Geosyntec consultants

Emerging Tools For Communication of Climate Change Impacts Towards Increased Resiliency

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Andrea Braga PE, CPESC

2017 NEWEA Spring Meeting
June 5, 2017

NEW ENGLAND WATER ENVIRONMENT ASSOCIATION
NEWEA
WORKING FOR WATER QUALITY

Background

- Climate Change Induced Flooding is Increasing
- How to Communicate Potential Impacts Towards Increased Resiliency?
- Three Case Studies

TIDEGateway
- Modeling
- Visualization

Rise:NYC
- Audits
- Dashboards

UNH Lamprey
- Modeling
- Visualization

TideGateway:

Assessments, Modeling, Visualizations

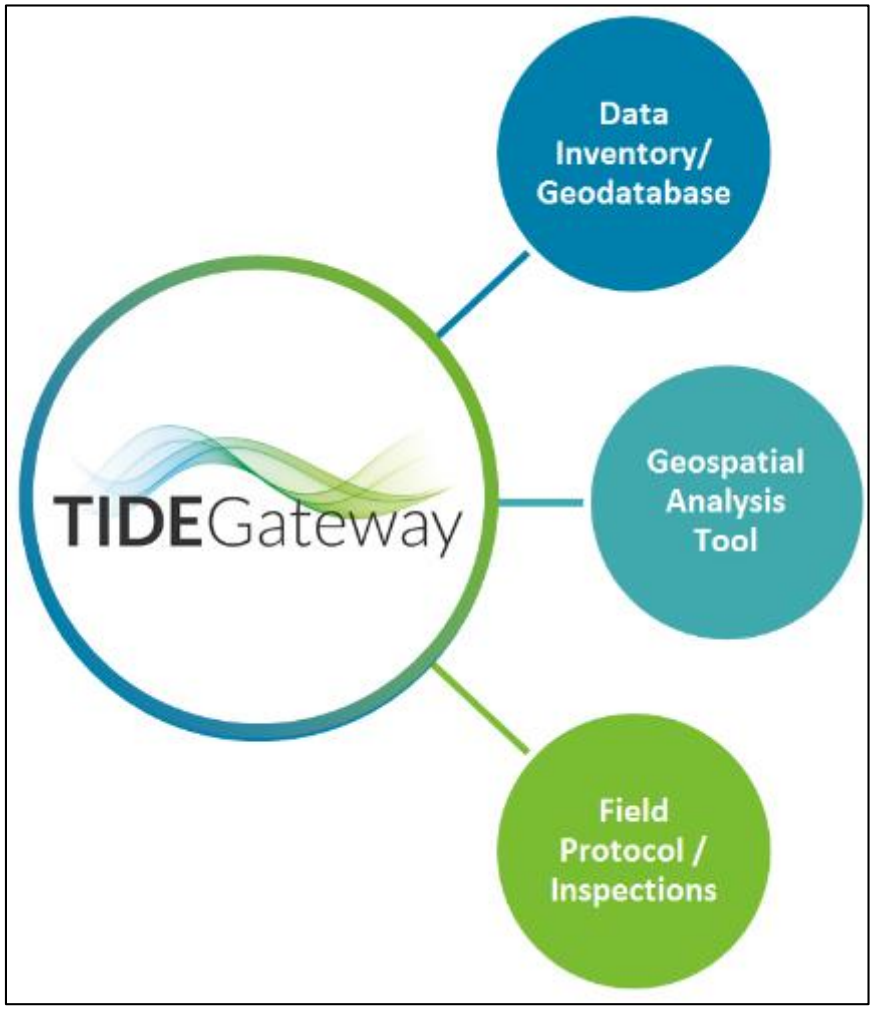
TIDEGateway

Tidegate Inventory and Data Evaluation Gateway

Geosyntec consultants

Case Study #1: TIDEGateway

***Why Needed*?** **Limited / incompatible data on hundreds (?) of tide gates with varying ecological impacts and restoration potential.**



Field Assessments

- Standardized Field Assessment Protocols / Forms

- 50 Tide Gate Assessments / Staff Training

Geospatial Analysis Tool

- Climate change resiliency planning
  - Sea level rise scenarios
  - Storm surge Scenarios

- Ecological restoration planning
  - Where is restoration feasible… Without increased flood risk?

TIDEGateway

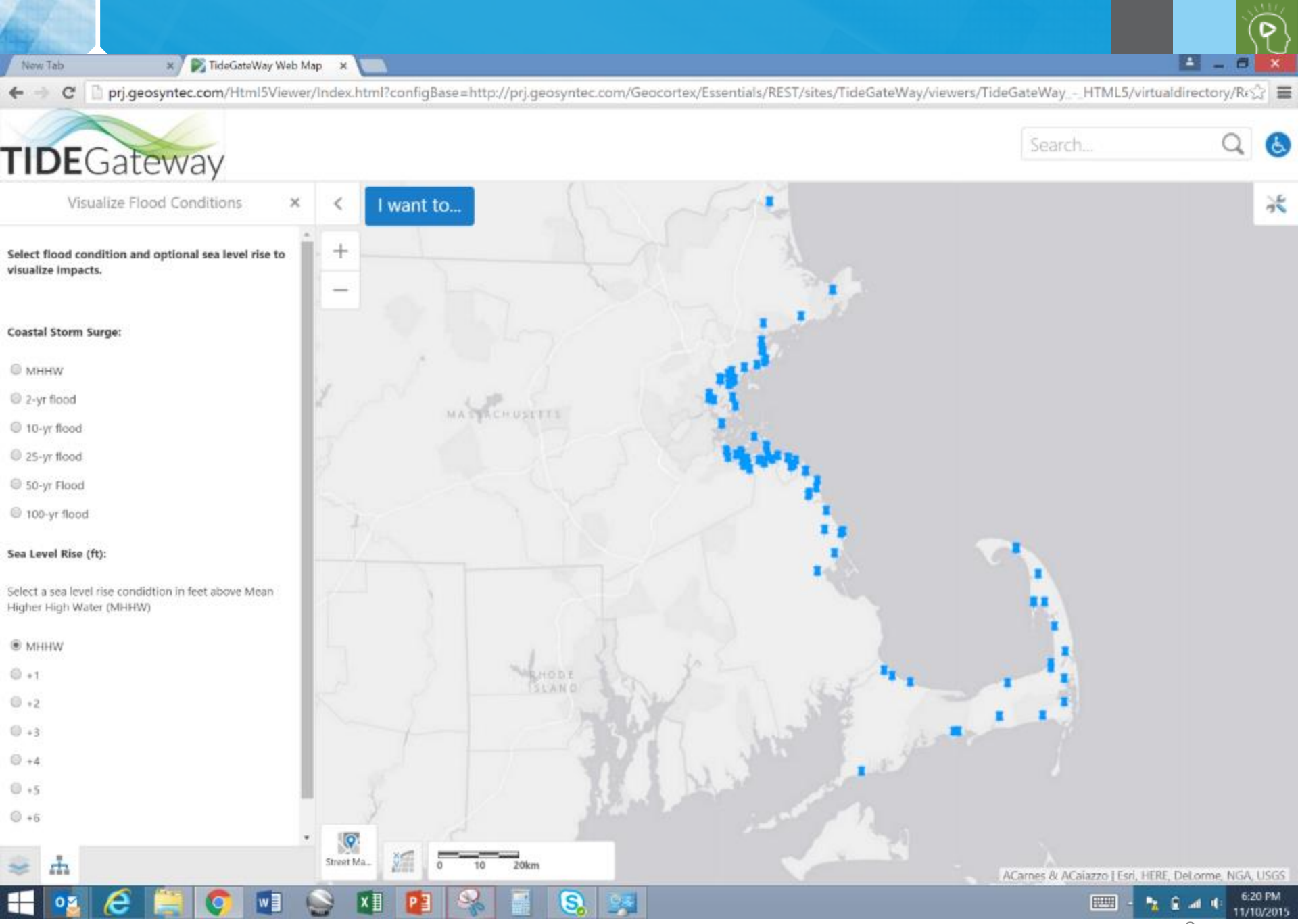
Interactive Tide Gate Map

Tide Gate Inventory

Field Inspection Protocols

MassBays
NATIONAL ESTUARY PROGRAM

Massachusetts Office of
Coastal Zone Management


New Tab
TideGateWay Web Map
prj.geosyntec.com/Html5Viewer/Index.html?configBase=http://prj.geosyntec.com/Geocortex/Essentials/REST/sites/TideGateWay/viewers/TideGateWay_-_HTML5/virtualdirectory/Re
TIDEGateway
Search...
Visualize Flood Conditions
I want to...
Select flood condition and optional sea level rise to visualize impacts.
Coastal Storm Surge:
MHHW
2-yr flood
10-yr flood
25-yr flood
50-yr Flood
100-yr flood
Sea Level Rise (ft):
Select a sea level rise condition in feet above Mean Higher High Water (MHHW)
MHHW
+1
+2
+3
+4
+5
+6
MASSACHUSETTS
RHODE ISLAND
Street Ma...
0 10 20km
ACarnes & ACaiazzo | Esri, HERE, DeLorme, NGA, USGS
6:20 PM
11/10/2015

New Tab | TideGateWay Web Map

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TIDEGateway

Search...

Visualize Flood Conditions

Select flood condition and optional sea level rise to visualize impacts.

Coastal Storm Surge:

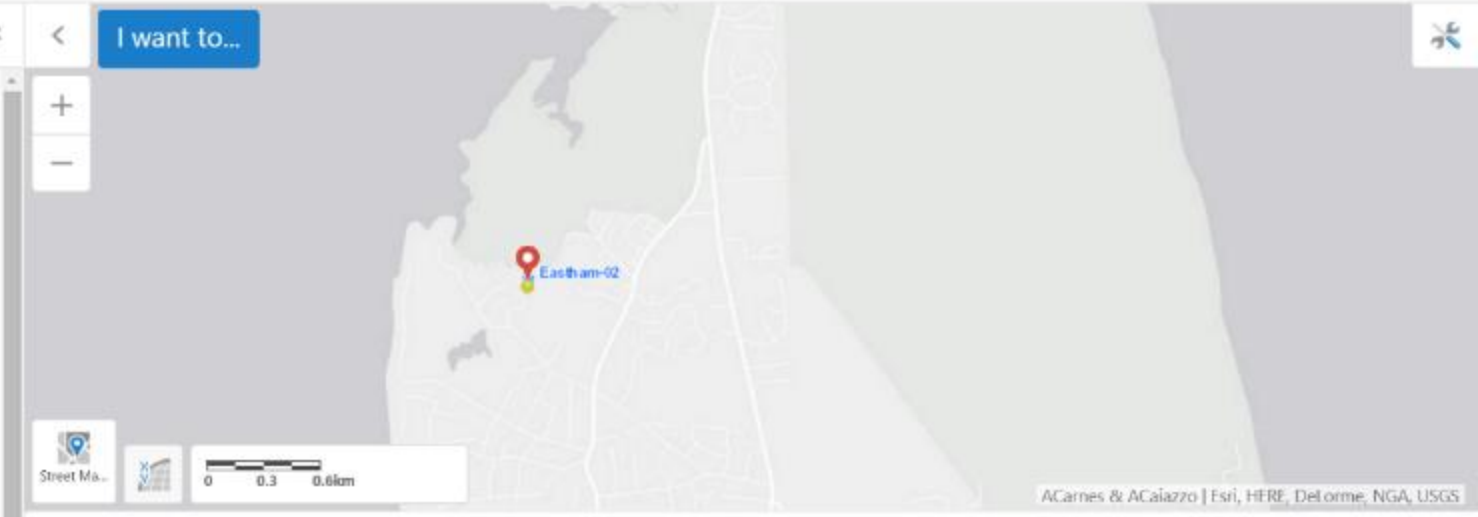
- MHHW
- 2-yr flood
- 10-yr flood
- 25-yr flood
- 50-yr Flood
- 100-yr flood

Sea Level Rise (ft):

Select a sea level rise condition in feet above Mean Higher High Water (MHHW)

- MHHW
- +1
- +2
- +3
- +4
- +5
- +6

I want to...



