



Tools for Flood Risk Management & Increased Resiliency

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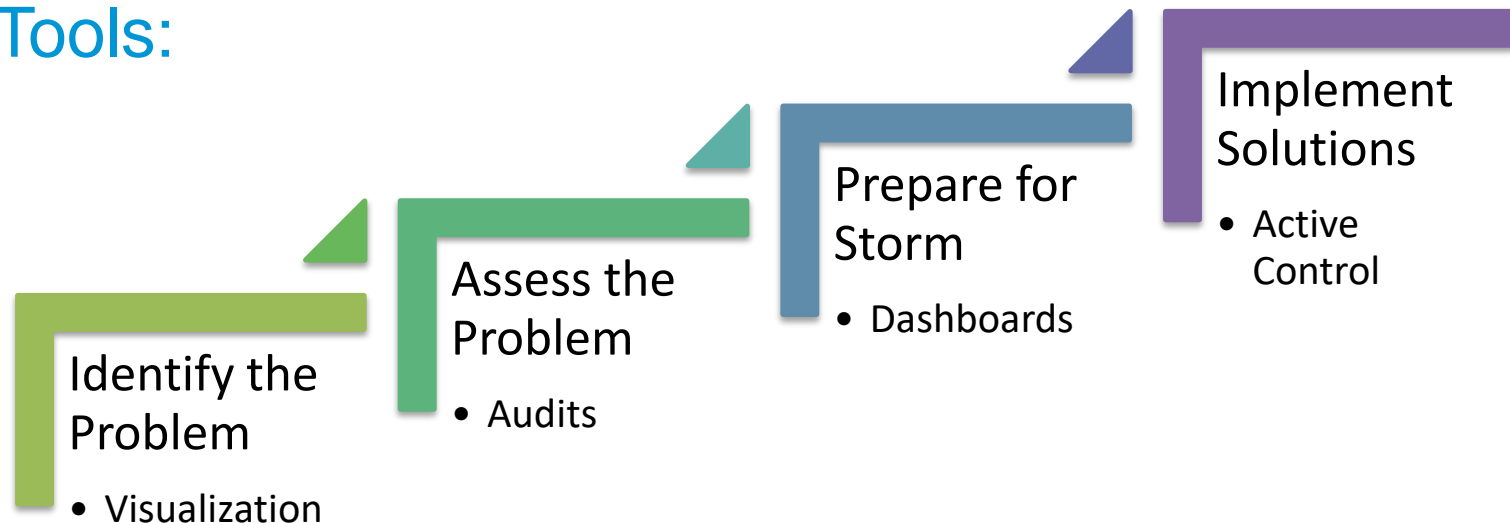
Illinois Association of Floodplain and Stormwater Managers

March 15, 2018





- Climate Change Induced Flooding is Increasing
- How to Decrease Risk and Increase Resiliency?
- Tools:



Identify the Problem:

Modeling and Data Visualizations



Tool #1: TIDEGateway



- **Geospatial Analysis Tool**
 - **Climate change resiliency planning**
 - Sea level rise scenarios
 - Storm surge scenarios
 - Upland storm event scenarios
 - **Ecological restoration planning**
 - Where is restoration feasible...
Without increased flood risk?





TIDEGateway

[Interactive Tide Gate Map](#)

[Tide Gate Inventory](#)

[Field Inspection Protocols](#)

prj.geosyntec.com/Html5Viewer/Index.html?configBase=http://prj.geosyntec.com/Geocortex/Essentials/REST/sites/TideGateway/viewers/TideGateWay_-_HTML5/virtualdirectory/R/

TIDEGateway

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

MASSACHUSETTS

RHODE ISLAND

0 10 20km

ACarnes & ACAiazza | Esri, HERE, DeLorme, NGA, USGS

6:20 PM 11/10/2015

prj.geosyntec.com/Html5Viewer/Index.html?configBase=http://prj.geosyntec.com/Geocortex/Essentials/REST/sites/TideGateway/viewers/TideGateway_-_HTML5/virtualdirectory/R/

TIDEGateway

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- ☐ +4
- ☐ +5
- ☐ +6

I want to...

