CHTY SHULATOR

DEP AGREEMENT 22PLN91

VULNERABILITY ASSESSMENT WITH CITY STIMULATOR

Image courtesy of City of Clearwater social media @MyClearwater

NO LIFEGUARI ON DUTY NO HAY SALVAVIDA: EN SERVICIO SWIM AT YOUR OWN RIS 60





CAtkinsRéalis

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The city seeks to further understand the future impacts of both sea level rise and extreme heat by conducting city-wide vulnerability assessments using Atkin's City Simulator tool.

TEA

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How City Simulator Works

Digital Twin

System Users System Infrastructure System Control



Measure

Economy

Productivity Storm damage Energy Consumed

People

Trips disrupted Freight disrupted Heat days disrupted

Environment Carbon Footprint Water Quality

Benefits

- Data-driven process
- Able to support grant processes and requirements
- Incorporates how the community functions (traffic, housing, job occupations, etc.)
- Provides a planning tool to stress test the city for expected climate impacts



AtkinsRéalis



Study Goals and Objectives

- Quantify potential future impacts of acute (storms and surge) and chronic (sea level rise) flooding and extreme heat by conducting a city-wide vulnerability assessment
- Measure impacts in terms of economics (lost productivity, damage to structure), people (trips disrupted, heat exposure), and natural systems (water quality, air quality, carbon footprint).
- Measure return on investment of mitigation and adaptation actions to assist in city's capital investment planning process and assist the creation of a future climate action report.

Drivers

- Rain (w/ storm type)
 Max Temperature
- Sea Level

Hazards

• Flood:

- Inland Flooding
- Coastal Surge (SLR)
- Tidal (SLR)
- Extreme Heat
 - Citizen Exposure
 - Increase energy
 - usage