Eastham - Hatches Creek

Description | Hyperlinks | Details | Tidegate Characteristics | Culvert Characteristics | Miscellaneous Site Characteristics

UNIQUE_ID 8	TG_MATERIAL Metal
Tidegate Name Eastham-02	ORIG_ATLAS_ID EA-9
TOWN Eastham	EX_TIDAL_INF_US N/A
WATER_BODY Hatches Creek	EX_TIDAL_INF_DS N/A
TYPE Flap Gate	

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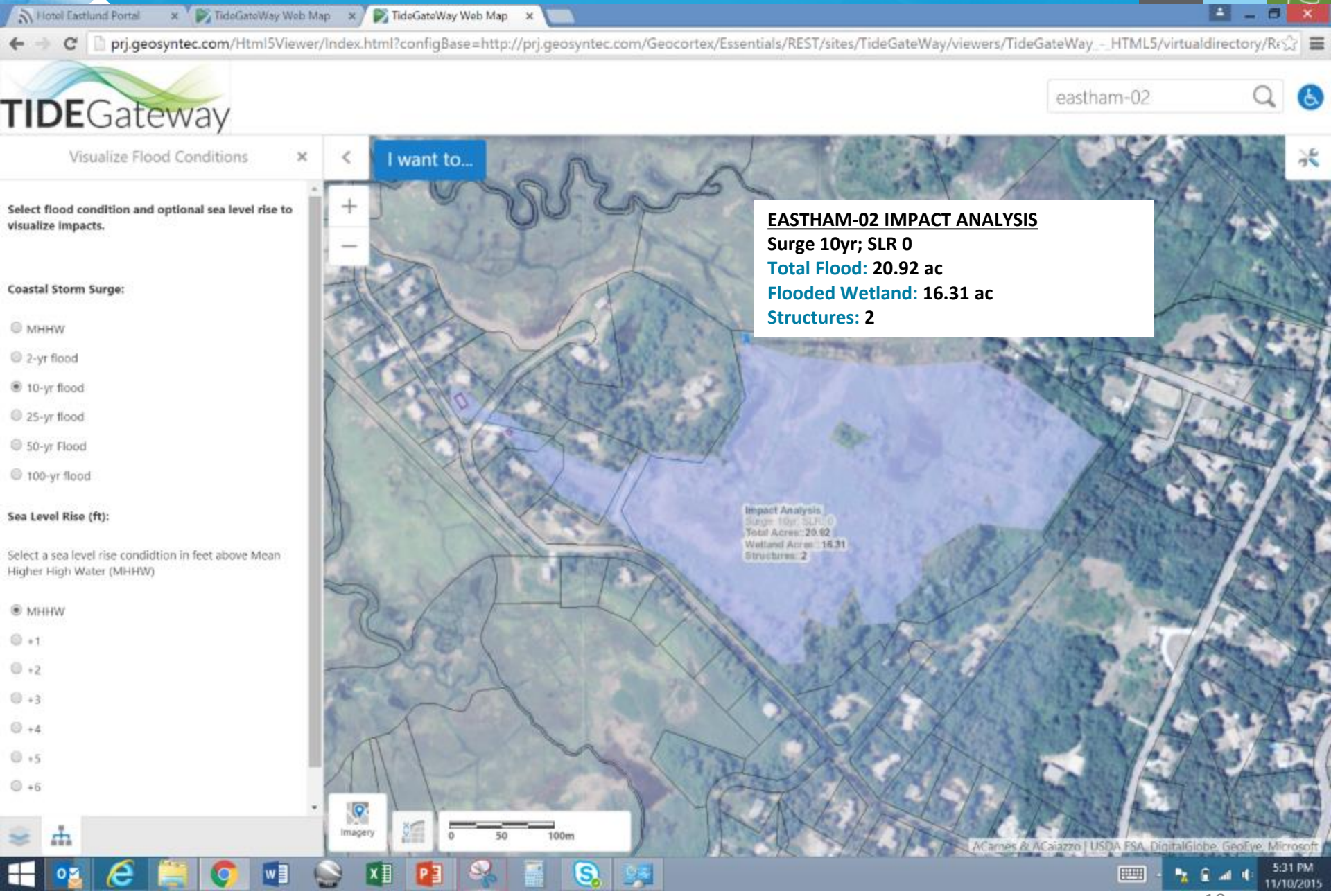
Hotel Eastlund Portal
TideGateWay Web Map
TideGateWay Web Map
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TIDEGateway
eastham-02
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MHHW
2-yr flood
10-yr flood
25-yr flood
50-yr Flood
100-yr flood
Sea Level Rise (ft):
Select a sea level rise condition in feet above Mean Higher High Water (MHHW)
MHHW
+1
+2
+3
+4
+5
+6
EASTHAM-02 IMPACT ANALYSIS
Surge 10yr; SLR 0
Total Flood: 20.92 ac
Flooded Wetland: 16.31 ac
Structures: 2
Impact Analysis
Total Acres: 20.92
Wetland Acres: 16.31
Structures: 2
Imagery
0
50
100m
ACarnes & ACaiazzo | USDA FSA, DigitalGlobe, GeoEye, Microsoft
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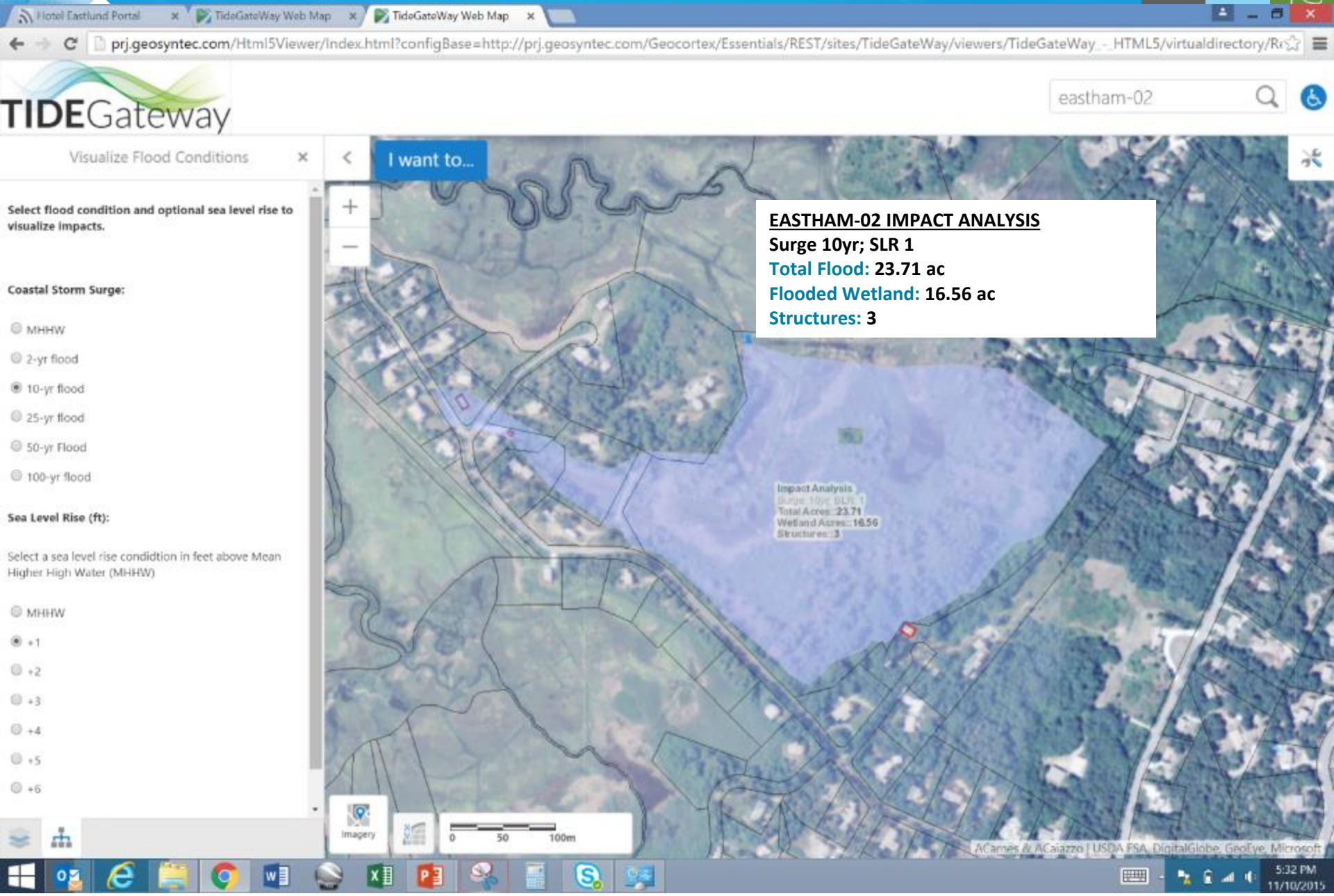
11/10/2015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TIDEGateway
eastham-02
Visualize Flood Conditions
I want to...
Select flood condition and optional sea level rise to visualize impacts.
Coastal Storm Surge:
MHHW
2-yr flood
10-yr flood
25-yr flood
50-yr Flood
100-yr flood
Sea Level Rise (ft):
Select a sea level rise condidtion in feet above Mean Higher High Water (MHHW)
MHHW
+1
+2
+3
+4
+5
+6