Eastham-02

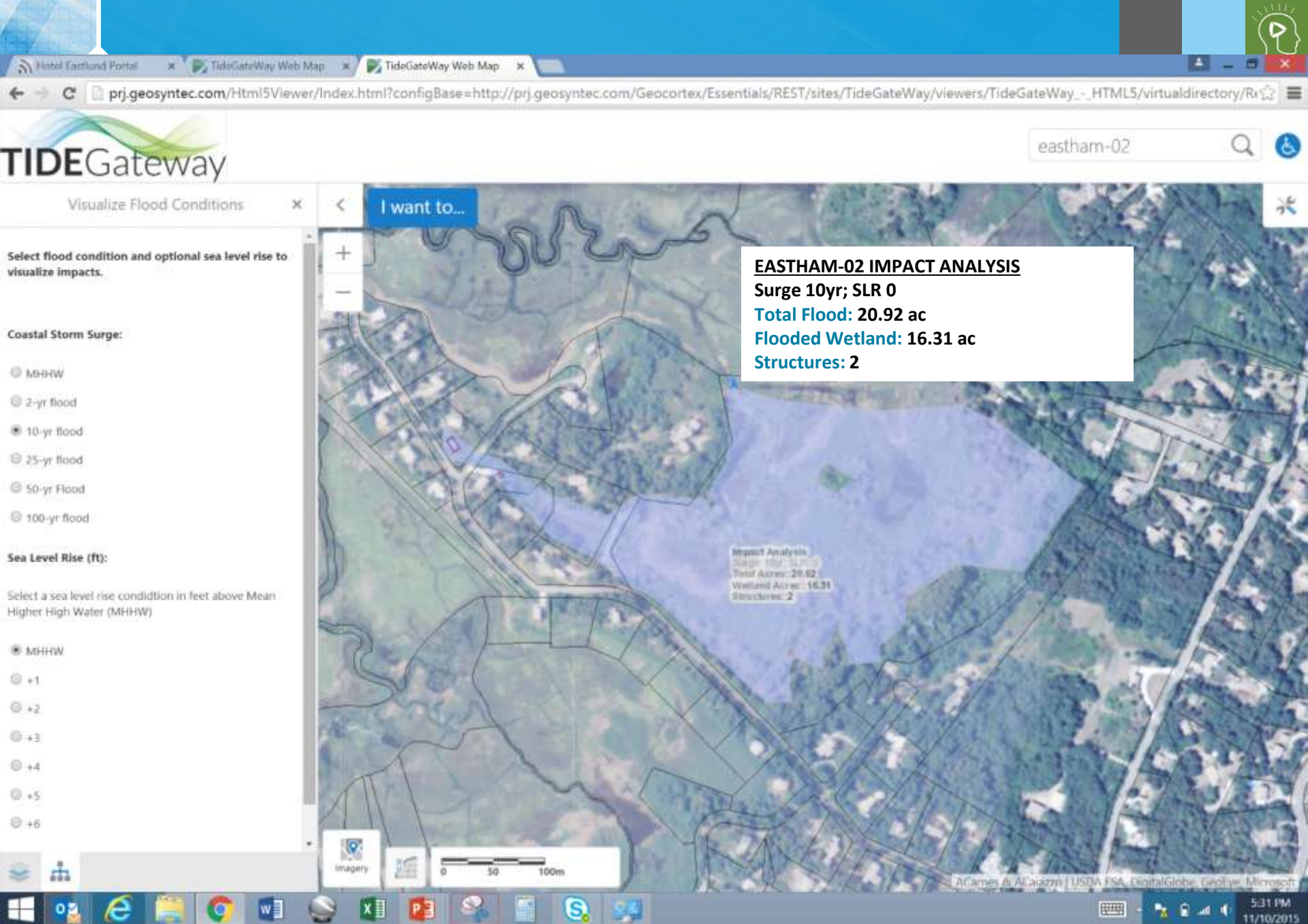
Street Map

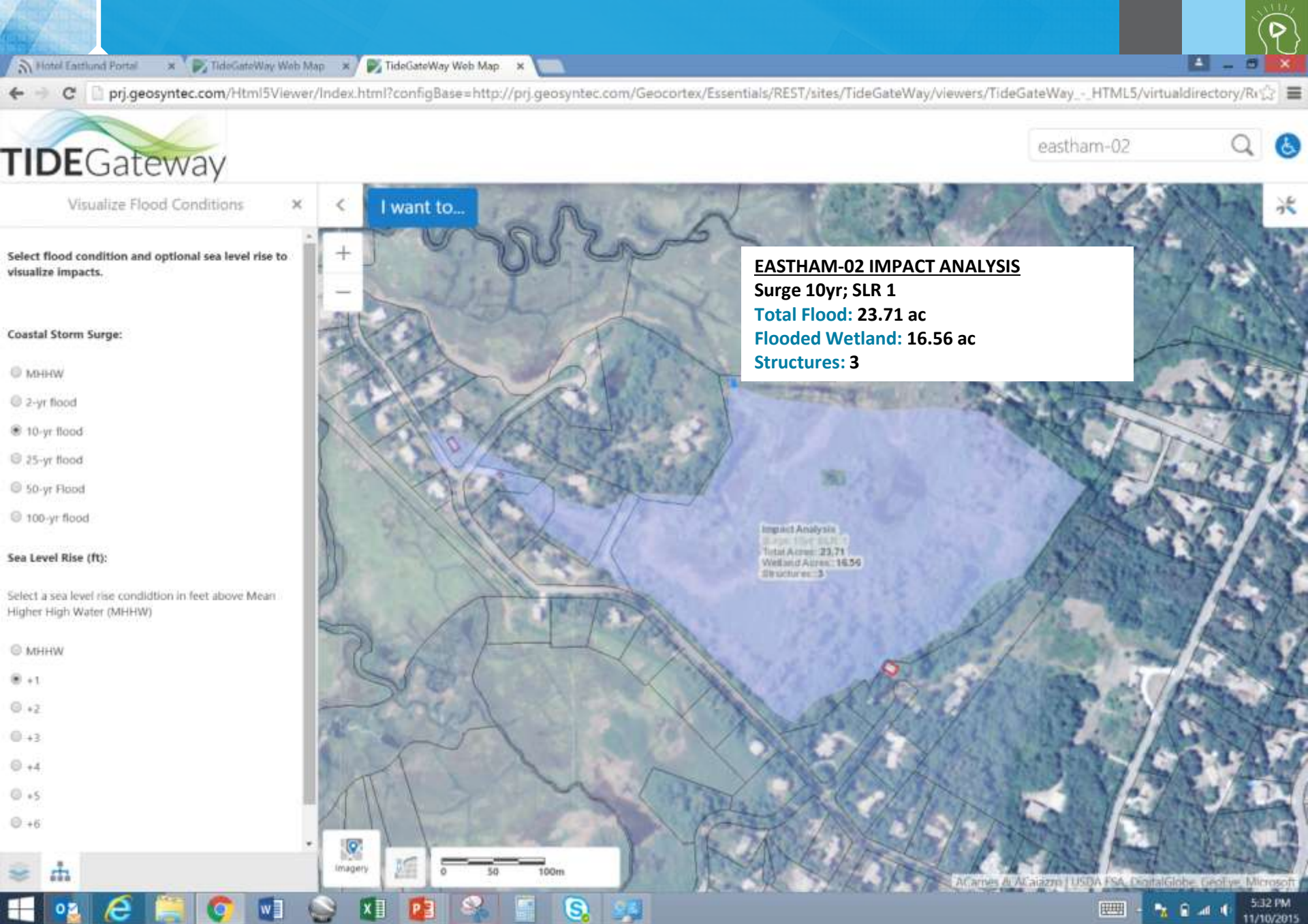
0 0.3 0.6km

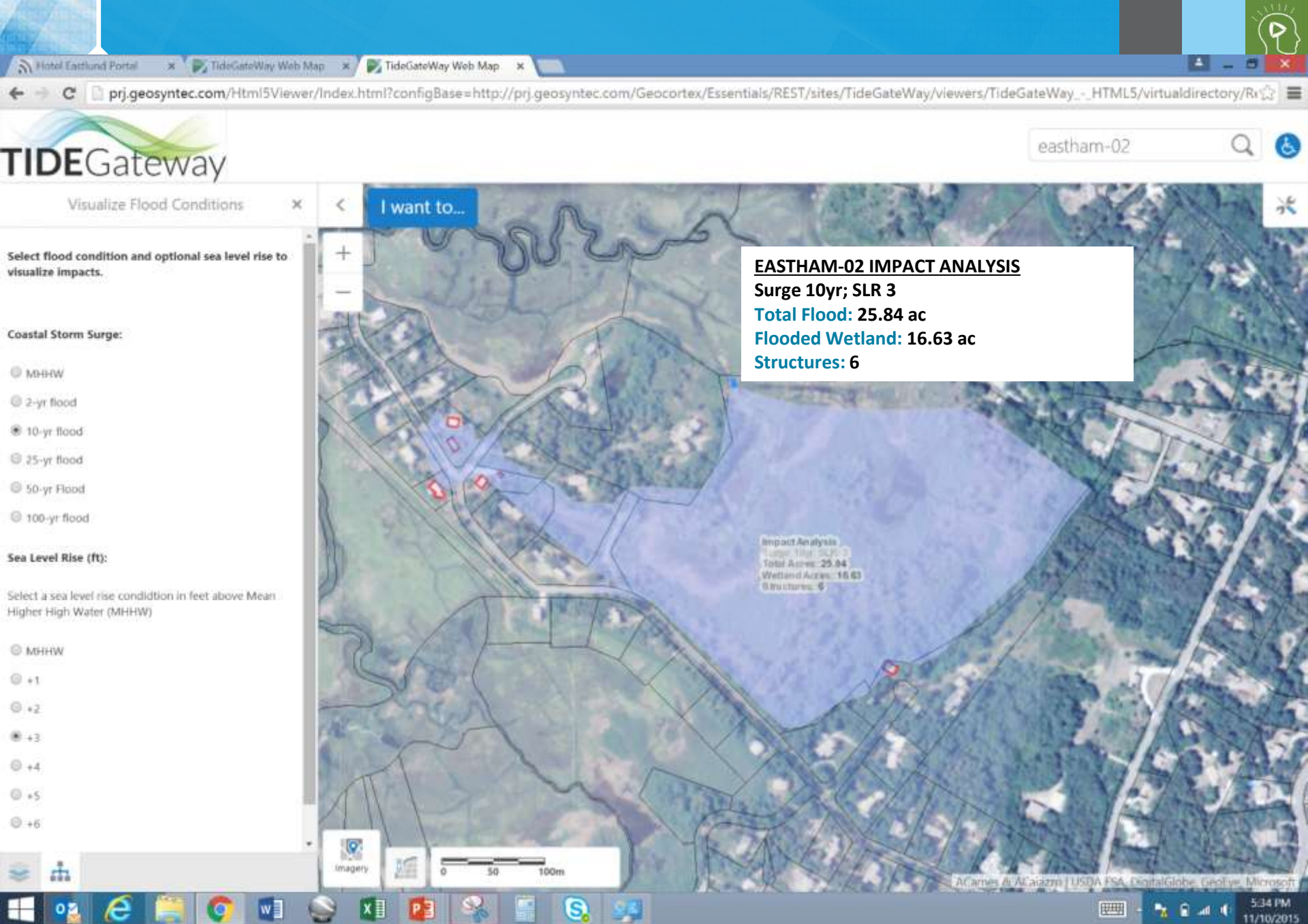
Eastham - Hatches Creek

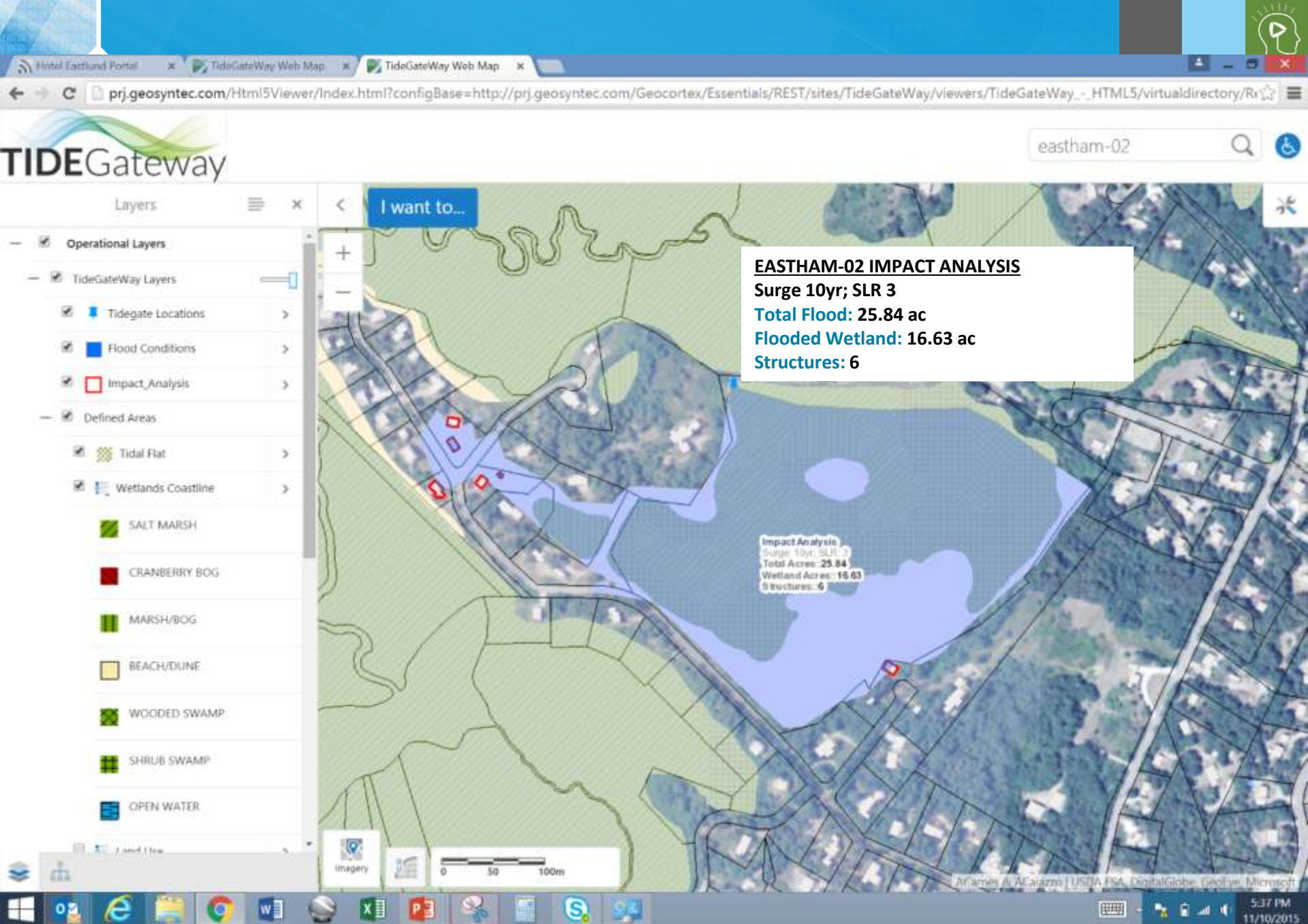
Description	Hyperlinks	Details	Tidegate Characteristics	Culvert Characteristics	Miscellaneous Site Characteristics
UNIQUE_ID 8			TG_MATERIAL Metal		
Tidegate Name Eastham-02			ORIG_ATLAS_ID EA-9		
TOWN Eastham			EX_TIDAL_INF_US N/A		
WATER_BODY Hatches Creek			EX_TIDAL_INF_DS N/A		
TYPE Flap Gate					

6:22 PM 11/10/2015









Identify the Problem: Takeaways



- Scenario Driven Modeling Results
 - Understanding the risk
- Findings Shareable Via Web (Secure or Public)
- Interact and Visualize Scenarios
 - Visualizing the risk



Assess the Problem:

Hyper-Localized Resiliency Audits



Tool #2: Resiliency Audits



- **Purpose:**
 - Identify potential flood risk and flood vulnerabilities
- **Modeling:**
 - Estimate localized flooding elevations under different rainfall, tidal and surge conditions
- **Site Audit:**
 - Field assessment to identify measures which may mitigate risk



Superstorm Sandy
business recovery
program managed by
NYC EDC

Assessing Exterior Vulnerabilities



Assessing Interior Vulnerabilities



Data-Driven Reports & Recommendations



<p>Geosyntec consultants</p> <p>Business Name: Sample Company</p> <p>Business Point of Contact: Mr. X Audit Date: XX/XX/20XX</p> <p>Background and Information This business was Floodproofing System program managed Development Block Urban Development receiving Flood Resilience. This report</p> <p>Disclaimer and Liability Information collected causes of flooding indicated in the Model modeling assumptions flood risk predictions are provided for information only.</p> <p>Summary of Findings Three flood risk zones potentially occur: basement floor of building above the illustrating the flood</p> <p>1. Inundation Risk risk for each flood combined precipitation to occur once every mean high-high water Annualized risk is (inundation depth)</p>	<p>Geosyntec consultants</p> <p>Zone</p> <p>Site</p> <p>Basement</p> <p>Building</p> <p>2. Vulnerability: In an explanation of considered to help</p> <p>3. Potential Solutions listed below. Potential any or all potential</p> <p>The most effective stackable flood gate waterproof seals any major vulnerability</p> <p><i>Refer to the attached</i></p>	<p>Geosyntec consultants</p> <p>↑</p> <p>↓</p>	<p>Geosyntec consultants</p> <p>Flood Resiliency Audit Form Sample Company. Audited: XX/XX/20XX Photo(s) of identified Building Zone vulnerabilities</p> <div> <p>1 (01)-161206-018.JPG</p> <p>Steel Door at Northern Building Exterior</p> </div> <div> <p>1 (01)-161206-019.JPG</p> <p>Steel Door at Northern Building Exterior (gap between door and floor)</p> </div>
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Accompanying Fact Sheets



Wet Flood

Wet Flood to enter equalize for structural frequent relocation located

Dry Flood

Dry floodproofing tight materials, the building ac installation of m utilities above th to existing walls

