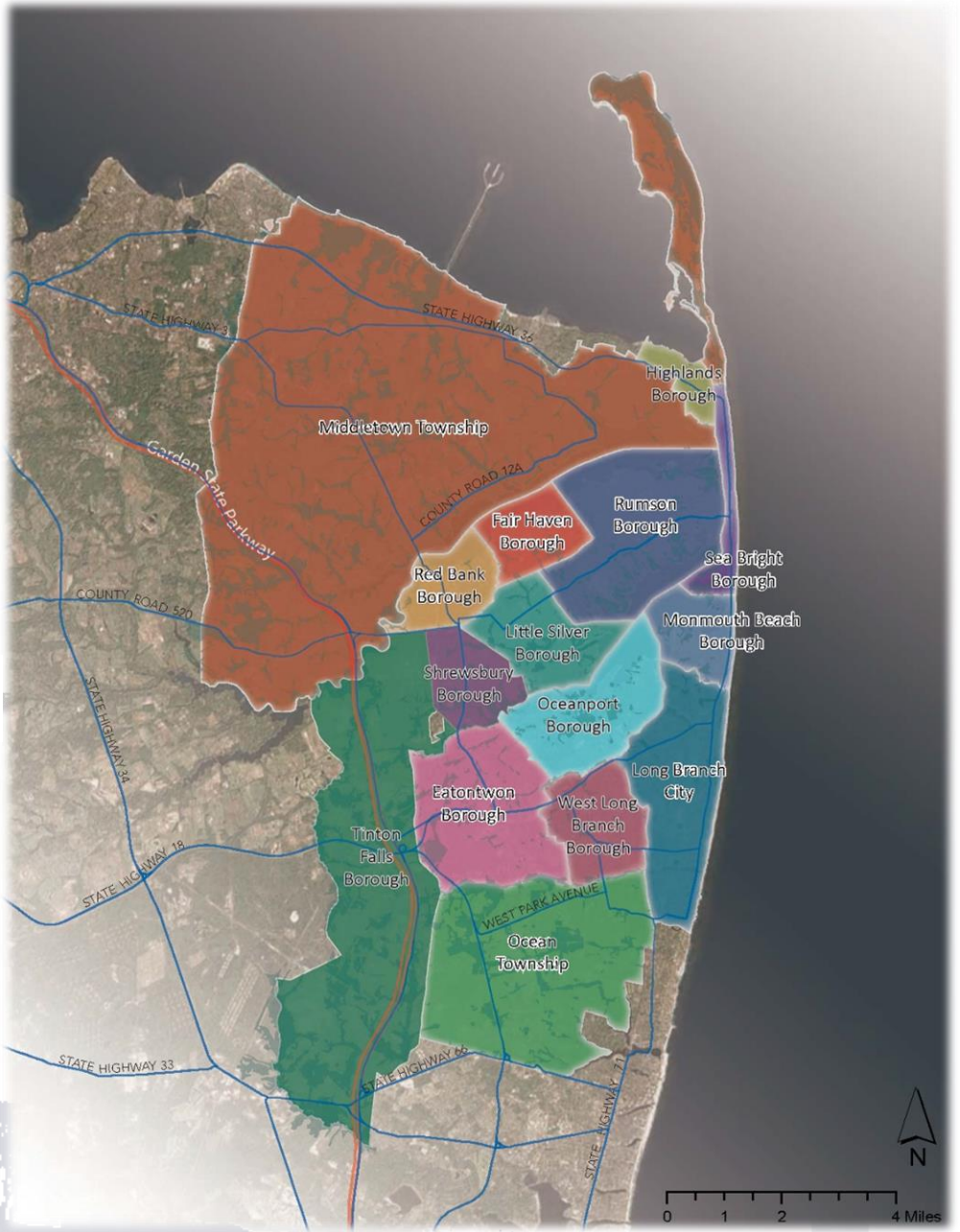
NJ FRAMES

New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios

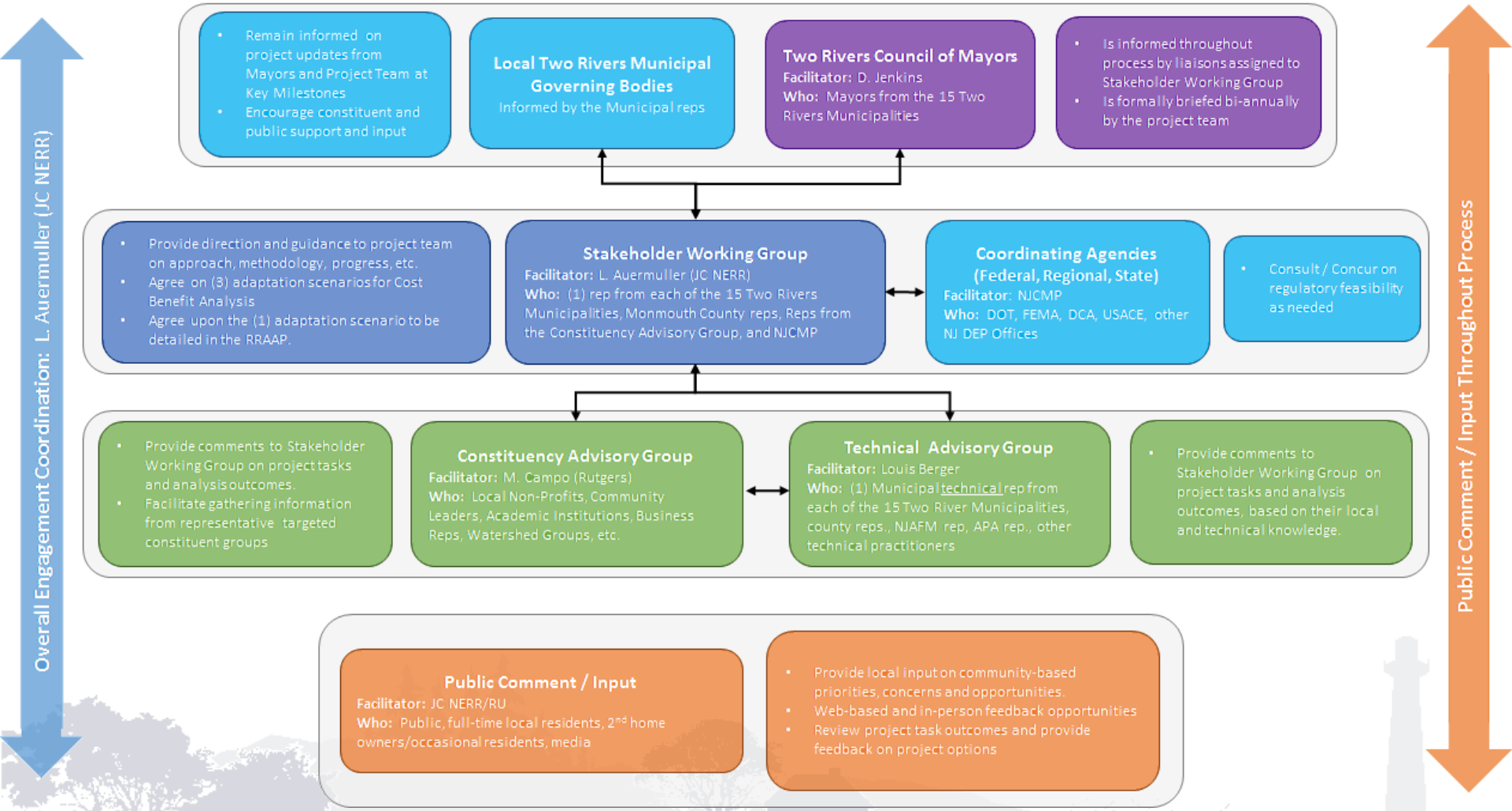
NJ FOSTERING REGIONAL ADAPTATION THROUGH MUNICIPAL ECONOMIC SCENARIOS (NJ FRAMES)