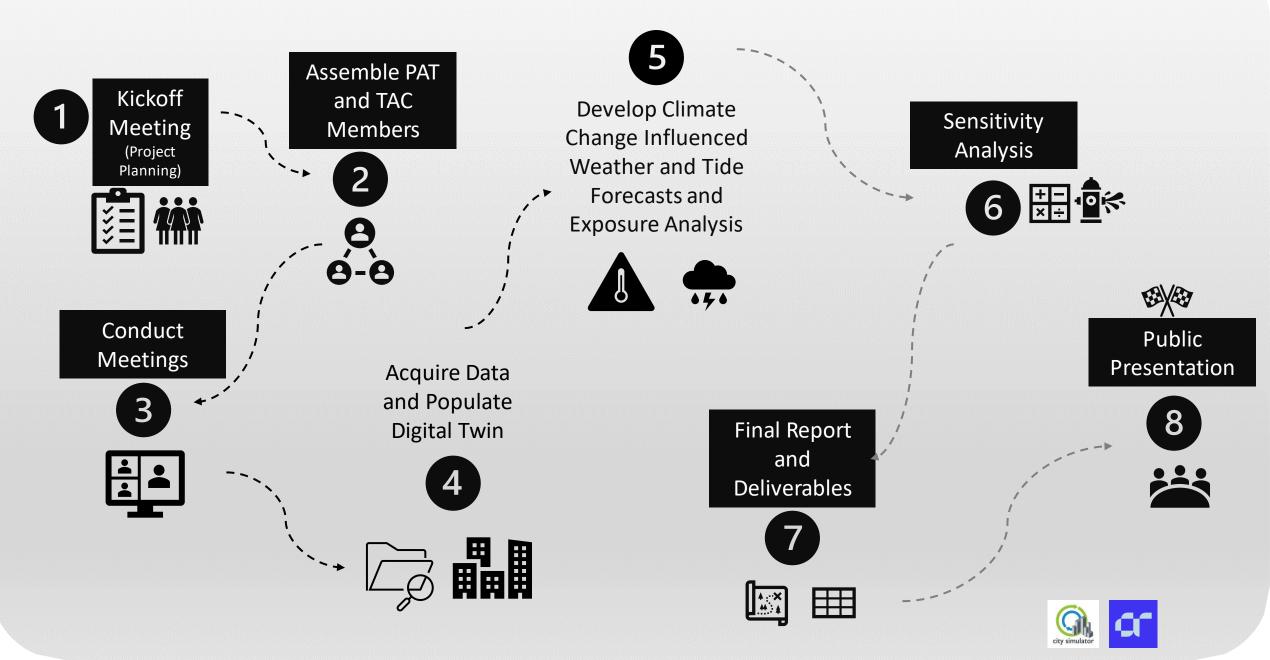
Metrics

• Climate

- Change in characteristic
- storms
- Change in surge levels
- Change in Temperatures
- Economic
 - Storm Damage to property
 - Storm Damage to
 - assets
- People
 - Disrupted Days
 - Disrupted Trips
 - Flood Damage at Homes/commercial
 - Heat exposure



Project Roadmap



Baseline Digital Twin + Future Conditions

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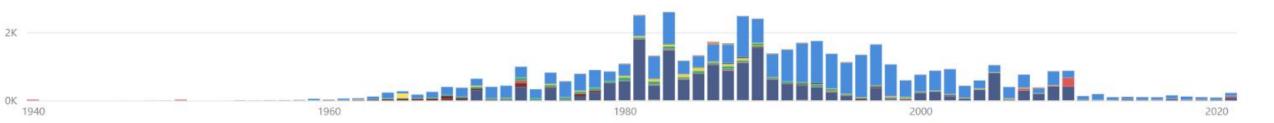
Building the Model

Single Family	Condominiums	e.			1
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					(
					1
					2
					3
					4
	24 220/				
	34.22%				5
	Multi-family	Office buil	Reside	С	9