Sewer

Flooding of s through drain of wastewater prevent sewer water sensor the valve.

Permanent

Permanent bar the location in side hinged ge designed to au deploy with el lifted, or locked

Temporary

Temporary Barriers flood event. They a plastic, aluminum, provide protection for extended protec installed prior to the these systems are essential to implem

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.

Geosyntec[®]
consultants

SUMP

System detected

Pros
Keeps flood in below-water sensor

Cons
Can be subject to

Deploy
N/A – Self installed

Local New York
Sump Pump Water Pl Plumbing Industrial

1. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
2. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
3. The NYC Department of Buildings General Construction Code is a General Construction Code.
<http://www1.nyc.gov/site/buildings/businesshiring-a-professional-page>

ELEVATION

Method entails elevating them float on top of flood

Pros
Allows continued protection.

Cons
Initial installation for reconfiguring changes.

Estimated Deployment Time
Not Applicable – If tractor or plumber

Local New York
Dry Floodproofing through G-Net Cor through FloodMD

1. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
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3. The NYC Department of Buildings General Construction Code is a General Construction Code.
<http://www1.nyc.gov/site/buildings/businesshiring-a-professional-page>

SEWER

A flap or che Backflow De when the bac

Pros
Prevents or le Passive backflo the flooding eve

Cons
Requires suffic Regular testing is free of debris of wastewater f could result in s

Estimated Deployment Time
Approximately 1

Local New York
Backflow Prev Prevention of f

1. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
2. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
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<http://www1.nyc.gov/site/buildings/businesshiring-a-professional-page>

RETRACT GATES

Flood protection and operations

Pros
Permanent flood not deployed. Car systems (e.g. wat device should be

Cons
Initial construction barrier systems

Estimated Deployment Time
Approximately 5

Local New York
Presary Watertig direct from Pres

1. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
2. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
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<http://www1.nyc.gov/site/buildings/businesshiring-a-professional-page>

SAND BAG

Sand filled bags st sand, or can be fill

Pros
Cheapest temporary m

Cons
Lengthy and labor-intar disposal due to the te floodwaters Requires a stored on-site

Estimated Deployment Time
Time varies based on n be protected. Approxim a 40 ft long sand barrie

Local New York
Sand Bags to Go – P Brooklyn, NY

ACECO Industrial Pac sand bags located in Ni AGSCO Corporation – S
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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 (doorsteps 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 Granger Industrial Supply, Inc., located in Brooklyn, NY.

