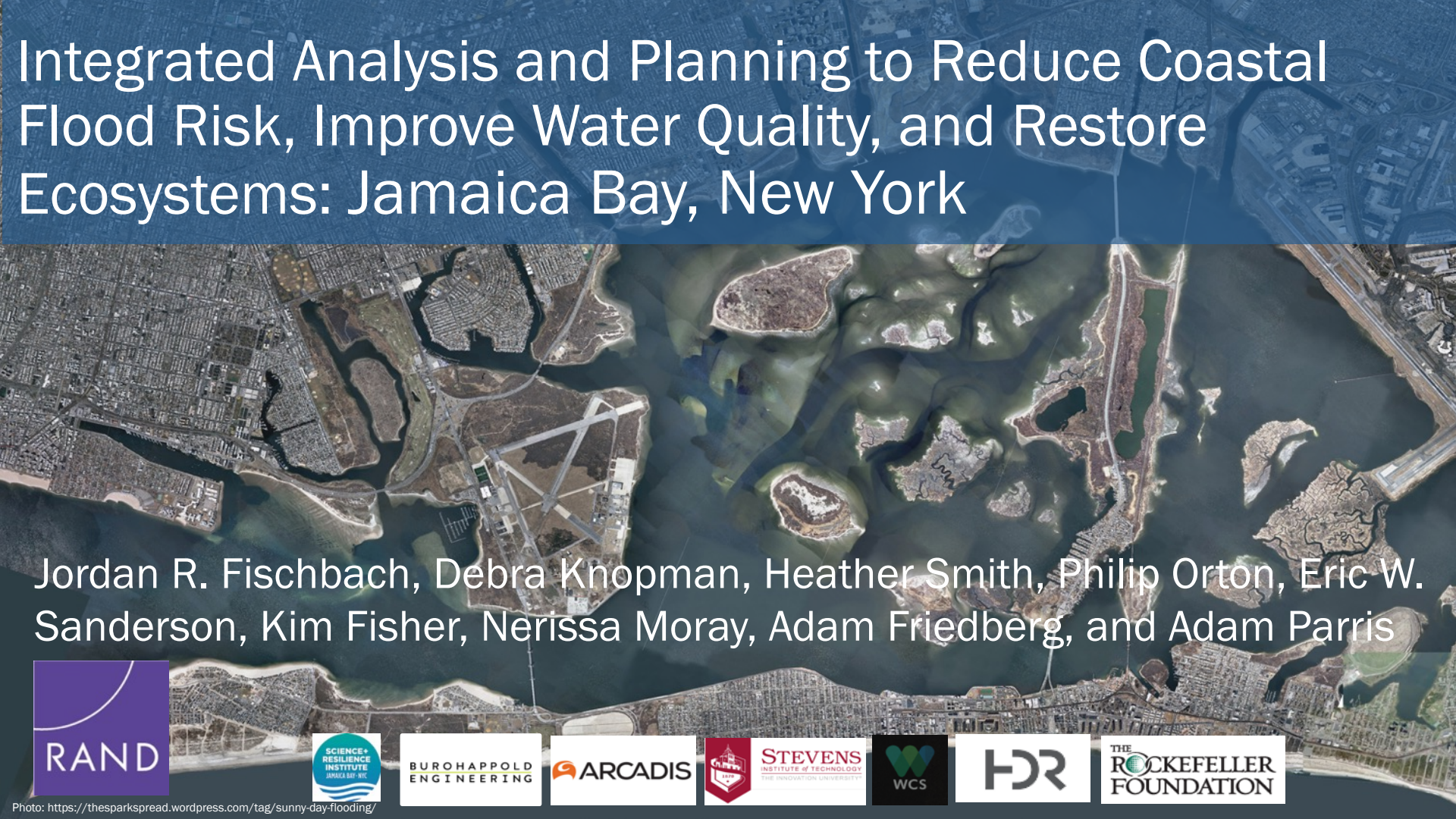
Integrated Analysis and Planning to Reduce Coastal Flood Risk, Improve Water Quality, and Restore Ecosystems: Jamaica Bay, New York



Jordan R. Fischbach, Debra Knopman, Heather Smith, Philip Orton, Eric W. Sanderson, Kim Fisher, Nerissa Moray, Adam Friedberg, and Adam Parris

RAND

SCIENCE+ RESILIENCE INSTITUTE JAMAICA BAY - NYC

BUROHAPPOLD ENGINEERING

ARCADIS

STEVENS INSTITUTE of TECHNOLOGY THE INNOVATION UNIVERSITY

WCS

HDR

THE ROCKEFELLER FOUNDATION

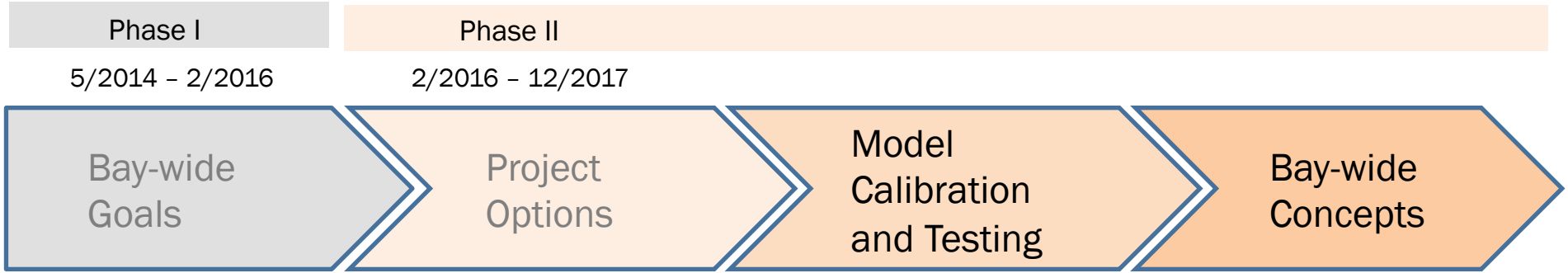
Photo: https://thesparkspread.wordpress.com/tag/sunny-day-flooding/


Jamaica Bay is experiencing salt marsh erosion, more frequent tidal flooding, and stresses on water quality

Project background

- Funding
  - Grant in 2014 from the Rockefeller Foundation to RAND in partnership with BuroHappold and the Science + Resilience Institute
  - Team included Institute members, Wildlife Conservation Society and Stevens, with partners Arcadis and HDR
- Objective
  - Demonstrate value of building integrated analytical tools and interactive approach to long-term planning under uncertainty

Project demonstrated value of building integrated models and interactive approach to facilitate planning under uncertainty



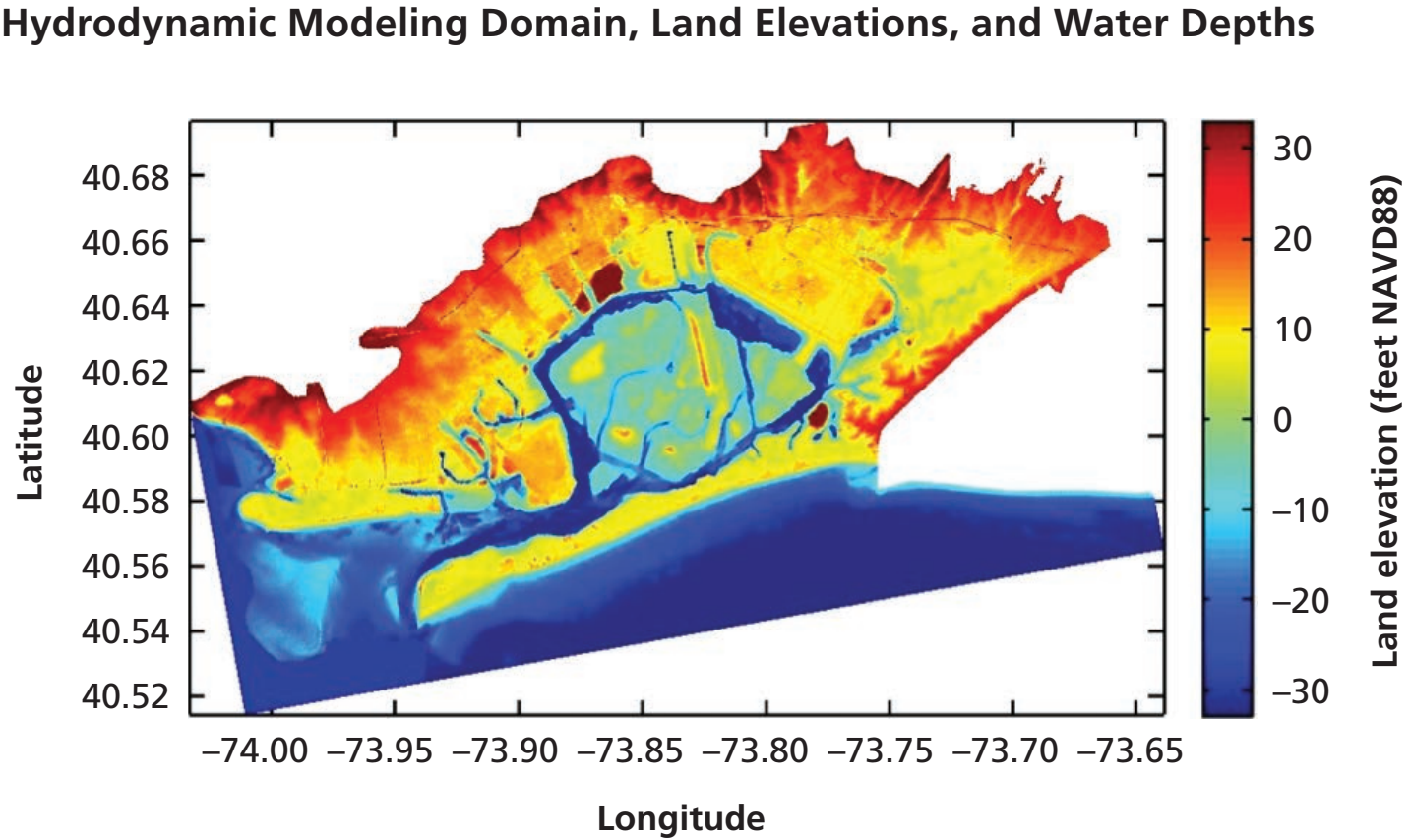
We engaged a range of stakeholders to discuss:

