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JBLE-Langley Case Study. Increasing Adaptive Capacity Through Natural and Engineered Solutions.

Battelle March 29, 2022

ACKNOWLEDGE

NGS

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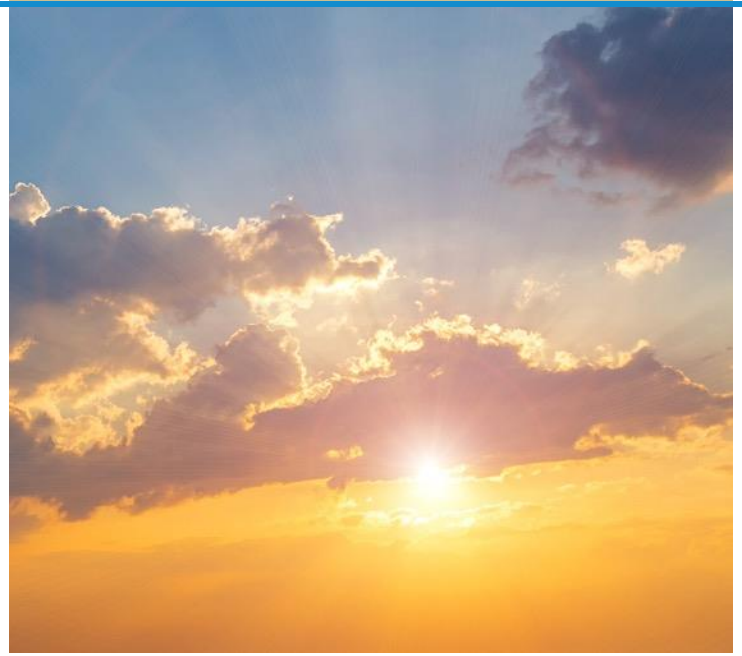

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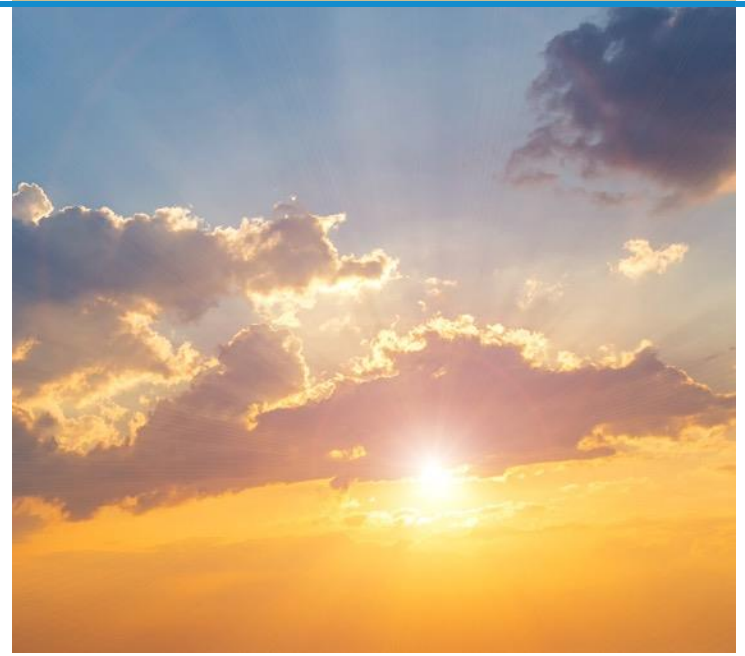
Building Adaptive Capacity:

Expand your coping range and strengthen your coping capacity.