Tiger Dams – available direct from Tiger Dams
1. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
2. Research was conducted to identify floodproofing measures for NYC area that could protect from flooding.
3. The NYC Department of Buildings General Construction Code is a General Construction Code.
<http://www1.nyc.gov/site/buildings/businesshiring-a-professional-page>



Source: FEMA Chapter 8: Barriers



Cost for Average Building Installation

Sources and Additional Information:

- FEMA: "Floodproofing Non-Residential Buildings." FEMA P-630 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). <https://www.fema.gov/media-library/assets/documents/400>
- FEMA: "Selecting Appropriate Mitigation Measures for Floodprone Structures." FEMA 651 (March 2007). https://www.fema.gov/media-library/data/20130726-1600-20400-5083/fema_561.pdf
- De Graaf, Rutger, and Vermeer, Dura. "Technologies for flood-proofing 'hotspot' buildings". Flood Probe Research Project, 2nd Edition (July 2013). http://www.floodprobe.eu/parttwo/assets/documents/Technologiesforflood-proofinghotspotbuildings_DeltaSync_18032013.pdf
- Thomasnet.com "Qualified Supplier Discovery." <http://www.thomasnet.com/supplier/> Website Search Engine. (October 2016).
- MFG.com: "Manufacturing Companies Worldwide Directory." <https://discover.mfg.com/?country=2&search=1> Website Search Engine. (October 2016)

Assess the Problem: Takeaways



- Location Specific Resiliency Assessments
 - Engage, inform, & empower owners
- Data Collection via. Web-Based Forms
- Auto Generated Reports
 - Modeling Results & Expected Risk
 - Identified Vulnerabilities
 - Recommendations & Fact Sheets



Prepare & Increase Resilience:

Resiliency Dashboards



Tool #3: Flood Resiliency Dashboards



Opti

Reset

Projects (3)
Groups (16)

54 Commerce St. Corp. / Alpha Marine Inc.

Forecasted Flood Inundation & System Statuses

Glumenta Corp. DBA Architectural Grille

HeartSong Speech and Language Pathology

Hook Enterprises, LLC

Ice Stone LLC

Jeffrey F. Zwerling, MD PC

John Lepore Insurance Agency

M&R Rockaway

GOODY'S

The map is filtering results. Remove Filter

Link to Site-Specific Resiliency Dashboards

Site Locations

Leaflet | Bing, © 2018 Microsoft Corporation, Esri/DeLorme, SIO

Resiliency Dashboards



Forecasted Flood Inundation & System Statuses

Forecasted Site Inundation Depth

"UNKNOWN" status indicates data is unavailable or forecasted precipitation and tide are below modeled thresholds.



Current Flood Advisory System Statuses

"OFFLINE" indicates that one or more datastream has been offline in the past 48 hours which might impact computation of site-specific flood information.



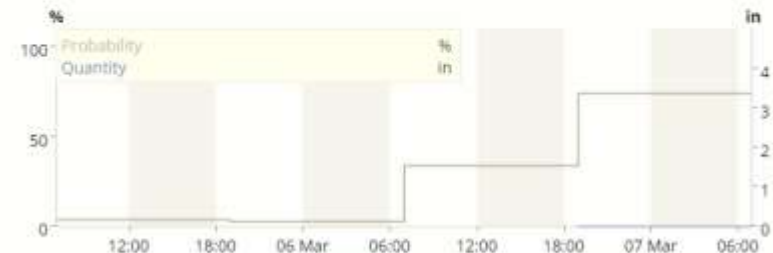
Radar

[Latest Image](#) | 12hr | 24hr



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).



Radar and
Precipitation
Forecast

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", Orange = 3-6", Red =>6")



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)

03/05/2018 14:20
0.0

Site Zone (ft)

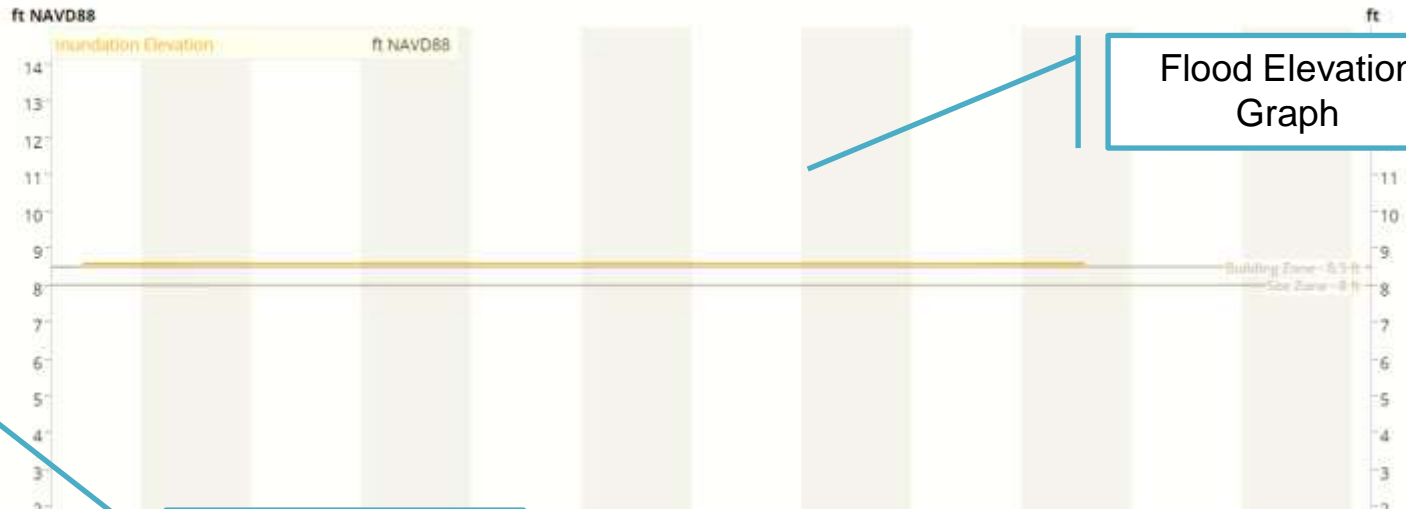
03/05/2018 14:20
0.0

Estimated Flood Inundation Depth

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".

