Achieving Buy-In for Adaptation

EPA Webcast Series

Helping Communities and Stakeholders
Decide on Economically Viable
Sea Level and Storm Surge Adaptation Strategies
with the COAST software tool

Catalysis Adaptation Partners, LLC

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Vice President of Environmental Planning
March 21, 2013
1:00 PM Eastern

What is "COAST?"

<u>CO</u>astal

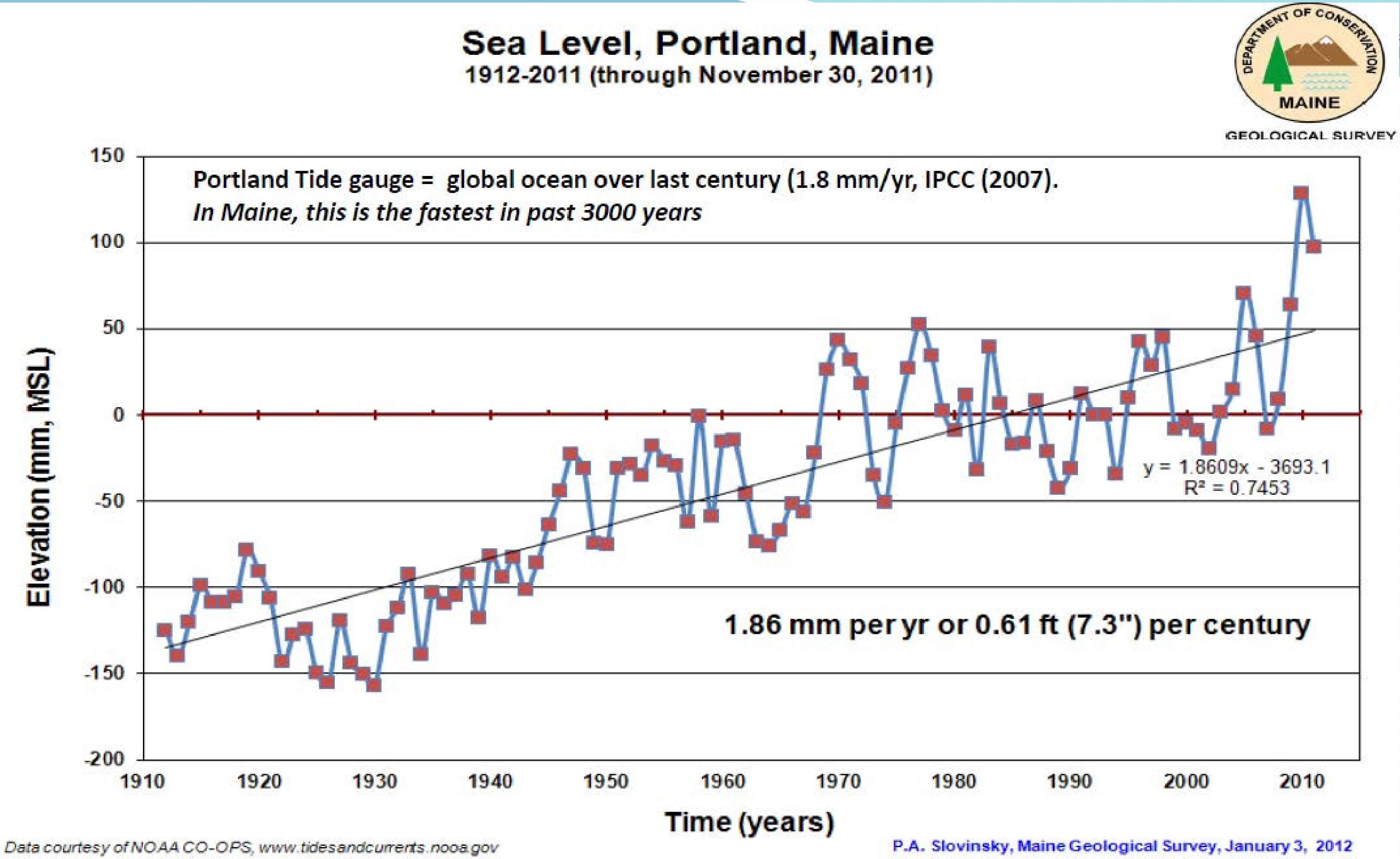
<u>A</u>daptation to

<u>S</u>ea level rise

<u>T</u>ool

Steps in the COAST Process

1. Engage Stakeholders to Select Different Scenarios for Sea Level Rise and Storm Surge.



Use Local Data – Connect with Peoples' Experiences

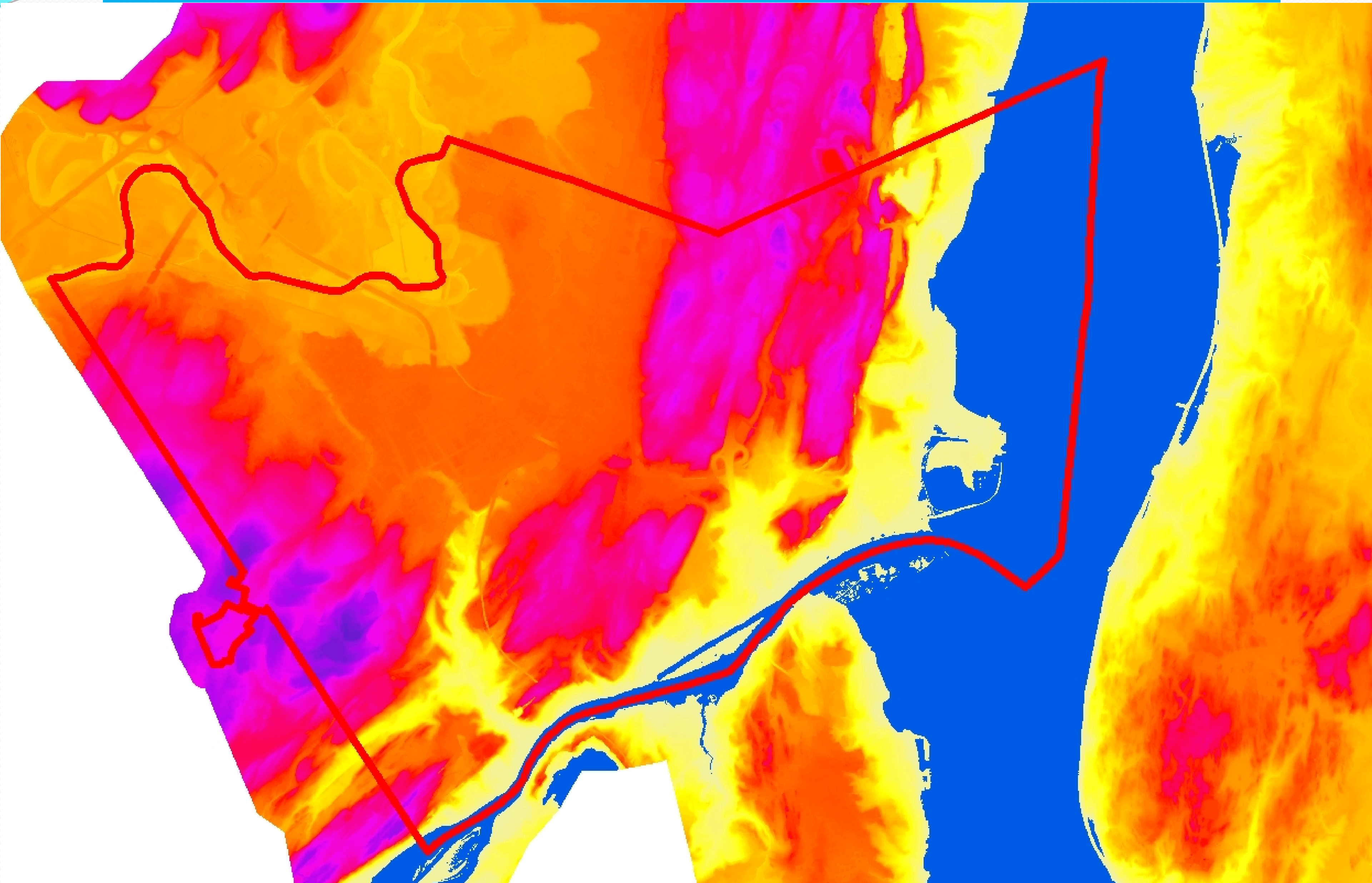
Steps in the COAST Process

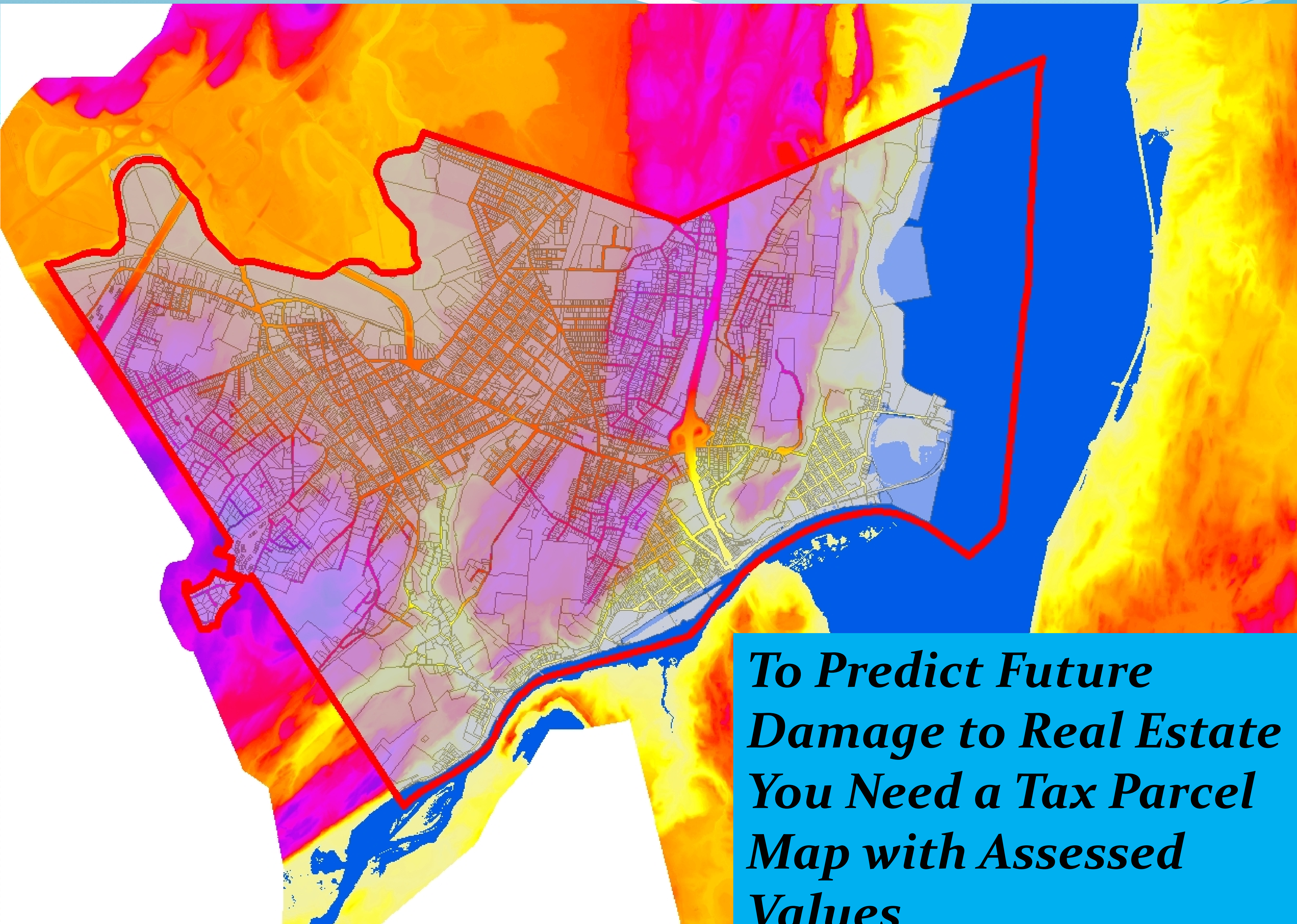