JBLE-Langley Capacity Building Utilizes

- Built Infrastructure
  - Sea Walls
  - Rip Rap
  - Increased First Floor Foundation Elevations
  - Key Equipment Elevation
  - Door Dams
  - Stormwater Management/Pumping
- Natural Resources
  - Living Shorelines
  - Bioswales
  - Strategic Planting Initiative
  - Preservation of Wetlands
- Human Resources
  - Embedding Climate Change professionals in diverse projects across the installation

Existing BMPs and Functioning Outfalls



HEC-RAS Model Development

- Inventory of all existing BMPs on the Base
- Elevation data - 2020 Base LIDAR and Regional LIDAR
- Rainfall Data obtained from NOAA Atlas-14 increased by 20%
- Maximum tidal wave height measured during the past 10 years at NOAA's Sewells Point was used for modeling existing tidal conditions
- Calibrated with water surface elevation measured during Hurricane Irene in 2011

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HEC-RAS Modeling Supports Forecasting of Numerous Short- and Long-term Scenarios

- Existing Tidal Influenced Flooding
  - Existing Tidal Influenced Flooding coupled with Rain Events (2 year, 100 year and 500 year)
- **Future Tidal Influenced flooding accounting for a SLR of 1 ft above the current 10 year maximum value**
  - SLR coupled with Rain Events (2 year, 100 year and 500 year)
- Extreme Weather Flooding
  - Storm Surge (Based on Hurricane Irene 2011, 8 ft)
  - Storm Surge coupled with Rain Events (2 year, 100 year, 500 year)

Proposed BMPs to address Tidal Flooding plus 1 ft SLR

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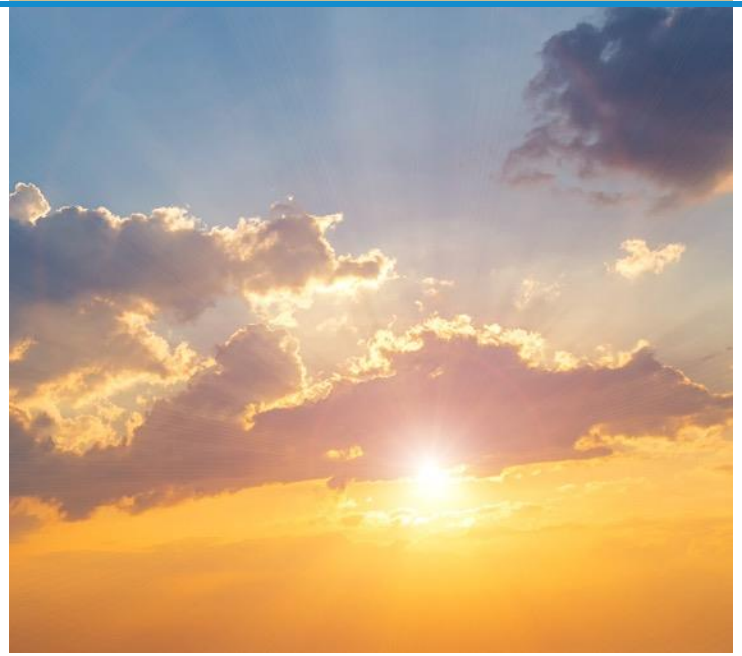
Global and Regional Sea Level Rise Scenarios for the United States

1. Multiple lines of evidence provide **increased confidence**, regardless of the emissions pathway, in a narrower range of projected global, national, and regional sea level rise by **2050** than previously reported (Sweet et.al., 2017)
2. By 2050, the expected relative sea level rise (RSL) will cause tide and storm surge heights to increase and will lead to a shift in U.S. coastal flood regimes, with major and moderate high tide flood events occurring as frequently as moderate and minor high tide flood events occur today. Without additional risk-reduction measures, U.S. coastal infrastructure, communities, and ecosystems will face significant consequences.