Study area

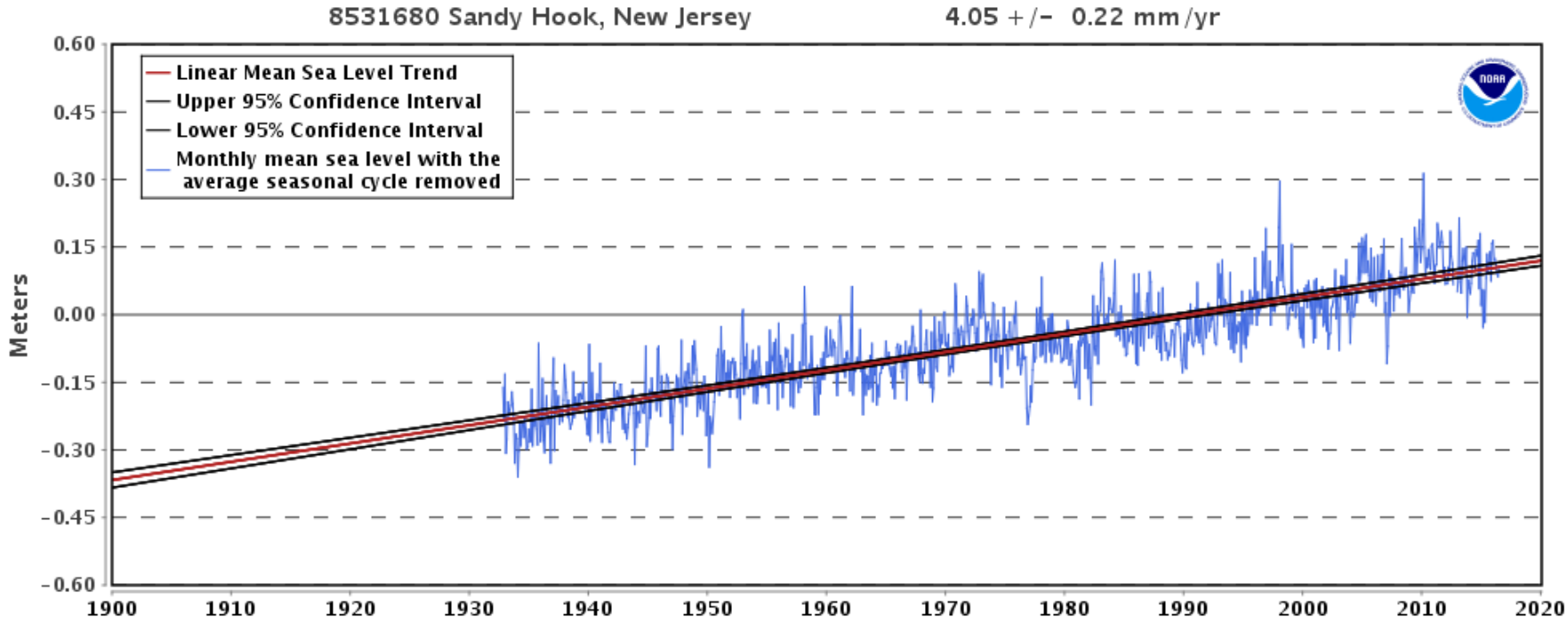
EATONTOWN BOROUGH
FAIR HAVEN BOROUGH
HIGHLAND BOROUGH
LITTLE SILVER BOROUGH
OCEANPORT BOROUGH
RED BANK BOROUGH
RUMSON BOROUGH
SEA BRIGHT BOROUGH
SHREWSBURY BOROUGH
TINTON FALLS BOROUGH
MONMOUTH BEACH BOROUGH
WEST LONG BRANCH BOROUGH
LONG BRANCH CITY
MIDDLETOWN TOWNSHIP
OCEAN TOWNSHIP