EASTHAM-02 IMPACT ANALYSIS
Surge 10yr; SLR 1
Total Flood: 23.71 ac
Flooded Wetland: 16.56 ac
Structures: 3
Impact Analysis
Total Acres: 23.71
Wetland Acres: 16.56
Structures: 3
Imagery
0
50
100m
ACarnes & ACaiazzo | USDA FSA, DigitalGlobe, GeoEye, Microsoft
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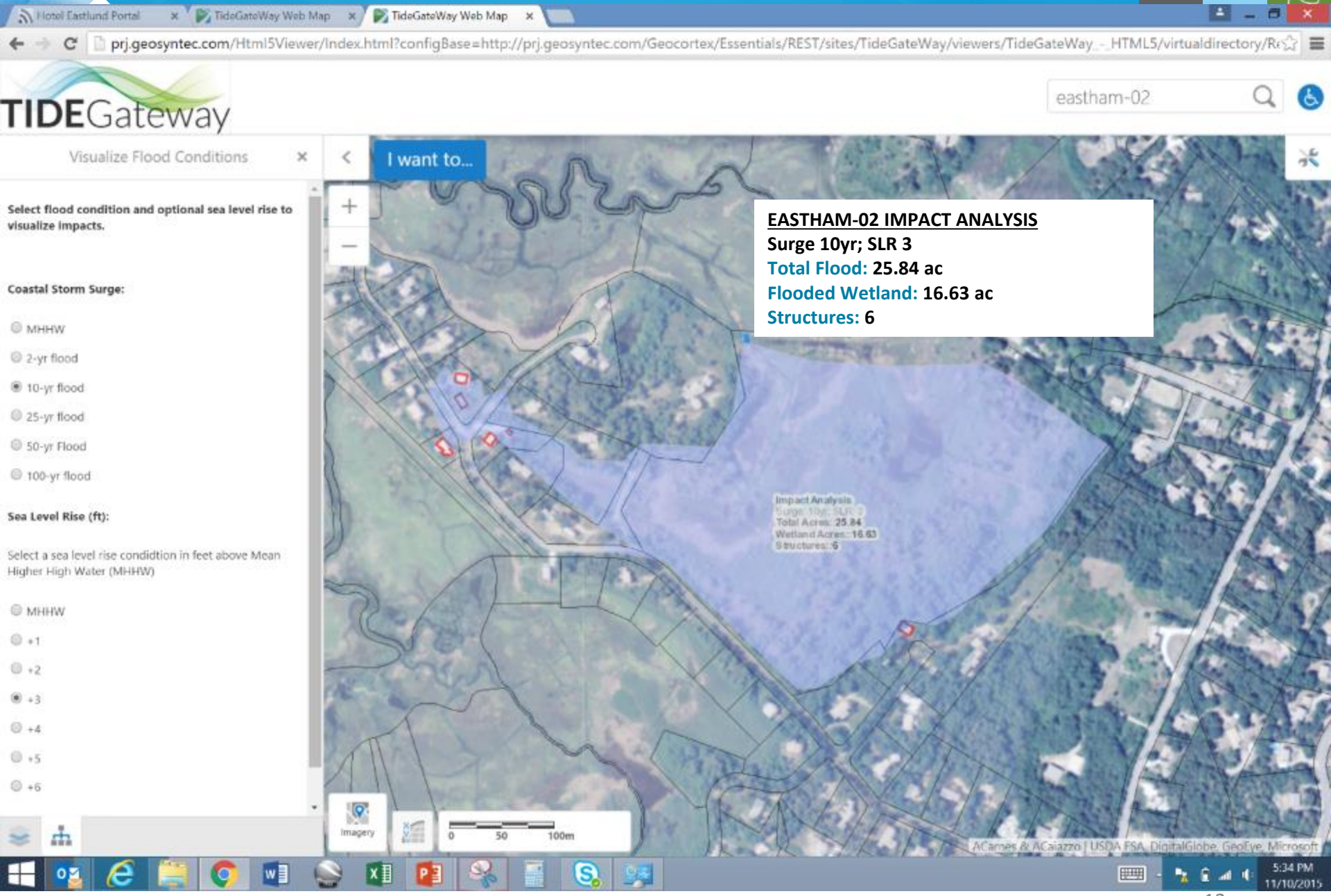
11/10/2015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TIDEGateway
eastham-02
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MHHW
2-yr flood
10-yr flood
25-yr flood
50-yr Flood
100-yr flood
Sea Level Rise (ft):
Select a sea level rise condidtion in feet above Mean Higher High Water (MHHW)
MHHW
+1
+2
+3
+4
+5
+6
EASTHAM-02 IMPACT ANALYSIS
Surge 10yr; SLR 3
Total Flood: 25.84 ac
Flooded Wetland: 16.63 ac
Structures: 6
Impact Analysis
Total Acres: 25.84
Wetland Acres: 16.63
Structures: 6
Imagery
0
50
100m
ACarnes & ACaiazzo | USDA FSA, DigitalGlobe, GeoEye, Microsoft
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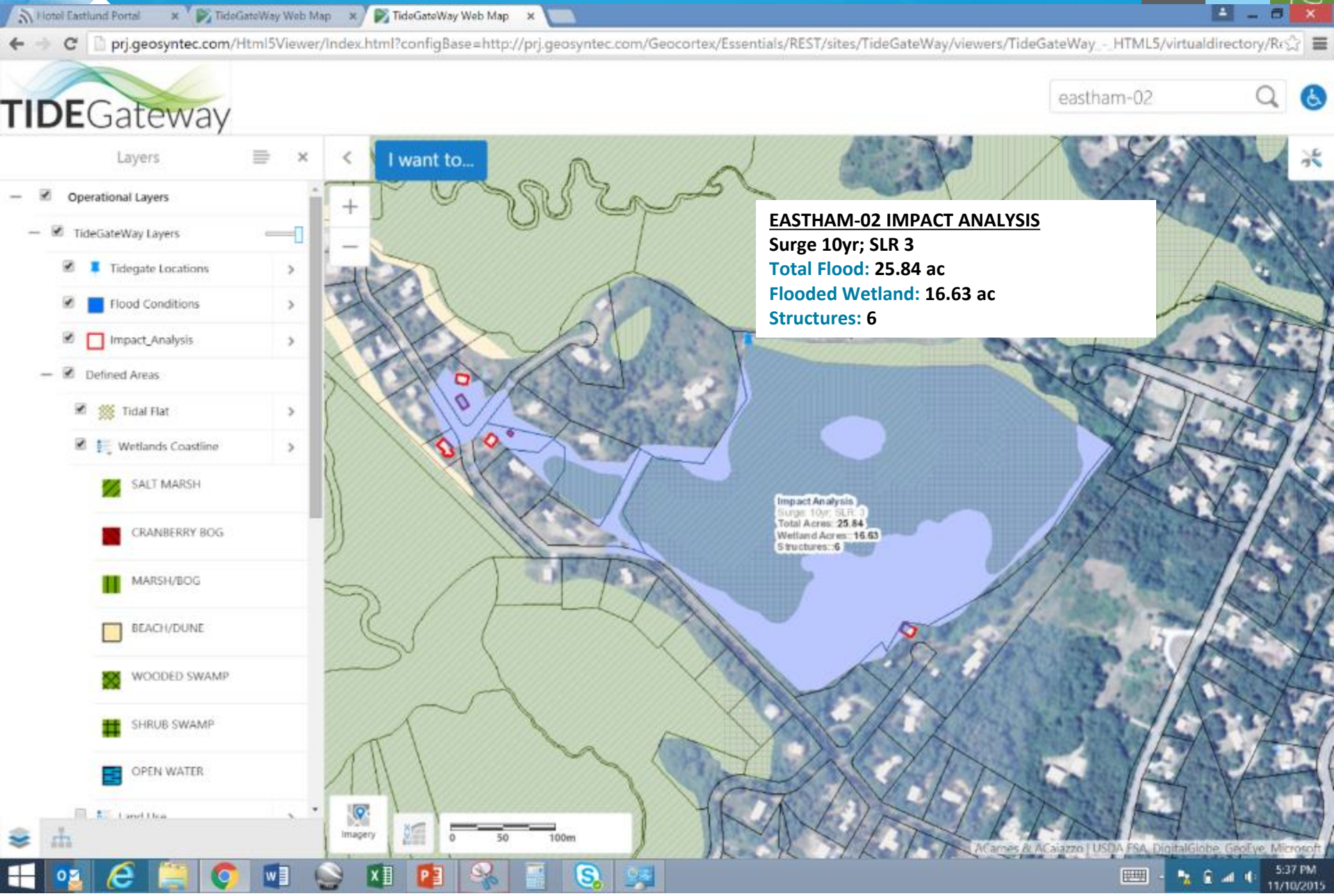
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TIDEGateway
eastham-02
Layers
I want to...
Operational Layers
TideGateWay Layers
Tidegate Locations
Flood Conditions
Impact_Analysis
Defined Areas
Tidal Flat
Wetlands Coastline
SALT MARSH
CRANBERRY BOG
MARSH/BOG
BEACH/DUNE
WOODED SWAMP
SHRUB SWAMP
OPEN WATER
EASTHAM-02 IMPACT ANALYSIS
Surge 10yr; SLR 3
Total Flood: 25.84 ac
Flooded Wetland: 16.63 ac
Structures: 6
Impact Analysis
Total Acres: 25.84
Wetland Acres: 16.63
Structures: 6
Imagery
0
50
100m
5:37 PM
11/10/2015

