

Science Center Public Forums: *Community Engagement for Environmental Literacy, Improved Resilience, and Decision-Making*



2017 NOAA Science on a Sphere
Users Collaborative Network Workshop
Francis Choi

Emily Hostetler, Meghan Wrenn, David Sittenfeld, Brian Helmuth
April 26, 2017



Northeastern University
Marine Science Center



Science Center Public Forums

Forum Design Principles

- **Diverse Representation**
- **Informed Citizen Participants**
- **Deliberative Multi-Directional Learning**
- **Clear, Comparable, and Usable Outputs, Formats, Outcomes**



Science Center Public Forums

Project Deliverables

8 deliberations at US science centers

4 climate hazards:

- *Sea Level Rise*
- *Extreme Precipitation Events*
- *Drought*
- *Heat Waves*

Visualization of data via:

- Planetariums
- Science on a Sphere
- Flat screens



Science Center Public Forums

Format for Deliberation Day

Planetarium Show



Thematic Sessions



Session Video



Group Deliberation



Expert Q&A



Voting



Format for Deliberation Day

Resilience Planning Process



Steps to Resilience:

- 1 Step 1: Explore Climate Threats
- 2 Step 2: Assess Vulnerability & Risks
- 3 Step 3: Investigate Options
- 4 Step 4: Prioritize Actions
- 5 Step 5: Take Action

<https://toolkit.climate.gov/#steps>

Planetarium Show



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Steps to Resilience:

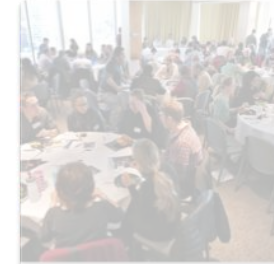
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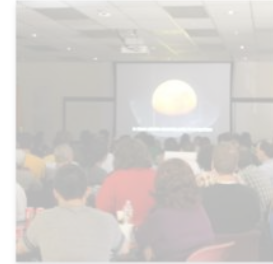
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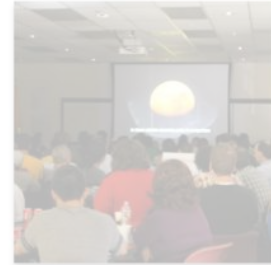
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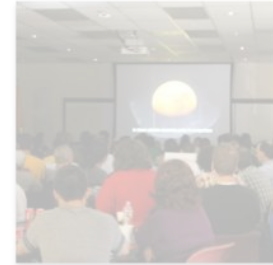
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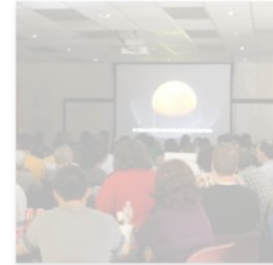
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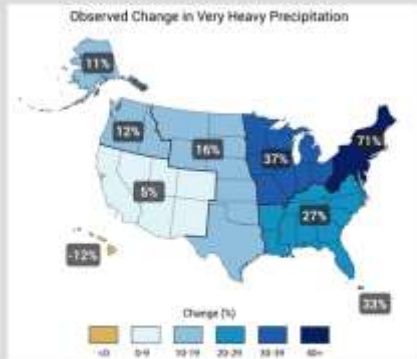
Group Deliberation

Visualizing Strategies and Outcomes



Group Deliberation

Visualizing Strategies and Outcomes



Percent increases in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events)

RIVERTOWN
IS EXPERIENCING 71%
MORE HEAVY
PRECIPITATION EVENTS
EACH YEAR

RIVERTOWN

Population: 195,000

Average Household Income: \$40,355

Top Employers:

- Public Schools
- Local University
- Healthcare Provider
- Large Supermarket Chain