- Nature of the decisions about risk reduction
- Goals and metrics for building resilience and equity
- Salient uncertainties that might influence future outcomes
- Modeling tools and data required to execute the analysis

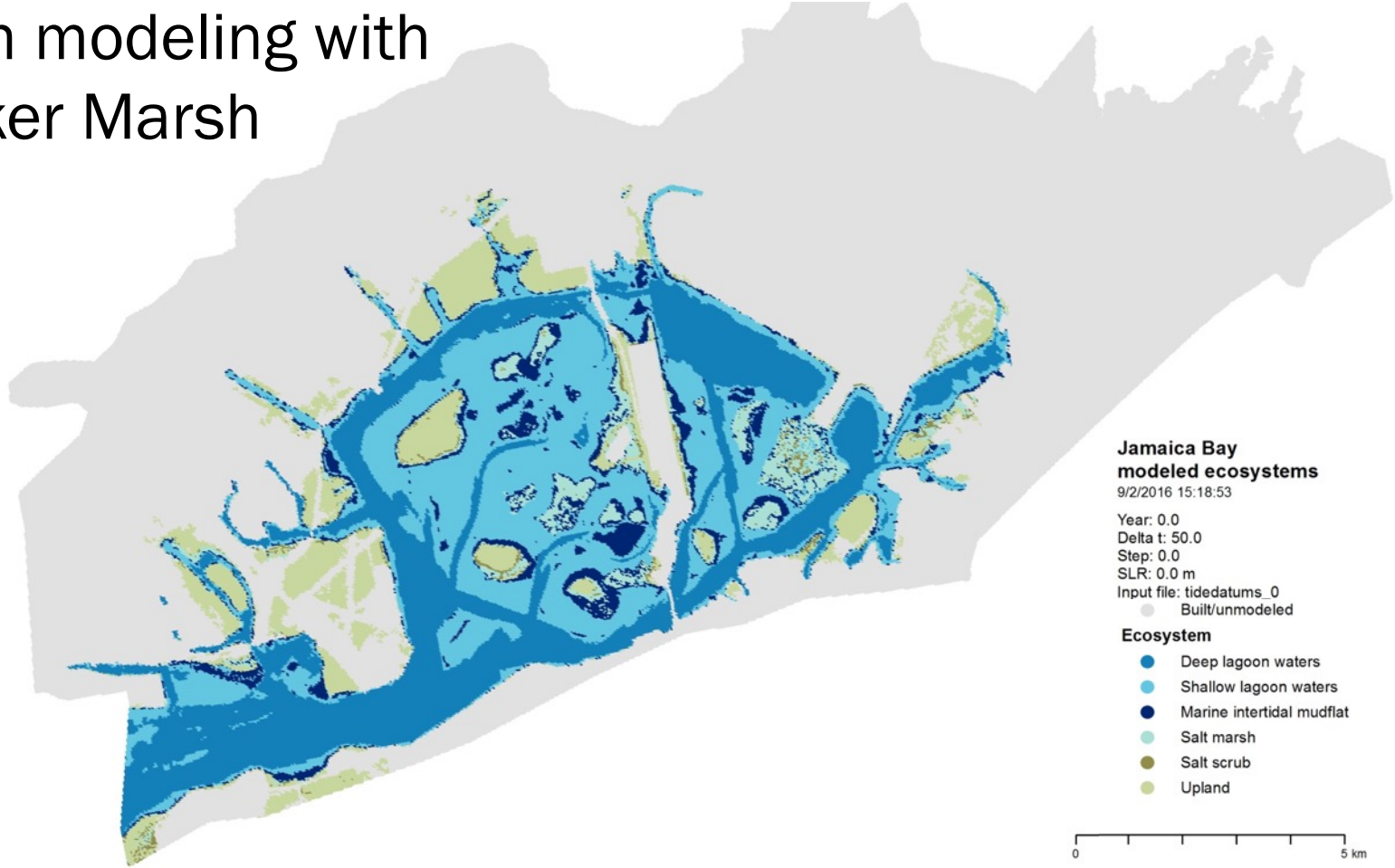
We considered multiple planning goals for the Bay

Goal	Metric(s)
Improve habitat and ecosystem function	• Acreage and extent of ecosystems by type • Change in land area (landscape gain/loss)
Reduce flood risk	• Change in tidal flood levels • Tidal flooding inundation area • Tidal flood exposure (count of structures flooded by type)
Improve water quality	• Dissolved oxygen concentration (bay-wide DO area-days)

Area of interest



Ecosystem modeling with Visionmaker Marsh



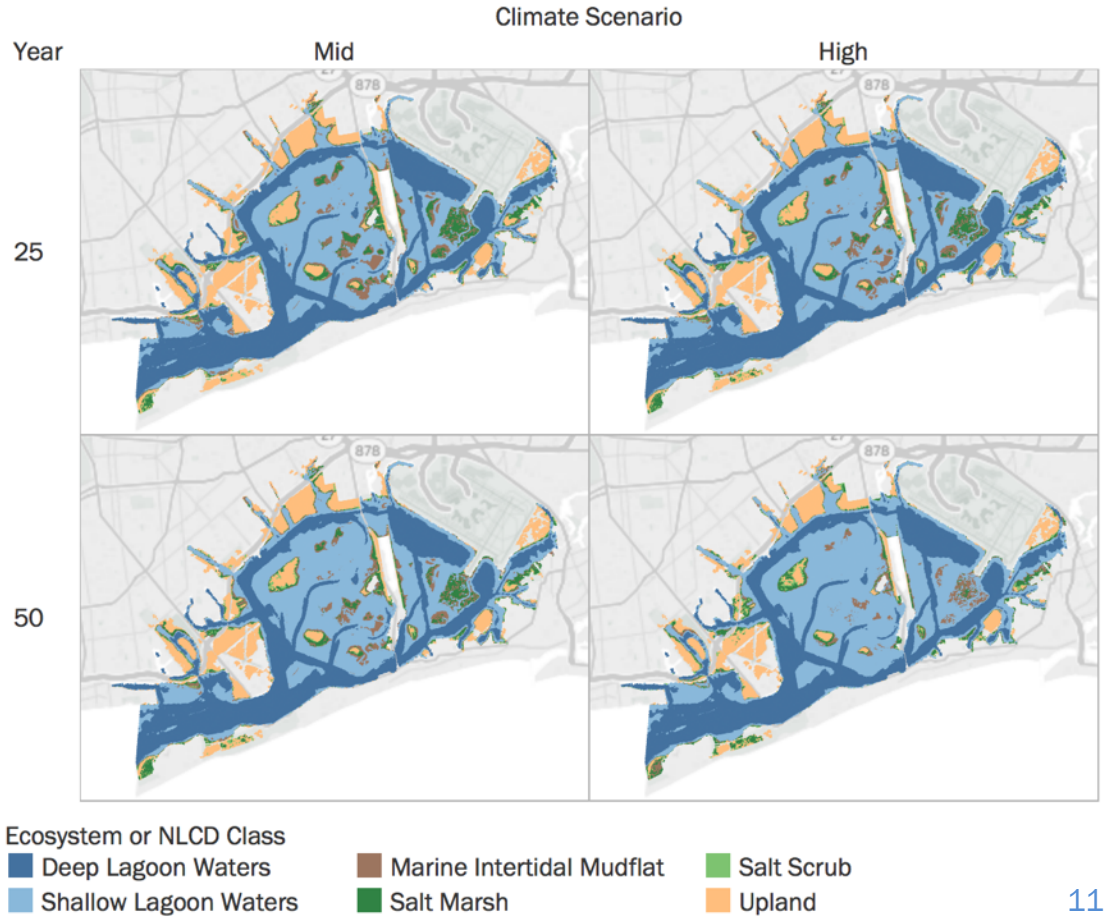
Changes in a Future Without Action

Year	Climate Scenario	NPCC Percentile	SLR (inches)	Temperature Change (Annual Average; °F)	Annual Rainfall Change (%)
2041	Mid	50	7.4	3.9	5
2041	High	90	15.8	5.2	10
2066	Mid	50	16.7	6.0	10
2066	High	90	35.6	8.3	15