		1.63%	1.26%		10
			Anna and and a	P	11
	3.28%	Vacant Res	Hotels		12
	Mobile Homes		1.15%		13
48.32%	Woblie Homes	Vacant Co	Stores		Tota



48.32%

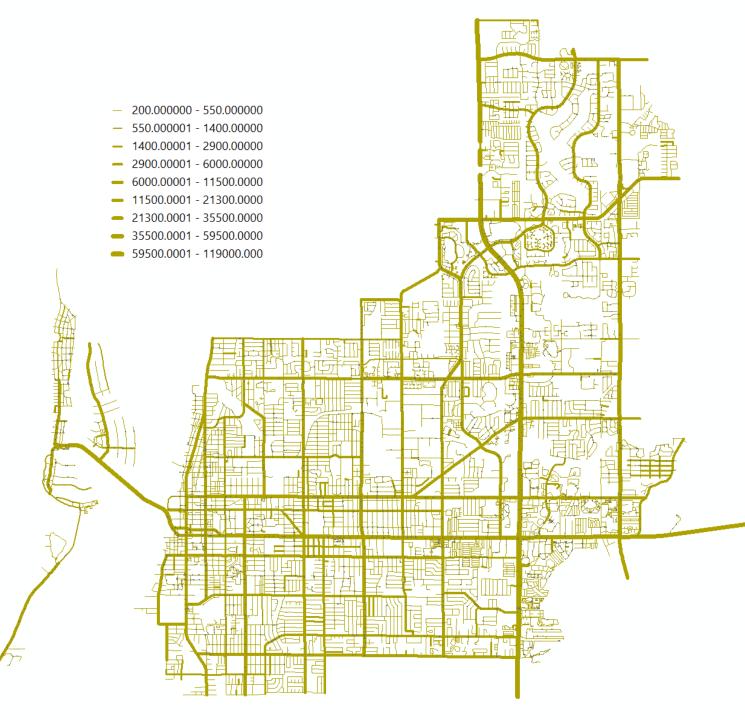
4 Sewage dispos... Single Family State, other th... Stores, one story Cupermarkets Tourist attracti... Utility, gas an... Vacant Com... Vacant Gover... Vacant Industrial Vacant Industrial Vacant Instit... Definition





Annual Average Daily Traffic (AADT QC)

- Used to assess most impacted roadways from various climate threats
- Road network based on original GIS layer provided by the city
- FDOT AADT sampled to road network for FDOT-maintained roads.



