

# Building a Stormwater Flood Resilience Plan – Mapping to Mitigation

MWCOG Chesapeake Bay and Water Resources Policy Committee (CBPC) Meeting

Friday, May 15<sup>th</sup>, 2026

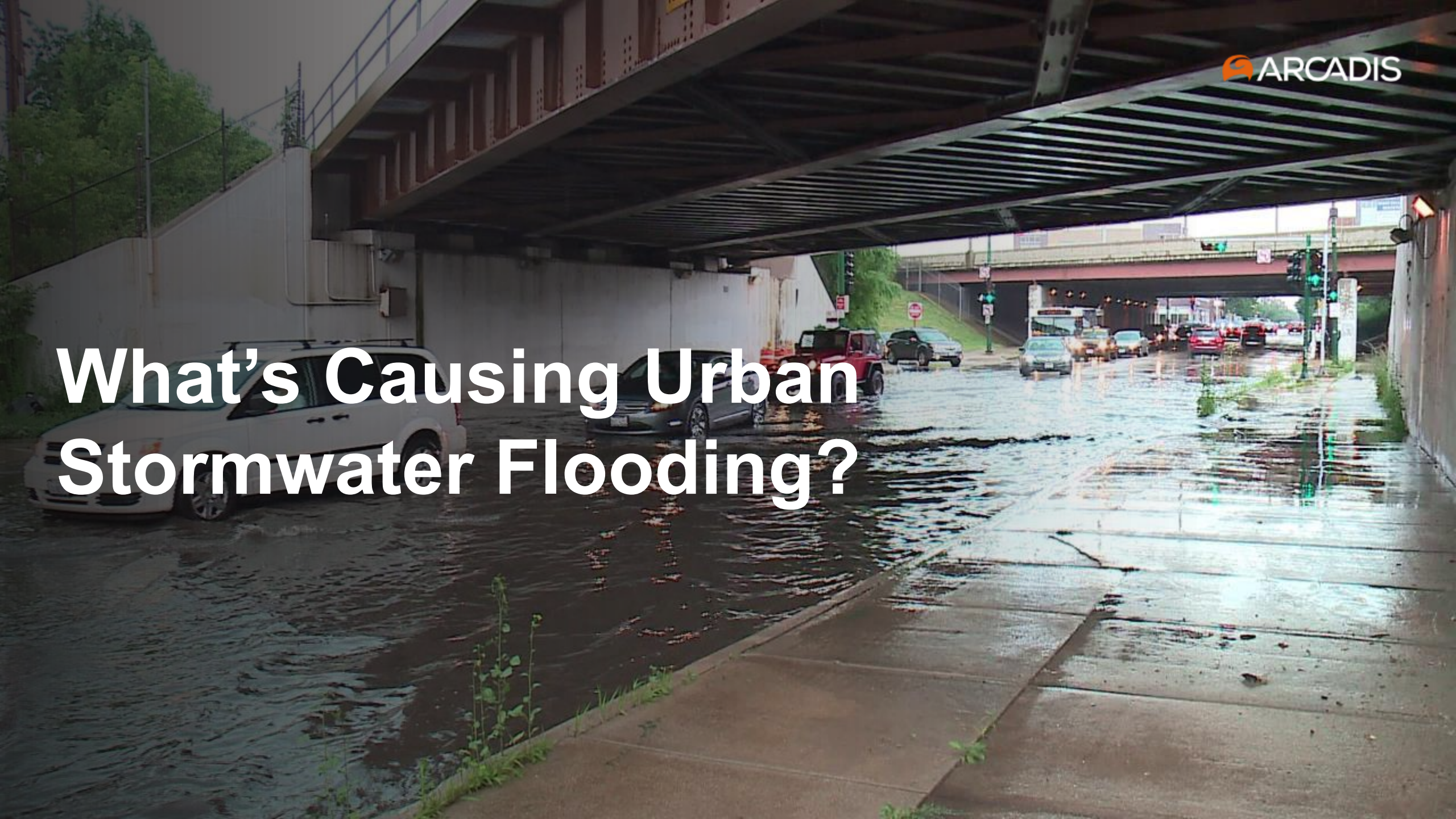


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Co-Lead Global Stormwater and Flood Risk Community of Practice