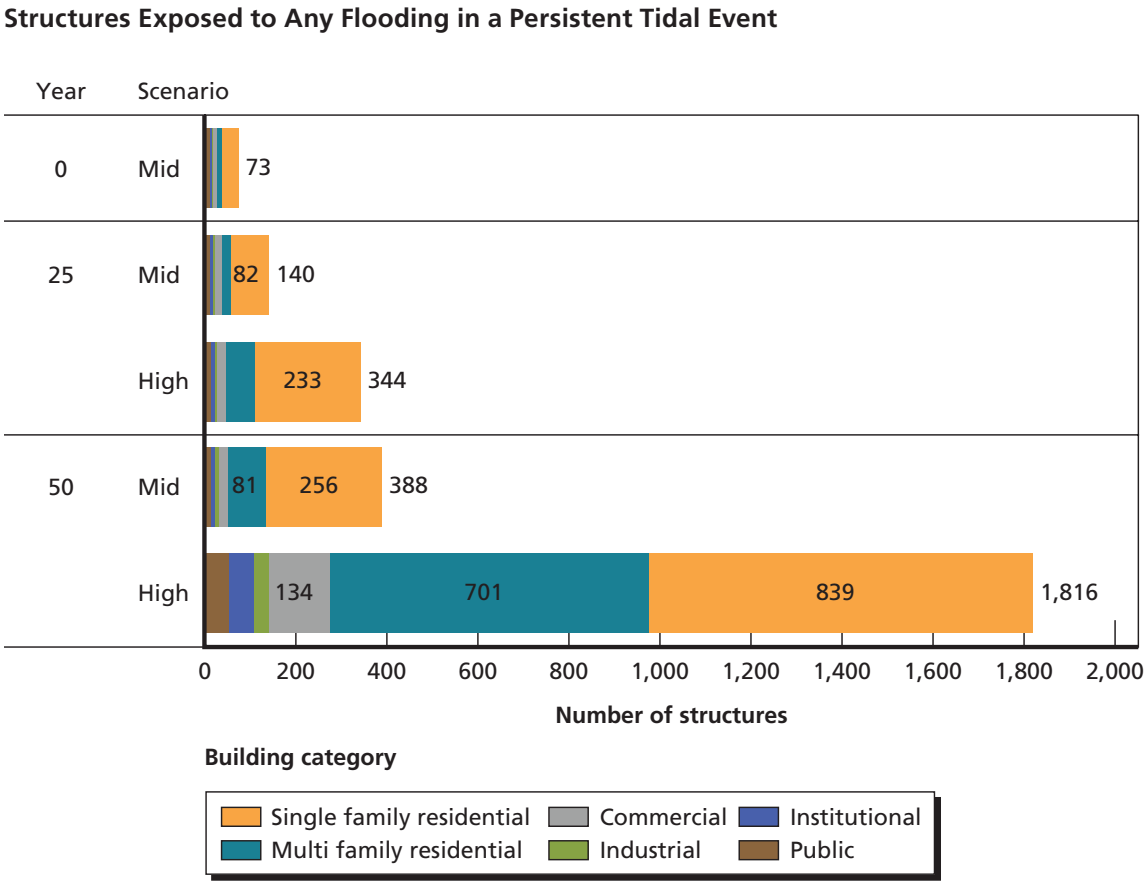
NOTE: SLR baseline converted to 2016. Temperature baseline = 1985.

25- and 50-year climate scenarios based on 2015 New York Panel on Climate Change (NPCC) estimates

Bay ecosystems show continued decline in future scenarios



High sea level rise dramatically increases tidal flood exposure



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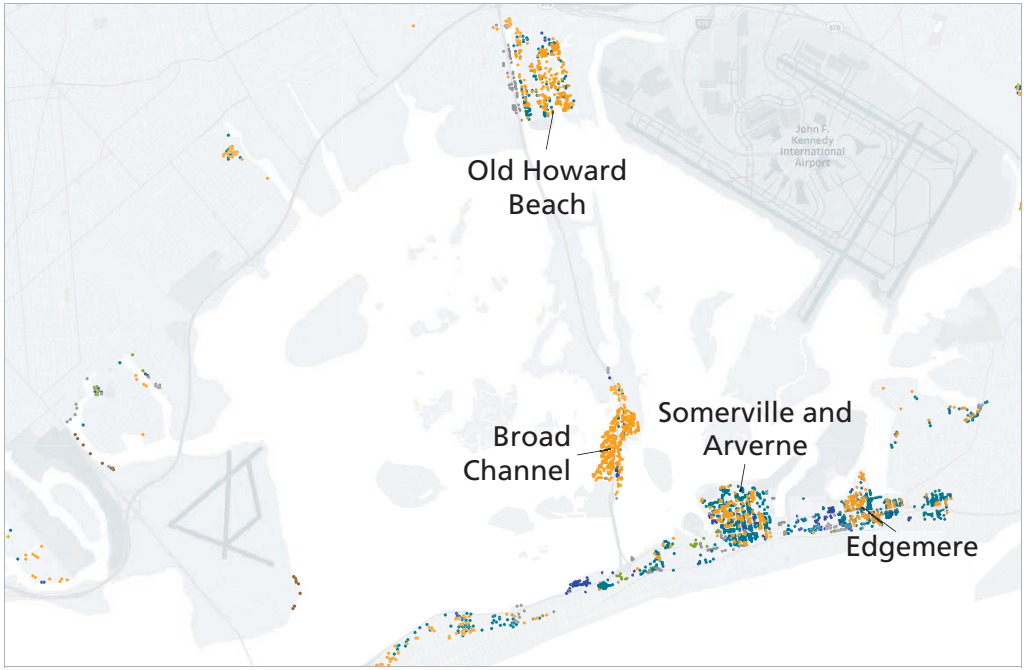
High sea level rise dramatically increases tidal flood exposure

Assets exposed to monthly tidal flooding (any depth), year 50



Building category

Single family residential
Multi family residential
Commercial
Industrial
Institutional
Public