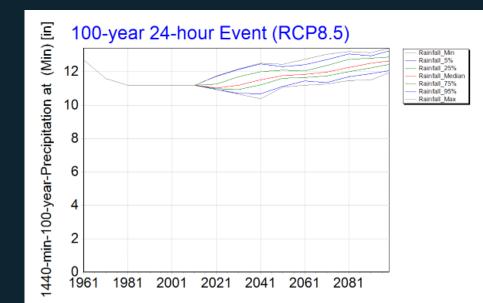
Future Conditions

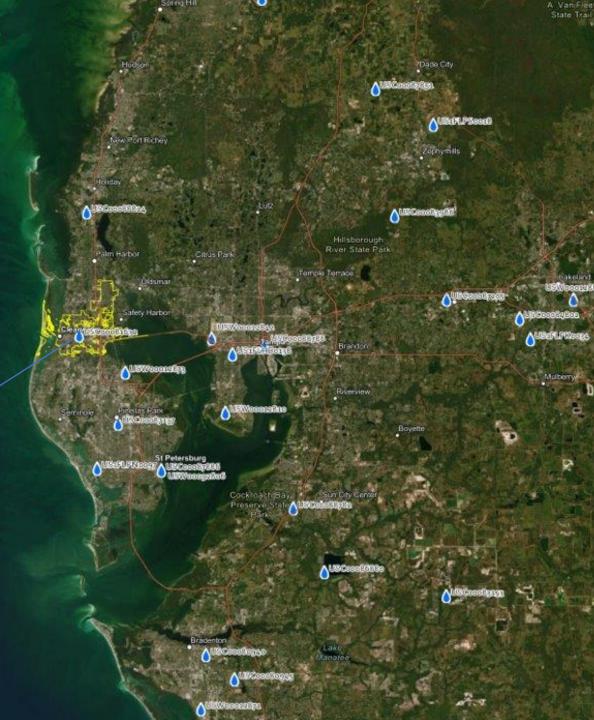
Simulation Findings: Future Rain

<u>^24%</u>

increase in 100-year 24-hour rainstorm by 2100.

- Rain Projection developed through City Simulator downscaling algorithm
- Using 100th percentile most severe future for simulations
- Projections:
 - (2) lan-sized storms from 2020 2100.
 - (6) 8" rainstorms (50-year event).





Findings: Future Sea Level

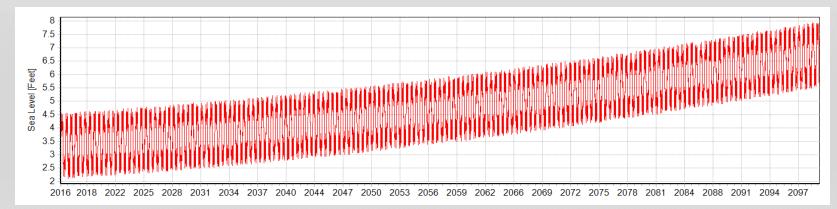
- Using NOAA Intermediate-High with Tide Predictions from the Clearwater Tide Gauge
- Tide predictions are used to estimate King Tide levels

Long Range Forecast Members

13.25 ft. by 2100

- NOAA Intermediate High projection
- Aligns closest with 2000-2020 observed rise.

	Include	Source	Title
		NOAA - 2022 SLR report	Low
		NOAA - 2022 SLR report	Intermediate-Low
		NOAA - 2022 SLR report	Intermediate
•	\checkmark	NOAA - 2022 SLR report	Intermediate-High
		NOAA - 2022 SLR report	High