Stakeholder-driven



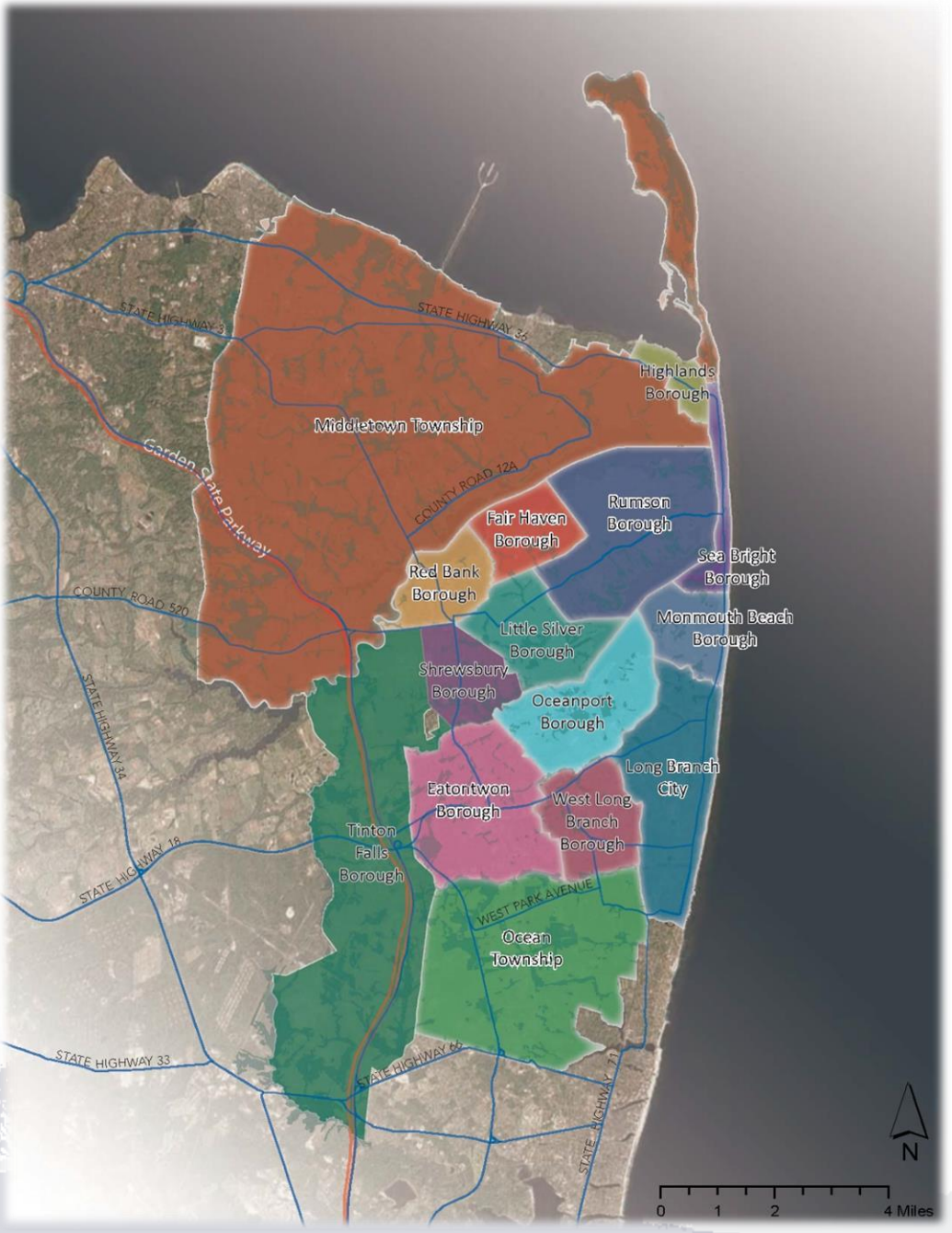
Science-based



The mean sea level trend is 4.05 millimeters/year with a 95% confidence interval of +/- 0.22 mm/yr based on monthly mean sea level data from 1932 to 2015 which is equivalent to a change of 1.33 feet in 100 years.

Regional planning

- Vulnerability Assessment
- Risk Analysis
- Adaptation Planning Scenarios
- Cost-Benefit Analysis
- Regional Resilience and Adaptation Action Plan (RRAAP)



Summary of Water Levels for FRAMES

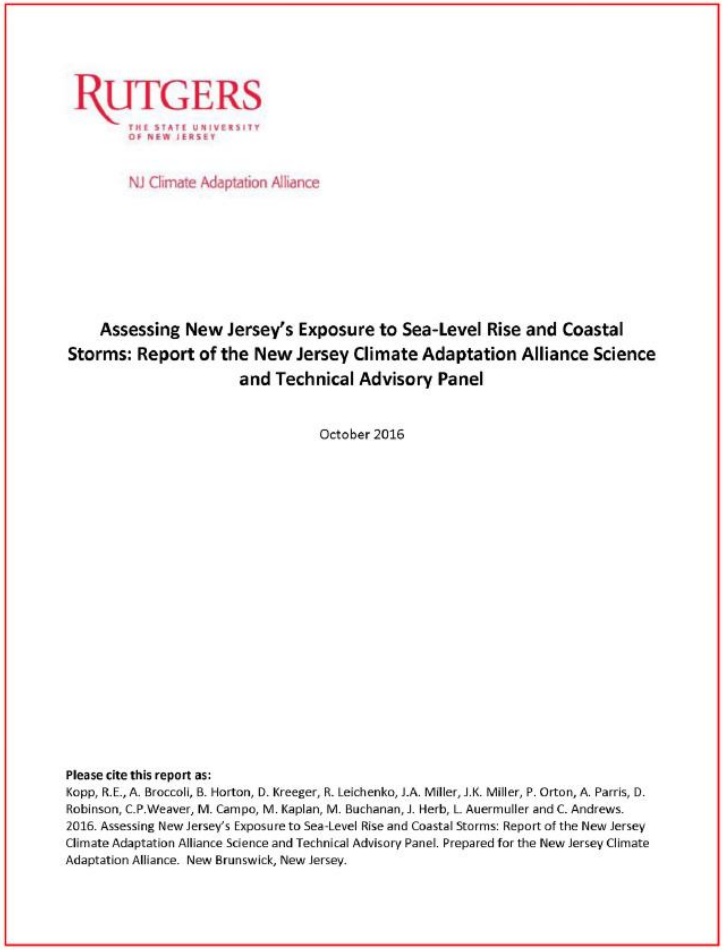
	Rounded Water Level	What High Water Level Condition Does This Height Represent?
Permanent Inundation / Coastal Flooding	3 ft.	• 2030 Annual Flood - 1-in-20 chance HE – 2.7ft • 2050 Annual Flood - LE/HE - 3.0ft • 2100 Permanent Inundation – HE - 3.4ft
Coastal Storm Flooding	7 ft.	• Current 100 Year Flood – 6.7ft • 2100 10% Chance Flood – HE - 7.3ft • 2100 Annual Flood - 1-in-20 chance HE – 6.9ft
Coastal Storm Flooding	12 ft.	• 2100 1% Chance Flood - 1-in-20 chance HE – 12ft. • 2100 Hurricane Sandy water level - HE – 11.7ft

Science and Technical Advisory Panel

Update on Report and STAP Conclusions

Science and Technical Advisory Panel (STAP)

1. What are the estimates of SLR and changing coastal storm hazards in New Jersey?
2. How probable are different levels of SLR and changes in coastal storm hazards?
3. How can stakeholders consider SLR and changes in coastal storms in light of different planning horizons, project types, and risk tolerances?
4. How can efforts to apply current science recognize scientific uncertainties and the ongoing nature of scientific learning, and how often should stakeholders reassess advances in scientific information for purposes of applying the latest science into practice?
5. Are there special considerations that stakeholders should address, including but not limited to uniquely vulnerable people, places, and assets when evaluating options for incorporating estimates for SLR and changes in coastal storms?



RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

NJ Climate Adaptation Alliance

Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel

October 2016

Please cite this report as:
Kopp, R.E., A. Broccoli, B. Horton, D. Kreeger, R. Leichenko, J.A. Miller, J.K. Miller, P. Orton, A. Parris, D. Robinson, C.P.Weaver, M. Campo, M. Kaplan, M. Buchanan, J. Herb, L. Auermuller and C. Andrews. 2016. Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel. Prepared for the New Jersey Climate Adaptation Alliance. New Brunswick, New Jersey.

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Coastal Storms: No clear basis for NJ guidance to deviate from IPCC

- By increasing the baseline for flooding, higher sea levels will increase the impact of coastal storms on New Jersey.
- Changes in the frequency, intensity and tracks of coastal storms may also affect the impact of coastal storms in New Jersey. This is an area of active research.
- For now, planning and decision-making in New Jersey should be guided by the Intergovernmental Panel on Climate Change (IPCC)'s conclusions regarding changes in future storms, including:
  - The global frequency of tropical cyclones is not likely to increase, while maximum wind speeds are likely to increase;
  - Precipitation intensity during tropical cyclones is likely to increase; and
  - The global frequency of extratropical cyclones is not likely to change substantially.

Sea Level Rise: Projected HEIGHT Estimates for NJ (ft.)

	Central Estimate	Likely Range	1-in-20 Chance	1-in-200 Chance	1-in-1000 Chance
Year	*50% probability SLR meets or exceeds…*	*67% probability SLR is between…*	*5% probability SLR meets or exceeds…*	*0.5% probability SLR meets or exceeds…*	*0.1% probability SLR meets or exceeds…*
2030	0.8 ft	0.6 – 1.0 ft	1.1 ft	1.3 ft	1.5 ft
2050	1.4 ft	1.0 – 1.8 ft	2.0 ft	2.4 ft	2.8 ft
2100 Low emissions	2.3 ft	1.7 – 3.1 ft	3.8 ft	5.9 ft	8.3 ft
2100 High emissions	3.4 ft	2.4 – 4.5 ft	5.3 ft	7.2 ft	10 ft

Estimates are based on Kopp et al. (2014). Columns correspond to different projection probabilities. For example, the 'Likely Range' column corresponds to the range between the 17th and 83rd percentile; consistent with the terms used by the Intergovernmental Panel on Climate Change (Mastrandrea et al., 2010). *All values are with respect to a 1991-2009 baseline. Note that these results represent a single way of estimating the probability of different levels of SLR; alternative methods may yield higher or lower estimates of the probability of high-end outcomes.*

IPCC AR5 **global** projections for SLR: "For RCP8.5, the rise by 2100 is 0.52 m (1.7 ft) to 0.98 m (3.2 ft) with a rate during 2081–2100 of 8 to 16 mm yr".