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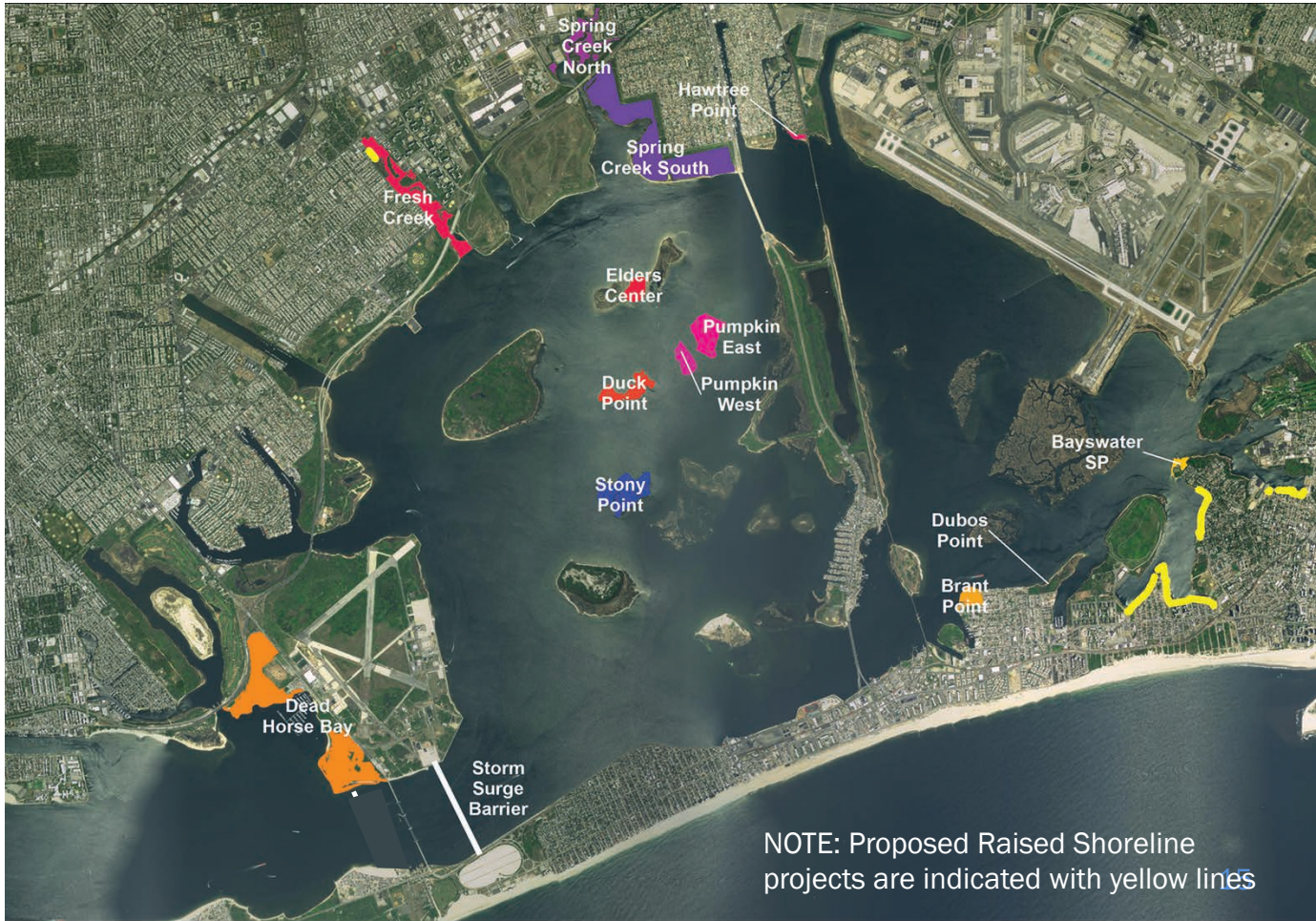
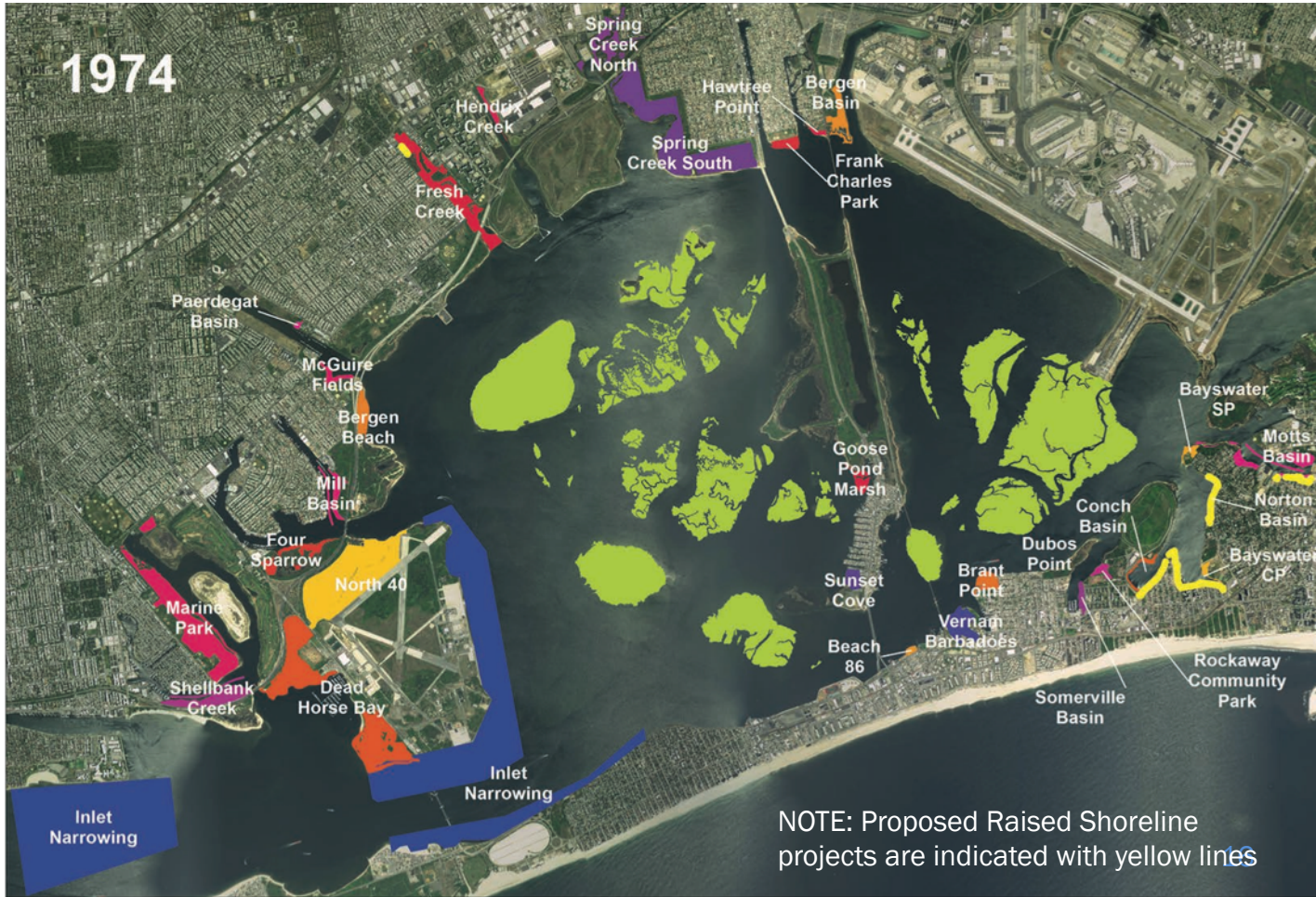
Baywide Concepts to Reduce Vulnerabilities