2. Provide a Vulnerability Assessment with Cumulative Expected Damage Estimates Over Time for a "No Action" Scenario of Sea Level Rise and Storm Surge

Example: Hudson River, Kingston, NY

Select an Asset to Model: Damage to Real Estate

You Need Accurate Elevation Data: LiDAR





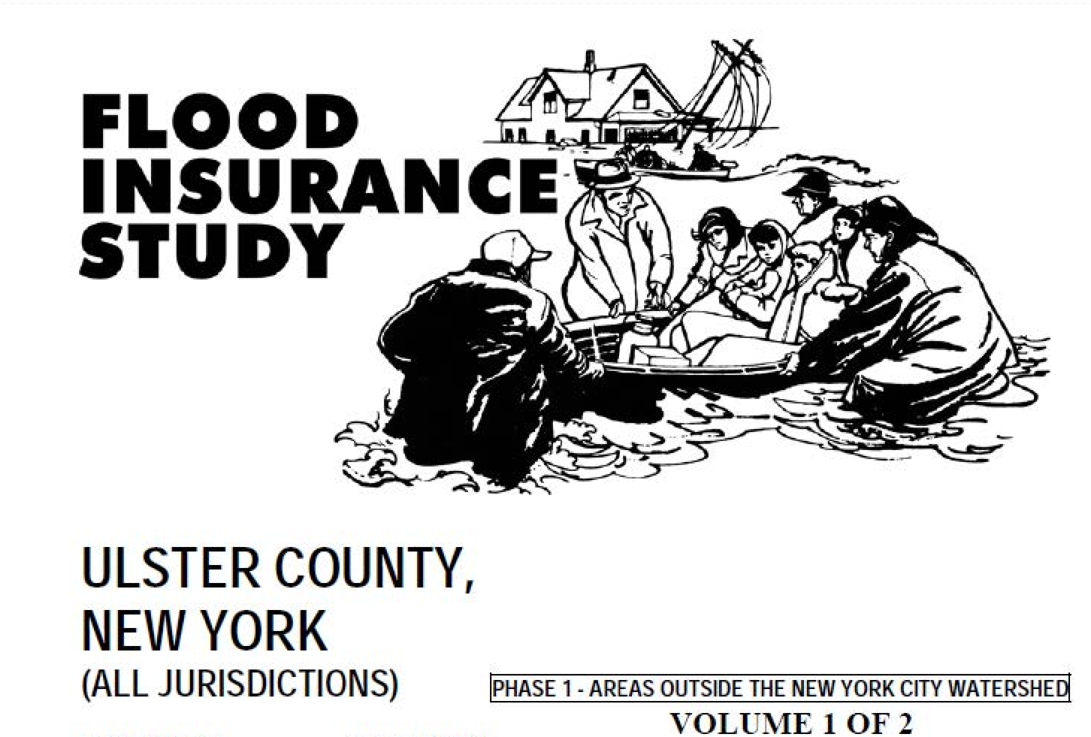
To Predict Future Damage to Real Estate You Need a Tax Parcel Map with Assessed Values