Soybean Farmer



City Planner



University Professor



Director of
Community Health



Historian

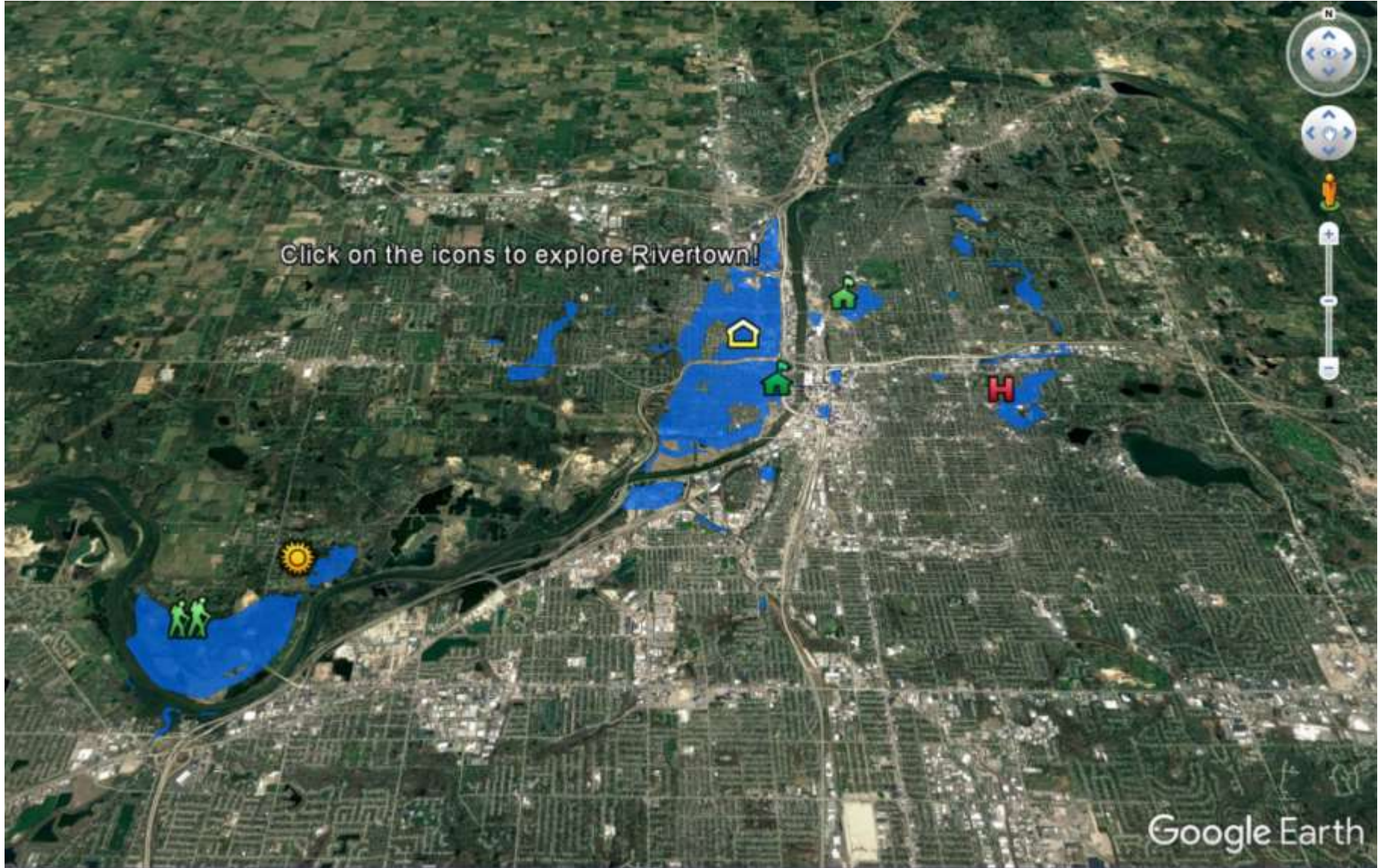


Floodplain Resident



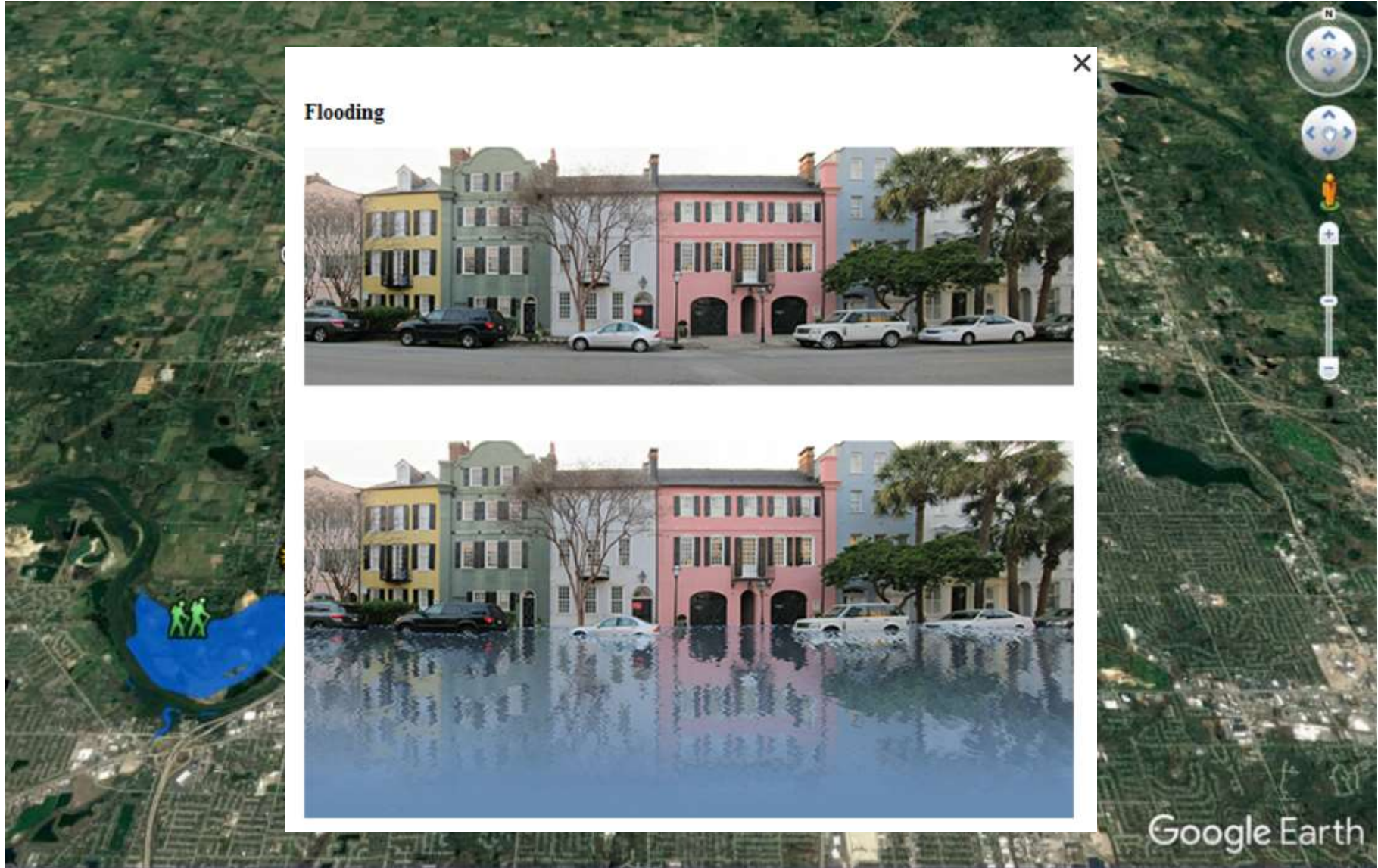
Group Deliberation

Visualizing Strategies and Outcomes



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Visualizing Strategies and Outcomes

Resilience Strategies



Keep It Out

Keep It Out involves improving water management systems through actions such as separating sewer systems, updating the local wastewater treatment plant, building stormwater basins, and protecting public transit systems.