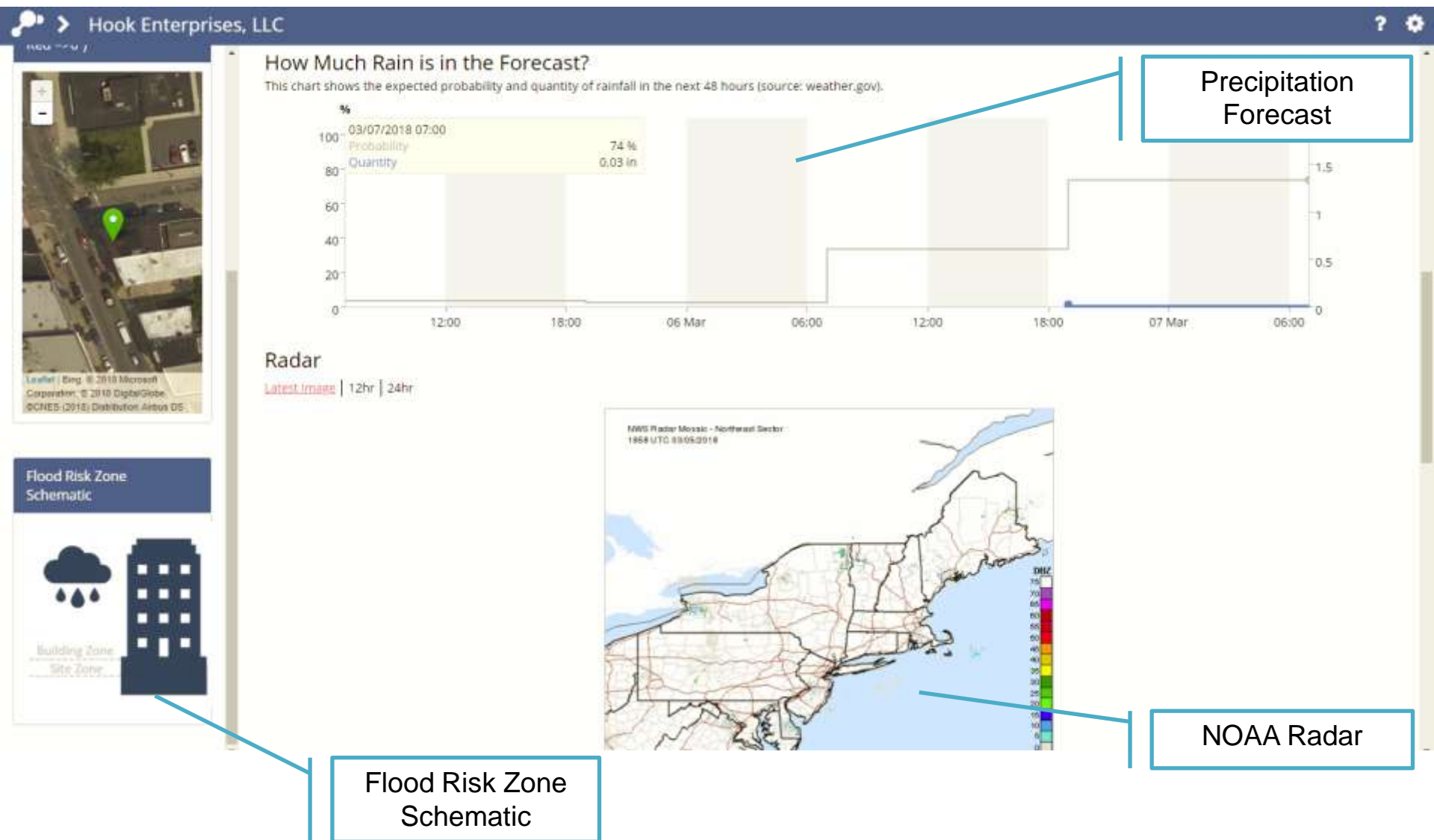
12hr | 24hr | 48hr | 1wk



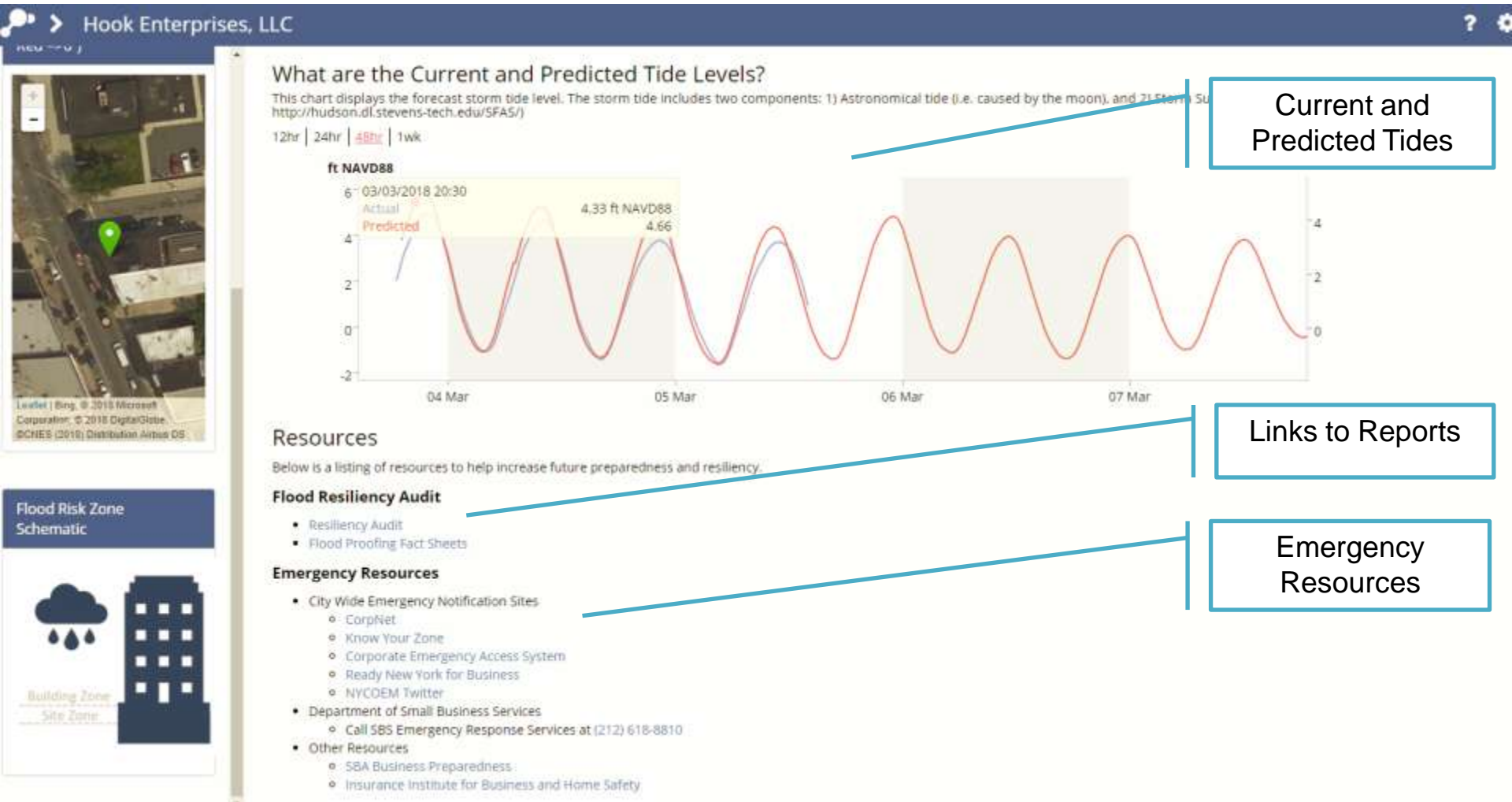
Flood Elevation Graph

Estimated Flood Risk Indicator

Resiliency Network Dashboards



Resiliency Network Dashboards



Prepare for Storm: Takeaways



- Real-time estimates of flooding risk (including timing)
- Actions can be taken to prepare for storm & increase resiliency
- Empowers owners & heightens overall community awareness



Implementing Solutions:

Active Management & Control



Tool #4: Active Controls



- Case Study: Curtiss Pond, Minnesota
- Goal
 - Increase Efficiency of Pond through retrofit with Continuous Monitoring and Control
- Benefits