RISE:NYC:

Hyper-Localized Resiliency Audits & Resiliency Dashboards

RISE:NYC

Geosyntec consultants

Case Study #2: RISE:NYC

RISE:NYC
Resiliency Innovations for a Stronger Economy

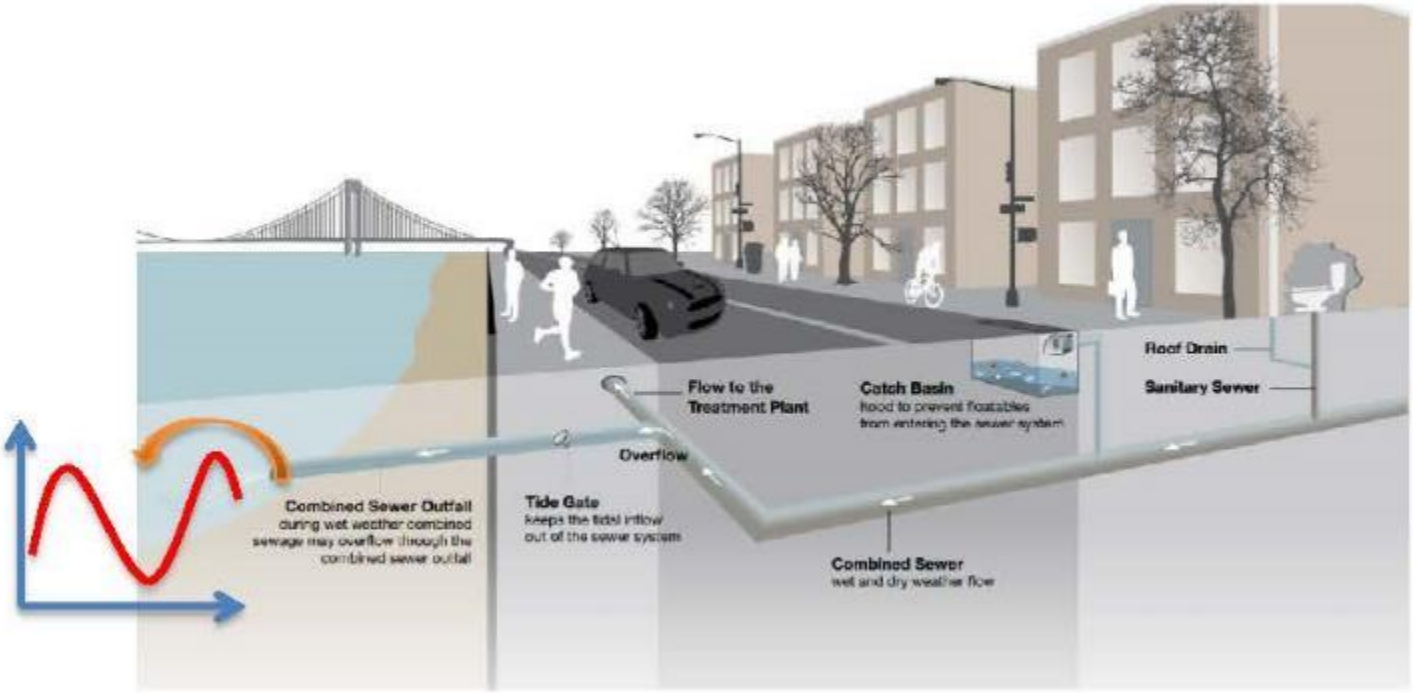
- Superstorm Sandy business recovery program managed by New York City Economic Development Corporation
- Launched in 2014 as a global competition **to identify innovative technologies to improve a business' ability to adapt to and mitigate the impacts of climate change**
- Working with 30 beneficiaries for this project

Source: http://rise-nyc.com/

Site-specific flood modeling

- **Purpose:** Identify potential flood risk
- **Modeling:** Estimate localized flooding elevations under different rainfall, tidal and surge conditions
  - 90 Scenarios per site

Boomi Environmental



Source for the Urban Drainage Figure: The NYC DEP Climate Change Program Assessment and Action Plan, May 2008

Example Scenario Output

Superstorm Sandy Conditions
Typical Depth 4-6 feet

Results calibrated/verified from Owner information

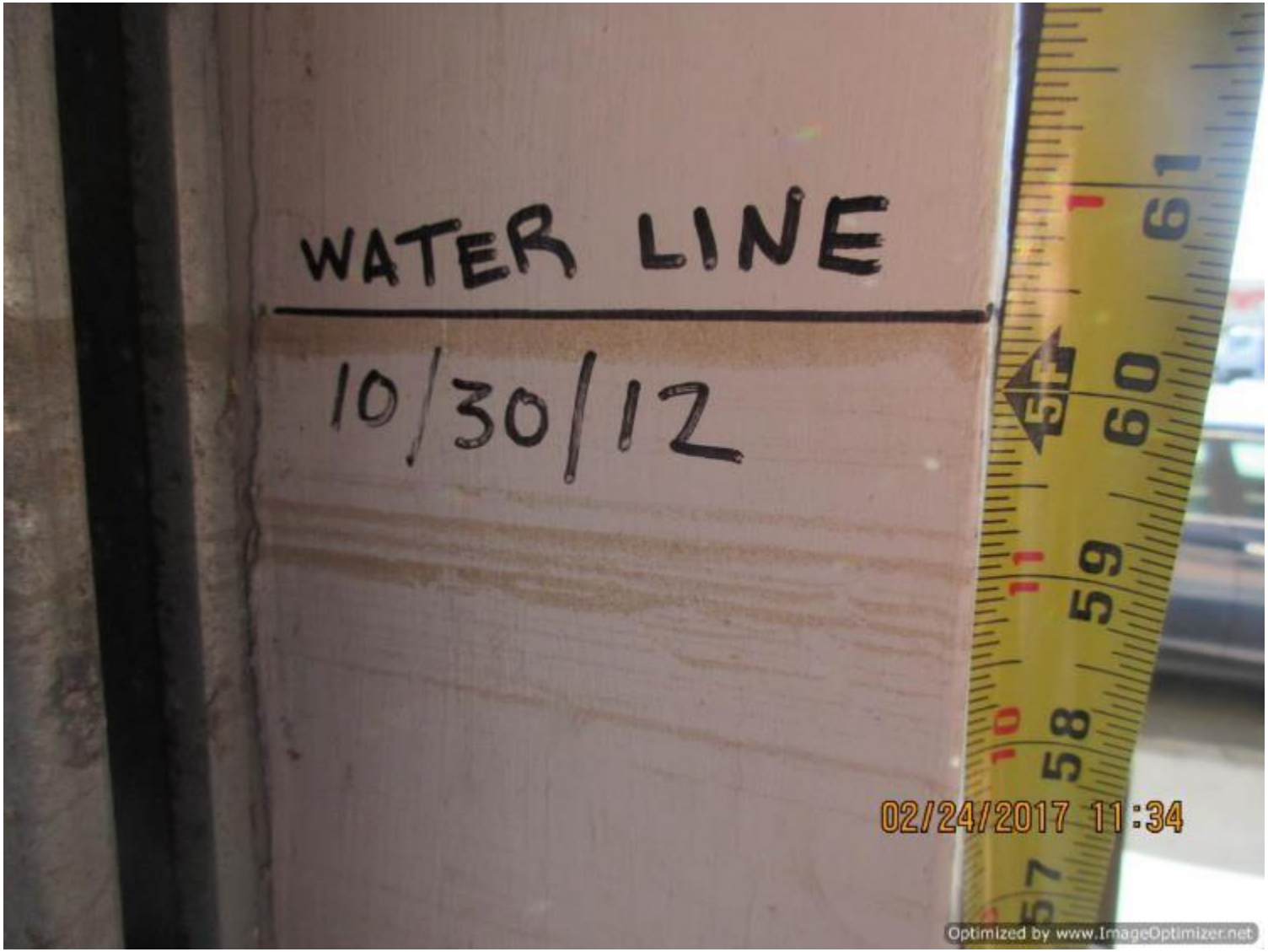
Resiliency Audits

- Purpose:
  - Identify potential flood risk and flood vulnerabilities

- Audit Protocols:
  - Rapid Assessments
  - No Specialized Equipment
  - Automated Reporting

- Site Audit:
  - Field assessment to identify solutions which may mitigate risk

Verifying Model Results



Assessing Exterior Vulnerabilities

Assessing Exterior Vulnerabilities

Document all first floor windows and doors!

Assessing Interior Vulnerabilities

Electrical Equipment, Utilities, Etc.