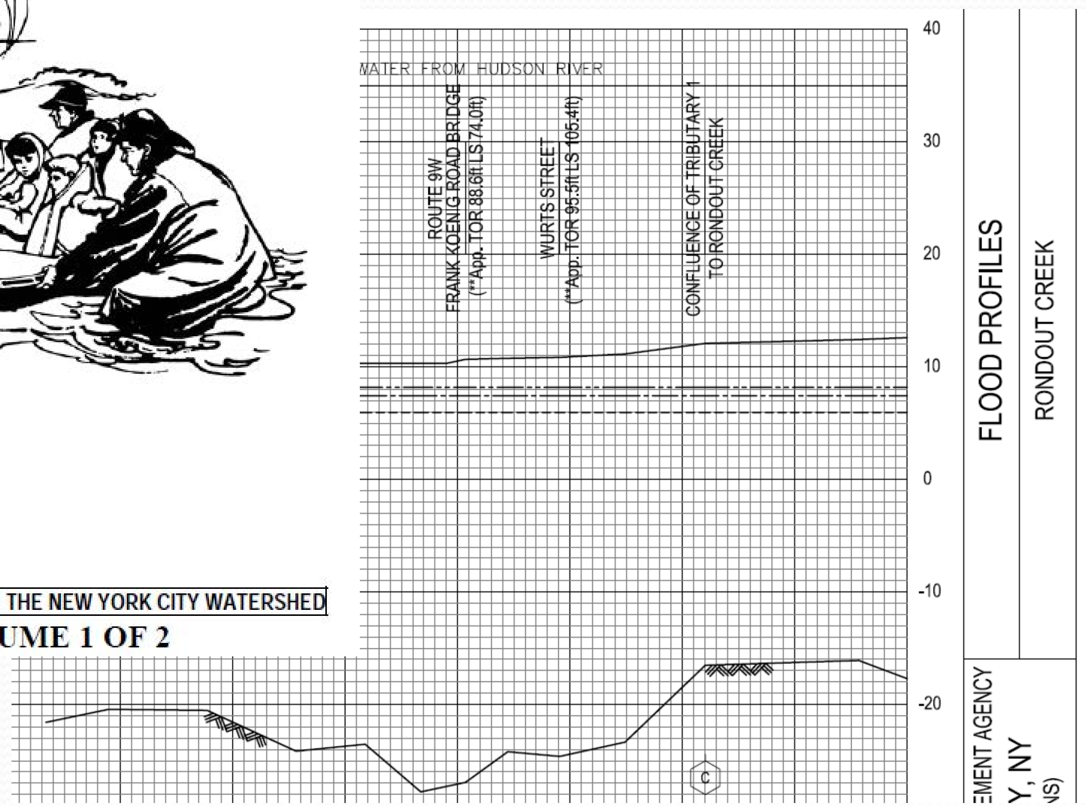
Then you need a "Depth-Damage Function"...