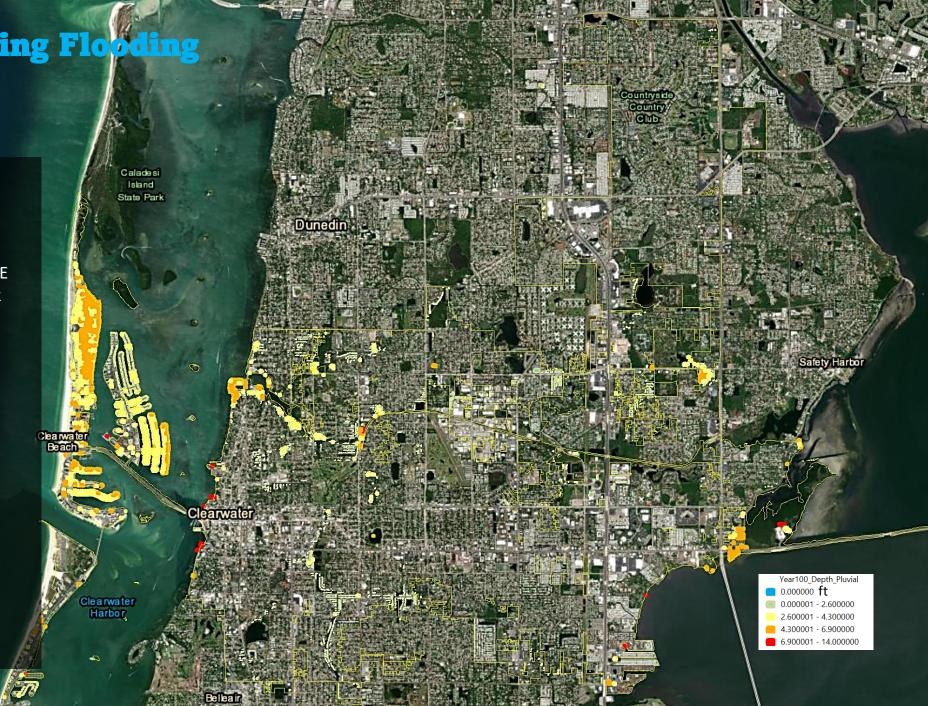
Findings: Building Flooding

1290 buildings with above-FFE flood risk

- 150 Commercial
- 1140 Residential
- Assumed FFE
- Commercial

ex

- Single Family Residential
- Multi-Family Residential

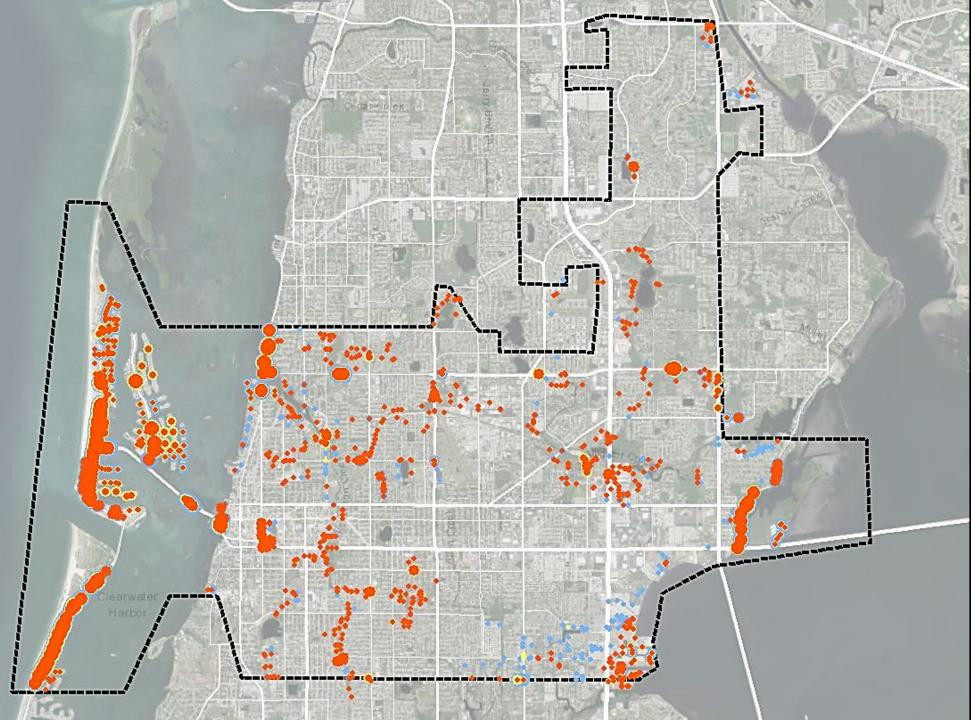


Findings: Trip Disruptions



Gulf of Mexico

- Major disruptions in coastal islands
- N. Fort Harrison Ave & Sunset Point Rd
- Stevenson Creek area



Findings: Future Temperature

个300%

increase in days > 90F

- All models agree in pronounced and sustained increase in Avg. Max Temp between 2020 and 2100.
- Lower emissions scenario (RCP2.6 and RCP4.5) shows level off by 2050-60.
- Used Higher Emissions Scenario in this study (RCP8.5) to stress test.