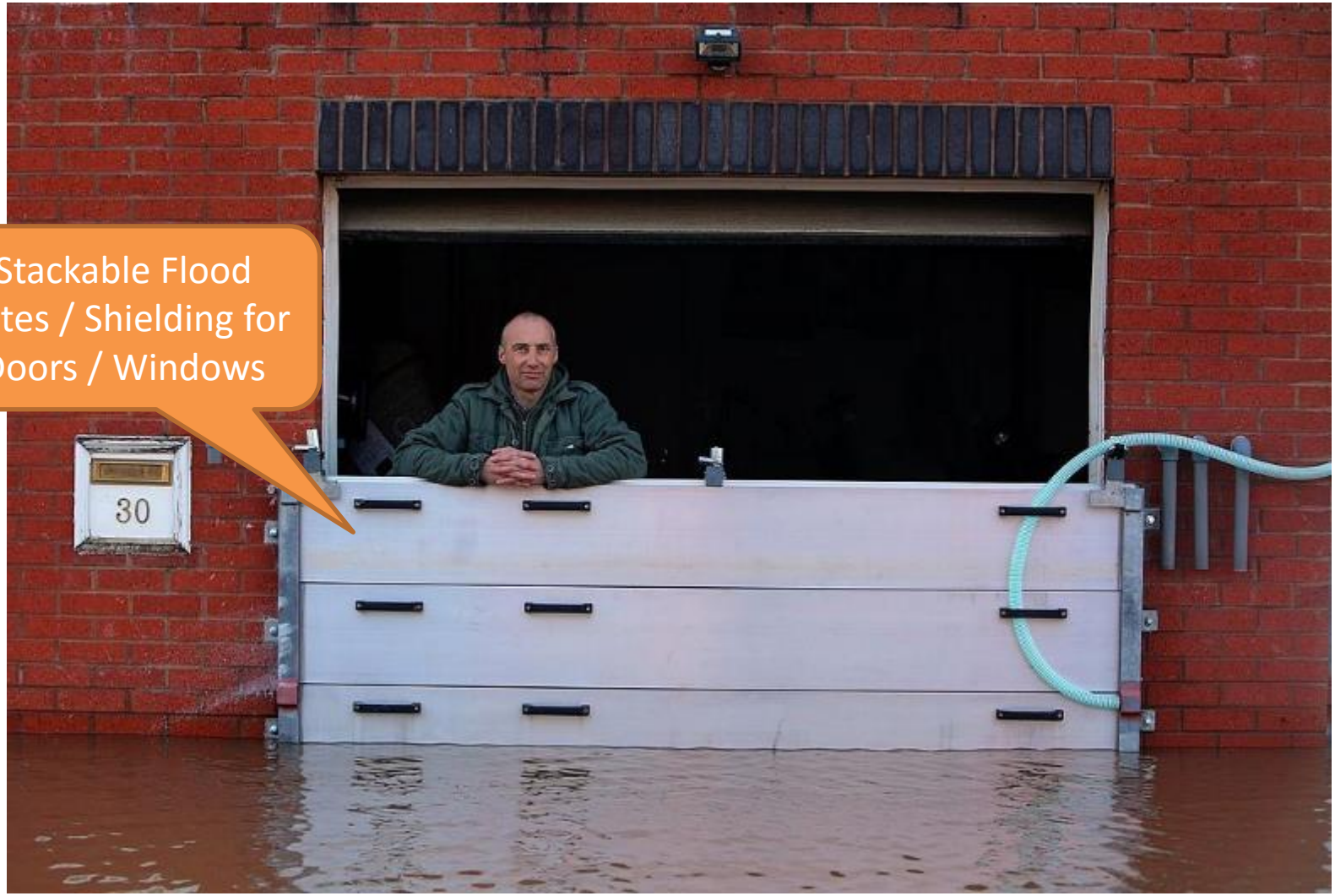
Assessing Interior Vulnerabilities

Assessing Interior Vulnerabilities

Typical Recommendations

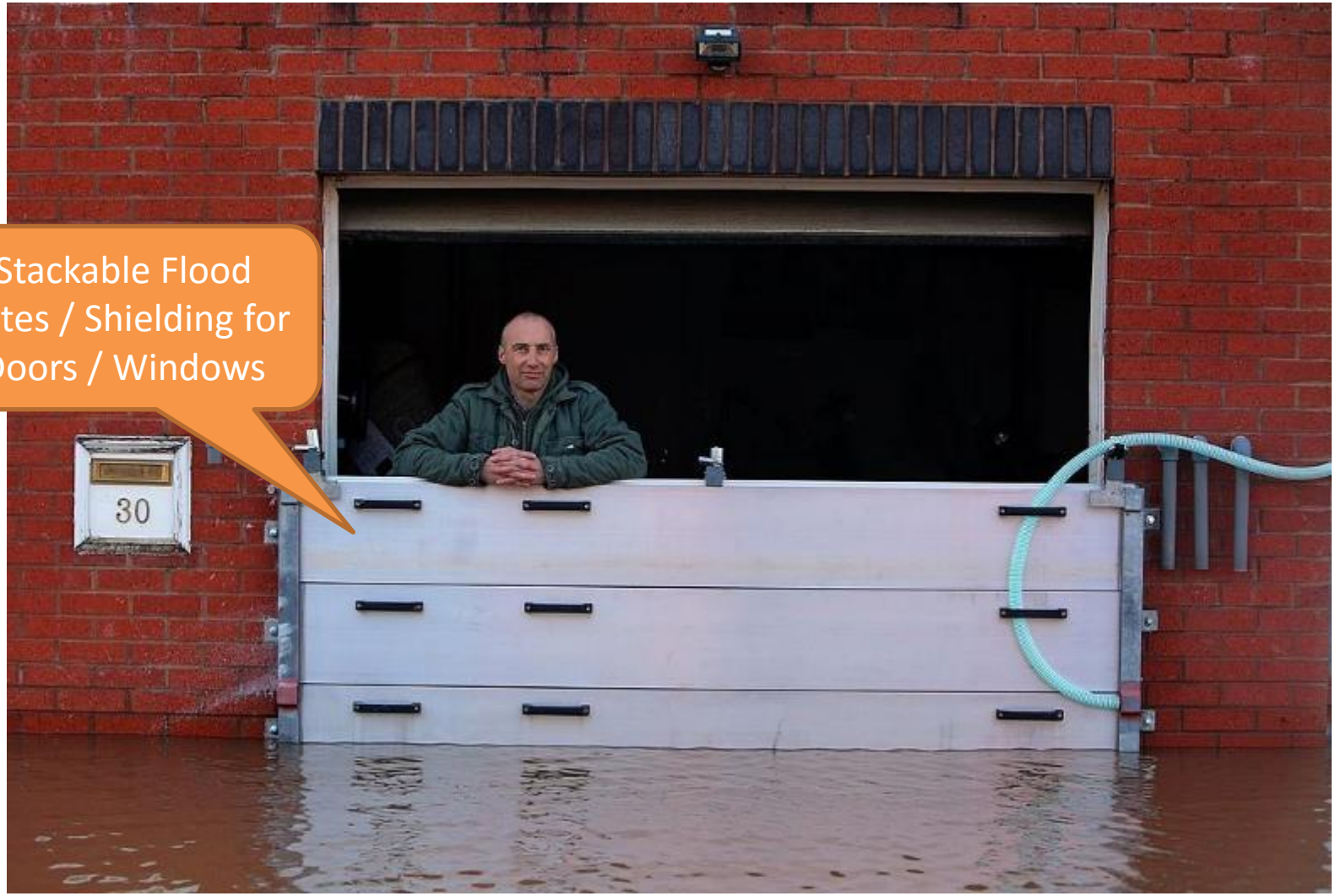
Seal Gaps

Typical Recommendations



Stackable Flood Gates / Shielding for Doors / Windows

Typical Recommendations

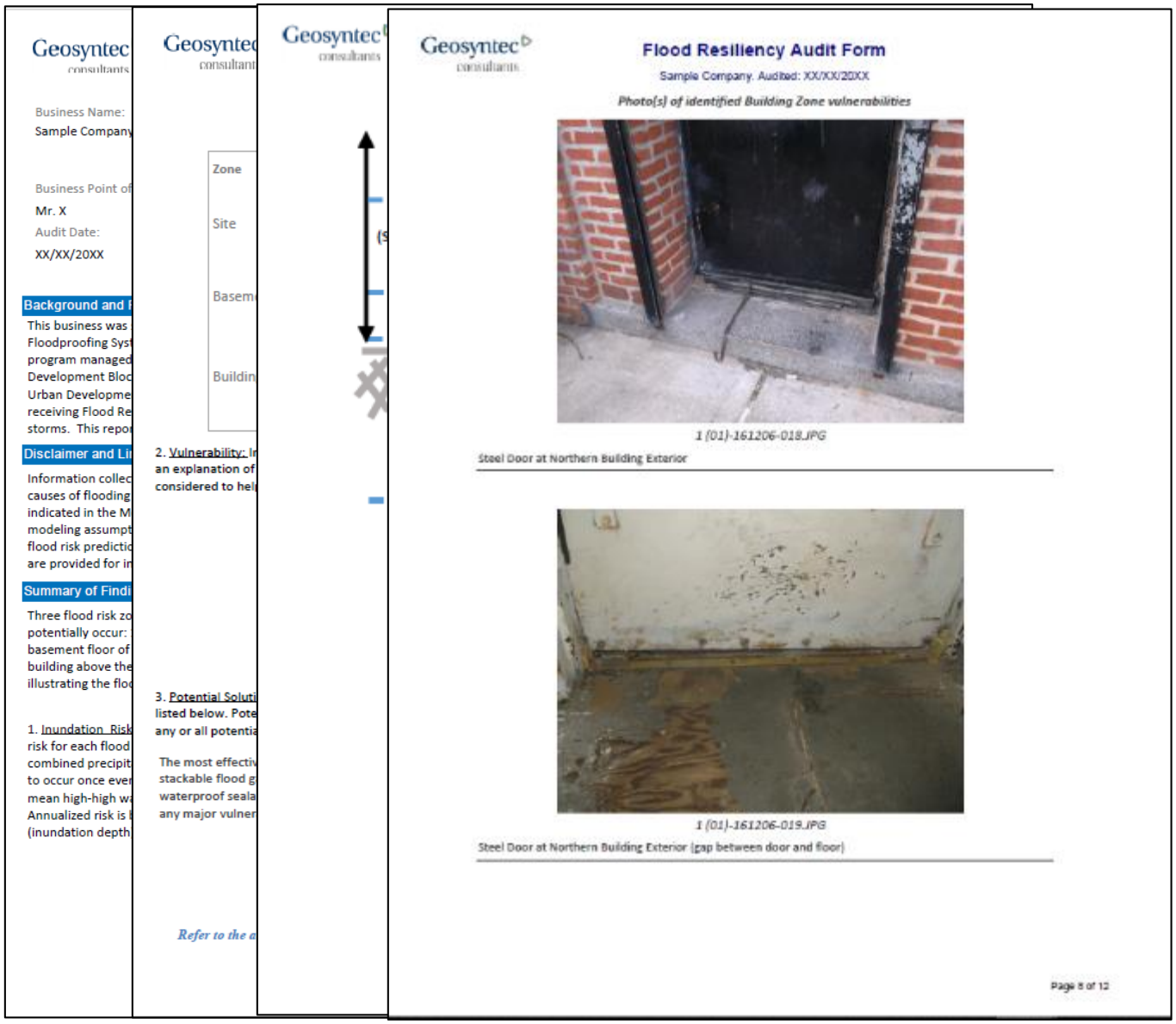


Stackable Flood Gates / Shielding for Doors / Windows

Typical Recommendations

Elevate Utilities or Constructed Barriers

Data-Driven Reports & Recommendations



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Business Name:
Sample Company

Business Point of
Mr. X
Audit Date:
XX/XX/20XX

Background and
This business was
Floodproofing Syst
program managed
Development Bloc
Urban Developme
receiving Flood Re
storms. This repo

Disclaimer and Li
Information collec
causes of flooding
indicated in the M
modeling assumpt
flood risk predictio
are provided for in

Summary of Findi
Three flood risk zo
potentially occur:
basement floor of
building above the
illustrating the flo

1. Inundation Risk
risk for each flood
combined precipit
to occur once ever
mean high-high wa
Annualized risk is
(inundation depth

Zone
Site
Basem
Buildin

2. Vulnerability: I
an explanation of
considered to hel

3. Potential Soluti
listed below. Pote
any or all potentia

The most effectiv
stackable flood g
waterproof seala
any major vulner

Refer to the a

Geosyntec consultants

Flood Resiliency Audit Form

Sample Company. Audited: XX/XX/20XX

Photo(s) of identified Building Zone vulnerabilities

1 (01)-161206-018.JPG

Steel Door at Northern Building Exterior

1 (01)-161206-019.JPG

Steel Door at Northern Building Exterior (gap between door and floor)

Page 8 of 12

Floodproofing Fact Sheets

Temporary Barrier Systems

Temporary Barriers Systems provide temporary flood protection from a flood event. They are constructed of a variety of materials, including sand, plastic, aluminum, and steel. Some temporary barriers are designed to provide protection for a single flooding event, while others can be re-used for extended protection time. Temporary barrier systems are required to be installed prior to the start of the flooding event in order to provide protection; these systems are not permanent. Proper warning time and personnel are essential to implement these protection systems prior to flooding.

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INFLATABLE BARRIERS

Water filled barriers made of durable flexible plastic materials that are filled until they provide a barrier of protection from flooding. When not in use, the deflated barriers can be rolled and stored until required prior to flooding.

Pros

Available in versatile sizes (doorstops to large dams) and can be folded and stored between flooding events.

Cons

Require warning time, routine maintenance, and reliable water source to fill.

Estimated Deployment Time

Approximately 5-10 minutes required to lay out barrier, but time to fill depends on flow rate of water filling barrier to desired height.

Local New York Suppliers:

Quick Dam – available at Grangier Industrial Supply, Inc., located in Brooklyn, NY.

Tiger Dams – available direct from Tiger Dams.

1: Research was conducted to identify NYC contractors that configure and/or install applicable floodproofing measures; however, the list provided may not contain all contractors in the NYC area that perform these services.

2: Research was conducted to identify vendors that supply/provide applicable floodproofing systems; however, the list provided may not include all suppliers in the NYC area.