Depth-Damage Function
for Single Family Residential Structures with Basement

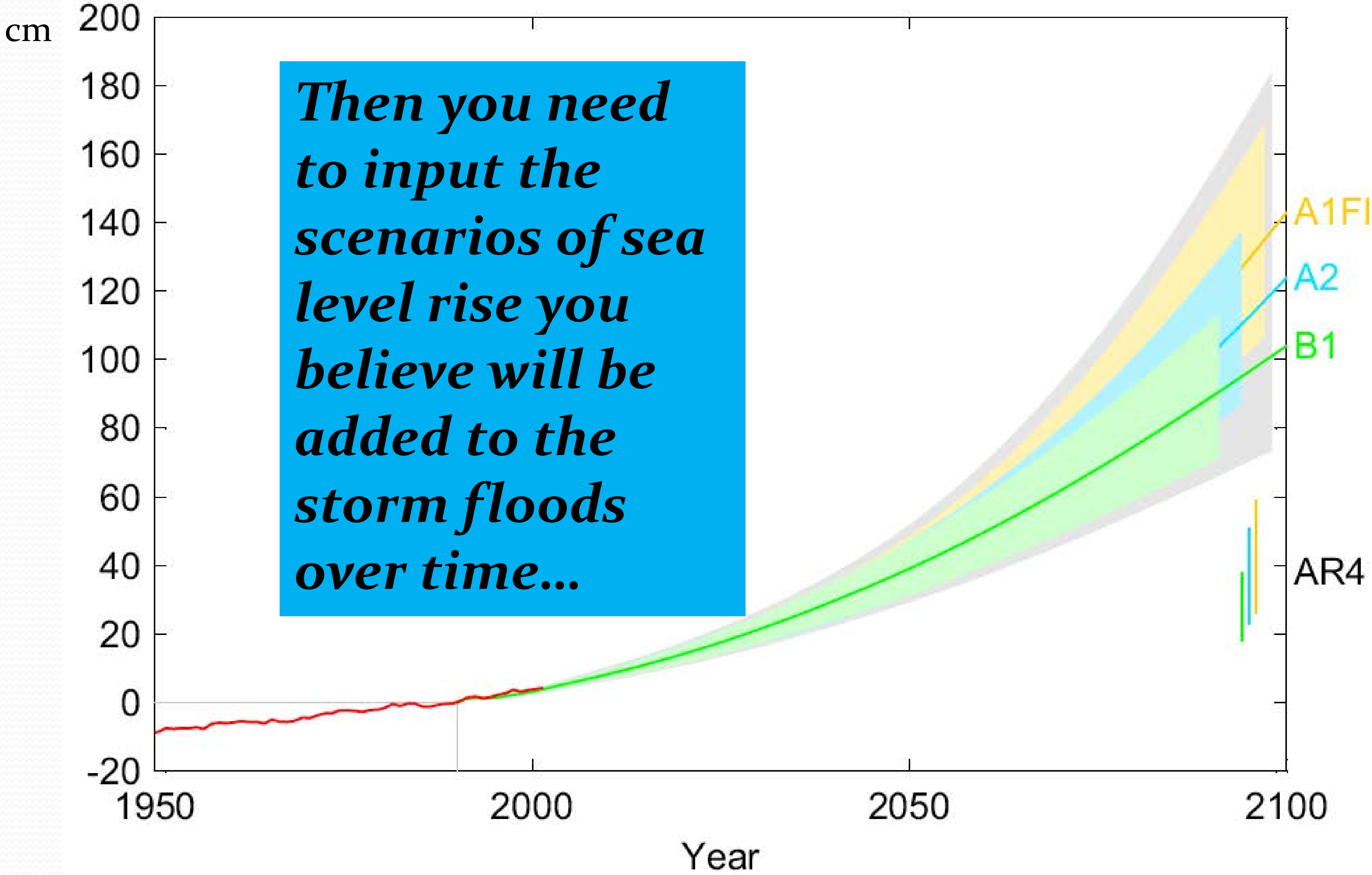
Depth	Mean of Damage	Standard Deviation of Damage
-8	0%	0
-7	0.7%	1.34
-6	0.8%	1.06
-5	2.4%	0.94
-4	5.2%	0.91
-3	9.0%	0.88
-2	13.8%	0.85
-1	19.4%	0.83
0	25.5%	0.85
1	32.0%	0.96
2	38.7%	1.14
3	45.5%	1.37
4	52.2%	1.63
5	58.6%	1.89
6	64.5%	2.14

Then you need to input predicted flood heights from the 10 year, 25 year, 50 year, 100 year, and 500 year storms, from your FEMA flood insurance study or whatever you've got…





Projection of Sea Level Rise from 1990 to 2100



Then you need to input the scenarios of sea level rise you believe will be added to the storm floods over time…

Vermeer and Rahmstorf (2009) Global sea level linked to global temperature. PNAS 106, 21527–21532.

COAST Model Results

The model will then tell you the amount of dollar damage predicted for a particular-sized storm in a particular year…

And it will calculate the cumulative expected damage, summed up from all of the predicted storms from today until that particular year.

COAST Model for City of Kingston - Modeled Water Levels and Vulnerability Assessment Results

Year	Sea Level Rise Scenario	Storm Inten-sity (return period in years)	Predicted Elevation of Flood Height from FEMA Flood Insurance Study, 2007 NAVD88 (ft.)[1]	COAST Model of Sea Level Rise Above MHHW in 2013 Selected by Kingston (in./ft)[2]		COAST Model Total Flood Elevation for Each Scenario NAVD 88 (ft.)	COAST Model Expected Damage to the Value of All Buildings & Improvements From This Single Storm Incident in the Scenario Year ($ Million)	COAST Model Expected Damage to the Value of Waste Water Treatment Plant Only From This Single Storm Incident in the Scenario Year ($ Million)	COAST Model Cumulative Expected Damage to the Value of All Buildings & Improvements From All Storms, 2013 to Scenario Year ($ Million)[3]	COAST Model Percent of Cumulative Expected Damage to the Value of All Buildings & Improvements From 2013 to Scenario Year Attributable to Sea Level Rise Only (Percent)[3]
2013	1 No SLR	10 yr	6.0	0	0	6.0	**12.0**	**8.7**	**n/a**	**n/a**
2013	2 No SLR	100 yr	8.2	0	0	8.2	**21.7**	**16.8**	**n/a**	**n/a**
2060	3 Lo SLR	10 yr	6.0	20	1.67	7.7	**18.8**	**14.4**	**69.0**	**26.8%**
2060	4 Lo SLR	100 yr	8.2	20	1.67	9.9	**24.7**	**18.8**	**69.0**	**26.8%**
2060	5 Hi SLR	10 yr	6.0	36	3	9.0	**22.0**	**16.8**	**73.5**	**31.7%**
2060	6 Hi SLR	100 yr	8.2	36	3	11.2	**29.5**	**22.2**	**73.5**	**31.7%**
2100	7 Lo SLR	10 yr	6.0	33	2.75	8.8	**21.9**	**16.8**	**82.7**	**28.6%**
2100	8 Lo SLR	100 yr	8.2	33	2.75	11.0	**27.5**	**20.6**	**82.7**	**28.6%**
2100	9 Hi SLR	10 yr	6.0	68	5.67	11.7	**29.7**	**22.2**	**88.3**	**34.8%**
2100	10 Hi SLR	100 yr	8.2	68	5.67	13.9	**34.5**	**24.8**	**88.3**	**34.8%**