Regional sea levels may reach values up to 30% (or higher) above the global mean sea level off of the Northeast coast. If you were add 30% to the GMSL, you would get a range from 2.2 - 4.2 feet.

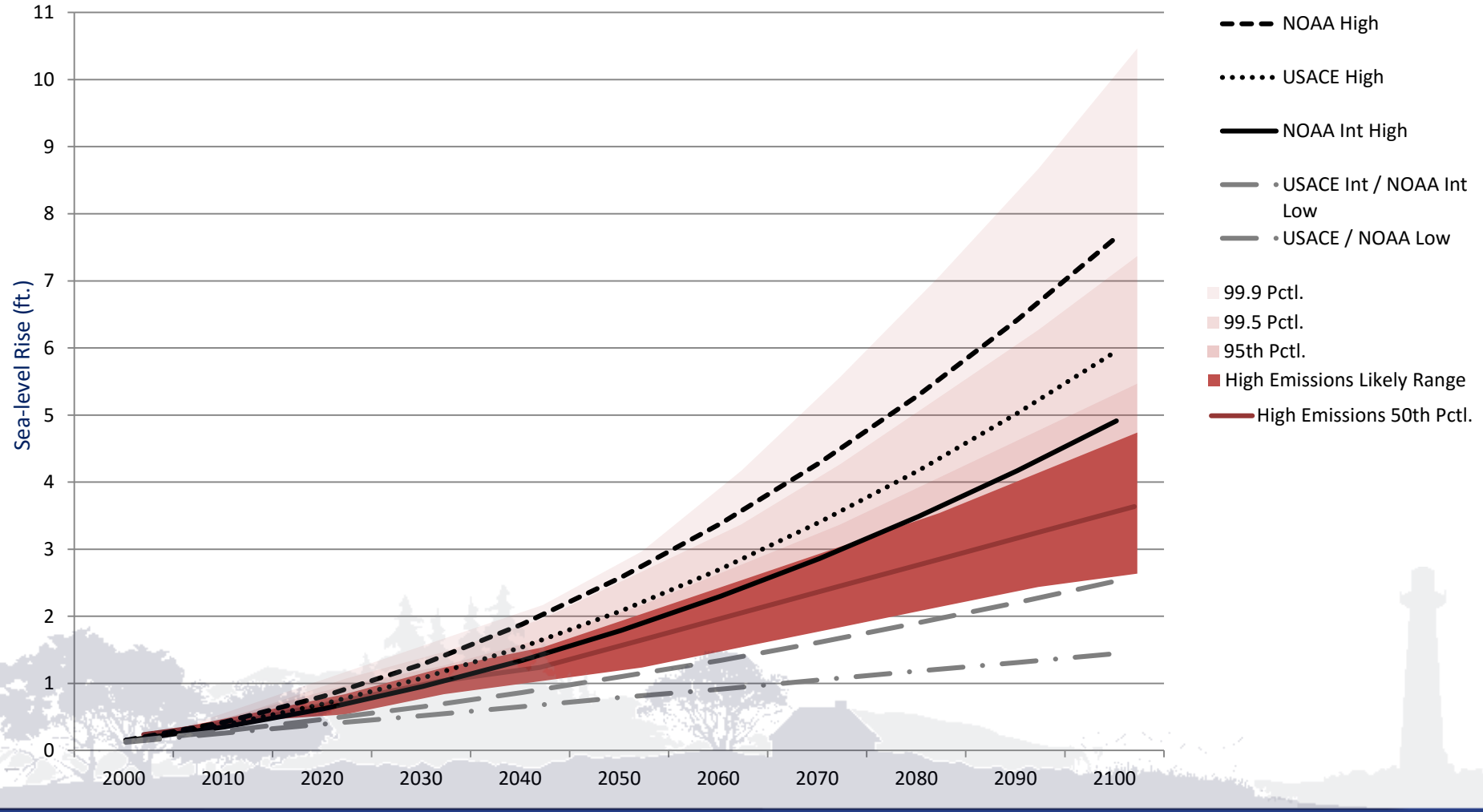
Sea Level Rise: Projected RATE Estimates for NJ (ft.)

	Likely Range	1-in-20 Chance
Year	*67% probability SLR RATE is between…*	*5% probability SLR RATE meets or exceeds…*
2030	0.2 to 0.4 in/yr	0.5 in/yr
2030 - 2050 Low Emissions	0.2 to 0.4 in/yr	0.5 in/yr
2030 - 2050 High Emissions	0.3 to 0.5 in/yr	0.6 in/yr
2050 - 2100 Low emissions	0.2 to 0.4 in/yr	0.5 in/ yr
2050 - 2100 High emissions	0.3 to 0.7 in/yr	0.8 in/yr.

Estimates are based on Kopp et al. (2014). Twenty-year average rates of SLR. Columns correspond to different projection probabilities. For example, the 'Likely Range' column corresponds to the range between the 17th and 83rd percentile; consistent with the terms used by the Intergovernmental Panel on Climate Change (Mastrandrea et al., 2010). *All values are with respect to a 1991-2009 baseline.*