3: The NYC Department of Buildings maintains documentation on local construction professionals in a General Contractor License Search Engine located at the following link:
http://www1.nyc.gov/site/buildings/business/hiring-a-professional.page

Source: FEMA Chapter 8 Barriers

Cost for Average Building Installation

Sources and Additional Information:

FEMA. "Floodproofing Non-Residential Buildings." FEMA P-936 Edition 1 (July 2013).
https://www.fema.gov/media-library/assets/documents/34270

FEMA. "Homeowner's Guide to Retrofitting." Barriers Chapter 8.0. FEMA P-312 Edition 3 (2014).
http://www.fema.gov/media-library/assets/documents/480

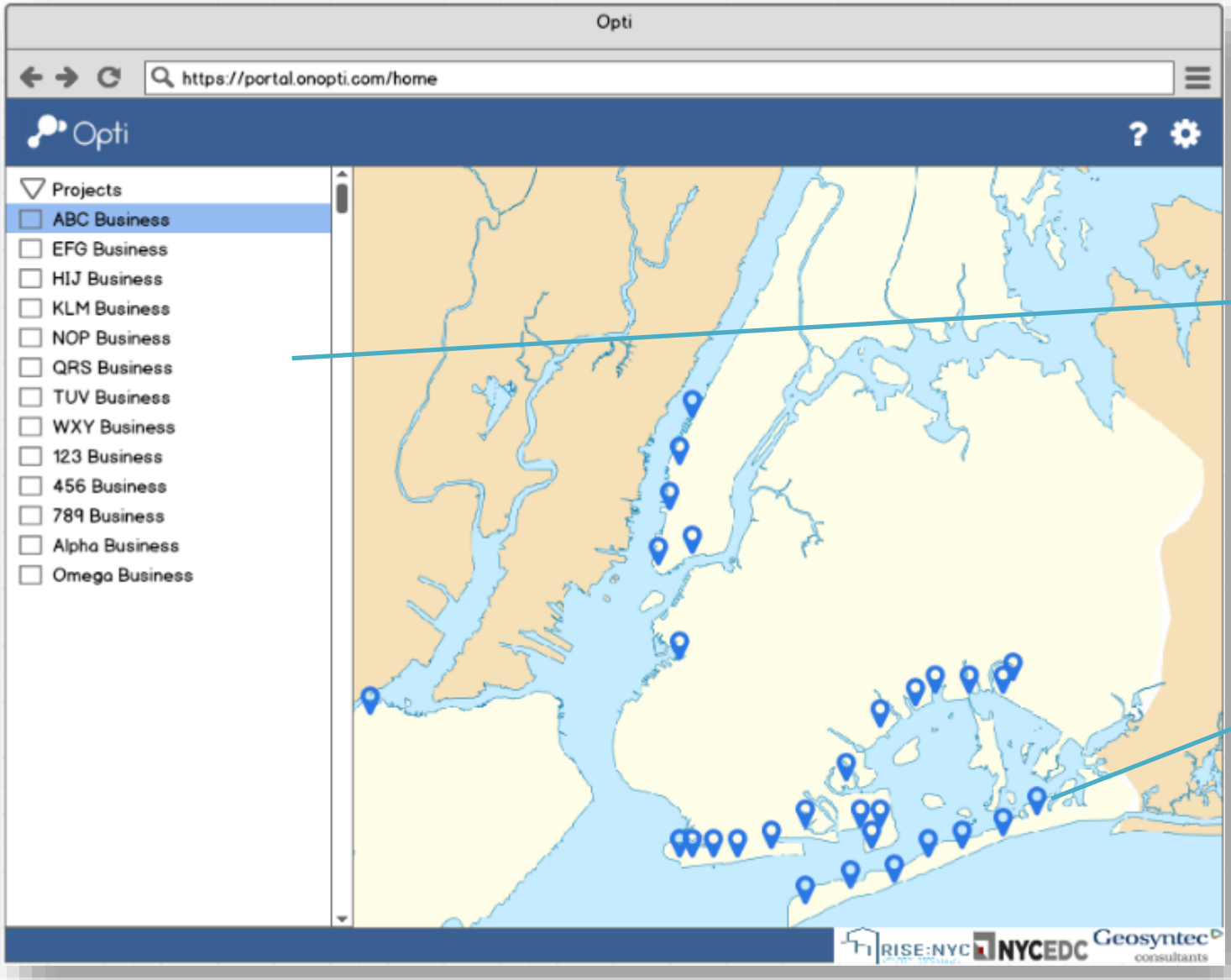
FEMA. "Selecting Appropriate Mitigation Measures for Floodprone Structures." FEMA 551 (March 2007).
http://www.fema.gov/media-library-data/20130726-1609-20490-5083/fema_551.pdf

De Graaf, Rutger, and Vermeer, Dura. "Technologies for flood-proofing "hotspot" buildings". Flood Probe Research Project, 2nd Edition (July 2012).
http://www.floodprobe.eu/partner/assets/documents/Technologiesforflood-proofinghotspotbuildings_DeltaSync_18032013.pdf

Thomasnet.com "Qualified Supplier Discovery". http://www.thomasnet.com/suppliers/. Website Search Engine. (October 2016).

MFG.com. "Manufacturing Companies Worldwide Directory". https://discover.mfg.com/?country=92&search=1. Website Search Engine. (October 2016)

Flood Resiliency Dashboards



Link to Site-Specific Resiliency Dashboards

Site Locations

Flood Resiliency Dashboards

Color-coded locations by estimated flood risk

Forecasted flood risk for each business

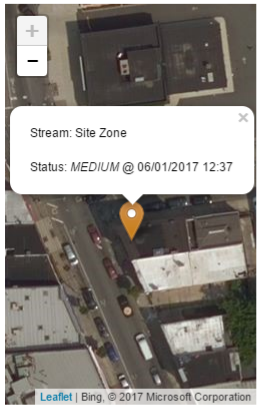
Resiliency Network Dashboards

Hook Enterprises, LLC

Flood Resiliency Dashboard Purpose

To provide real-time estimates of potential property inundation over the next 48 hours.

Potential Inundation Depth (Property Low Point – Green =<3", Yellow = 3-6", Red =>6")



Flood Risk Zone Schematic

What's My Expected Flood Depth?

This table shows the maximum predicted level and timing of flooding over the next 48 hours as referenced to the lowest point on the property "Site Zone" and just below the first floor of the building "Building Zone" (Null value if data unavailable or forecast tide and precipitation are below modeled thresholds).

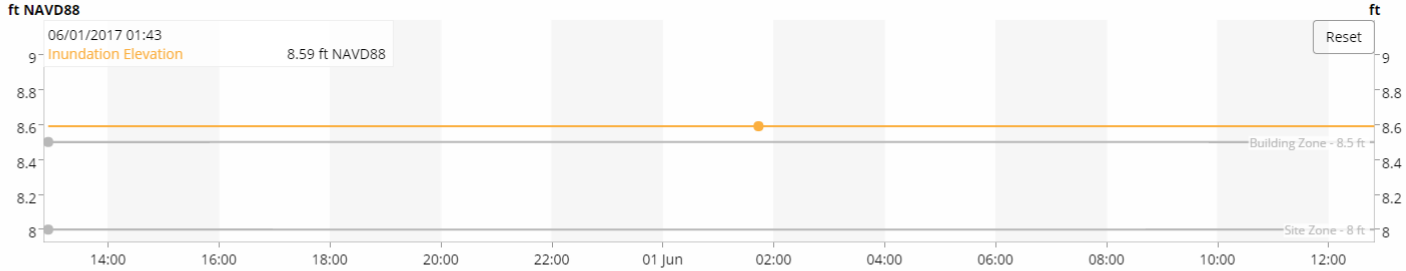
Building Zone (ft NAVD88)
06/01/2017 12:49
0.1

Site Zone (ft NAVD88)
06/01/2017 12:49
0.6

What's My Expected Flood Elevation?

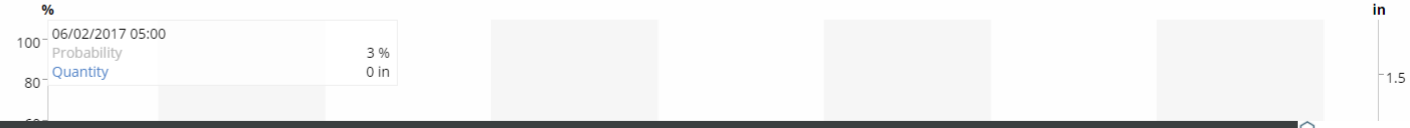
This chart shows a continuous time-series of the potential flood elevation at the property as it relates to the elevation of the "Site Zone" and "Building Zone".

12hr | 24hr | 48hr | 1wk



How Much Rain is in the Forecast?

This chart shows the expected probability and quantity of rainfall in the next 48 hours (source: weather.gov).



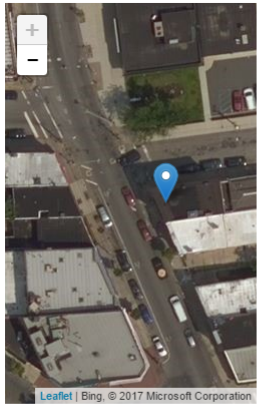
Project developed by RISE:NYC NYCEDC Geosyntec consultants

Resiliency Network Dashboards

Hook Enterprises, LLC

Flood Risk Zone Schematic

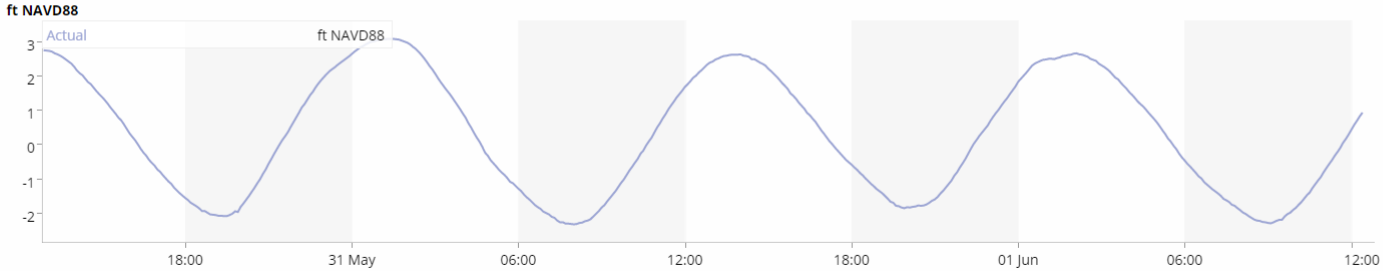
Site Location



What are the Current and Predicted Tide Levels?

This chart displays the forecast storm tide level. The predicted storm tide levels are forthcoming. The storm tide includes two components: 1) Astronomical tide (i.e. caused by the moon), and 2) Storm Surge (i.e. caused by wind and waves) (source: http://hudson.dl.stevens-tech.edu/SFAS/)

12hr | 24hr | 48hr | 1wk



Resources

Below is a listing of resources to help increase future preparedness and resiliency.