Soak It Up

Soak it up involves creating solutions to increase water drainage by using the earth's natural resilience capabilities. These strategies include vegetative solutions such as green roofs and rain gardens, as well as using porous pavement to allow water to filter into the ground.



Inform the Public




Inform the Public involves enhancing public safety, communication, and knowledge about extreme precipitation events. This means keeping the power on so that communities are not isolated, as well as making sure the public is educated about the risks and knows where to go in case of an emergency.

STRATEGIES	RESILIENCE PLAN A	RESILIENCE PLAN B
<p>"Keep it Out"</p> 	 	
<p>"Soak it Up"</p> 	 	
<p>"Inform the Public"</p> 	 	

Group Deliberation

Visualizing Strategies and Outcomes

My Resilience Plan 1

STRATEGIES	RESILIENCE PLAN A	RESILIENCE PLAN B
Keep it Out 	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>
Soak it Up 	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>
Inform the Public 	<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/>

What resilience plan would you make for Rivertown? Why did you choose this plan?




Mark the empty coin spaces to choose a plan. Remember you only have three coins and can't use all three on one strategy!

- Why: 0/2 KIO: even the most investment made leads to MORE manmade structures being created (cement) → increased drain to river from structures & pavement

- 1P 1/2: cheap & sustainable for future (big impact little cost) → upkeep of structures

- 2/2 SU: expensive but only upfront cost, upkeep minimal & cheap. erected = expensive & older ones have fallen into disrepair (vulnerable to failure w/o \$ for backup plan)

My Resilience Plan 1

STRATEGIES	RESILIENCE PLAN A	RESILIENCE PLAN B
Keep it Out 	<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/>
Soak it Up 	<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/>
Inform the Public 	<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/>

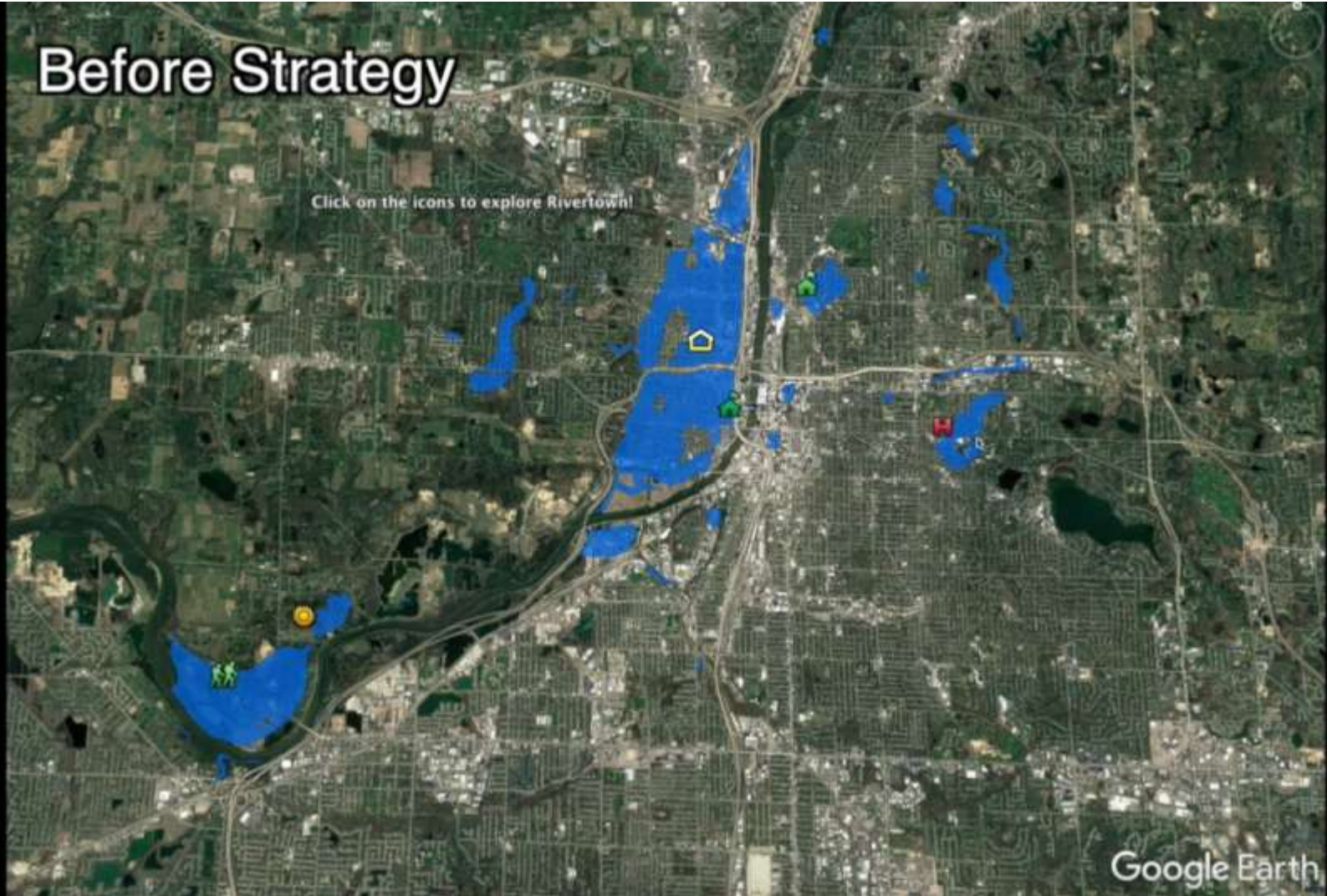
What resilience plan would you make for Rivertown? Why did you choose this plan?