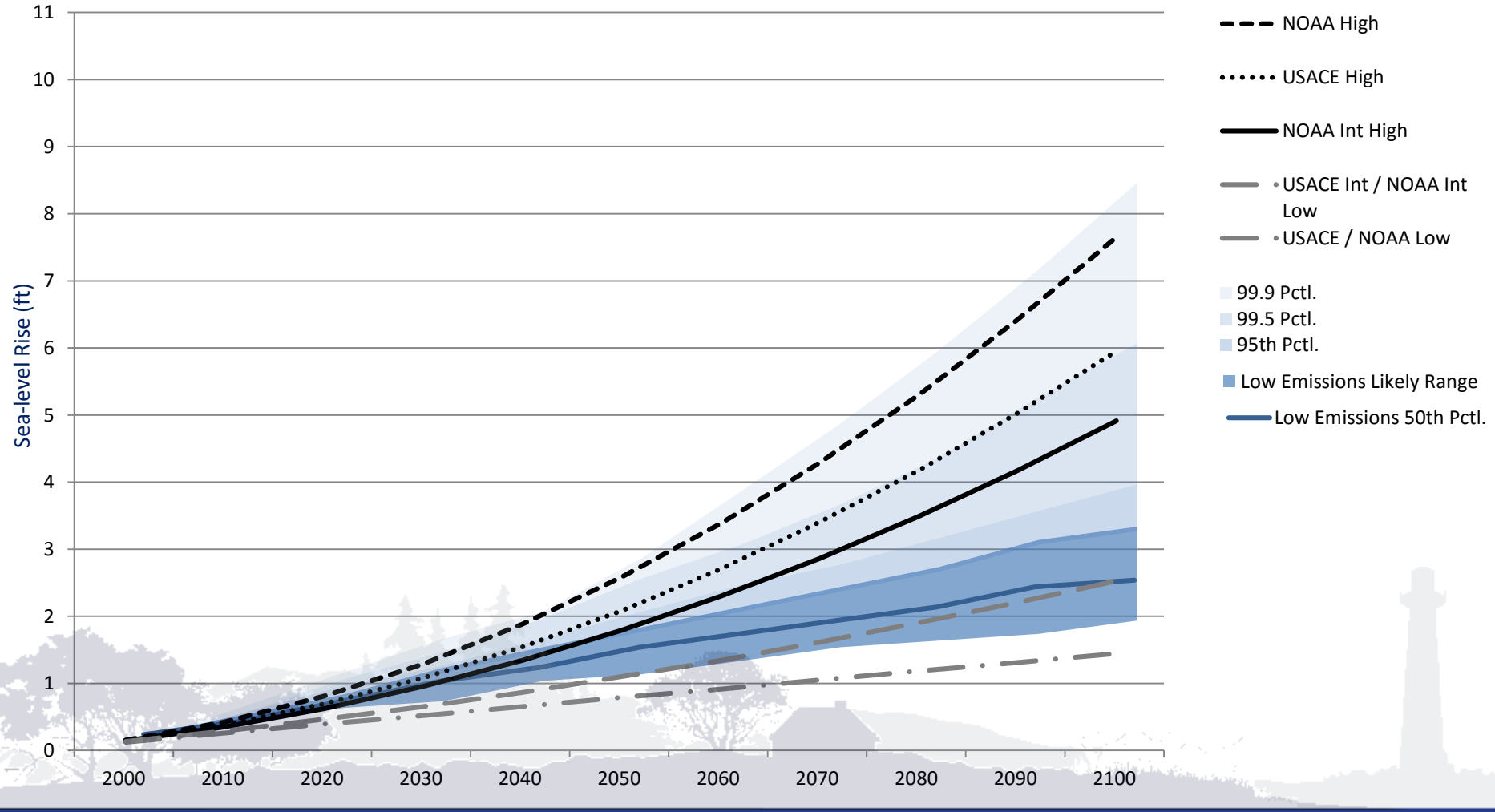
STAP compared with New Jersey/Federal Projections

High Emissions [RCP 8.5] SLR Projections for New Jersey (Atlantic City) Compared to Federal SLR Projections

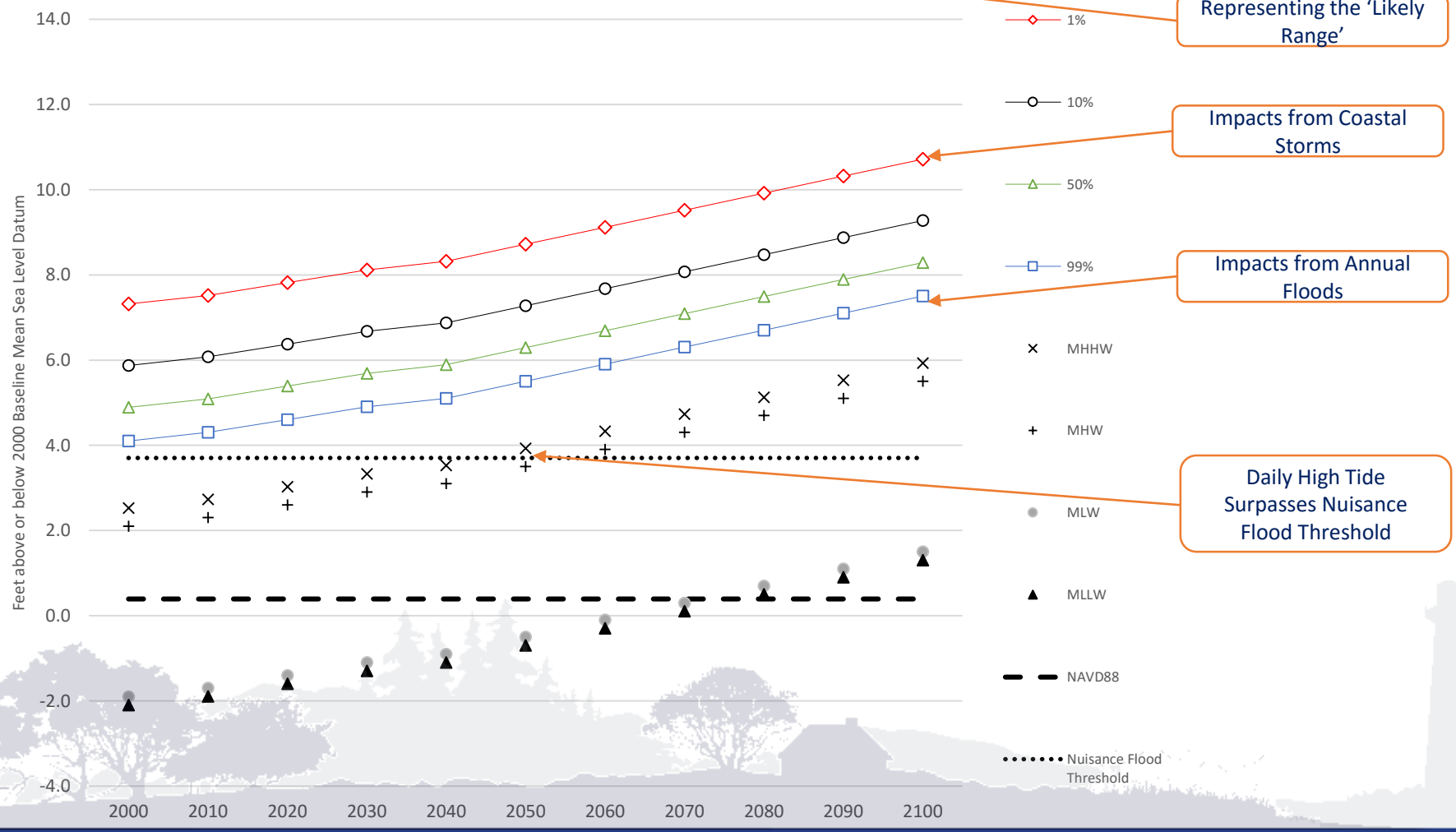


STAP compared with New Jersey/Federal Projections

Low Emissions [RCP 2.6] SLR Projections for New Jersey (Atlantic City) Compared to Federal SLR Projections



High Emissions Central Estimate SLR Projections For Flood Levels and Tidal Datums (Atlantic City, NJ)



When conducting assessments, practitioners should:

- Evaluate at **least two SLR scenarios**
  - 1 in 'Likely Range'
  - 1 above 'Likely Range'
- Two needed to consider exposures of people, places and assets that are particularly vulnerable to flooding, or for which the consequences of damage and failure have significant magnitude.

- Evaluate at least **three flood conditions** representing
  - Inundation
  - Tidal / Nuisance Flooding
  - Extreme Coastal Flooding (Storms)
- Three needed to represent conditions that occur with varying frequency and last for varying amounts of time

Water Levels

What Will Adaptation Cost?