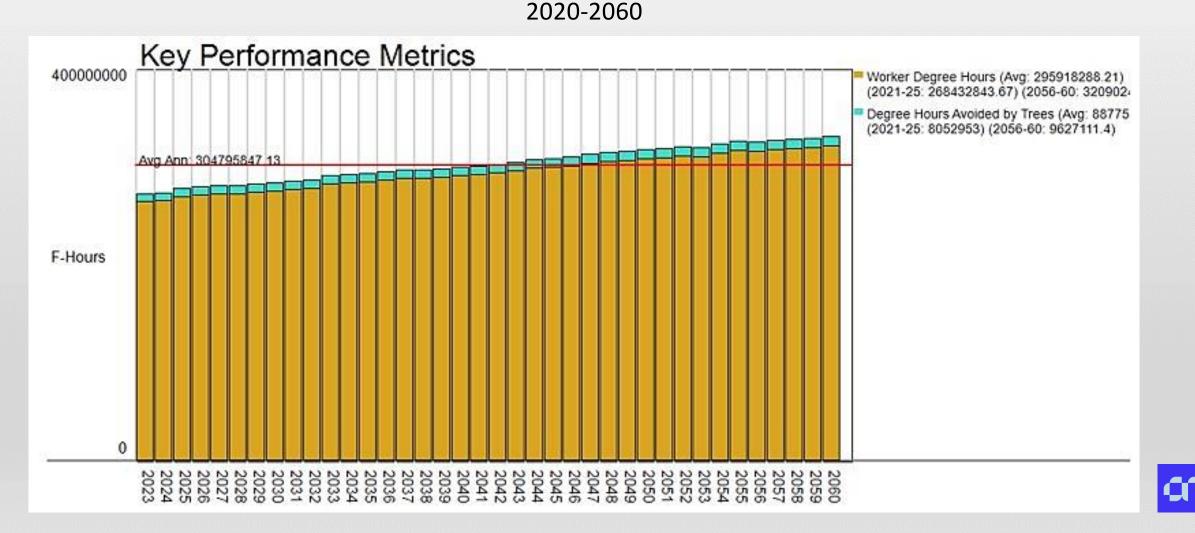


Findings: Heat Exposure

个14%

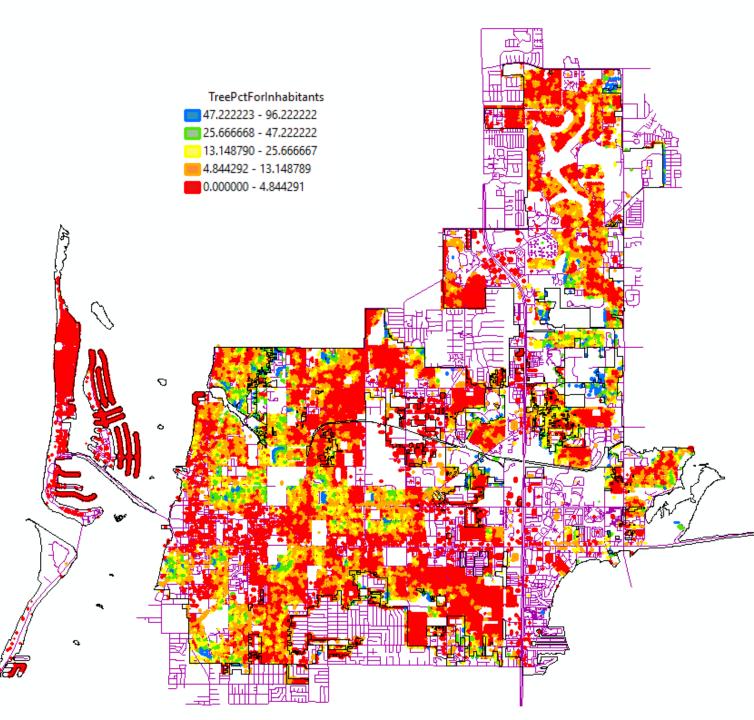
Heating Degree Hours over

- Highest in low tree percentage locations
- Highest in impervious areas



Building Inhabitant Tree Percentage

- Average tree percentage for workers or residents who are outdoors during the day.
- Note that 30% is considered high for tree percentage.
- Parts of city at 30% or higher, but majority is below.
- Particularly impactful to outdoor workers and residents.



Scenario Development

Initia	Scena	arios

Scenario Planning

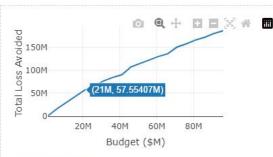
Scenario #	Geography of Interest	Actions to Evaluate	Value to the Study
1	Stevenson Creek	Elevate <u>roads;</u>	High exposure to flooding; ongoing studies in
	Acquire structures		the area.
2	Citywide	Increase tree coverage	City has Greenprint 2.0 plan for sustainability and intends to mitigate for heat exposure.
3	Barrier Islands	Elevate seawalls	High exposure to flooding; ongoing studies in the area.
4	Coastal Zone 3	Elevate roads	High exposure to flooding; ongoing studies in the area.
5	Barrier Islands	Elevate structures	High exposure to flooding; ongoing studies in the area.
6	Citywide	Acquire structures	Help the city identify good candidates for acquisition due to high return on investment.
7	Hercules and US 19 Corridors	Acquire structures	These are economic development areas of interest.
8	Coastal Zone 1, Central Business District, and North Greenwood	Acquire structures; Add tree coverage	These are income-impacted areas where the <u>City</u> is currently investing in improvements.
9	SR 60, Drew Street, and S. Missouri (Alt 19)	Stormwater improvements; Tree coverage; Density changes	These are future investment corridors with expected redevelopment activities.
10	Citywide	Elevate structures	Help the city identify good candidates for elevation due to high return on investment.

Scenario 1 – Stevenson Creek: Elevate Roads and Acquire Structures

Clearwater

Basic Assessment Setup Digital Twin Vulnerability Explorer Scenario Analysis Action Plan



