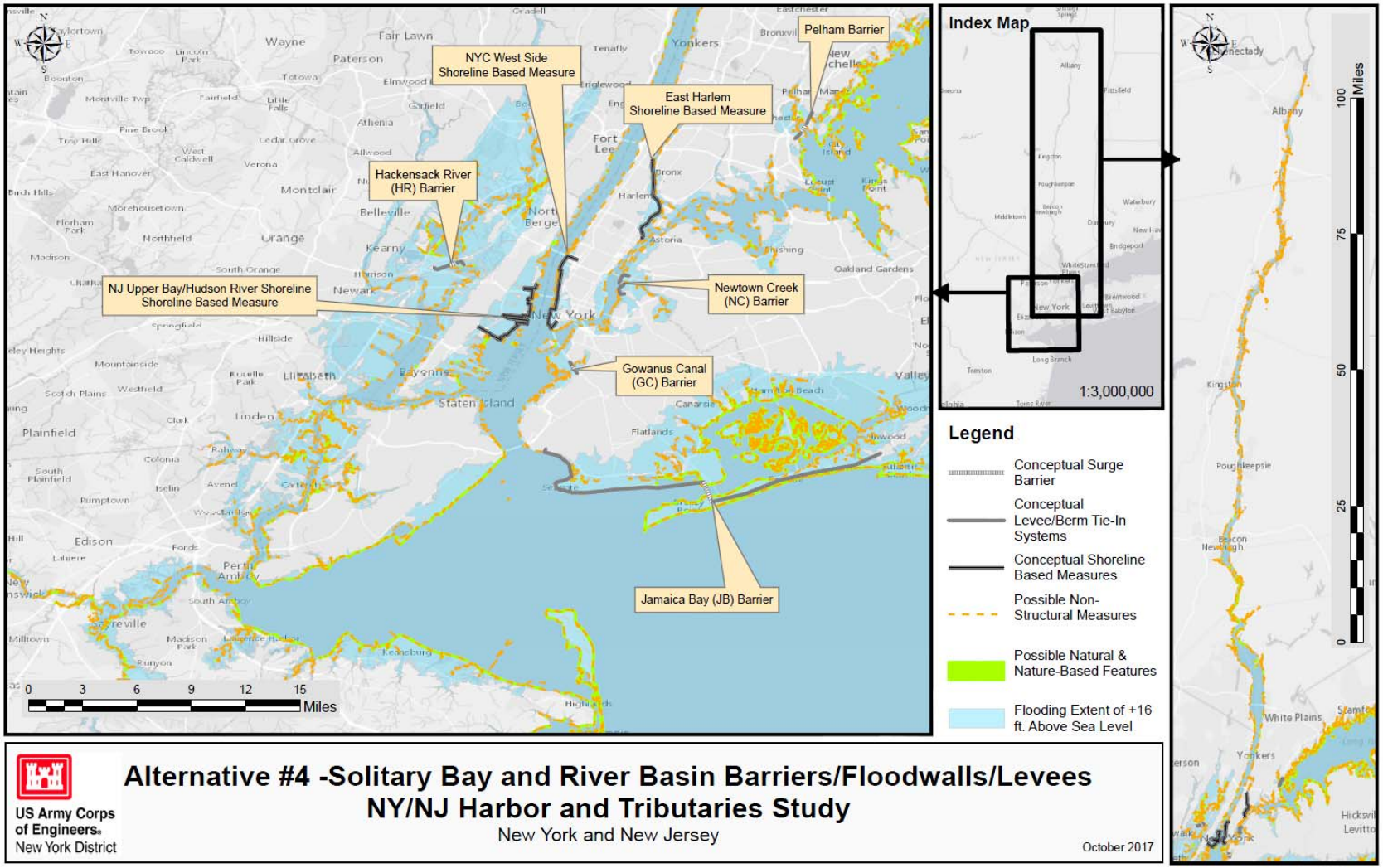
ALT. 4: SOLITARY BARRIER & FLOODWALLS/LEVEES



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Alternative #4 -Solitary Bay and River Basin Barriers/Floodwalls/Levees
NY/NJ Harbor and Tributaries Study
New York and New Jersey
October 2017