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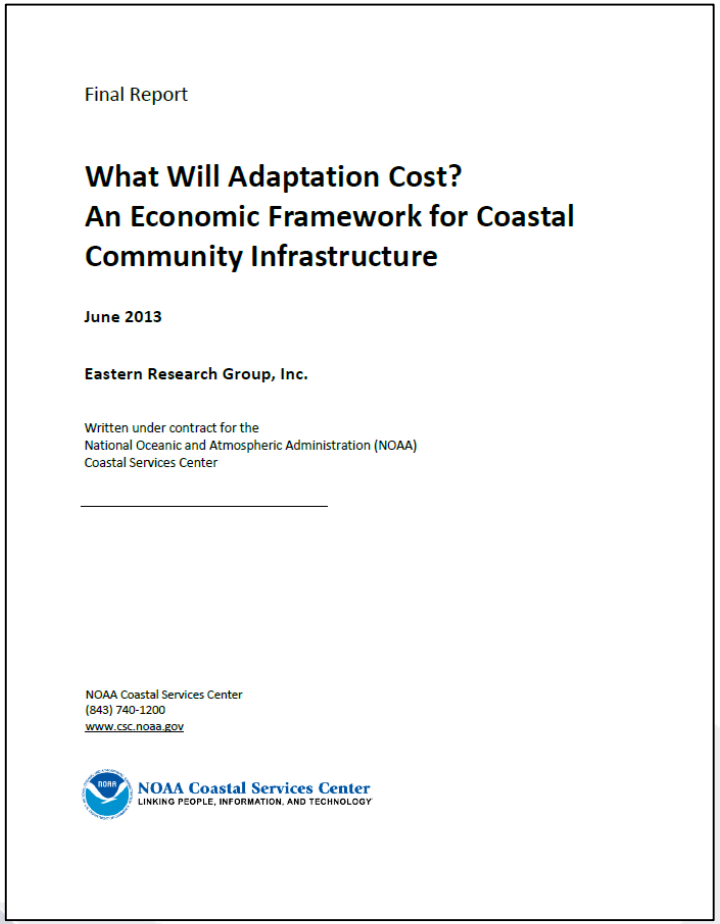

Final Report

What Will Adaptation Cost?
An Economic Framework for Coastal Community Infrastructure

June 2013

Eastern Research Group, Inc.

Written under contract for the
National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center

NOAA Coastal Services Center
(843) 740-1200
www.csc.noaa.gov

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

https://coast.noaa.gov/data/digitalcoast/pdf/adaptation-report.pdf

How levels were chosen

Task 1: Select Appropriate Local Sea Level Rise Scenarios

- **Three SLR Scenarios**
  - Low Emissions Central Estimate - 2.3 Ft. SLR by 2100
  - High Emissions Central Estimate - 3.4 Ft. SLR by 2100
  - High Emissions 1-in-20 Chance Estimate - 5.3 Ft. SLR by 2100

Task 2: Develop High-Water-Level Event Scenarios

- **Three flood conditions**
  - Inundation
  - Tidal / Nuisance Flooding
  - Extreme Coastal Flooding (Storms)
- Use NOAA Extreme Water Levels and Historic Storms
- Add sea level rise to water levels for chosen years

Task 3: Choose Water Levels for Assessment

Select 3-4 water-levels that represent a low, medium, high, and perhaps catastrophic water-level.
Project team consensus on 3 water levels based on group discussion and preliminary exposure assessment

How levels were chosen

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Projected Water Levels Relative to MHHW (ft.)

	2000	2030	2050	2100
1 **Low Emissions Central Estimate - 2.3 Ft. SLR by 2100**				
Hurricane Sandy	8.3	9.1	9.7	10.6
1% Chance Flood (100-year flood)	6.7	7.5	8.1	9
10% Chance Flood (10-year flood)	3.9	4.7	5.3	6.2
99% Chance Flood(Annual flood)	1.6	2.4	3	3.9
Permanent Inundation (MHHW)	0	0.8	1.4	2.3
2 **High Emissions Central Estimate - 3.4 Ft. SLR by 2100**				
Hurricane Sandy	8.3	9.1	9.7	11.7
1% Chance Flood (100-year flood)	6.7	7.5	8.1	10.1
10% Chance Flood (10-year flood)	3.9	4.7	5.3	7.3
99% Chance Flood(Annual flood)	1.6	2.4	3	5
Permanent Inundation (MHHW)	0	0.8	1.4	3.4
3 **High Emissions 1-in-20 Chance Estimate - 5.3 Ft. SLR by 2100**				
Hurricane Sandy	8.3	9.4	10.3	13.6
1% Chance Flood (100-year flood)	6.7	7.8	8.7	12
10% Chance Flood (10-year flood)	3.9	5	5.9	9.2
99% Chance Flood(Annual flood)	1.6	2.7	3.6	6.9
Permanent Inundation (MHHW)	0	1.1	2	5.3