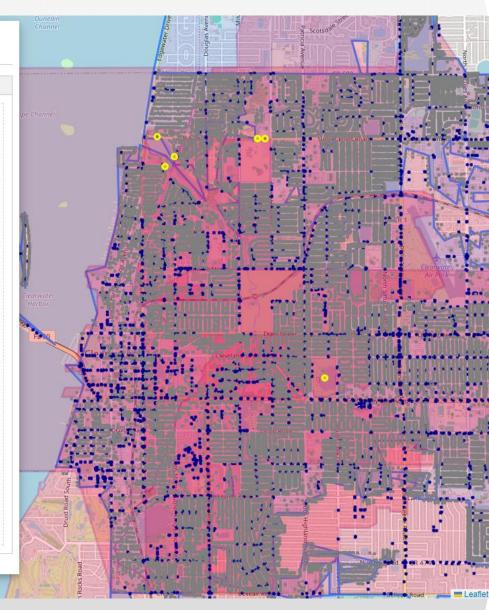


Show Actions on Map

7 Actions. Total Cost: \$20.98M

Inday	Name	Action Type	ROI	Cost (\$K)
muex	INdifie	Action type	KU	COSt (\$K)
1	Elevate_2083	Elevate Road	3.0534293999999997	5000
2	Elevate_6727	Elevate Road	2.7172936	5000
3	Elevate_5930	Elevate Road	2.6859182	5000
4	Elevate_5931	Elevate Road	2.6859182	5000
5	Acquire_null	Acquire Building	2.0500000000000003	356
6	Acquire_null	Acquire Building	2	324
7	Acquire_null	Acquire Building	1.549999999999999998	299

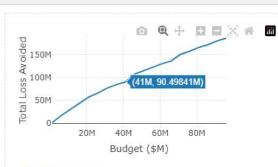
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Scenario 1 – Stevenson Creek: Elevate Roads and Acquire Structures

Clearwater Basic Assessment Setup Digital Twin Vulnerability Explorer Scenario Analysis Action Plan

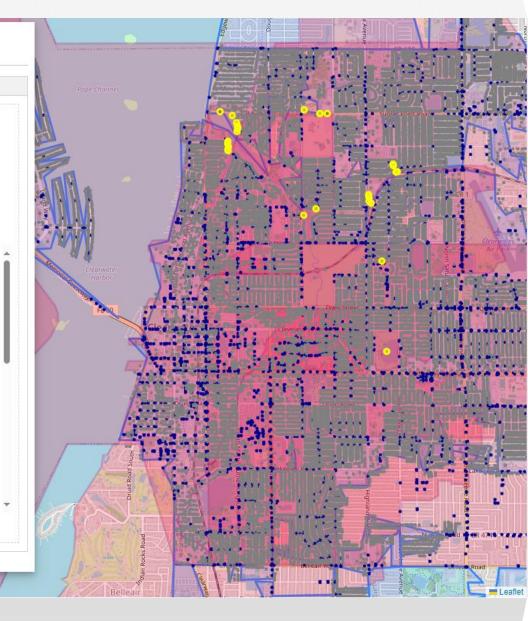




Show Actions on Map

29 Actions. Total Cost: \$40.96M

Index	Name	Action Type	ROI	Cost (\$K)
1	Elevate_2083	Elevate Road	3.05342939999999997	5000
2	Elevate_6727	Elevate Road	2.7172936	5000
3	Elevate_5930	Elevate Road	2.6859182	5000
4	Elevate_5931	Elevate Road	2.6859182	5000
5	Acquire_null	Acquire Building	2.0500000000000003	356
6	Acquire_null	Acquire Building	2	6178
7	Acquire_null	Acquire Building	2	1384
8	Acquire_null	Acquire Building	2	324
9	Acquire_null	Acquire Building	2	977
10	Acquire_null	Acquire Building	1.55	546
4.4	Acquire pull	Acquira Ruildina	4 60	500



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		39	33 Actio	ns. Tota	al Cost: \$6	5.00M		
		Ind	ex Name	Action Type	ROI	Cost (\$K)		
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		2	PlantTrees_null		1.3500000000000005			ME KAL
		3			1.3500000000000005			CR1 CR501
		5	PlantTrees_null		1.350000000000000000			
		6	PlantTrees_null		1.35000000000000005		West Bay Drive.	st Bay Drive
			PlantTrees_null	Plant Trees	1.3500000000000005	3		
		8	PlantTrees_null	Plant Trees	1.3500000000000005		Largo	Leaf

Clearwater Basic Assessment Setup Digital Twin Vulnerability Explorer Scenario Analysis Action Plan New Scenario Evaluate selected scenario New Scenario Evaluate selected scenario Scenario 3 - Coastal Zone 3 1 - 100 Elevate Not Roads 1 - 100 Elevate Not Roads Evaluate							o the Study	Value	Actions to Evaluate	t	ography of Interest	# Ge	enario
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Next Steps:

- Refine scenarios and update results
- Finalize report
- Prioritize areas for adaptation planning and future grant funding





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