Concept 1: Barrier Plus Restoration

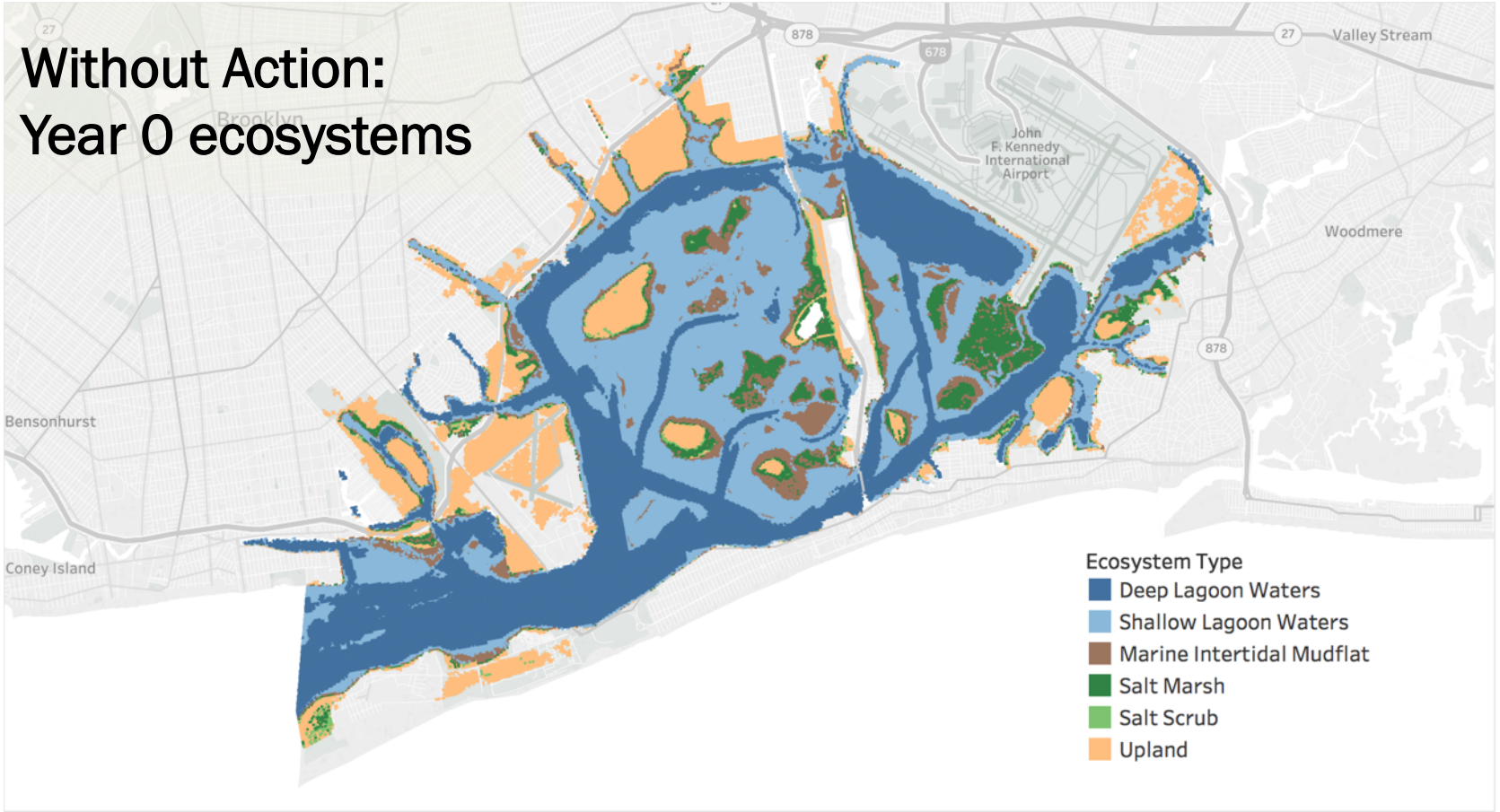


Concept 2: Narrowing and Wetlands

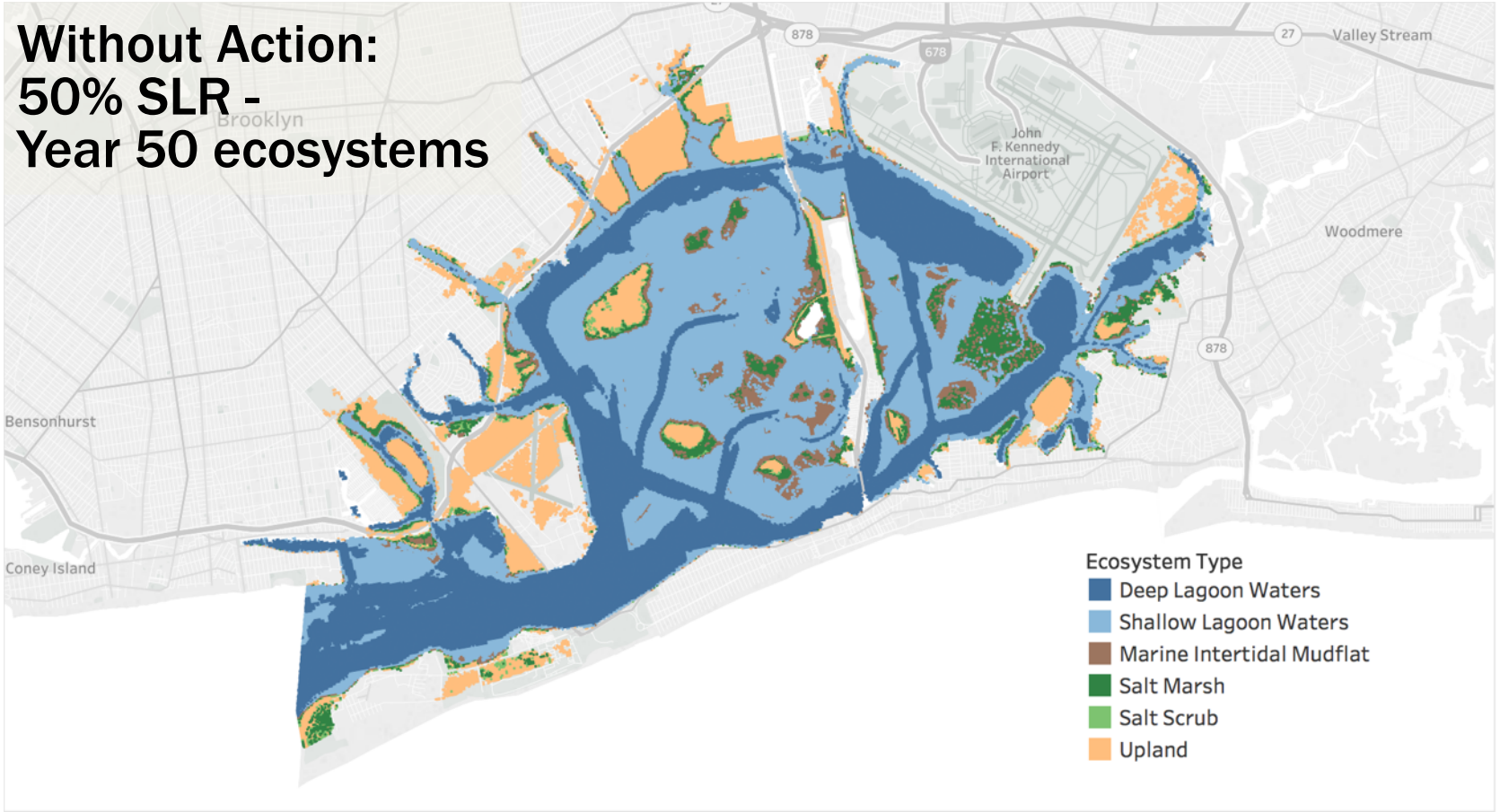


Baywide Concept Results

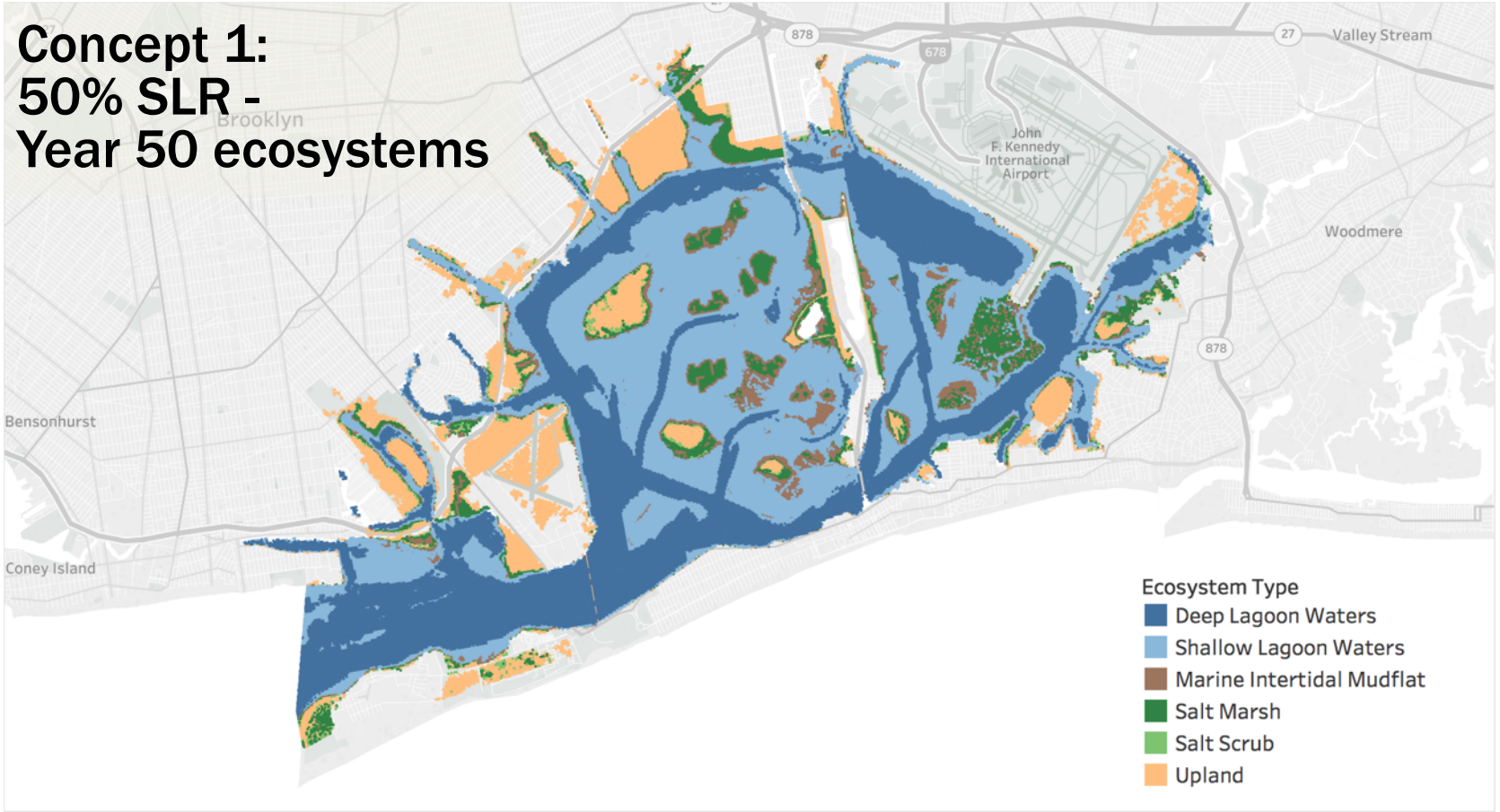
Without Action:
Year 0 ecosystems



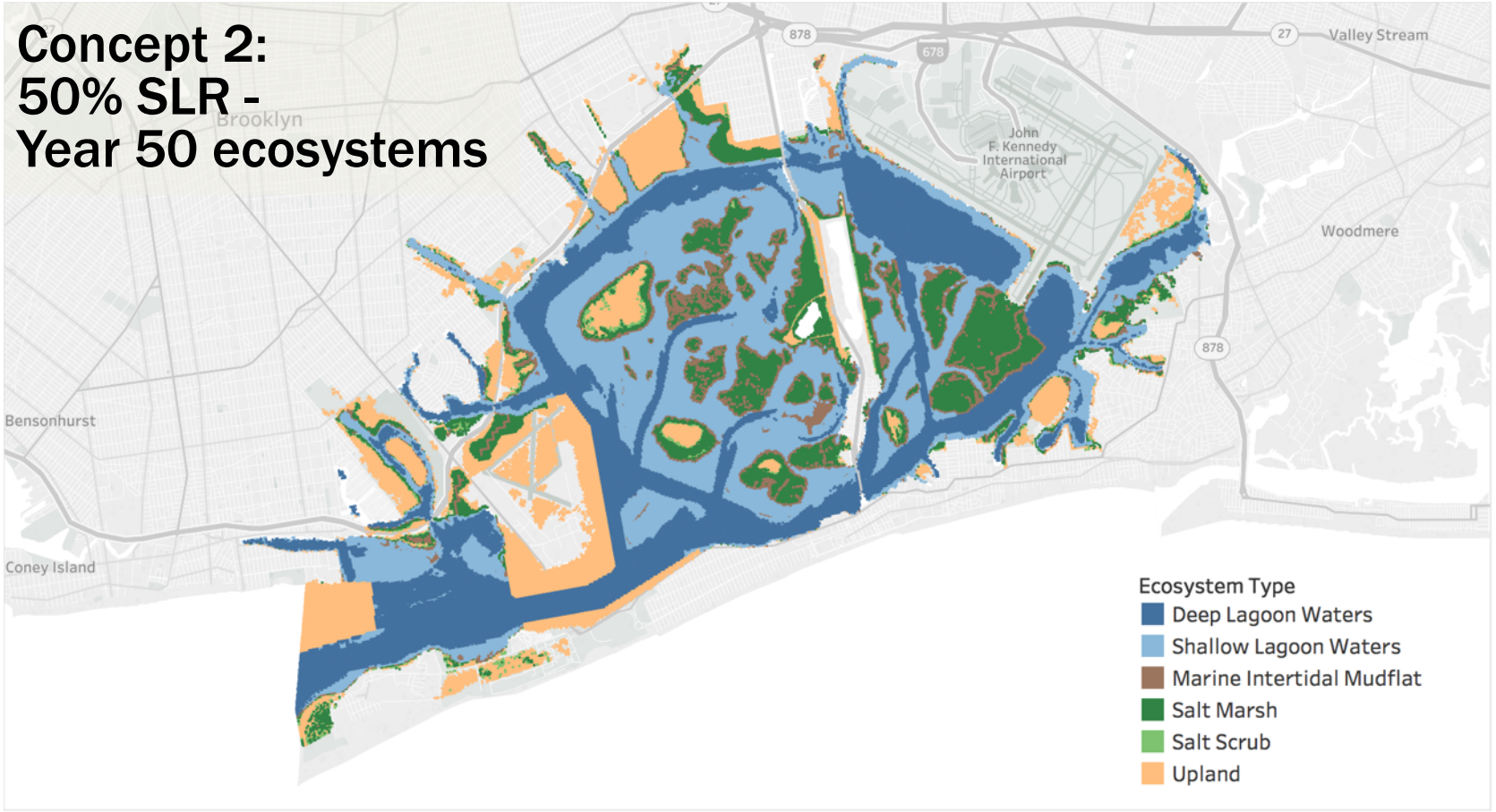
Without Action: 50% SLR - Year 50 ecosystems