Mark the empty coin spaces to choose a plan. Remember you only have three coins and can't use all three on one strategy!

We need to consider all 3 strategies--this is the only way to do it with the money allowed

Group Deliberation

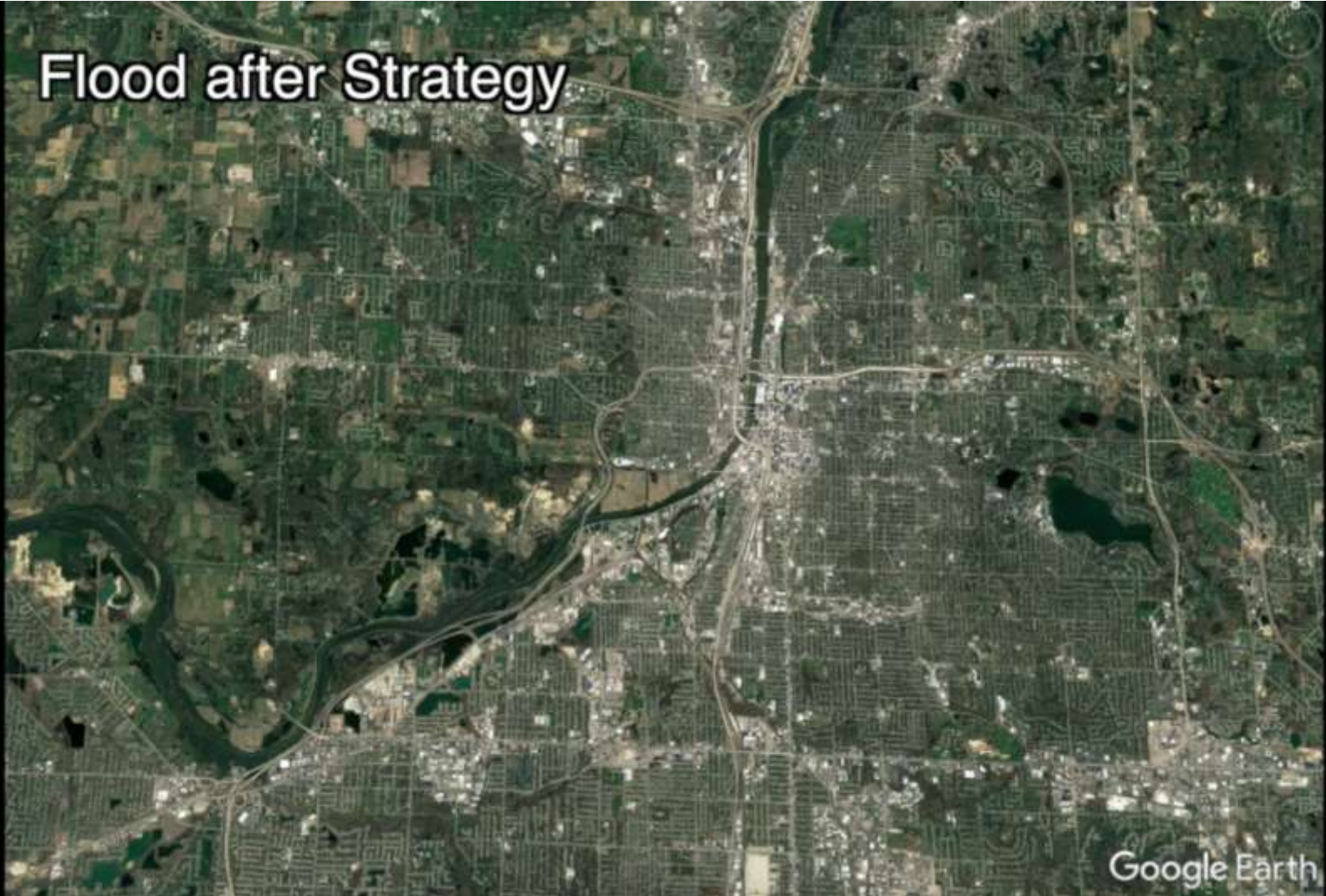
Visualizing Strategies and Outcomes



Group Deliberation

Visualizing Strategies and Outcomes

Flood after Strategy



Group Deliberation

Visualizing Strategies and Outcomes

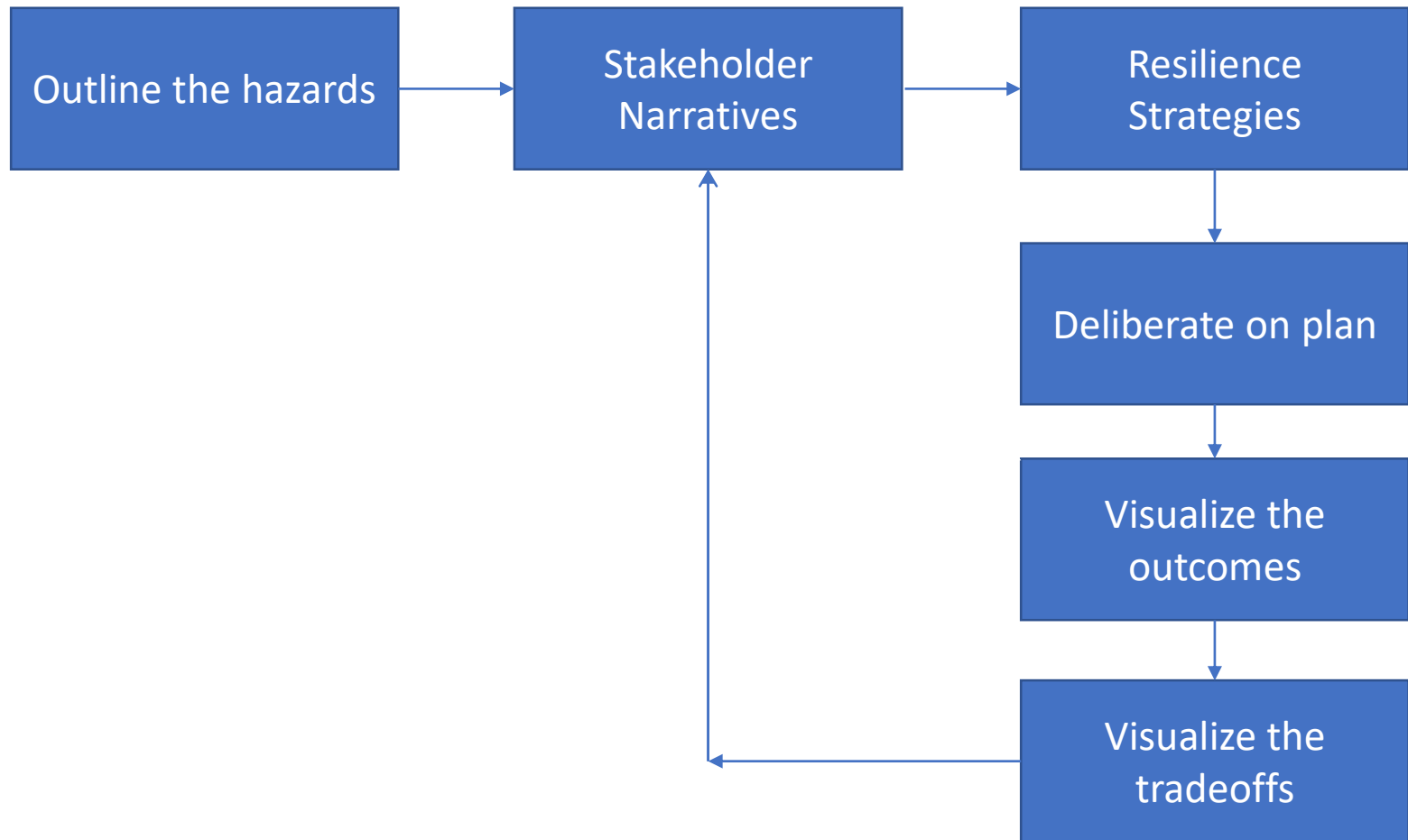


Visualizing tradeoffs from stakeholders

Google Earth

Narrative development:

Stakeholders, Strategies, and Scenarios





Sunday, June 11 | 9:00 am – 4:00 pm

[Share](#) [Tweet](#)

Sea Level Rise and Extreme Precipitation: Preparing for Boston's Uncertain Future

How should communities build resilience for dealing with weather and climate-related hazards in the coming decades? Participants will use visualizations to explore potential vulnerabilities to our infrastructures, social networks, and ecosystems from sea level rise and extreme precipitation events, then discuss potential strategies for addressing these threats, focusing on the priorities and needs of relevant stakeholders. At the event's conclusion, participants will make recommendations for increasing Boston's community resilience.