Flood Resiliency Audit

- Resiliency Audit
- Flood Proofing Fact Sheets

Emergency Resources

- City Wide Emergency Notification Sites
  - CorpNet
  - Know Your Zone
  - Corporate Emergency Access System
  - Ready New York for Business
  - NYCOEM Twitter
- Department of Small Business Services
  - Call SBS Emergency Response Services at (212) 618-8810
- Other Resources
  - SBA Business Preparedness
  - Insurance Institute for Business and Home Safety

Project developed by RISE:NYC NYCEDC Geosyntec consultants

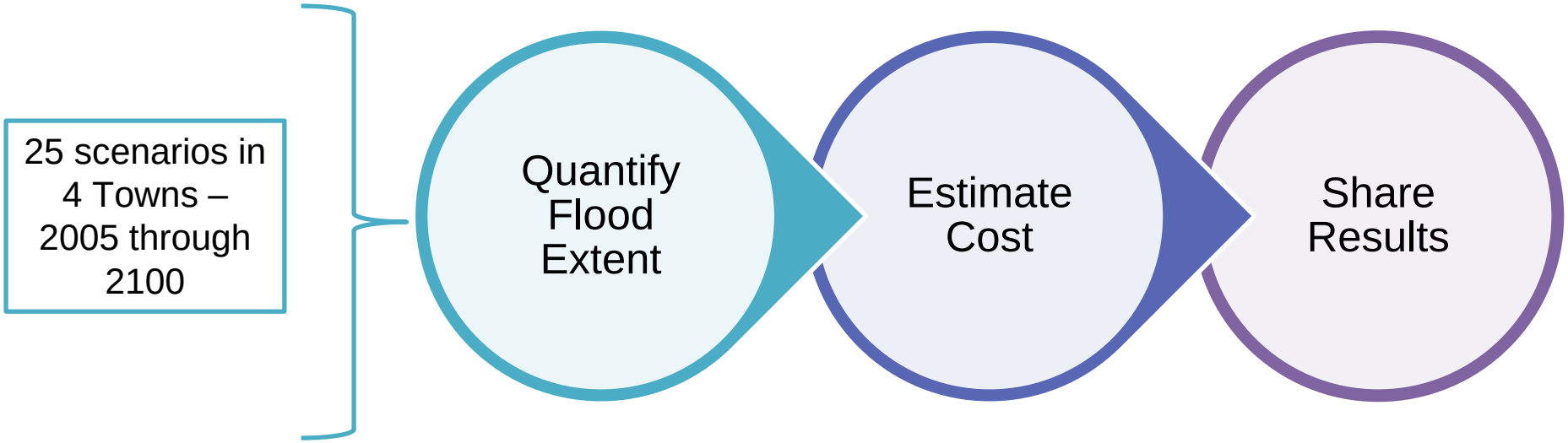
New Hampshire Flood Damage Analysis

Modeling & Interactive Visualization

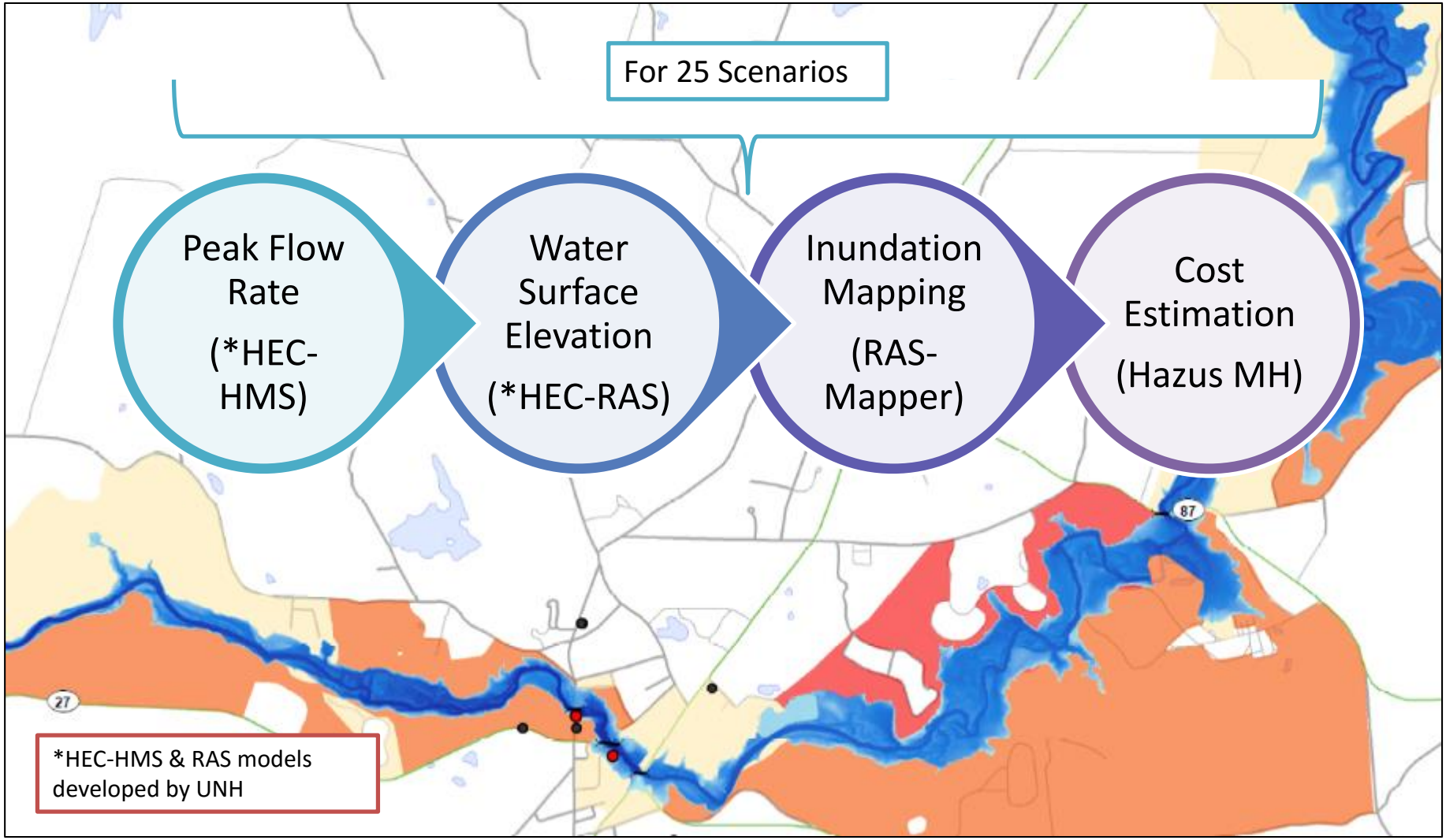
Geosyntec consultants

Study Objectives

- **Study Area**: Lamprey River, New Hampshire
- **Objective 1:** Estimate flood damage and cost as a result of changes in land use and climate.
- **Objective 2:** Share findings with communities and stakeholders



Modeling


For 25 Scenarios
Peak Flow Rate (*HEC-HMS)
Water Surface Elevation (*HEC-RAS)
Inundation Mapping (RAS-Mapper)
Cost Estimation (Hazus MH)
87
27
*HEC-HMS & RAS models developed by UNH

Loss Estimation – Hazus MH

- What is Hazus?