Concept 1: 50% SLR - Year 50 ecosystems

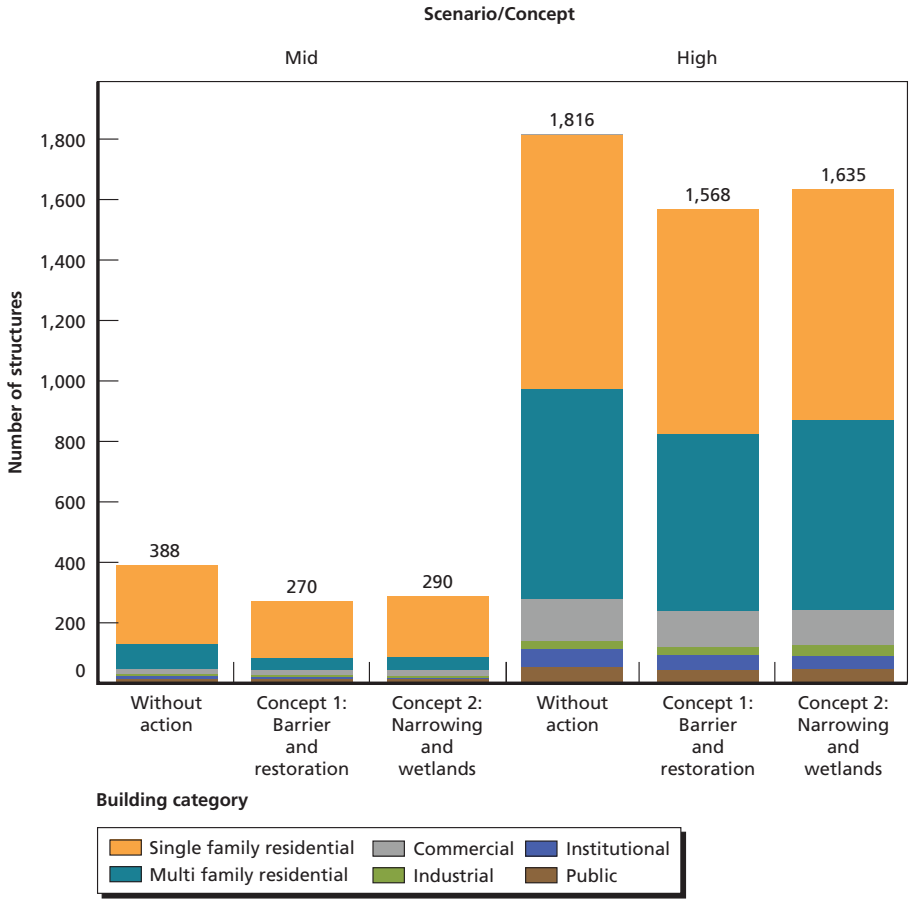


Concept 2: 50% SLR - Year 50 ecosystems



Concept 2: Narrowing and Wetlands, 50th percentile, Year 50

Baywide concepts somewhat reduce Year 50 exposure to flooding



NOTE: Asset exposure to any nonzero flood depth, MMHW.

Concept Summary for Selected Metrics Compared to a FWOA

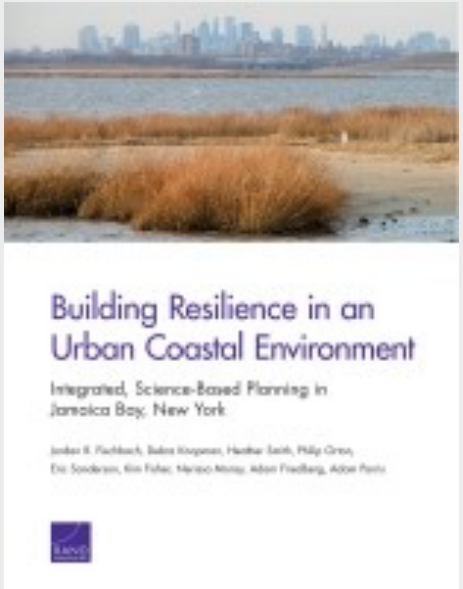
Metric	Year	Scenario	Concept 1 (%)	Concept 2 (%)
Land area change	25	Mid	3	23
		High	4	29
	50	Mid	4	30
		High	4	28
Number of assets no longer flooded	25	Mid	26	21
		High	31	27
	50	Mid	30	25
		High	14	10
Reduced bottom-layer area-days below 4.8 mg/L	50	Mid	5	13

Percent improvement from FWOA

Note: Land area change omits the inlet narrowing included in Concept 2

Outcomes and key findings

- Building trust in the analysis before results are generated is essential
- The process needs to allow for learning and modifying options
- Integrated model development often can be the rate-limiting step
- Widespread diffusion of these methods will require networks of users, easy-to-customize tools, and organizations to support local governments



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https://www.rand.org/pubs/research_reports/RR2193.html. Also available in print form.


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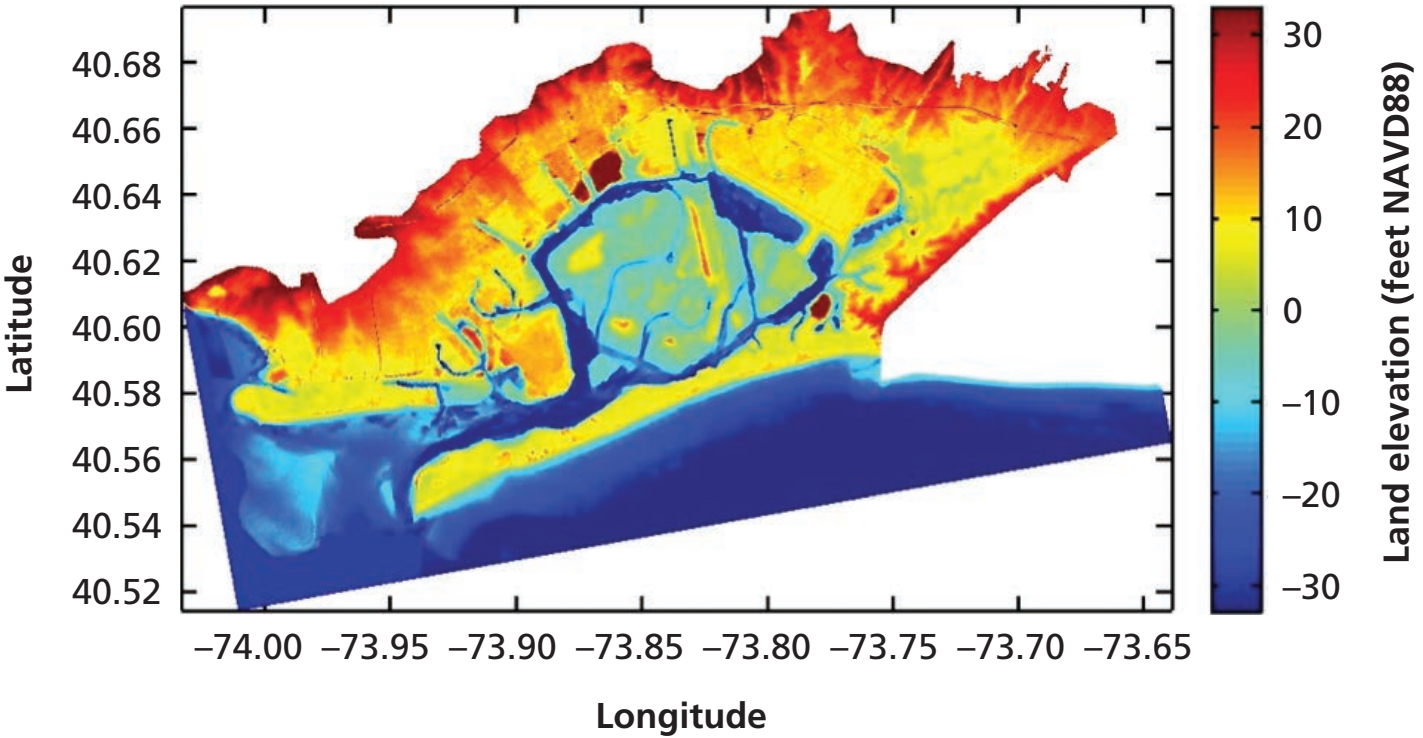
Integrated Modeling Framework