Apply to participate in this day-long forum at the Museum of Science. The event is designed to gather the opinions of a diverse range of people from different backgrounds, experiences, and perspectives. You don't need to have knowledge about the topic to be selected.

For more information: ecastonline.org/climate/boston

LOCATION
Museum of Science

AUDIENCE
Recommended for:
Grade 12 and adults

Public Event

Separate ticket required. Cost: Free with application; selected participants will receive a stipend

[Apply Online](#)

Sunday, June 11, 2017
9:00 am – 5:00 pm

Share the link!
ecastonline.org/climate/boston

This project is supported by a NOAA Environmental Literacy Grant. In collaboration with Expert and Citizen Assessment of Science and Technology.



Northeastern University
Marine Science Center

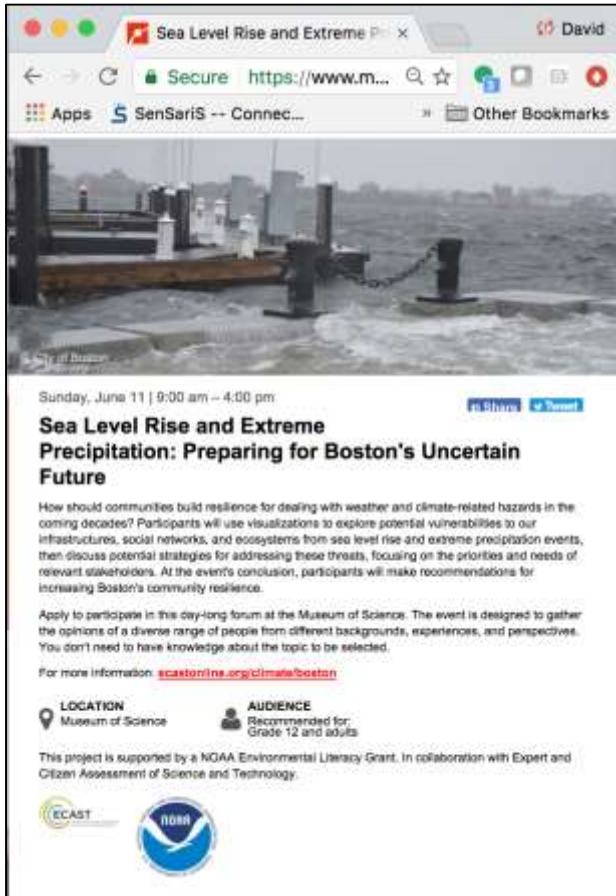


Consortium for Science,
Policy & Outcomes
at Arizona State University



Museum of Science

Diverse Representation: Participant Recruitment & Selection



Sea Level Rise and Extreme Precipitation: Preparing for Boston's Uncertain Future