Summary of Water Levels for FRAMES

	Rounded Water Level	What High Water Level Condition Does This Height Represent?
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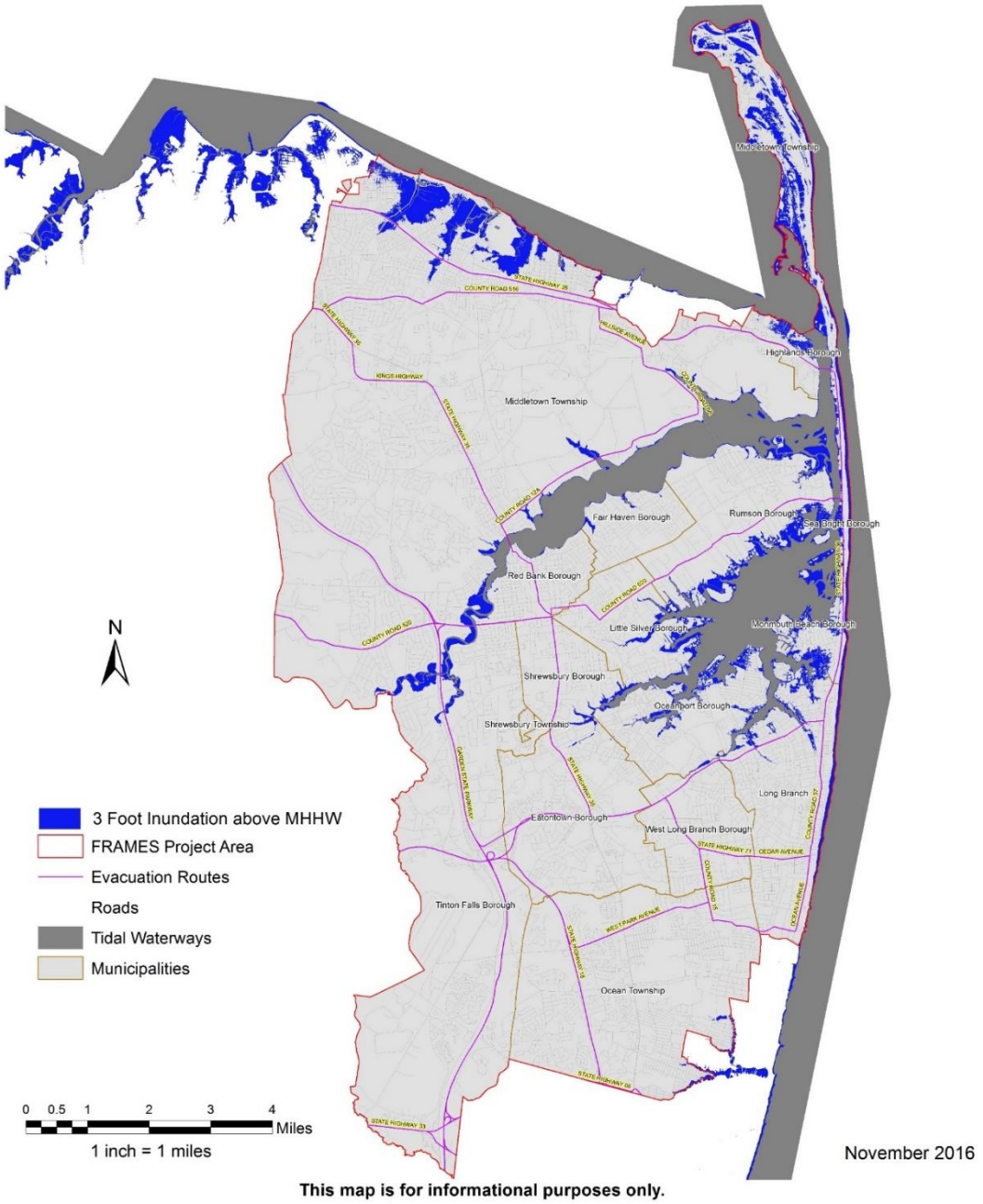
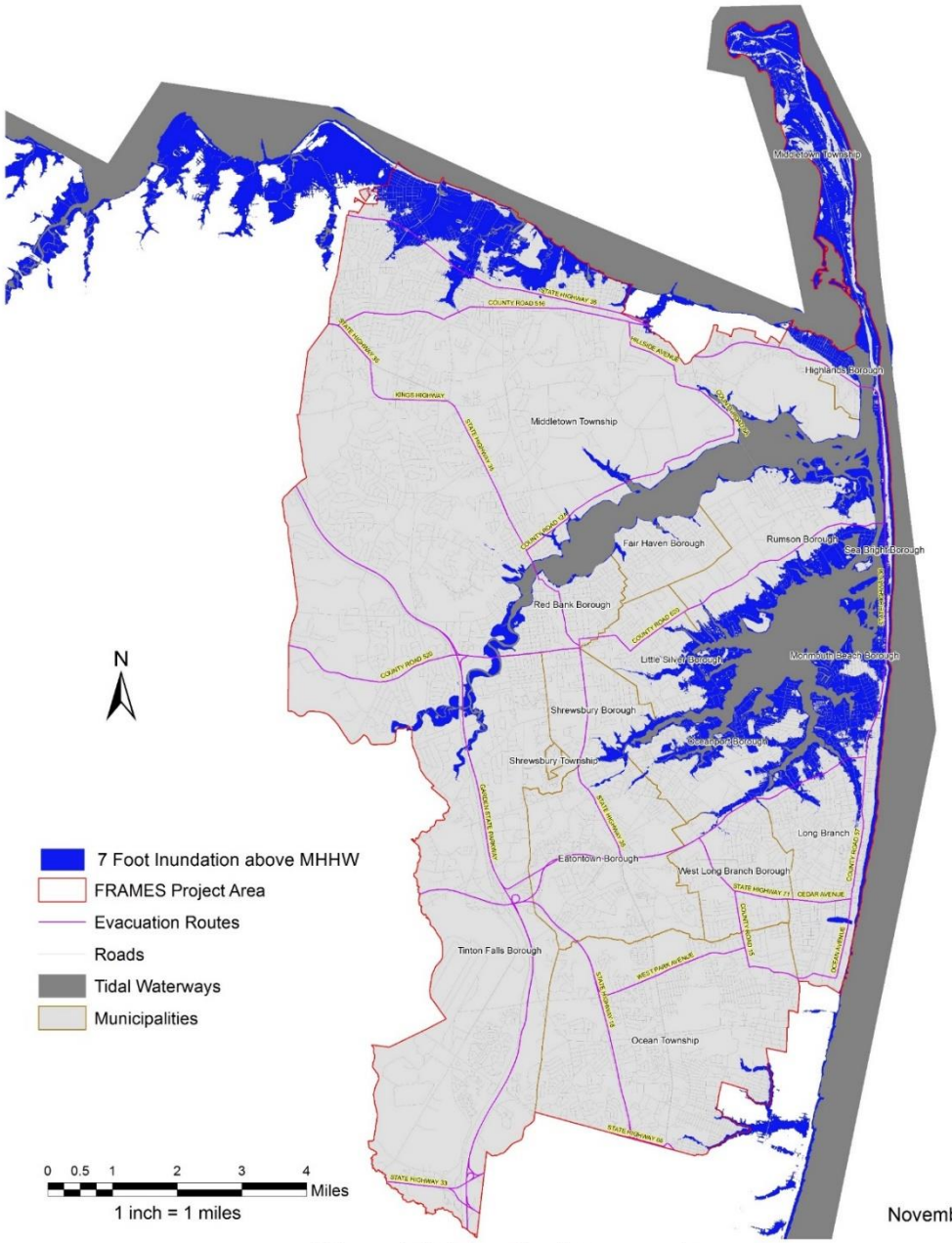
3 foot inundation

- 2030 Annual Flood (99% Chance) & SLR Scenario (1-in-20 chance) – 2.7ft
- 2050 Annual Flood (99% Chance) & SLR Scenario (LE/HE) - 3.0ft
- 2100 Permanent Inundation (MHHW) & SLR Scenario (HE) - 3.4ft