[1] Tidal state is included in FEMA FIS predicted flood elevations for the 10 year and 100 year storms.
[2] Elevation of Mean Higher High Water (MHHW) in year 2013 is 3.0 feet (NAVD 88).
[3] Discount Rate of 3.3 percent applied.

Date Run: 03-03-2013

A Close-up Look at the COAST Model Output…

Scenario 6:
Year 2060, 100-yr Storm, Hi SLR,
Height = 11.2 ft (NAVD 88)

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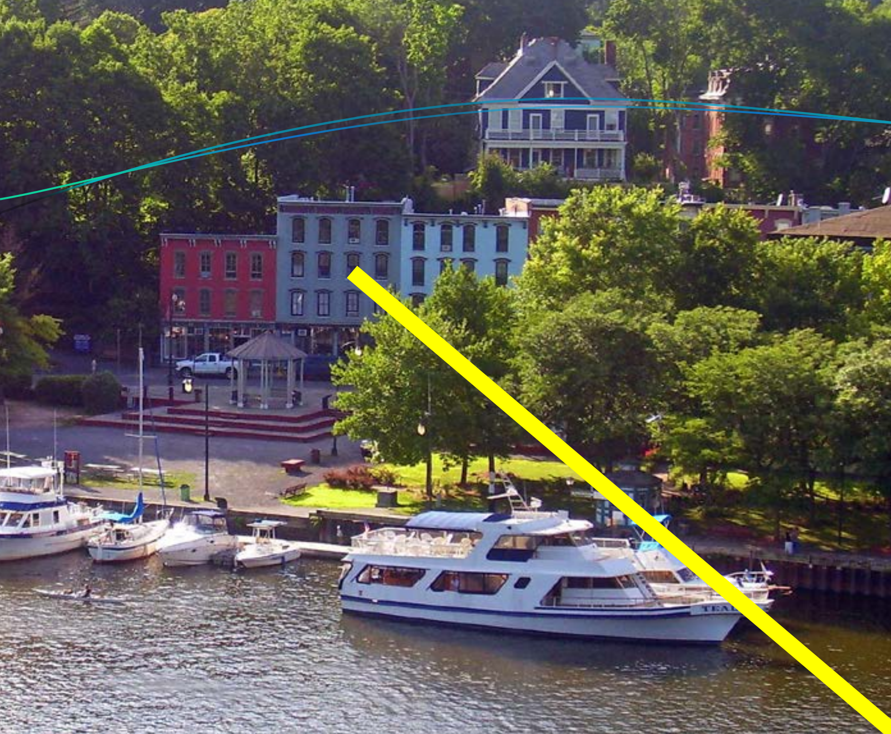