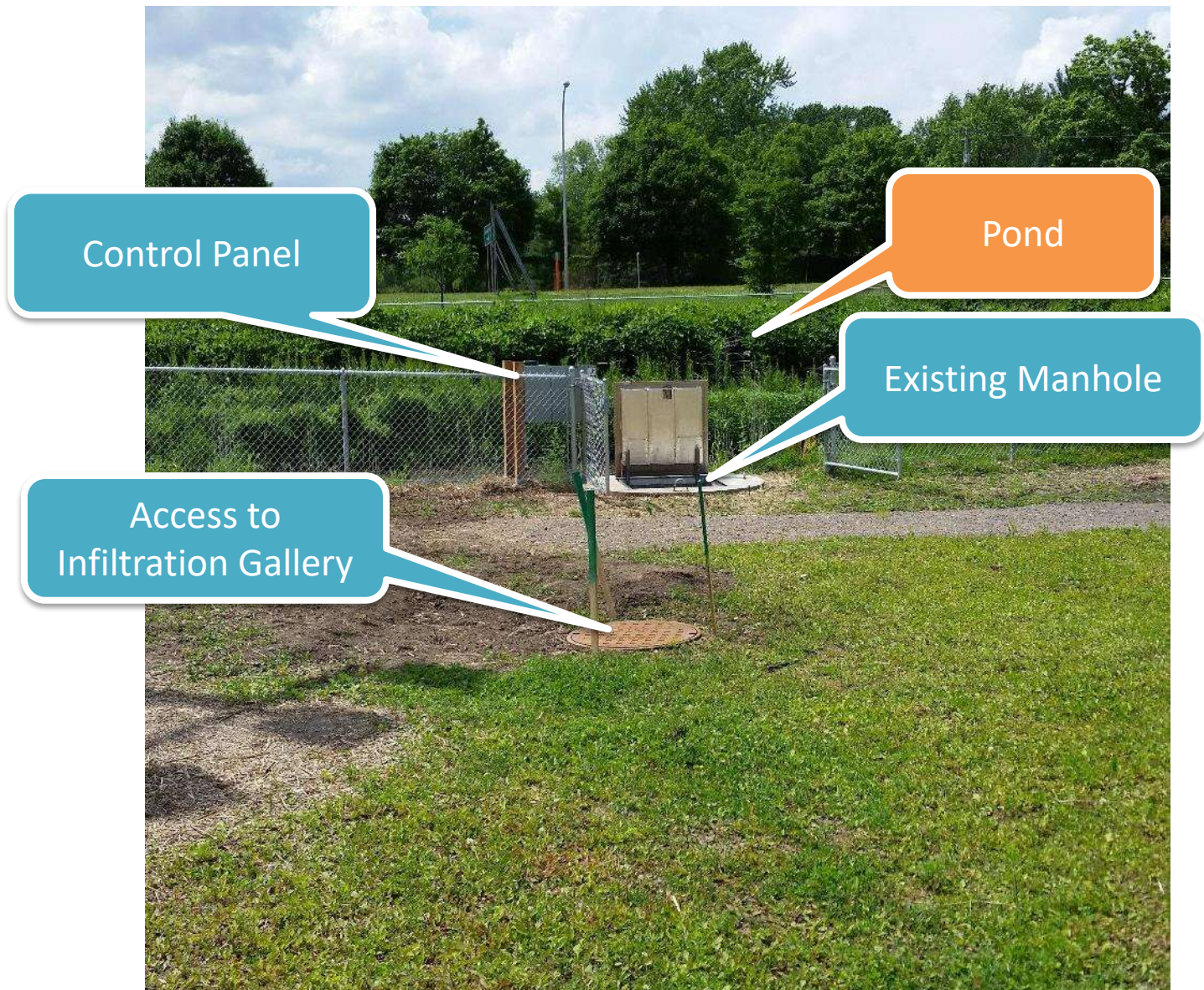
Minimize
Flooding &
Reduce Site Risk

Intelligent
Infiltration

Minimal
Maintenance

Remote
Monitoring &
Programming

Site Overview



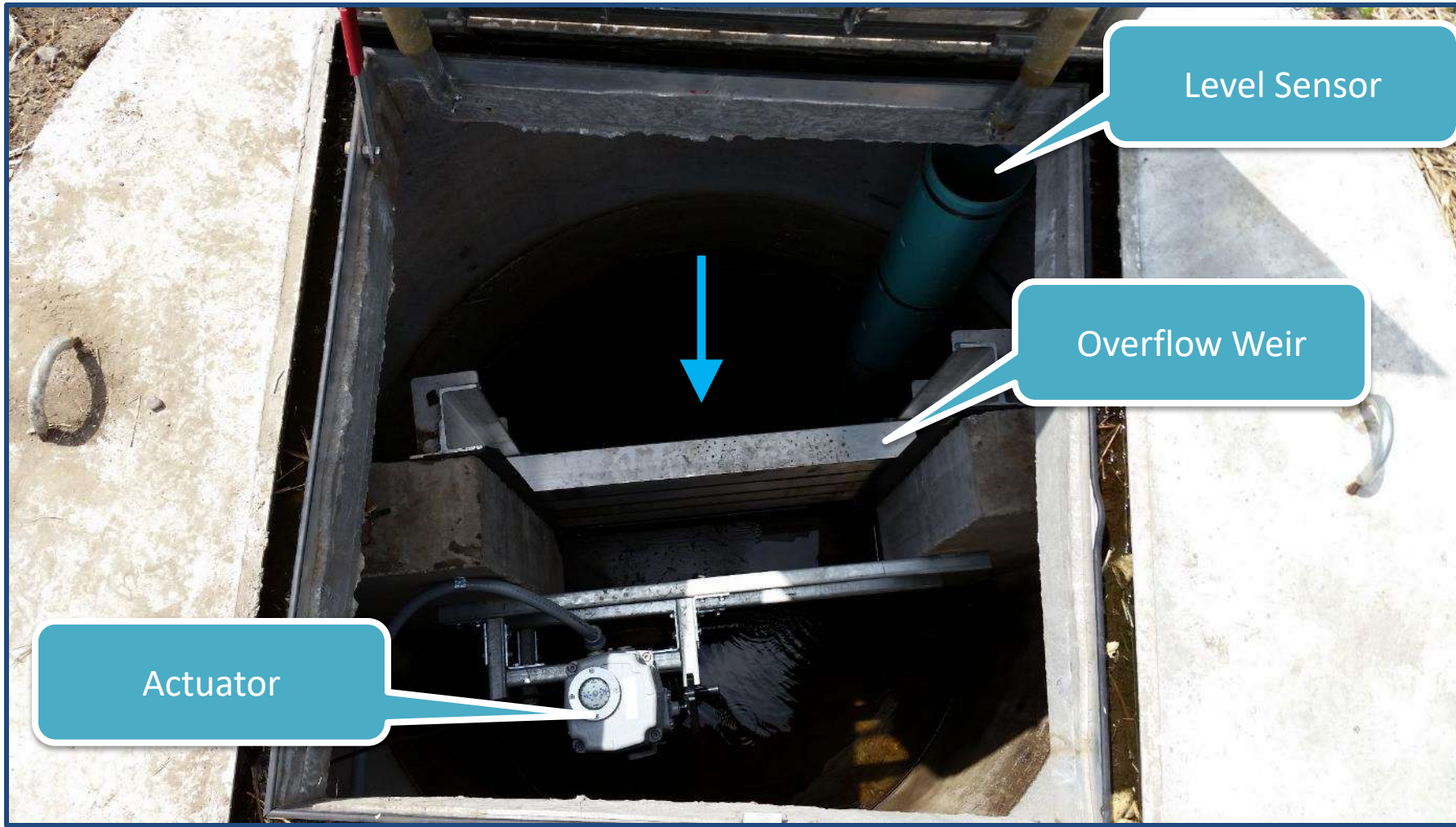
Site Overview



Electrical Panel



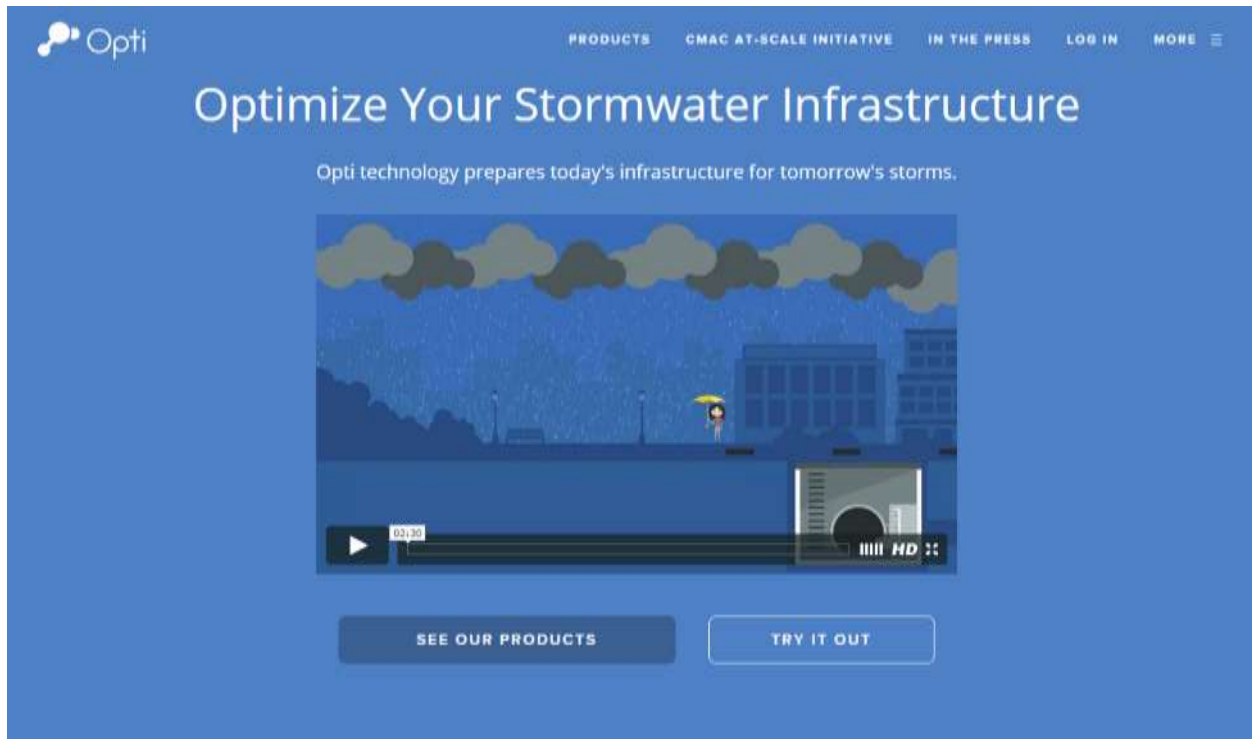
Manhole with Equipment



How Does it Work?