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ECASST NOAA



Project Timeline

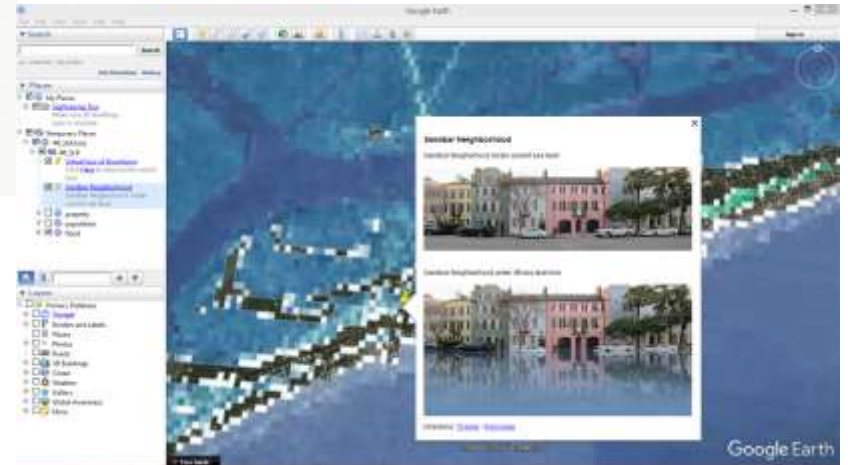
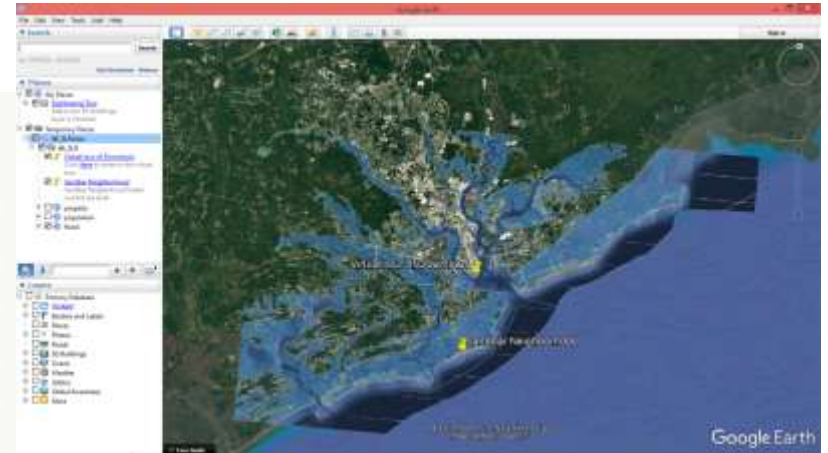
<i>Spring 2016</i>	Scenario Creation Workshops in Boston and Phoenix
<i>Mid 2016-Early 2017</i>	Narrative development: Stakeholders and Scenarios Writing of background packets Visualization development
<i>Spring 2017</i>	Formative evaluation: focus groups in March and April Develop training materials for year 3 sites Participant Recruitment/selection for pilot forums
<i>Summer/Fall 2017</i>	Pilot forums in Boston (June 11) and Phoenix (September 30) Training Seminars for Year 3 sites on June 12 in Boston
<i>Spring 2018</i>	Year 3 Forums at 6 US Science Centers
<i>Fall 2018</i>	Development of Resilience Forum Toolkit Summative project evaluation

Resilience Planning Process

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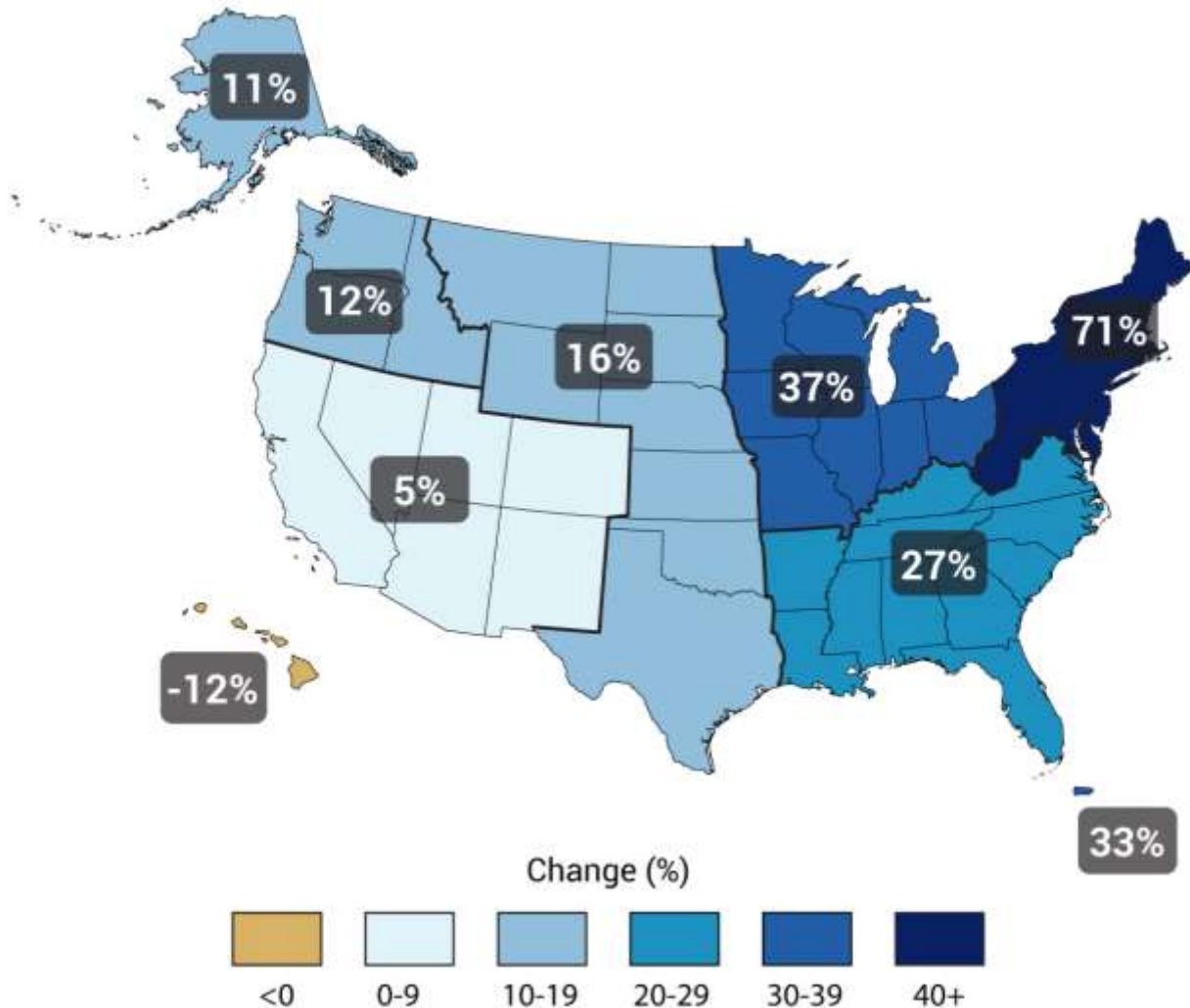
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An Introduction to Rivertown