Area of interest

Area of interest

Hydrodynamic Modeling Domain, Land Elevations, and Water Depths



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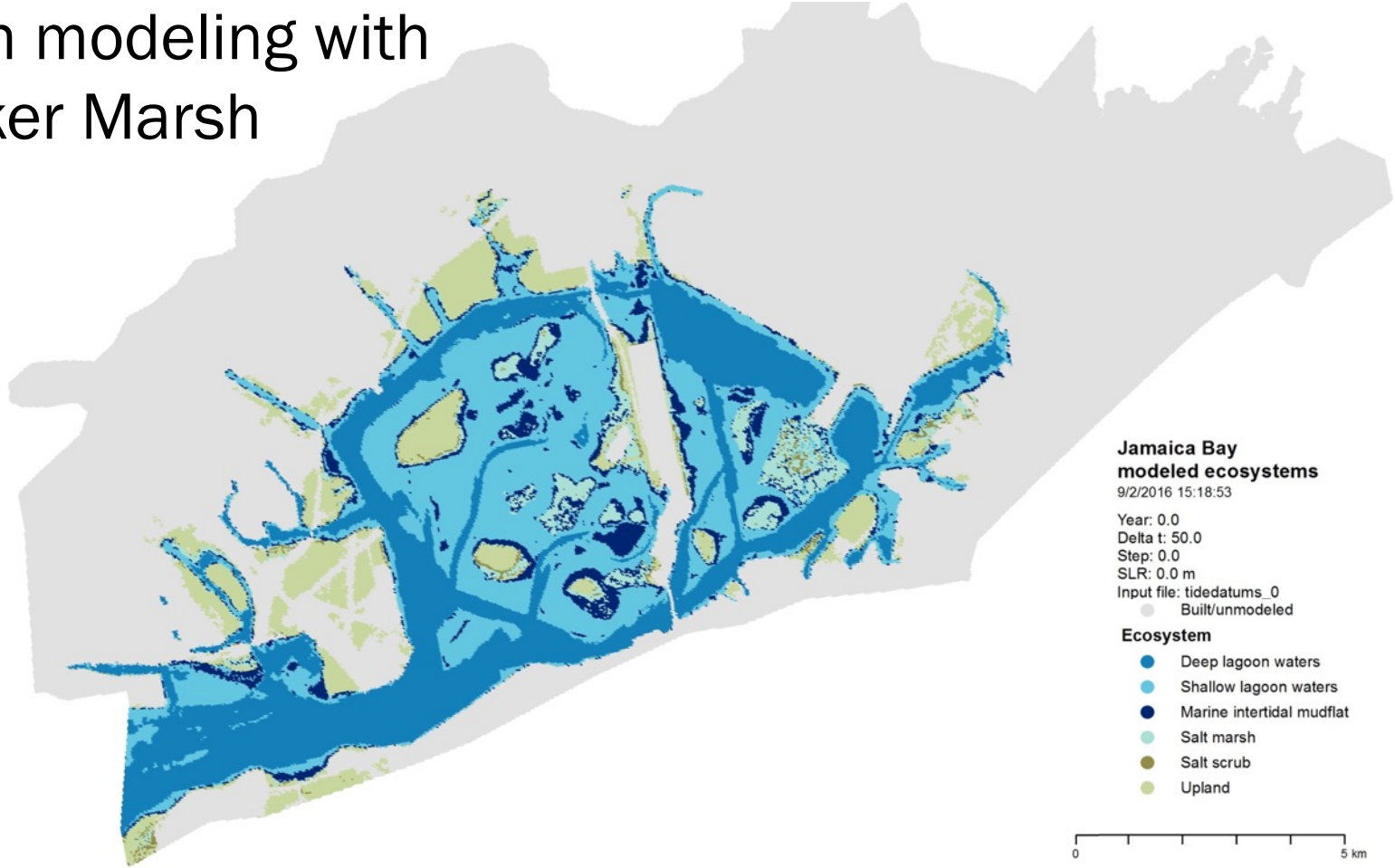
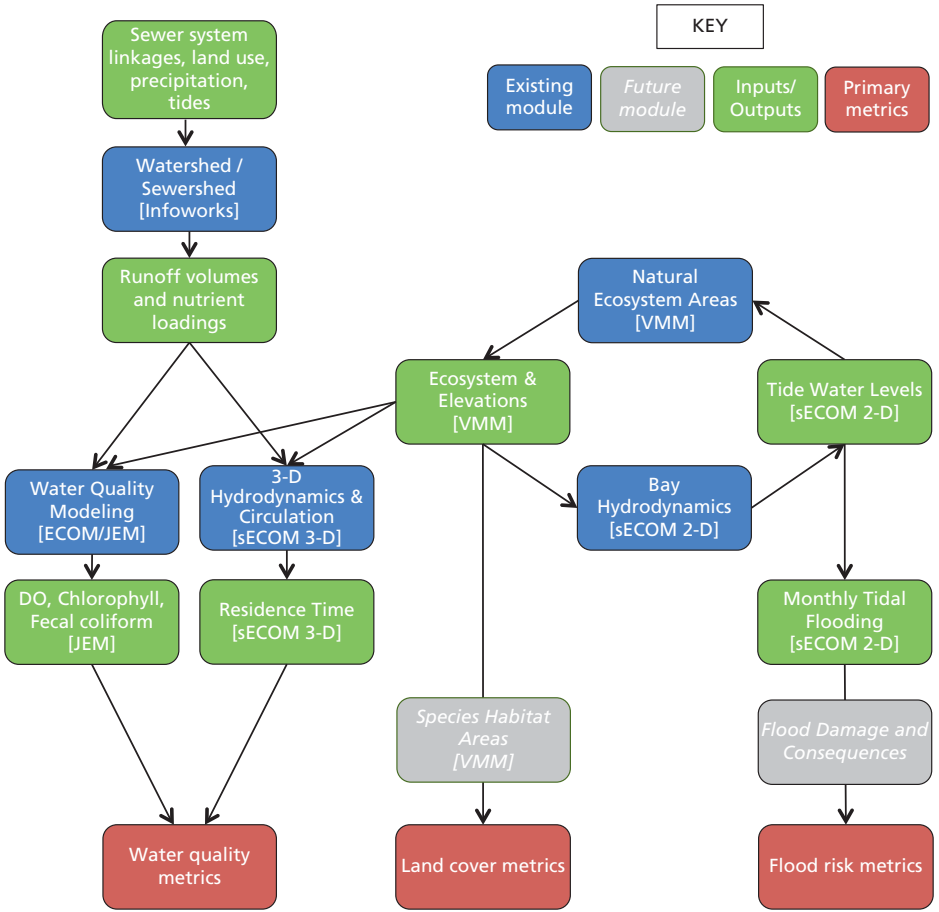


Process framework



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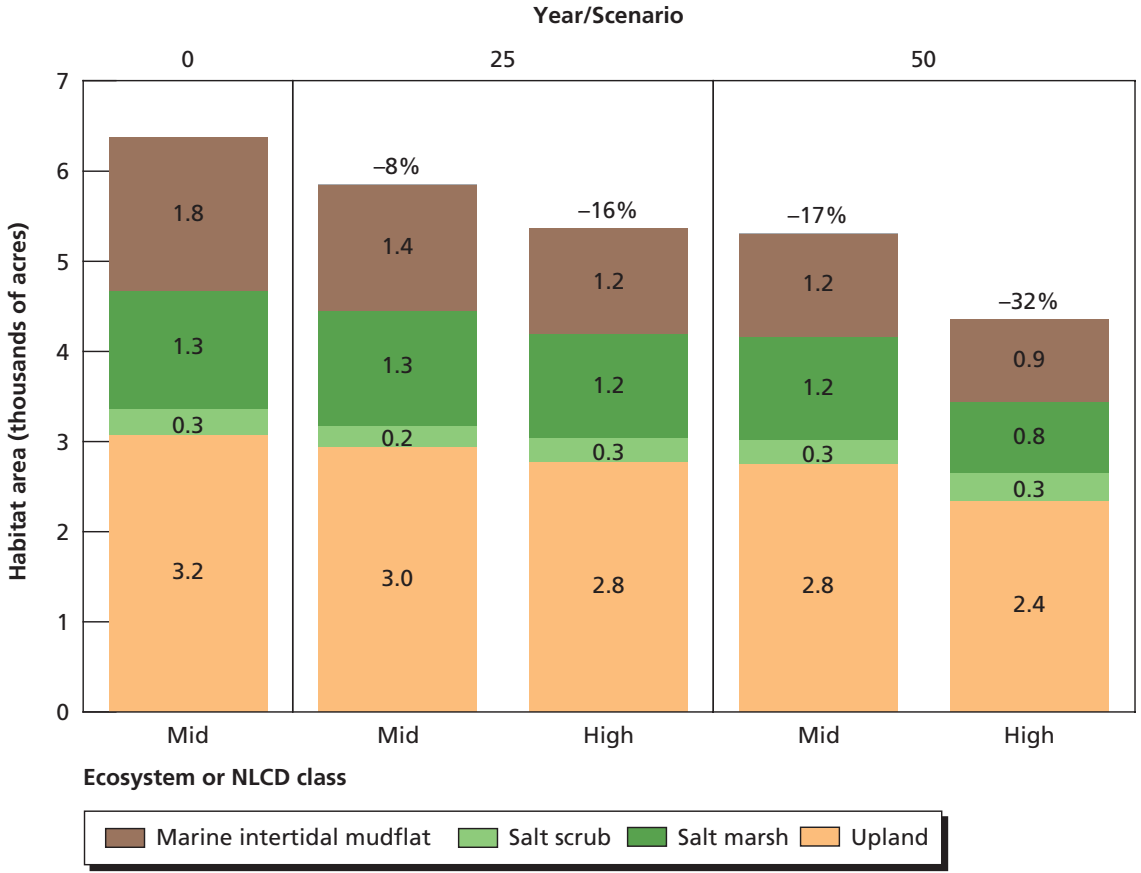