Calculates Economic Loss from Physical Damage

Nationally Applicable Standardized Methodology

- Levels of Analysis

Level 1 – Simplest Analysis

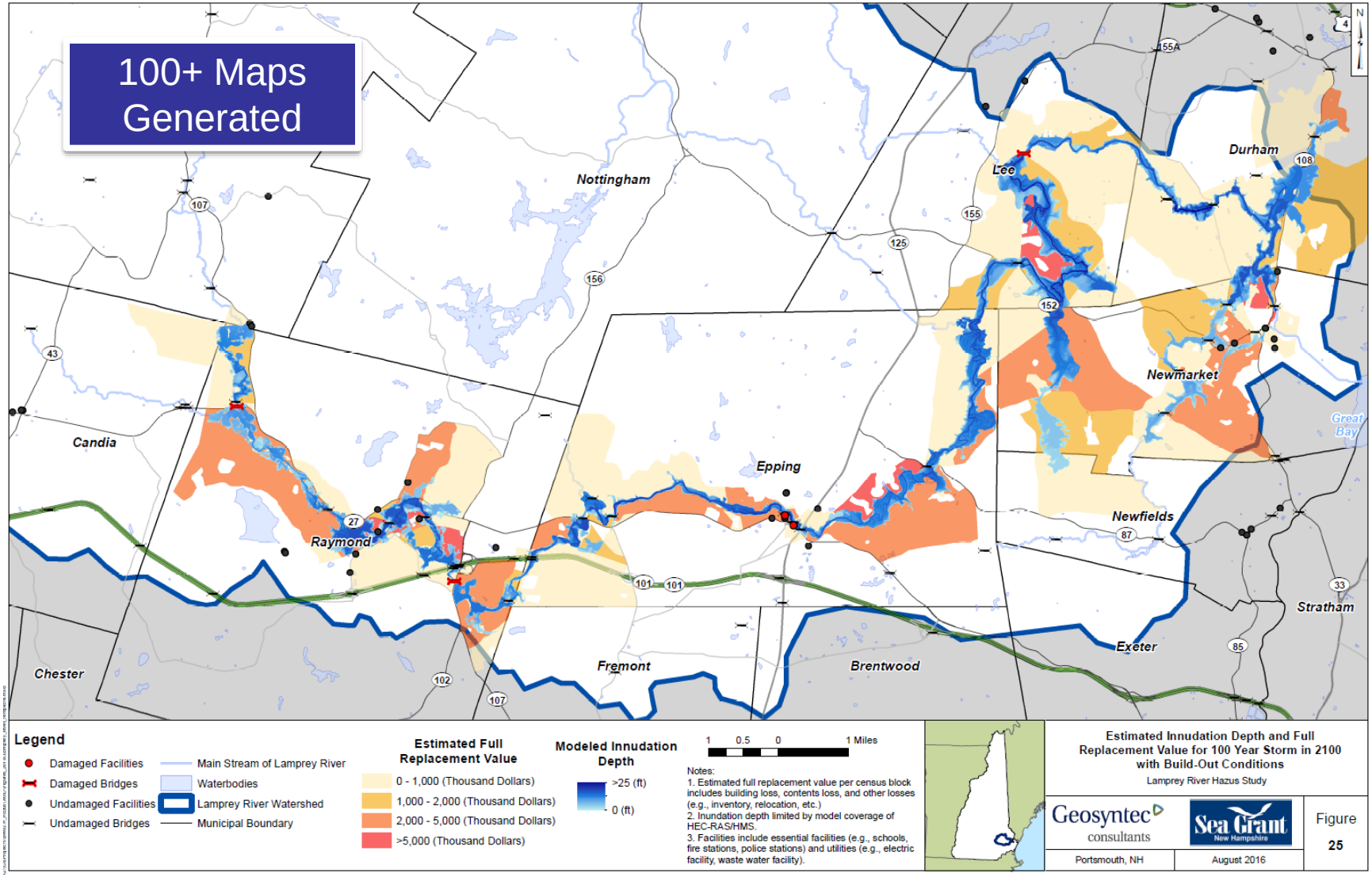
Built in Hydrologic Model

Levels 2&3 – More Complex

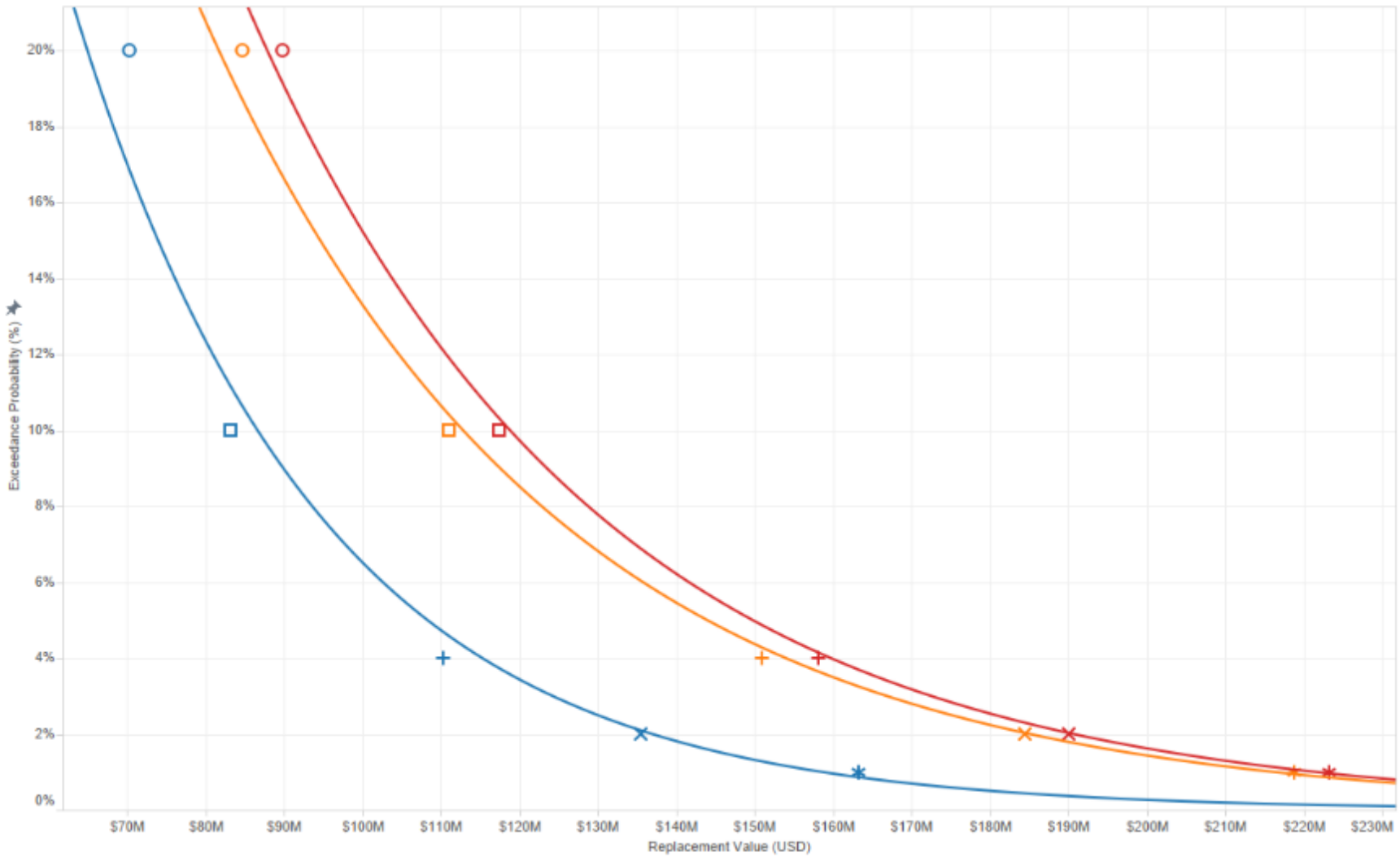
External Flood Data

Hazards U.S. – Multi Hazard, Developed by FEMA

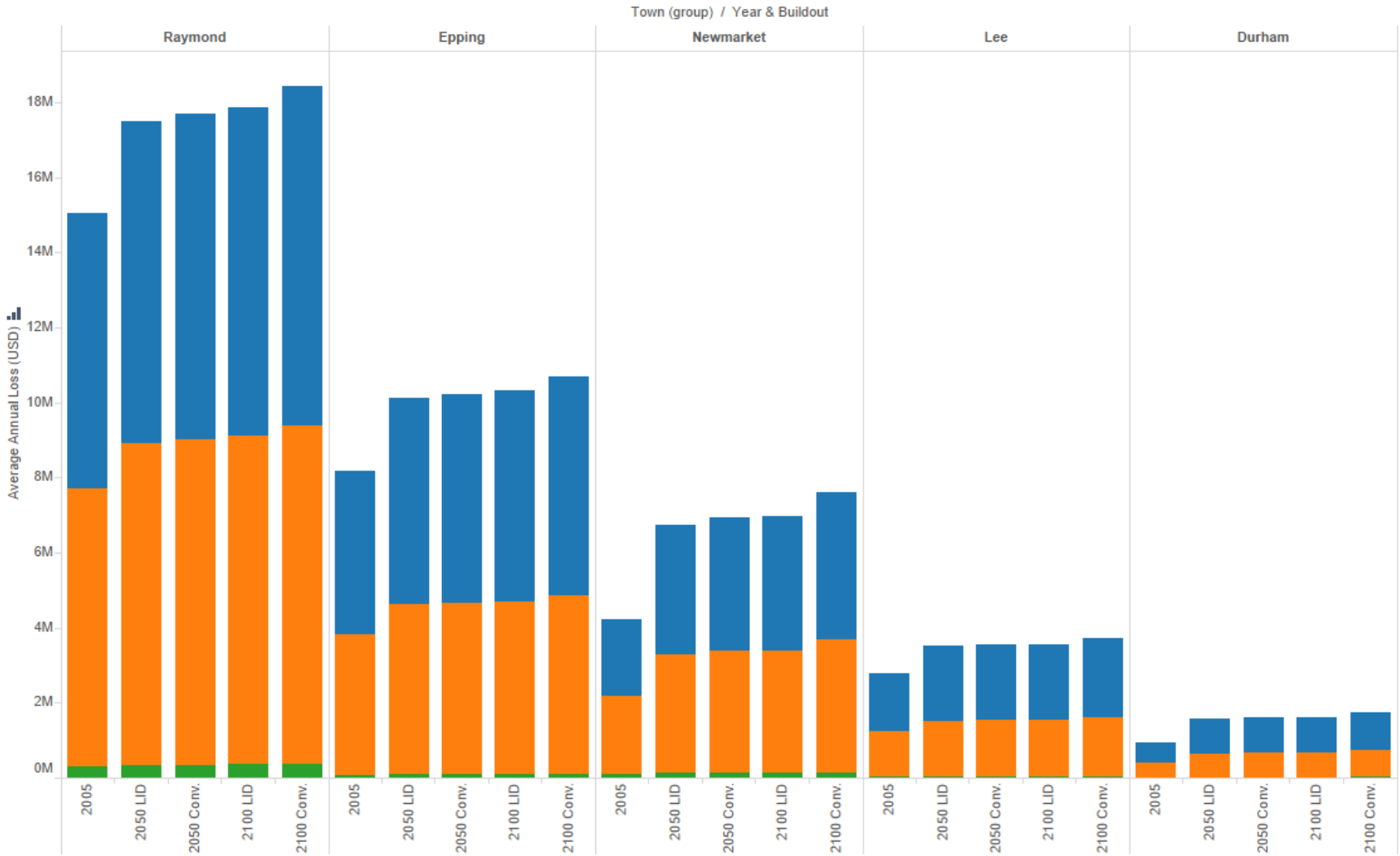
Study Results - Static



Study Results - Static



Study Results - Static



Study Results - Interactive

Tableau Business Intelligence Software

- Helps people see and understand data

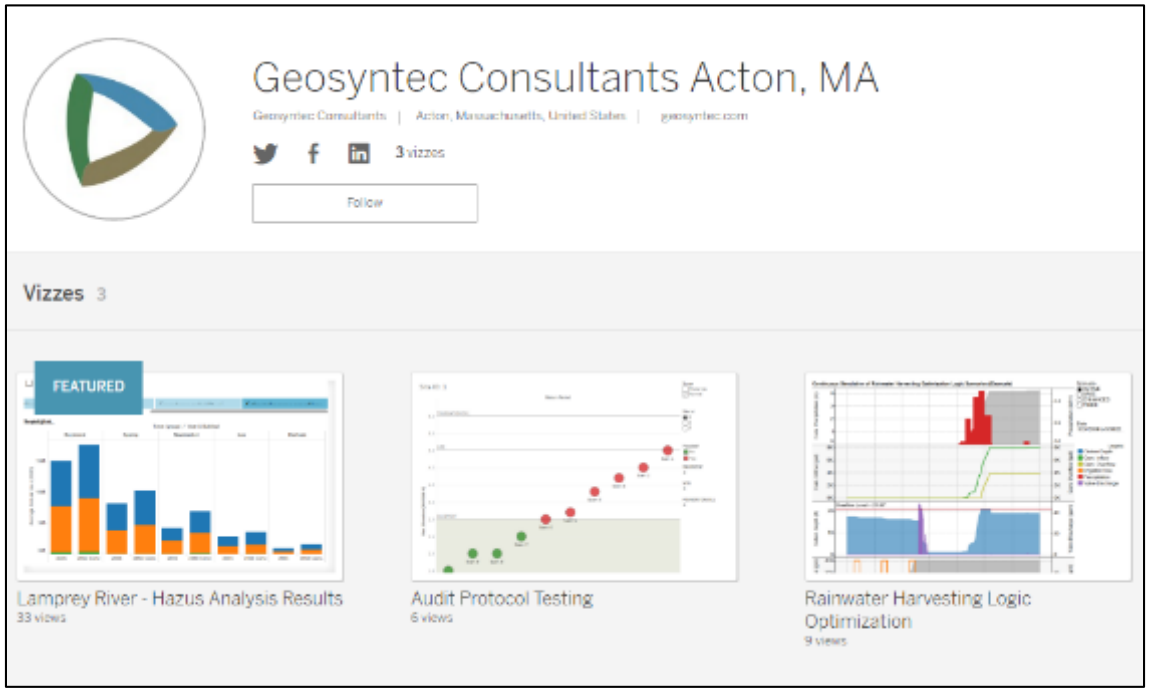
Drag and Drop Interface	Viable for all Skill Levels	Connects to Many Data Formats	Rapid and Insightful Analysis

- Produces live and interactive visualizations

- Users work from single point of truth

Study Results - Interactive

- Tableau Public – free way to share Tableau results online
- https://public.tableau.com/profile/geosyntec.acton#!/
- Demo



Study Results - Interactive

ArcGIS Story Maps

- Interactively communicate complex project findings to clients

- http://arcg.is/2en4DUK
- Demo

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