Observed Change in Very Heavy Precipitation



Percent increases in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events)



Keep it Out

Strategies to improve storm water management

Soak it Up

Reduce runoff and utilize green infrastructure

Inform the Public

Improve emergency management and social connectedness

Economic



Environmental



Social



KEEP IT OUT

ECONOMIC ★★

- Sewer separation is costly and extremely inconvenient for older cities
- Replacing aging infrastructure and removing dams are expensive projects
- Retrofit projects are a cost-effective management option

ENVIRONMENTAL ★★★★★

- Protecting wastewater treatment plants makes it less likely for plants to flood during storm events, preventing pollution from entering waterways
- Stormwater management helps to prevent nutrient pollution
- Road construction has negative environmental impacts

SOCIAL ★★★

- Wastewater prevented from entering buildings
- Recreation can be incorporated into stormwater management strategies
- Construction of stormwater management systems is disruptive

SOAK IT UP

ECONOMIC ★★★★★

- Green infrastructure is cost effective
- Jobs are created to build roads and sidewalks with porous pavement
- Porous pavement implementation limited by traffic volume, slope of the road, and soil

ENVIRONMENTAL ★★★★★

- Reduces runoff into waterbodies and treats runoff water by filtering pollutants
- Allows nutrients to be recycled and taken up by plants
- Green roofs and green infrastructure help lower carbon emissions, increase oxygen production, and lower urban heat

SOCIAL ★★★★★

- Aesthetic quality
- Creates more recreational space
- Avoids disruptive construction to install larger storm pipes
- Potential hazards include infectious pathogens carried via rodents, ticks and mosquitoes, as well as increased pollen allergens

INFORM THE PUBLIC

ECONOMIC ★★★★★

- Damage to electricity systems is costly to repair
- Burying lines is expensive and makes lines difficult to access if there is a problem
- Little to no cost to implement shelter and education programs but large benefit from preventing loss of life

ENVIRONMENTAL ★★★

- Possible disruption of habitats and damage to tree roots from managing trees or burying lines
- Little to no environmental impact

SOCIAL ★★★★★

- Protecting or relocating power and communication lines protects the health and safety of residents
- Refuge centers provide shelter, safety, and protection for people during storms
- Improved communication systems and education help to increase resilience to health concerns



Google earth

Soybean Farmer



City Planner



University Professor



**Director of
Community Health**



Historian



Floodplain Resident





KEEP IT OUT

PLAN A

The city's aging combined sewer system is currently releasing nearly 3 billion gallons of untreated wastewater into nearby water ways due to combined sewer overflows during heavy rainfalls. To reduce this amount of overflow by 95%, the city will replace half of the combined sewer system pipes and update the wastewater treatment plant - investing \$5 billion in construction costs over the next 25 years. The city will also prepare for future flooding events by designing and installing emergency covers for public transportation station entrances. This billion-dollar project will allow for quick and complete coverage of each vulnerable station entrance, allowing the stations to remain dry and functional for use immediately after a storm.

PLAN B

The city cannot currently afford to invest in high budget, long term projects, but needs to decrease the amount of stormwater from flooding the streets and running into the local river. The city has invested \$4.5 million in building a water plaza for the city. A water plaza can serve as a space to play sports, eat lunch, and relax when it's dry, but will catch stormwater and act as a water basin during an extreme rain event. These plazas can be a cost-effective way to beautify the city and take some stress off of the sewer system. To protect their public transportation tunnels, the city is planning a \$30 million project to raise the tunnel vents located in floodplains above ground level to prevent inundation, and seal off the vents that are not necessary.



SOAK IT UP

PLAN A

In order to clean up the local river, the city has initiated a \$2.5 billion green infrastructure project to prevent sewer overflows and excessive storm water runoff. The project will strive to replace unnecessary "grey infrastructure" with new "green" options that slow and filter stormwater into the ground or sewer system. Planters will be built around stormwater drains, rain gardens created along buildings, and green roofs installed. The city will also replace asphalt paving with porous pavement in parking lots and curbside parking areas that are close to the river. Green infrastructure tends to last longer than typical grey infrastructure, and can reduce energy costs in the long run. Cleaning up the river could also make it available for recreational uses.