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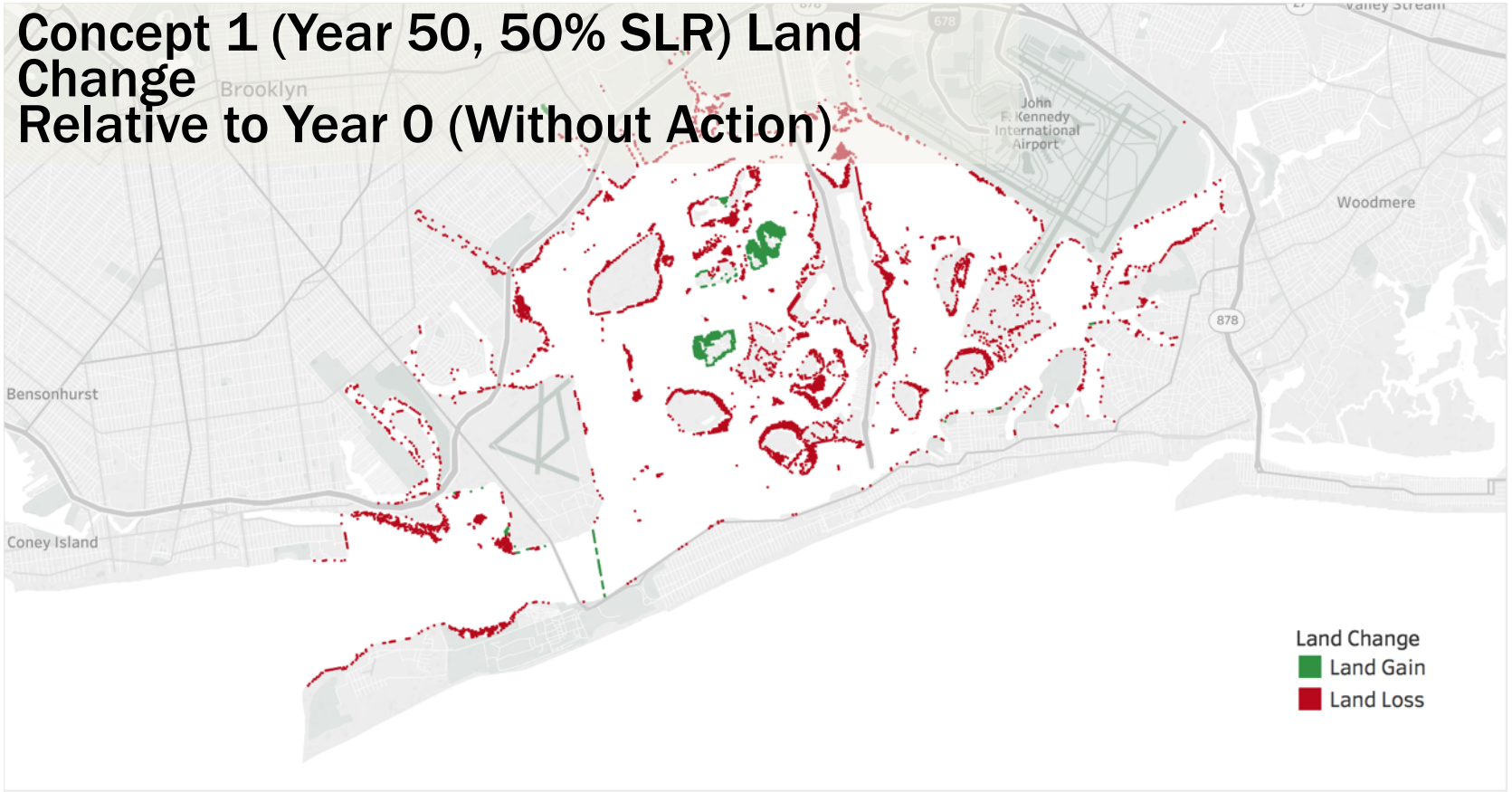
Without Action - 50% SLR - Year 50 land loss

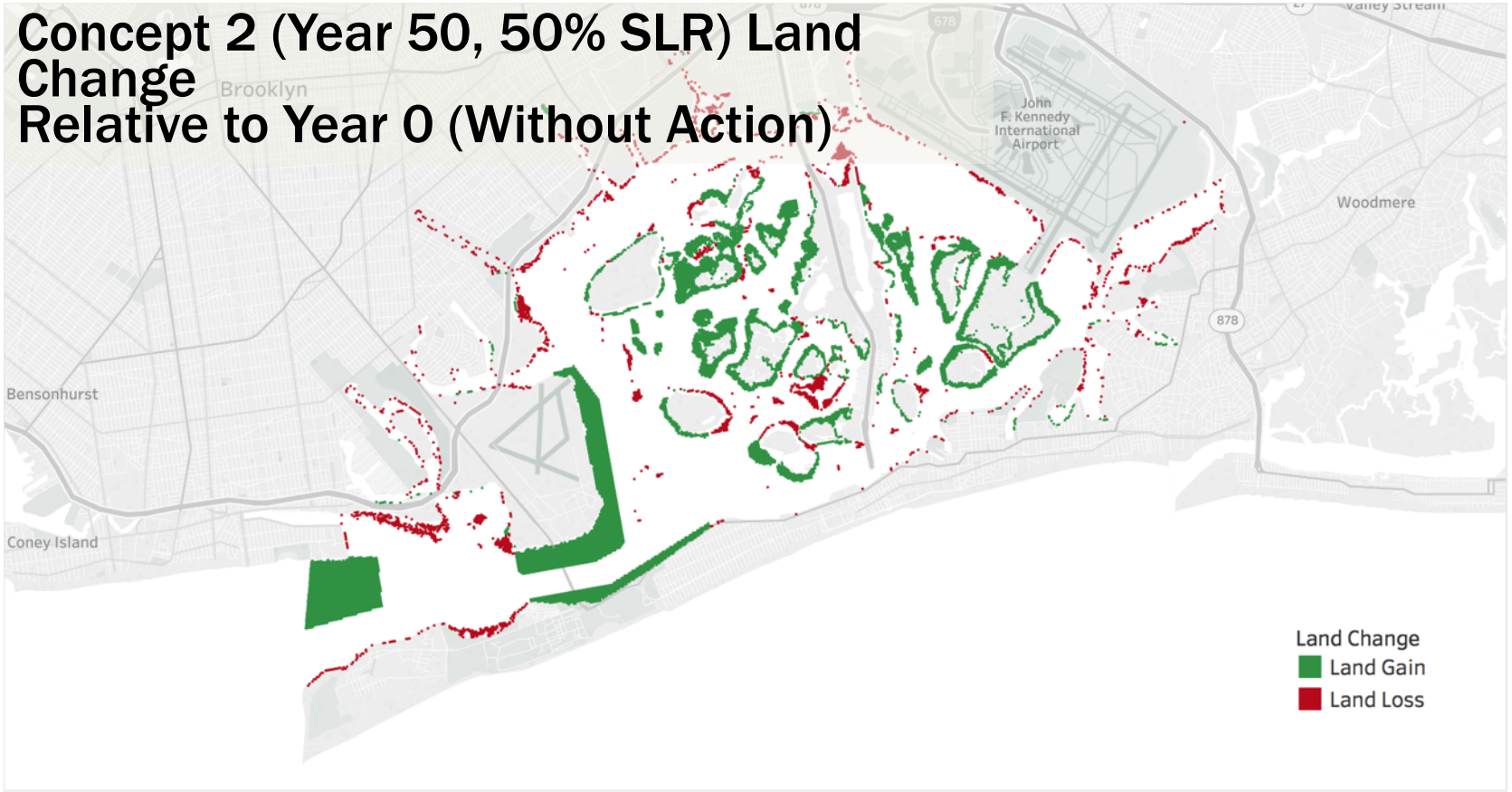
Without Action, 50th percentile, Year 50

Concept 1 (Year 50, 50% SLR) Land Change Relative to Year 0 (Without Action)



Concept 1: Barrier and Restoration, 50th percentile, Year 50 compared to Current Conditions (year 0). Land change reflects areas converting to or from shallow or deep lagoon waters.

Concept 2 (Year 50, 50% SLR) Land Change Relative to Year 0 (Without Action)



Concept 2: Narrowing and Wetlands, 50th percentile, Year 50 compared to Current Conditions (year 0). Land change reflects areas converting to or from shallow or deep lagoon waters.