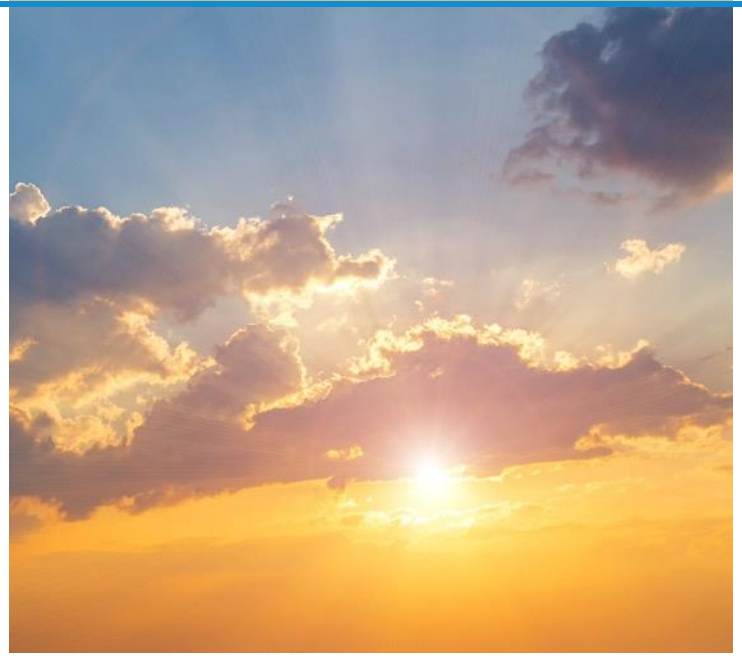
Risk-based, adaptive design is paramount.



Non-Stationarity Increases Risk

- When two or more parameters evolve with time, the paradigm shifts from a "stationary" approach, typically used for planning infrastructure until recently, to one reflecting significant temporal change in the probability distribution.
- With rising relative sea levels, p_t increases, and the risk is higher than that under stationarity.

$$R = 1 - \prod_{t=1}^{n} (1 - p_t)$$



Risk-Based Design

1. Overdesign to force the risk profile at or below stationarity which will drive up costs.
2. Adaptively design and implement in two or more phases.
    a) Phase 1, 25 years long
    b) Design for expansion in Phase II

Option #2 requires significantly more communication and planning than Option #1.

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Global and Regional Sea Level Rise Scenarios for the United States

3. Higher global temperatures increase the chances of higher sea level by the end of the century and beyond. The scenario projections of RSL along the CONUS coastline are 0.6-2.2 m in 2100 and 0.8-3.9 m in 2150 (relative to sea level in 2000); these ranges are driven by uncertainty in future emissions pathways and the response of the underlying physical processes.

4. Monitoring the sources of ongoing sea level rise and the processes driving changes in sea level is critical for assessing scenario divergence and tracking the trajectory of observed sea level rise, particularly during the time period when future emissions pathways lead to **increased ranges in projected sea level rise**.

Performance monitoring to determine timing and degree of design expansion is essential.

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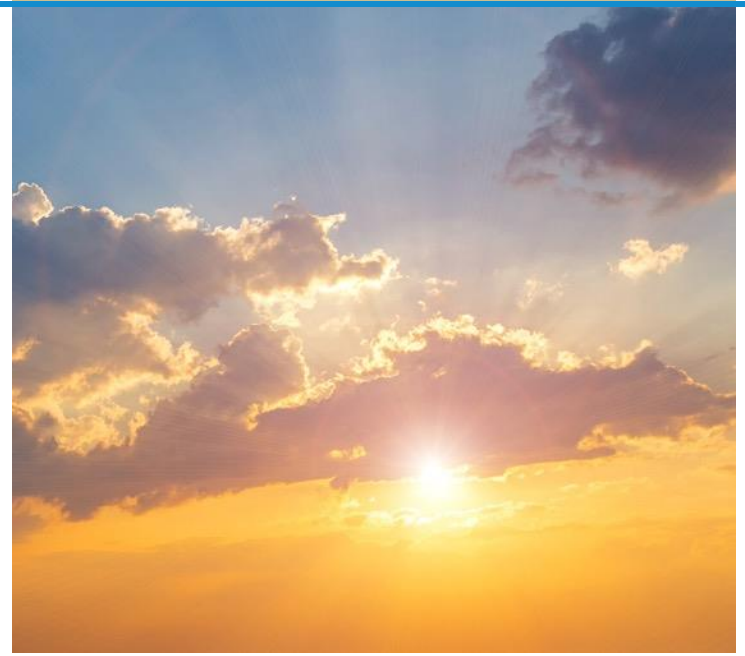

GeoTechnical Investigation

- Characterized the top 50-75 ft at each wall location using CPT and SCPTu, and the top 15 ft using Macro-Core.
- Groundwater was observed at depths which were variable from 1.3 ft to 5 ft bgs and was observed to be influenced by the tides.