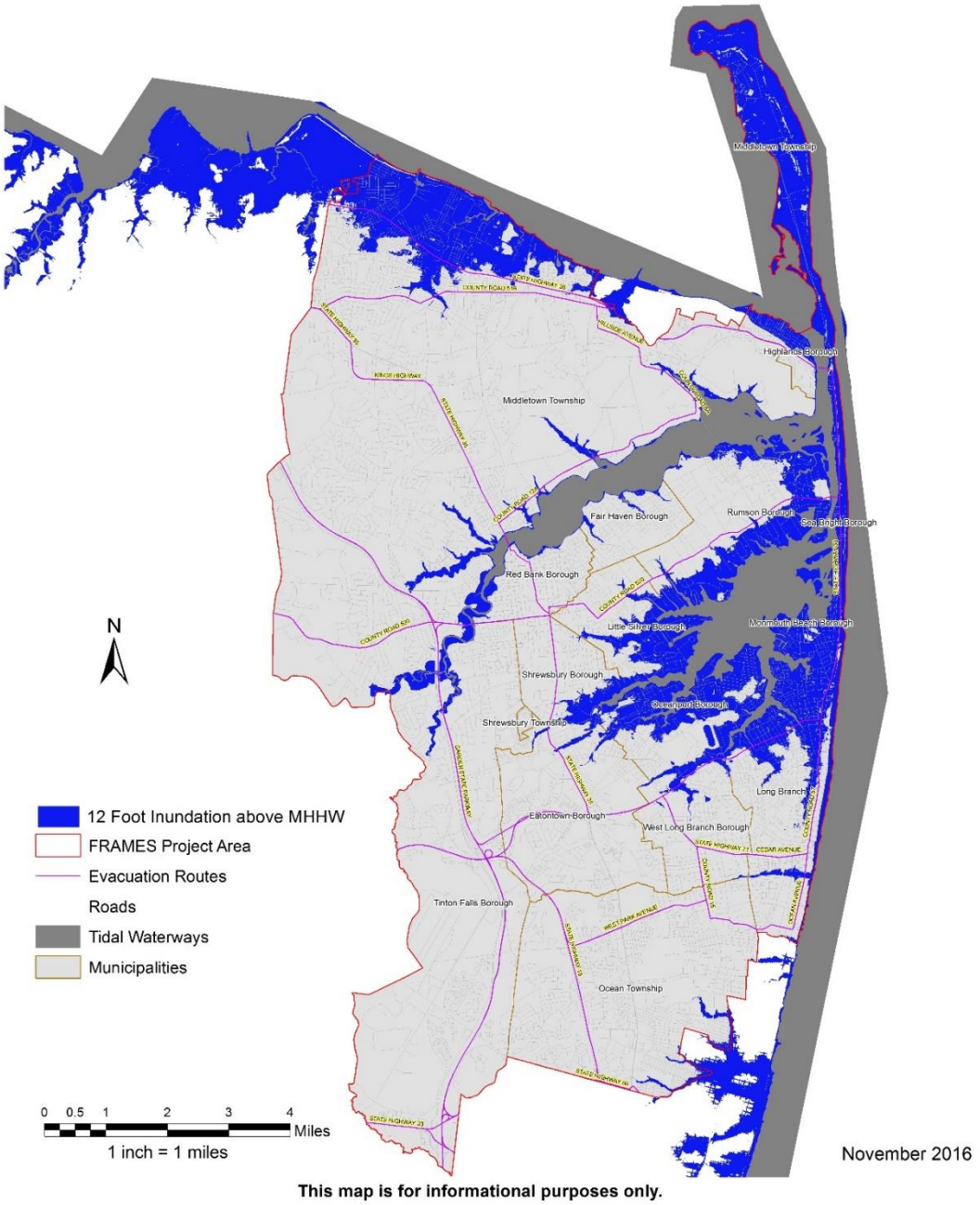
7 foot inundation

- Current 100 Year Flood (1% Chance) – 6.7ft
- 2100 10 Year Flood (10% Chance) & SLR Scenario (HE) - 7.3ft
- 2100 Annual Flood (99% Chance) & SLR Scenario (1-in-20 chance HE) – 6.9ft



12 foot inundation

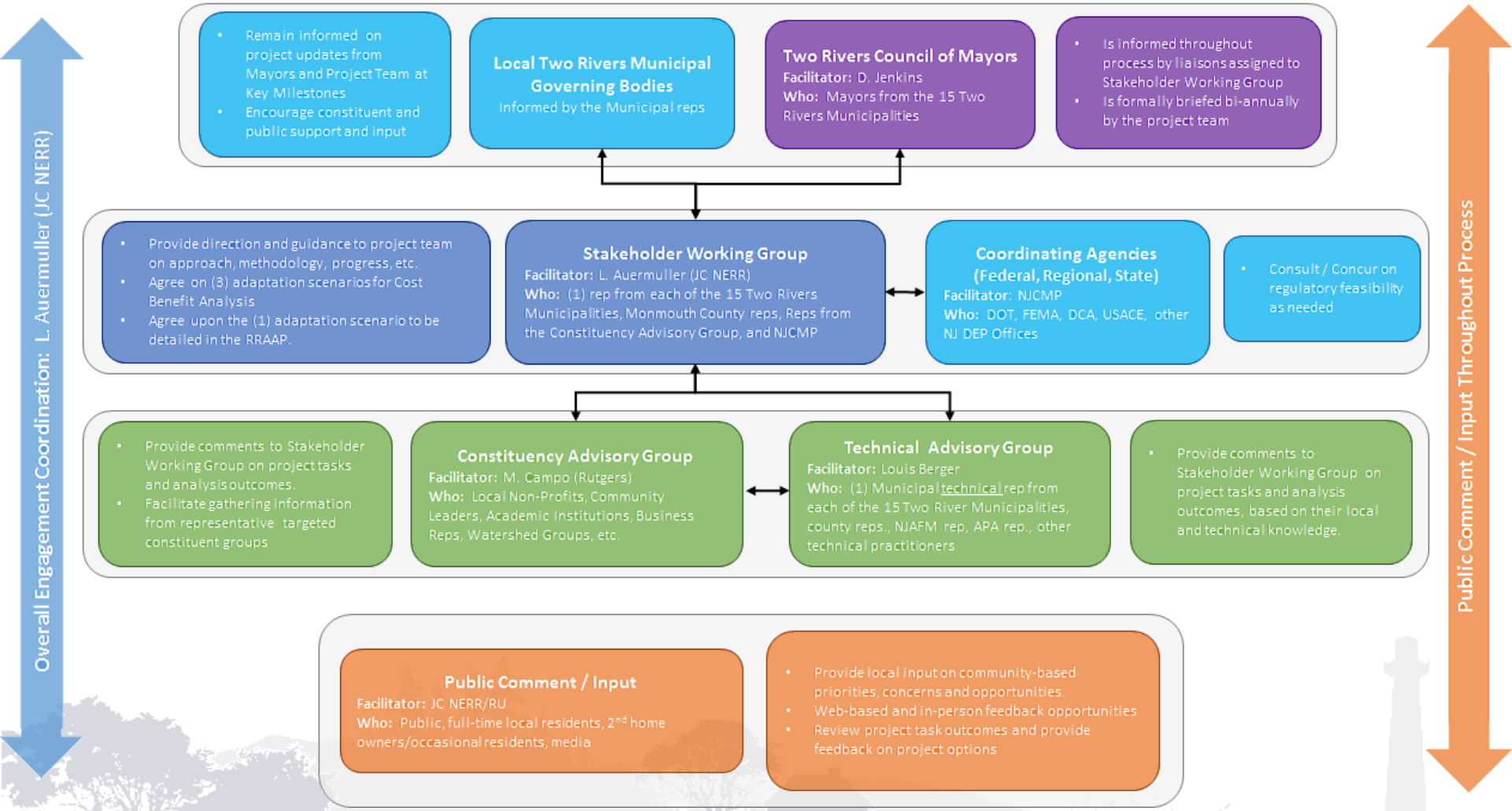
- 2100 100 Year Flood (1% Chance) & SLR Scenario (1-in-20 chance HE) – 12ft
- 2100 Hurricane Sandy & SLR Scenario (HE) – 11.7ft



How will this information be used?

Vulnerability Assessment	What critical and community assets are impacted by these water levels?
Risk Assessment	What is the risk to the critical and community assets?
No Action Scenarios	These water levels are the No Action Scenarios.
Planning Scenarios Development	How does the community want to plan for/respond to these water levels?
Cost Benefit Analysis	What is the net benefit of the community's planning response compared to action?

Stakeholder and Community Engagement



Thank you!

Your Advisory Group leader will be in touch about next steps and future meetings.

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