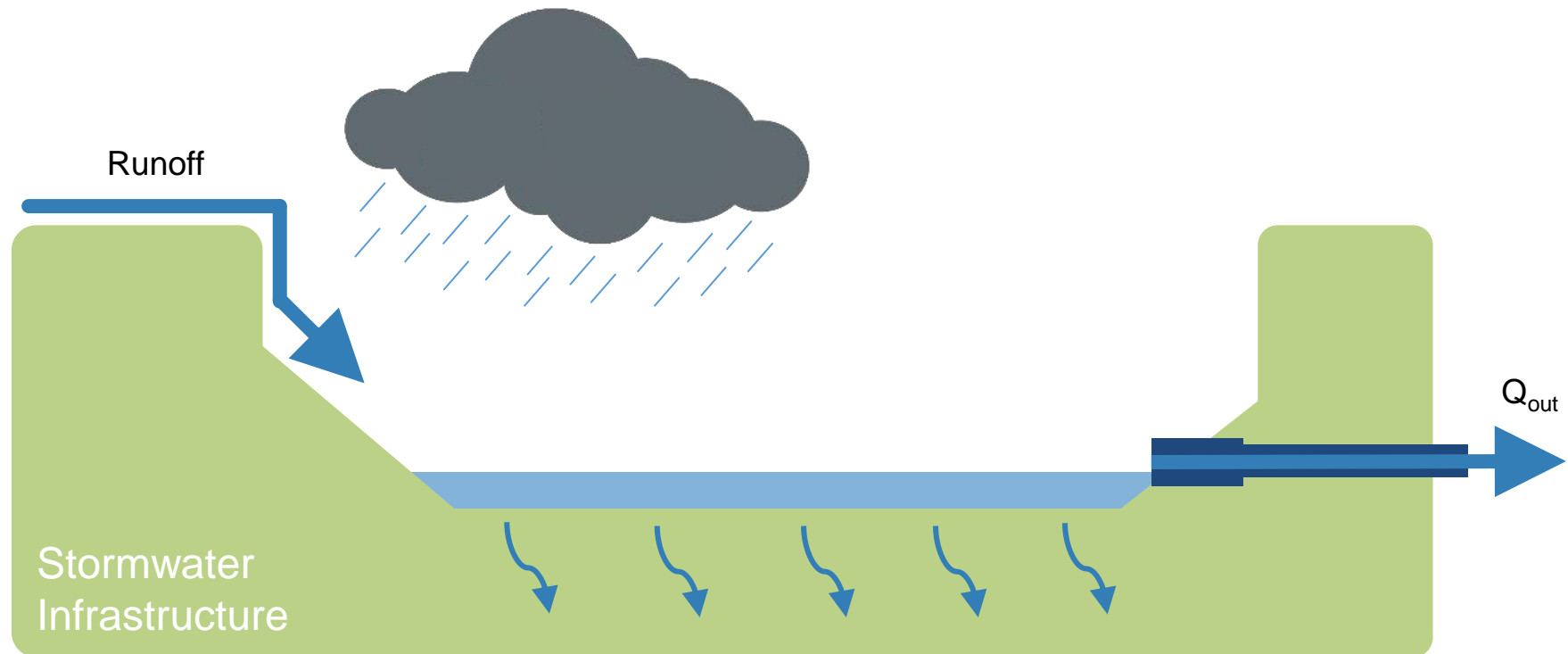
- Cloud-native platform that uses sensor data, forecast information, & modeling to actively control and/or maintain/monitor water infrastructure.



Traditional Infrastructure



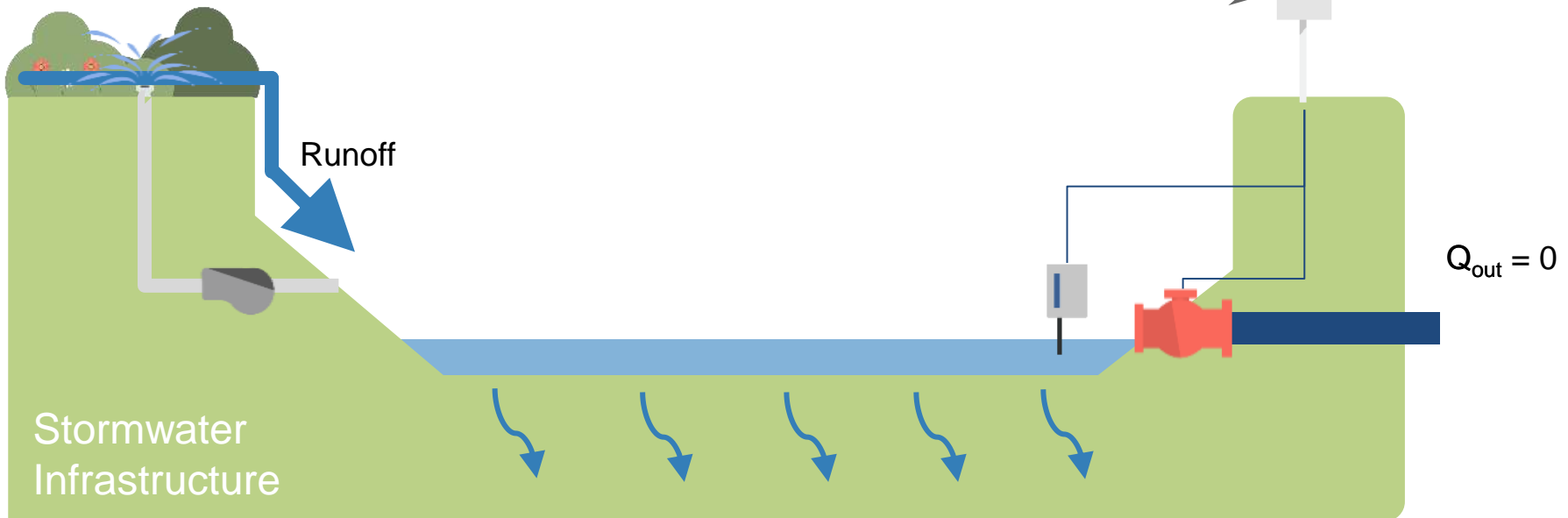
- Stormwater runoff is managed with passive infrastructure designed for a single purpose and design storm
- Performance and maintenance needs of stormwater infrastructure are manually calculated or unknown



Continuous Monitoring & Adaptive Control



Precipitation Forecast



*Image Courtesy of OptiRTC

Control Dashboard Visualization



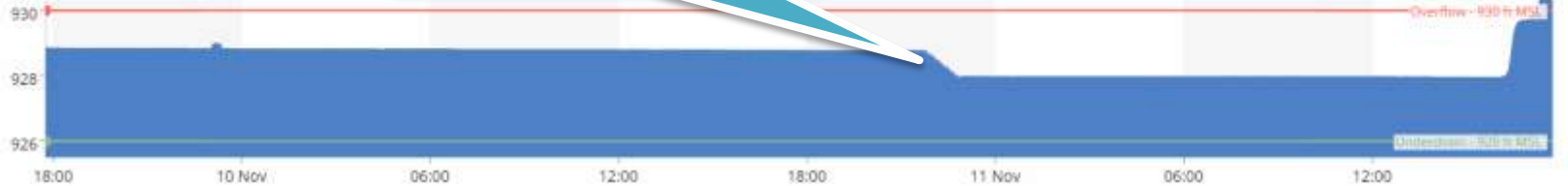
Pond Level

12hr | 24hr | **48hr** | 1wk

ft MSL

2015/11/09 23:12:36

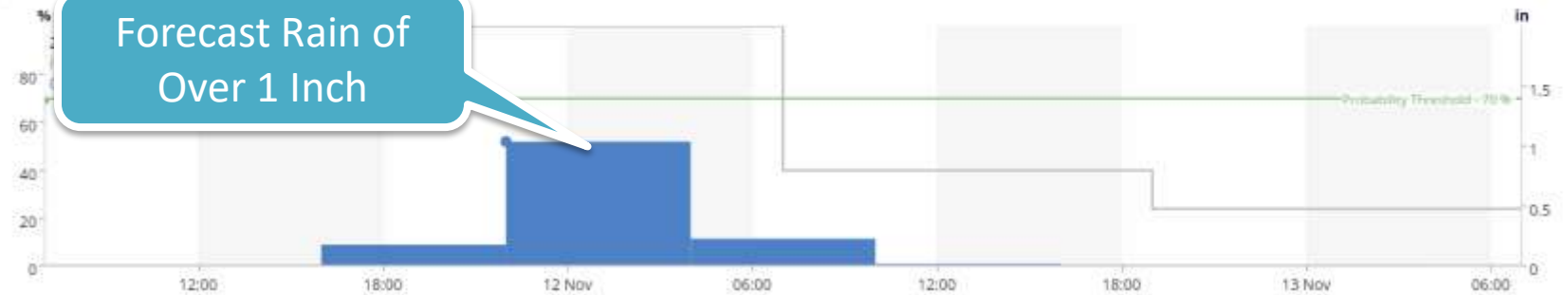
Level



Precipitation Forecast

(48hr)

Forecast Rain of Over 1 Inch



Infiltration Gallery

12hr | 24hr | **48hr** | 1wk

ft

2015/11/09 19:25:37

Level



Control Dashboard Visualization



Pond Level

12hr | 24hr | **48hr** | 1wk

ft MSL

2015/11/10 22:17:33

Level

932

930

928

926

18:00

11 Nov

06:00

12:00

18:00

12 Nov

06:00

12:00

Overflow Capacity Reached

Post-Storm

Precipitation Forecast

(48hr)