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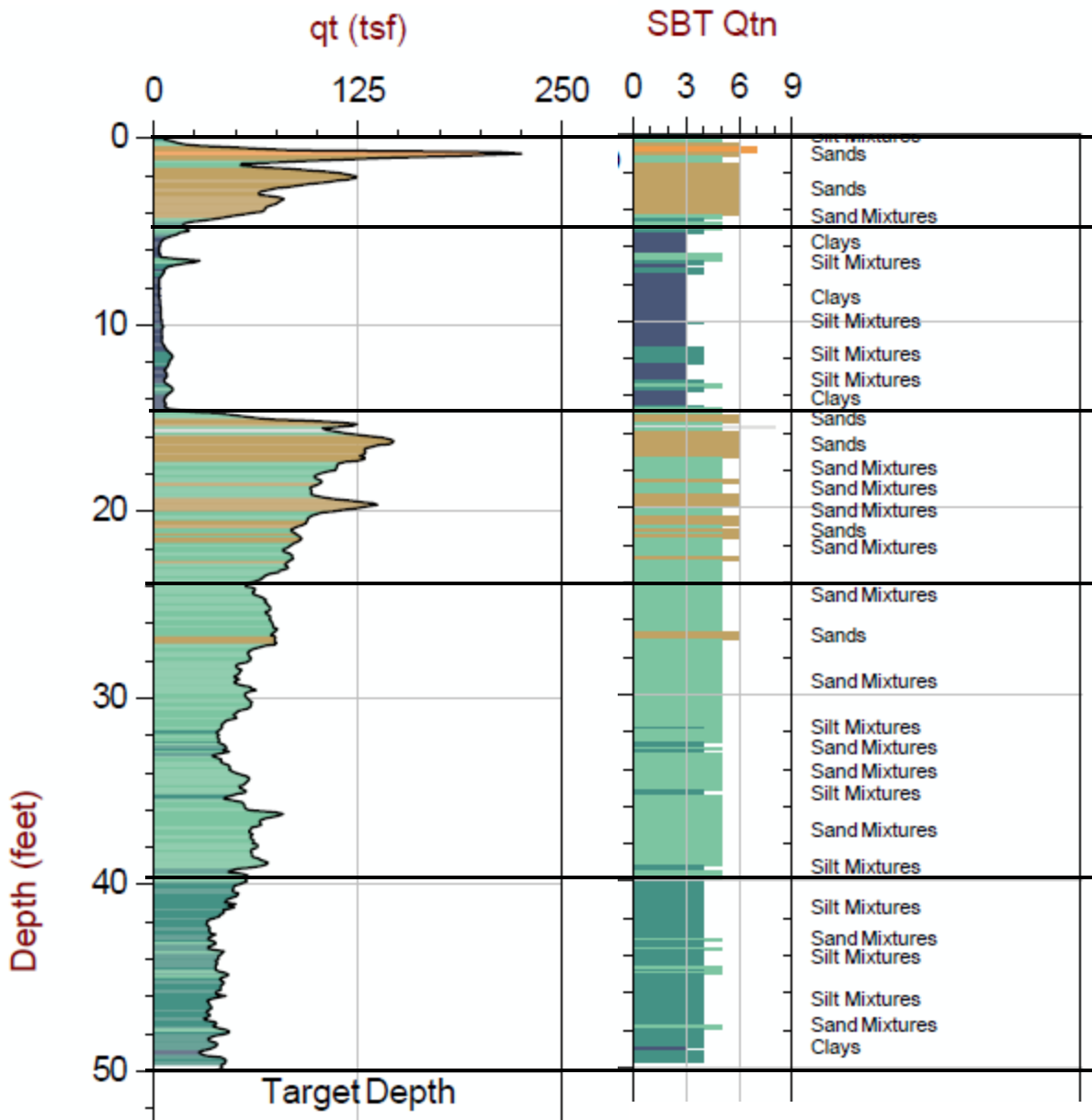
Example of a Typical CPTu Log