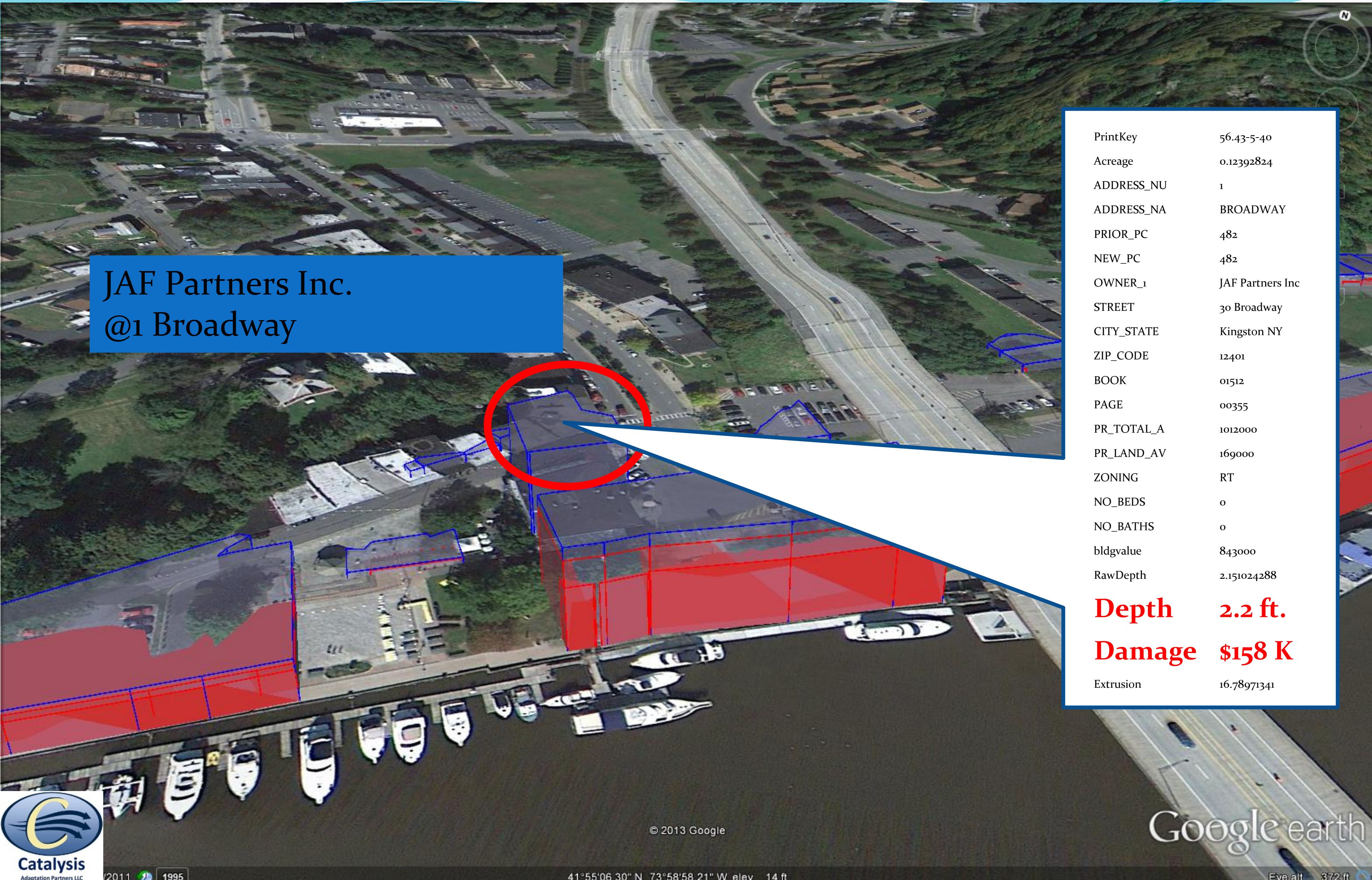
West Strand Street/Rondout Landing Area
COAST Output

- Relative Height of Blue Boxes Indicates Predicted Dollar Damages to Buildings and Improvements from Total Flood Height
- Relative Height of Red Boxes Indicates Predicted Dollar Damages from Sea Level Rise Only

JAF Partners Inc.
@1 Broadway

Scenario 6: Year 2060, 100-yr Storm, Hi SLR, Height = 11.2 ft NAVD 88

JAF Partners Inc.
@1 Broadway



PrintKey	56.43-5-40
Acreage	0.12392824
ADDRESS_NU	1
ADDRESS_NA	BROADWAY
PRIOR_PC	482
NEW_PC	482
OWNER_1	JAF Partners Inc
STREET	30 Broadway
CITY_STATE	Kingston NY
ZIP_CODE	12401
BOOK	01512
PAGE	00355
PR_TOTAL_A	1012000
PR_LAND_AV	169000
ZONING	RT
NO_BEDS	0
NO_BATHS	0
bldgvalue	843000
RawDepth	2.151024288
Depth	**2.2 ft.**
Damage	**$158 K**
Extrusion	16.78971341

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Scenario 6: Year 2060, 100-yr Storm, Hi SLR, Height = 11.2 ft NAVD 88