%

2015/11/13 04:00

Probability

Quantity

80

60

40

20

0

12:00

18:00

13 Nov

06:00

12:00

18:00

12 Nov

06:00

21 %

0 in

Probability Threshold = 70 %

in

1.5

1

0.5

0

Infiltration Gallery

12hr | 24hr | **48hr** | 1wk

ft

2015/11/12 15:56:43

Level

8

6

4

2

0

18:00

11 Nov

06:00

12:00

18:00

12 Nov

06:00

12:00

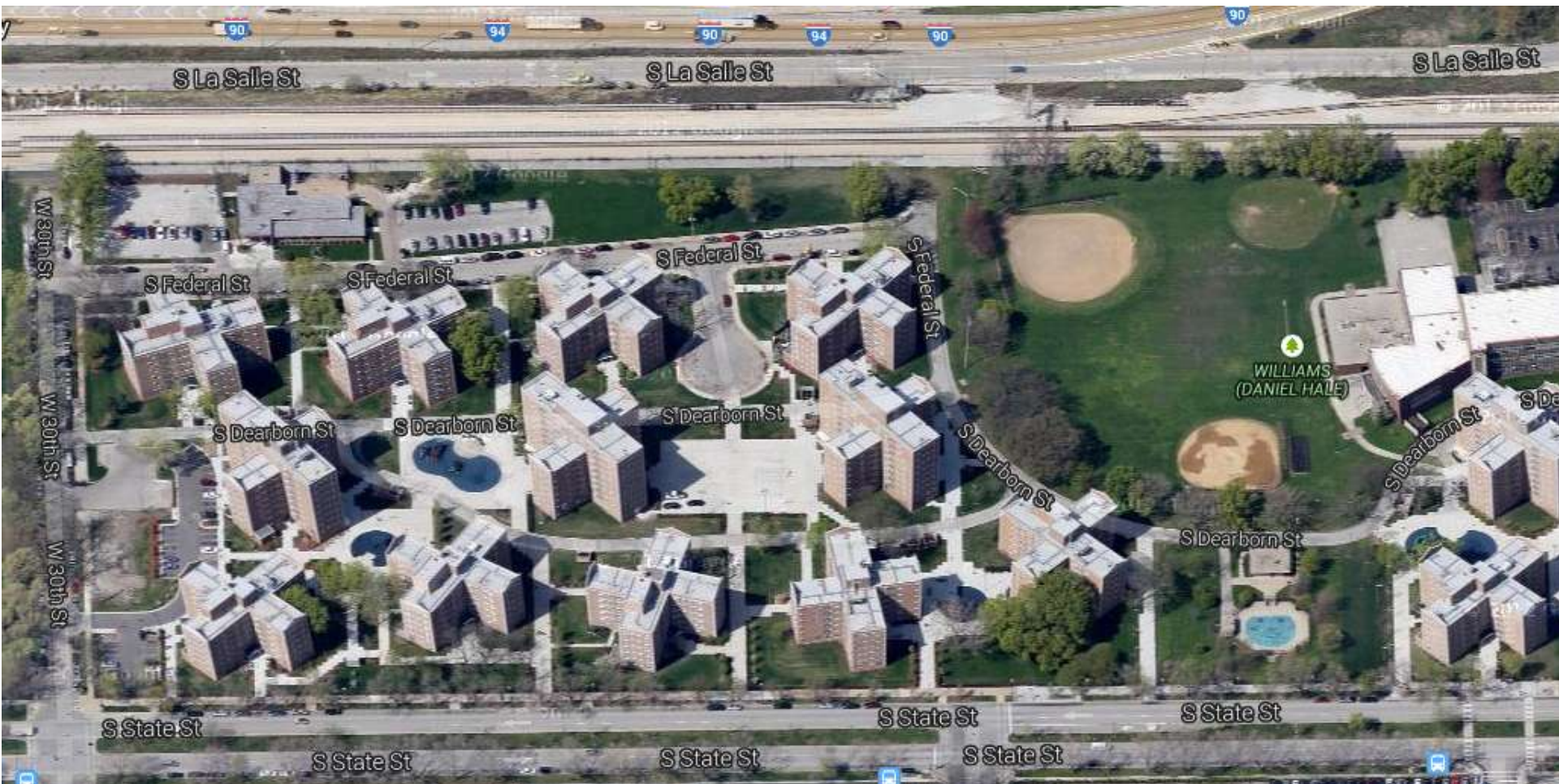
06:00

3.25 ft

8' depth reached!
(Max = ~10')

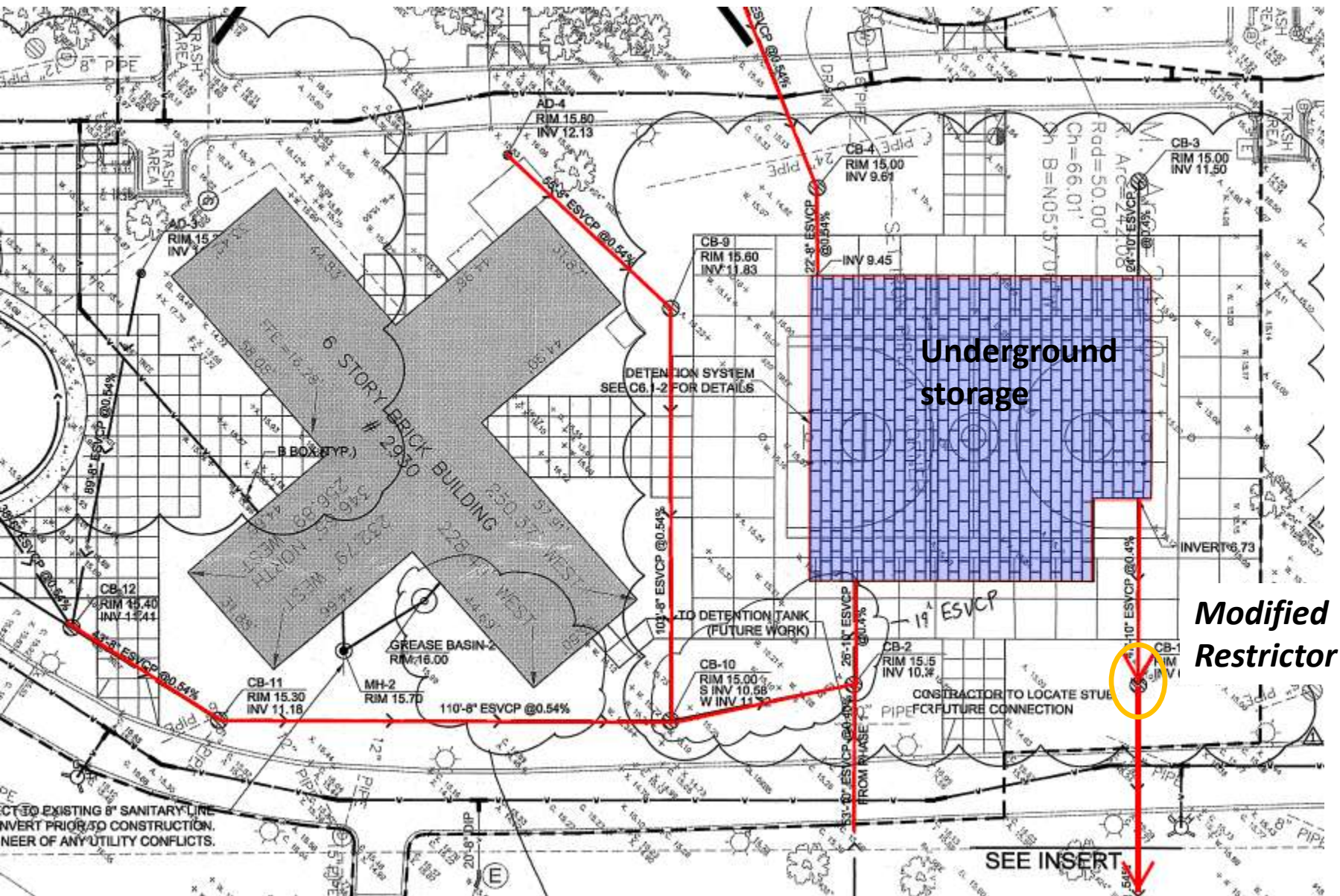
Capacity regained

Dearborn Homes: Chicago Housing Authority Sponsored by MWRD



Dearborn Homes – Spring 2018

Retrofit with real time control



Solution Implementation : Takeaways



- Optimize Performance of Traditional Infrastructure
- Minimize Potential Flooding and Site Risk
- Remote Monitoring & Programming





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A PROFESSIONAL CORPORATION

Boomi Environmental