Strata Encountered at JBLE Langley

Stratum I: Fill , SBT="Sands"

Stratum II:
Tabb Formation , SBT="Clays" or "Silt Mixtures", Expected to be Clayey Sands (SC)

Stratum III (not always observed):
Yorktown Formation , SBT="Sands" or "Sand Mixtures", Expected to be Silty Sands (SM) with High Amount of Shell Fragments decreasing with depth

Stratum IV:
Yorktown Formation , SBT="Sands" or "Sand Mixtures", Expected to be Silty Sands (SM), with less shell fragments than Stratum III

Stratum V (not always observed):
Yorktown Formation , SBT= mainly "Silt Mixtures" expected to be Clayey Sands (SC)

Groundwater vs Tides

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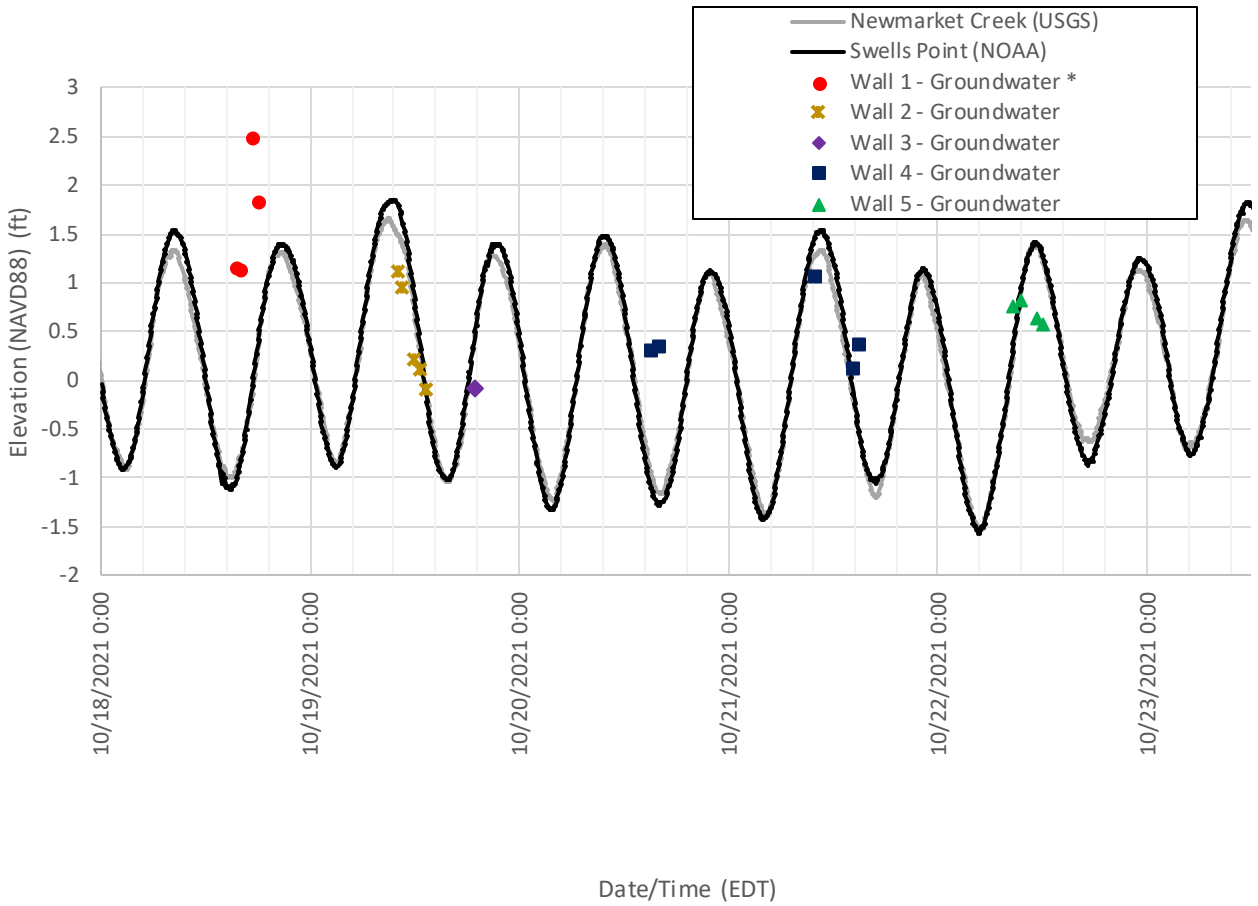
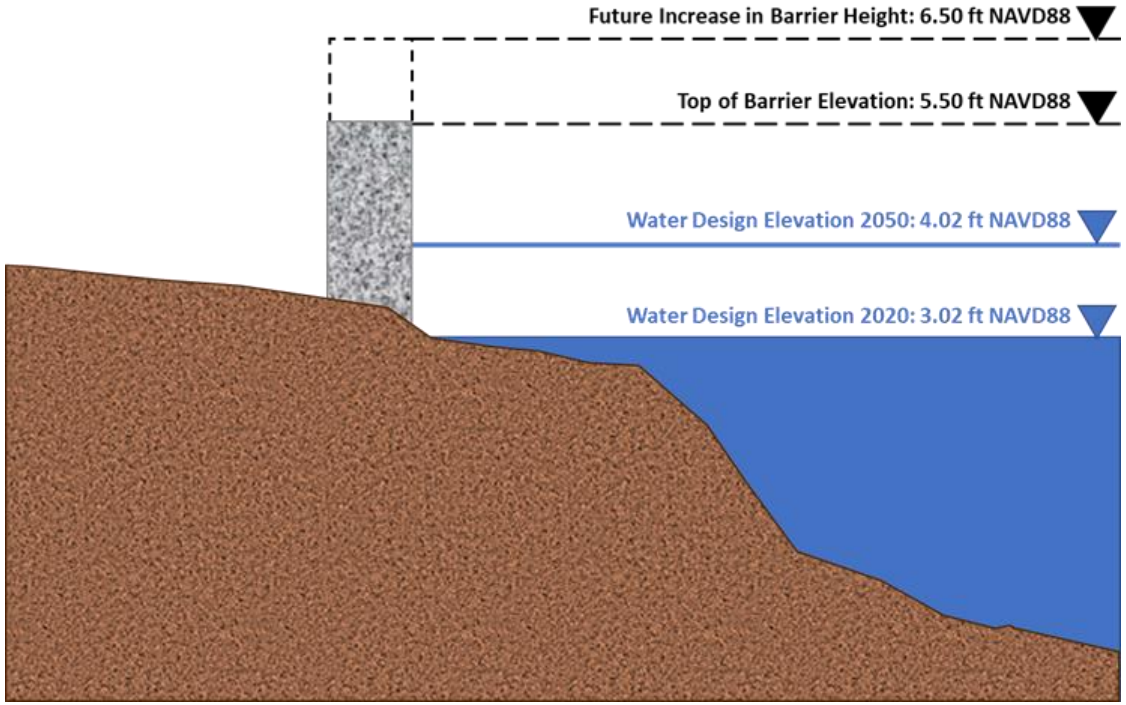


65% Basis of Design



Description	Scenario/Condition (ft NAVD88)	
	2020	2050
Water Design Elevation – Landward (Protected) Side (EL A)	N/A	N/A
Water Design Elevation – Oceanward Side (EL B)	3.02	4.02
Design Top of Water Barrier Elevation (C)	5.5	5.5
Available freeboard (C-B)	2.48	1.48

Communication is Key

- Designing to Protect Against RSLR up to 1ft above the current 10 year maximum which aligns with
  - NOAA Intermediate Scenario 2022
  - VA Institute Marine Science (VIMS) Quadratic Fit of existing data 2020-2050 including vertical land motion
- Designing to Survive a 1% annual chance (100-year) event
- Improving Resiliency
- Building Adaptive Capacity
- Not Creating a Dome Around the Installation
- Flooding May Still Occur
- Stormwater Management is Critical

Adaptation is a cycle.

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THANK YOU

For more info, visit NuGlobalSolutions.com or contact:

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