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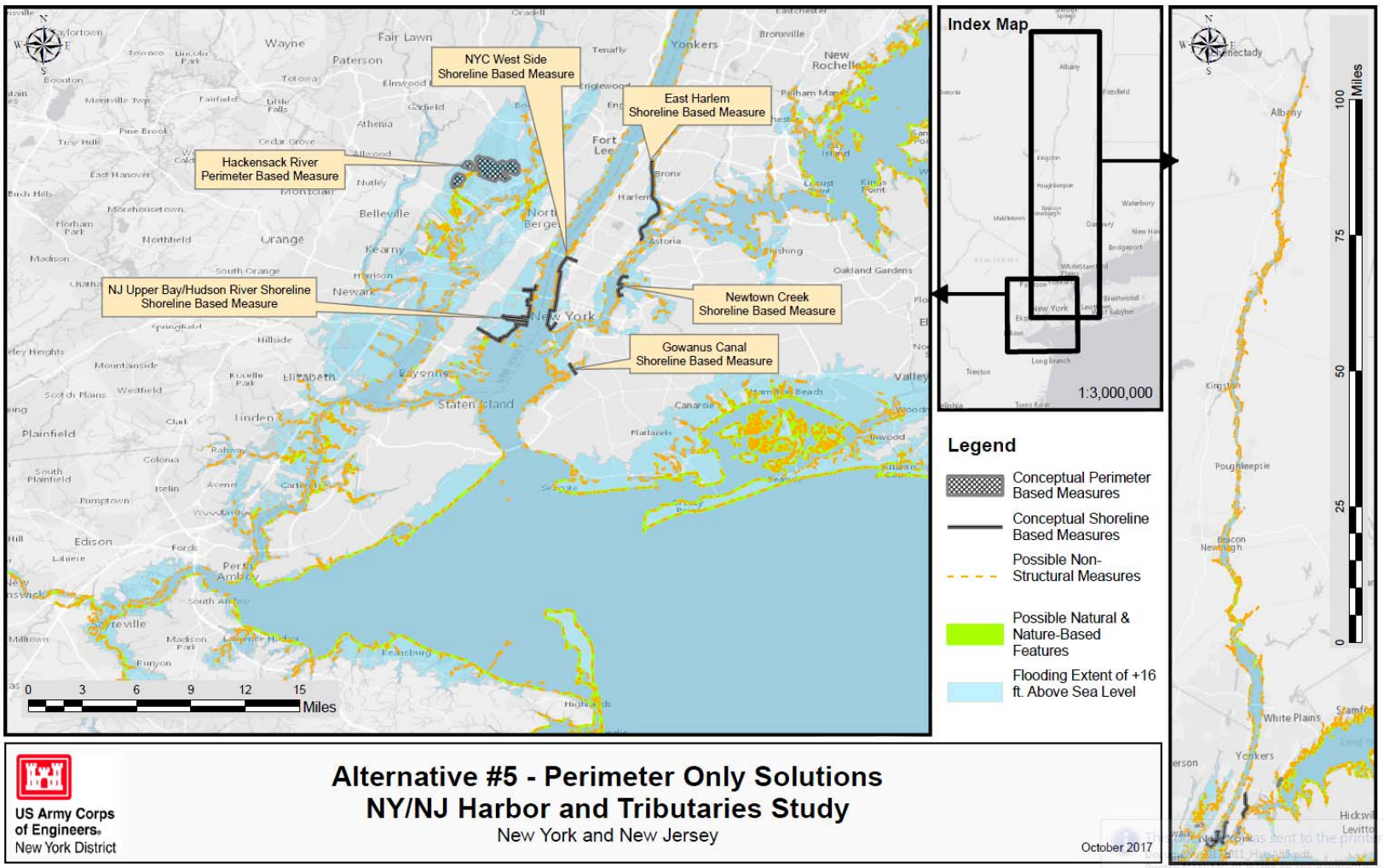
ALT. 5: PERIMETER ONLY



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Alternative #5 - Perimeter Only Solutions
NY/NJ Harbor and Tributaries Study
New York and New Jersey

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ALTERNATIVES SCREENING CRITERIA

- Does the alternative meet the planning objectives?
- Does the alternative avoid planning constraints?
- Does the alternative avoid impacts to the environment to the extent practicable?
- Does the alternative contribute to the P&G criteria of completeness, effectiveness, efficiency, and acceptability?
- Does the alternative contribute to the P&G accounts of NED, EQ, RED, and OSE?
- Does the alternative function well in a systems context?

Rockaway Beach, New York City

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ENVIRONMENTAL COMPLIANCE & RESOURCE AGENCY COORDINATION

- Invited Cooperating Agencies (22 September 2017)
  - Coast Guard
  - Environmental Protection Agency
  - Federal Emergency Management Agency
  - Fish and Wildlife Service
  - National Park Service
  - National Marine Fisheries Service
- Collecting existing project data for USACE, state, and local projects
- Project webpage established

Gateway National Recreation Area, NY and NJ (National Park Service)

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SUMMARY OF NEXT STEPS

- Path to the Tentatively Selected Plan Milestone (summer 2018)
- Screening-level evaluation of alternative benefits, costs, uncertainties and risks
- NEPA scoping & compliance
- Agency coordination
- Public outreach

East River kayaker approaching the Brooklyn Bridge

Brooklyn Bridge and East River (looking west to Manhattan)

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