PLAN B

The city has initiated an incentive program that issues grants and tax breaks to private property owners such as homeowners and businesses that integrate green infrastructure on their properties. The city plans to spend up to \$2.5 million, (approximately \$4,000 a house) in grants for homeowners to design and build their own rain gardens, purchase rain barrels, and build flow-through planters. Businesses will have similar incentives. With up to \$5 million allotted, the city will award grants to businesses that wish to build green roofs and rain gardens, and purchase cisterns to limit the amount of stormwater runoff from the mostly impervious concrete buildings and surroundings. These new incentives could decrease the amount of stormwater runoff by millions of gallons.















INFORM THE PUBLIC

PLAN A

A big problem during extreme weather events, including extreme precipitation, is power loss due to flooding, wind, and heavy snow affecting power lines. To keep the city's power on during unpredictable storms, the city will invest \$1 billion to move vulnerable powerlines under ground, raise vulnerable switchboards above the floodplain, and improve the system to include more redundancy. The city will spend an additional \$200,000 to update the emergency notification system to reach more people in more languages to make sure people can prepare and head to safety if needed, and designate more buildings as storm shelters throughout the city.

PLAN B

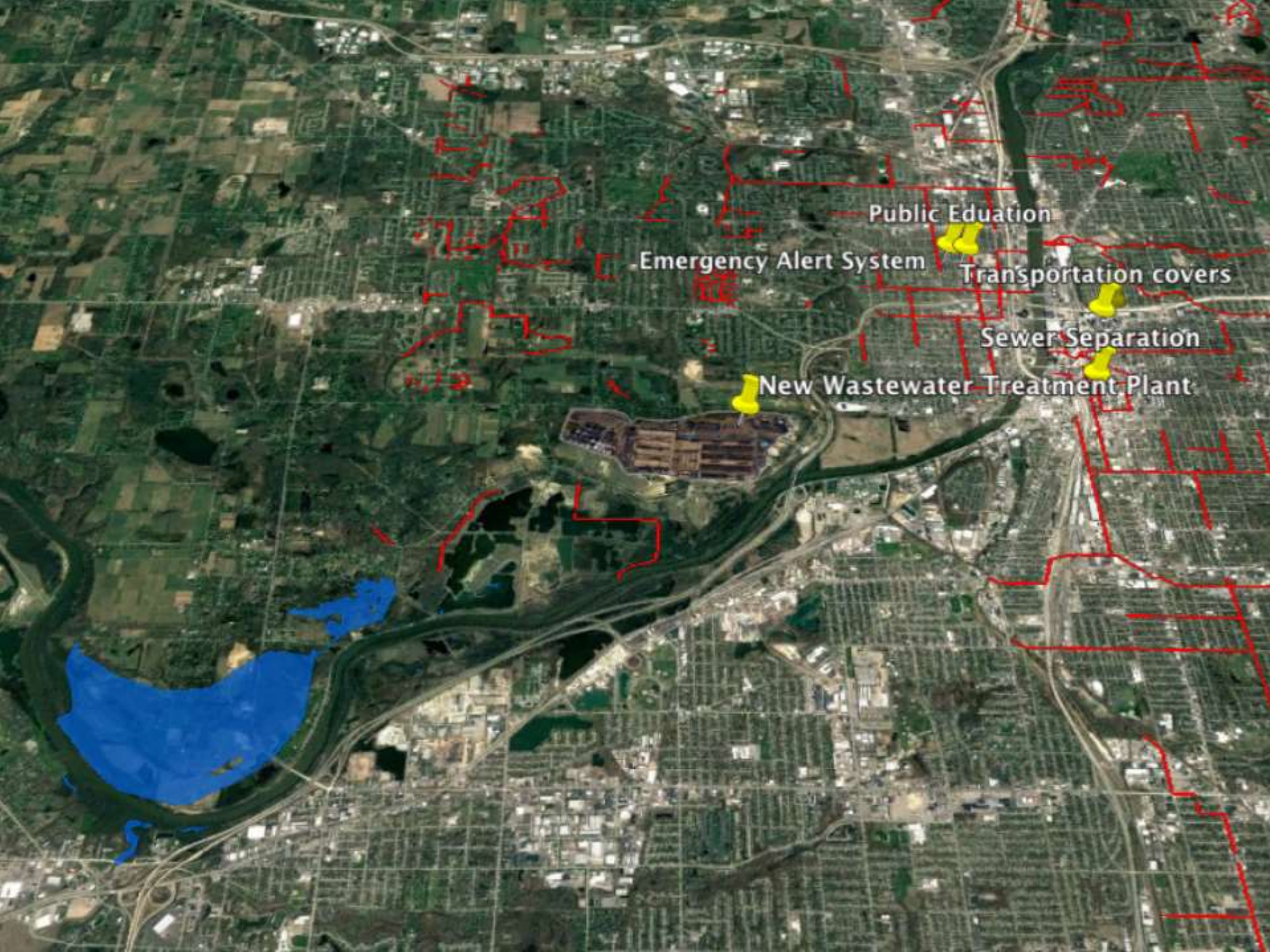
To keep costs low, but to ensure the city can limit the number of power outages, the city has decided to create microgrids for hospitals, homeless shelters, and schools. These microgrids will disconnect from the larger power grid and run on a separate power source during a storm, which allows the buildings to continue running properly if a power outage occurs. The city will also set up an emergency alert system that sends alerts in multiple languages to cell phones and start a public safety campaign that explains how to remain safe during extreme precipitation events, including when to evacuate and where to go if an evacuation is needed. All of these updates will cost just over \$20 million.

STRATEGIES	RESILIENCE PLAN A	RESILIENCE PLAN B
<p data-bbox="104 258 372 305">"Keep it Out"</p> 	 	
<p data-bbox="112 601 359 648">"Soak it Up"</p> 	 	
<p data-bbox="46 943 436 991">"Inform the Public"</p> 	 	



N

Google earth



Public Education

Emergency Alert System

Transportation covers

Sewer Separation

New Wastewater Treatment Plant