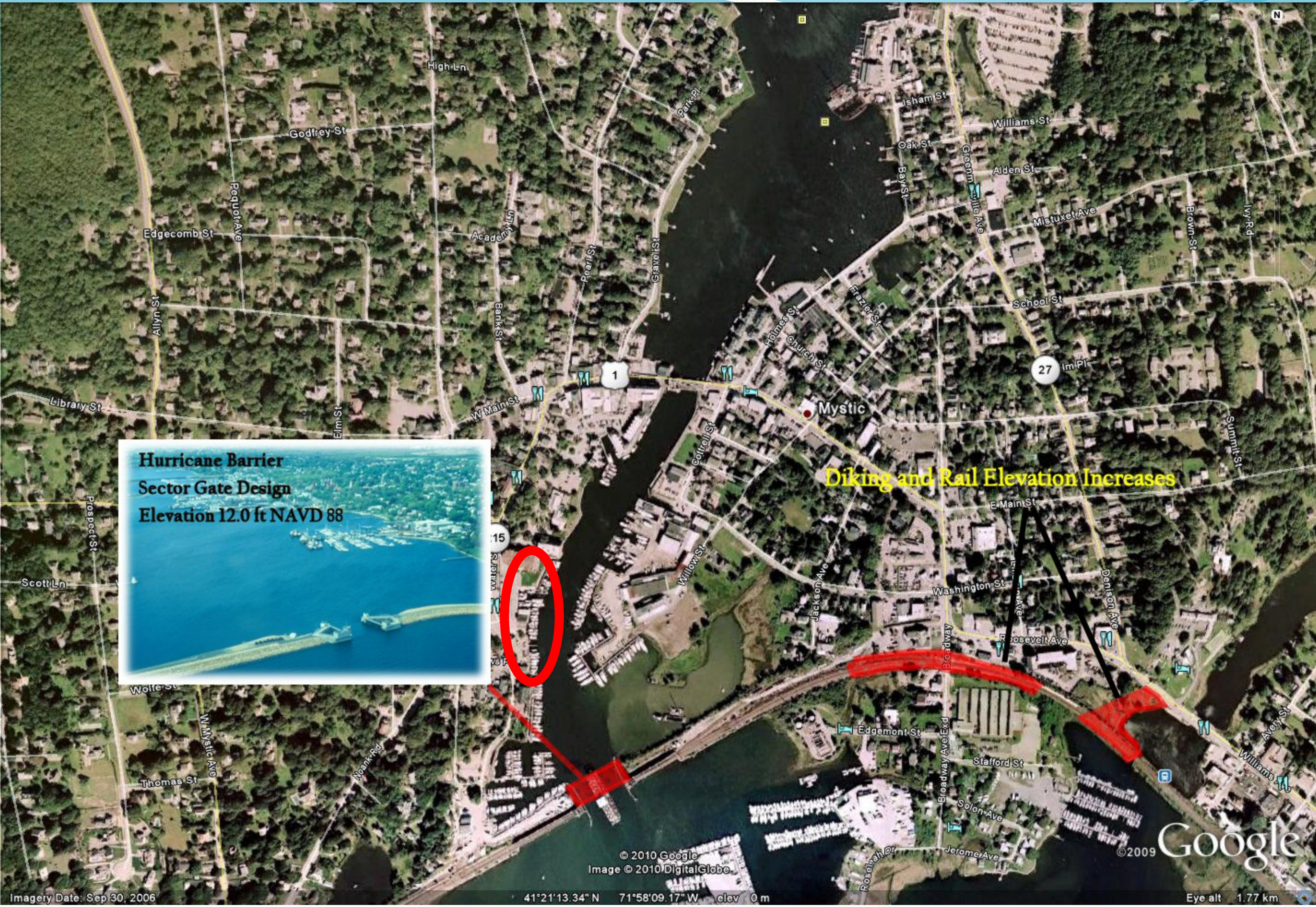
Damage to Assets Other than Real Estate Can be Modeled:

- Economic output
- Public health impacts
- Displaced persons, vulnerable demographics
- Natural resources values
- Cultural resources values
- Community impacts
- Infrastructure (transportation, energy, facilities, telecommunications)

Next Steps in the COAST Process

3. Select Candidate Adaptation Actions to Protect from Sea Level Rise and Storm Surge, Staged Over Time, and Estimate the Costs of Each Action
4. Perform a Cost Benefit Analysis of Adaptation Strategies

Example: Groton/Mystic, Connecticut


Hurricane Barrier
Sector Gate Design
Elevation 12.0 ft NAVD 88
Diking and Rail Elevation Increases
Mystic
High Ln
Godfrey St
Edgecomb St
Pequot Ave
Academy Ln
Pearl St
Gravel St
Park Pl
Isham St
Williams St
Oak St
Alden St
Bay St
Greenmanville Ave
Mistuxet Ave
Brown St
Ivy Rd
School St
Frazier St
Holmes St
Church St
Allyn St
Bank St
Elm St
Library St
W Main St
Cottrell St
E Main St
Summit St
Willow St
Jackson Ave
Washington St
Roosevelt Ave
Denison Ave
Broadway
Prospect St
Scott Ln
Wolfe St
W Mystic Ave
Thomas St
Noank Rd
Edgemont St
Stafford St
Broadway Ave Ext
Solon Ave
Jerome Ave
Williams St
Avery St
© 2010 Google
Image © 2010 DigitalGlobe
©2009 Google
Imagery Date: Sep 30, 2006
41°21'13.34" N 71°58'09.17" W elev 0 m
Eye alt 1.77 km

Scenarios		Max. Water Elev. (ft., NAVD88)	Engineering Options	Construction Costs	Annual Maintenance Costs
Sea level rise, normal tides	A	3.2 – 4.0	No action up to minimal flood proofing and infrastructure elevation along river.	Insignificant	Insignificant
	B	5.5 – 6.5	Hurricane Barrier at Mystic River entrance.	$18 Million	$75,000
100-year storm event in 2010	C	5.4			
	D	7.4			
10-year storm in 2070, Hi SLR	E	7.0			
	F	8.9	Hurricane Barrier at Mystic River entrance. ***ADDITIONAL FORTIFICATION** and elevating the railroad, as well as increased diking to east.*	$27-30 Million	$100,000
100-year storm in 2070, Hi SLR	G	8.6			
	H	10.5	Hurricane Barrier at Mystic River entrance. ***FURTHER FORTIFICATION** and elevating the railroad, as well as increased diking to east.*	$35 Million	$120,000

Last Step in the COAST Process

5. Start Doing Something! Implement the Strategies, and Move the Needle off of Zero.

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