*Arcadis*

# What's Causing Urban Stormwater Flooding?



# What's Causing Urban Stormwater Flooding?



**More intense and frequent rainfall**



**Gravity-driven drainage systems designed for a climate and built-environment that no longer exists**



**Outside the traditional FEMA floodplain**



**Lack of regulatory structure and funding for stormwater flooding**

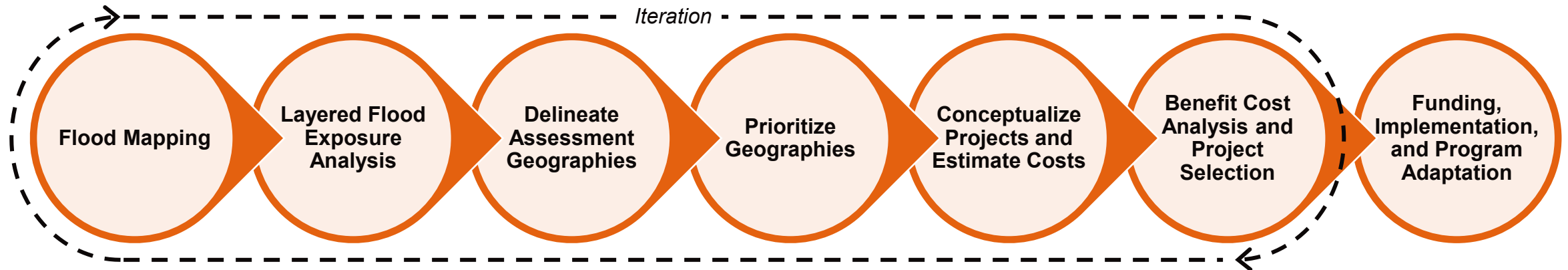
A photograph of a flooded road. In the foreground, a large, circular stormwater drain is overflowing with turbulent, grey water. The road surface is dark and wet. In the background, a black car is driving through the floodwaters, its rear end visible. Yellow caution tape with the word "CAUTION" printed in black is strung across the road, partially obscuring the car. Two white and red striped construction barriers with orange lights on top are positioned further back on the road. The scene is set against a backdrop of dense green trees.

# Building a Stormwater Flood Resilience Plan

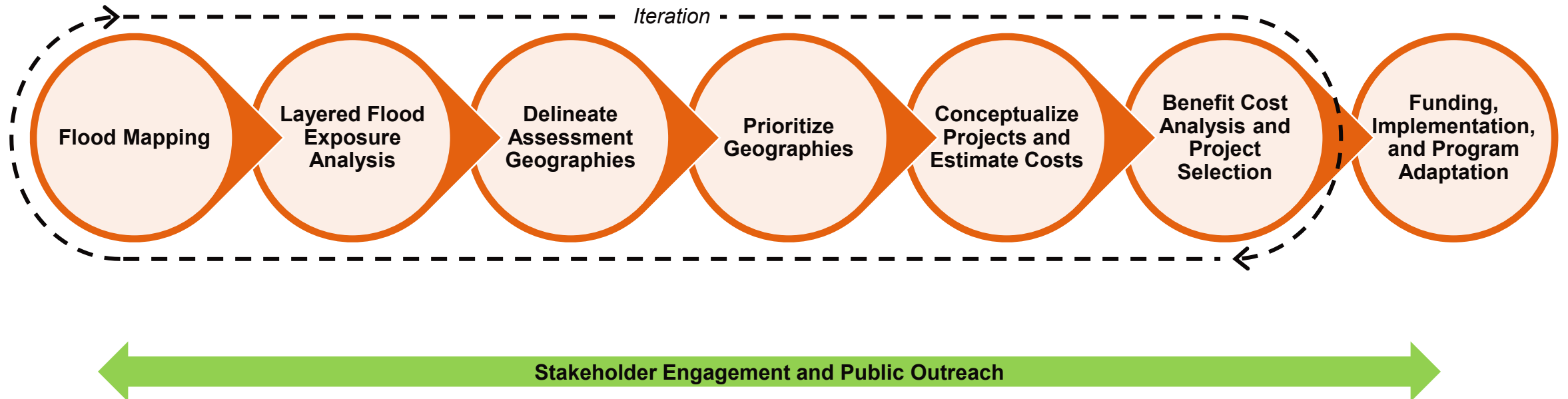
# Approach to Building a Stormwater Flood Resilience Plan



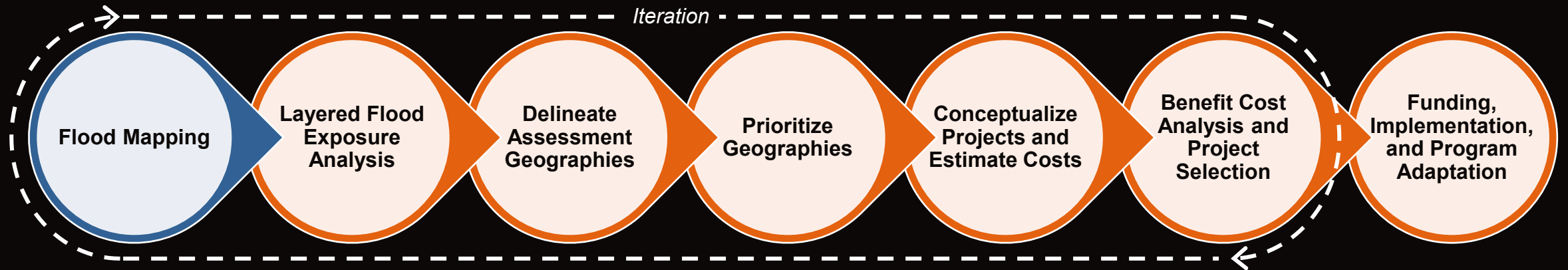
# Re-evaluate When Necessary!



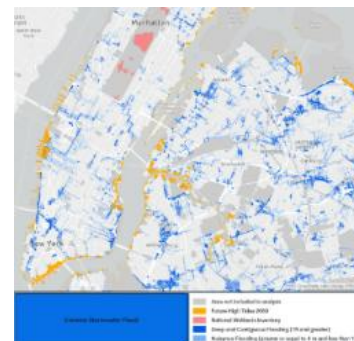
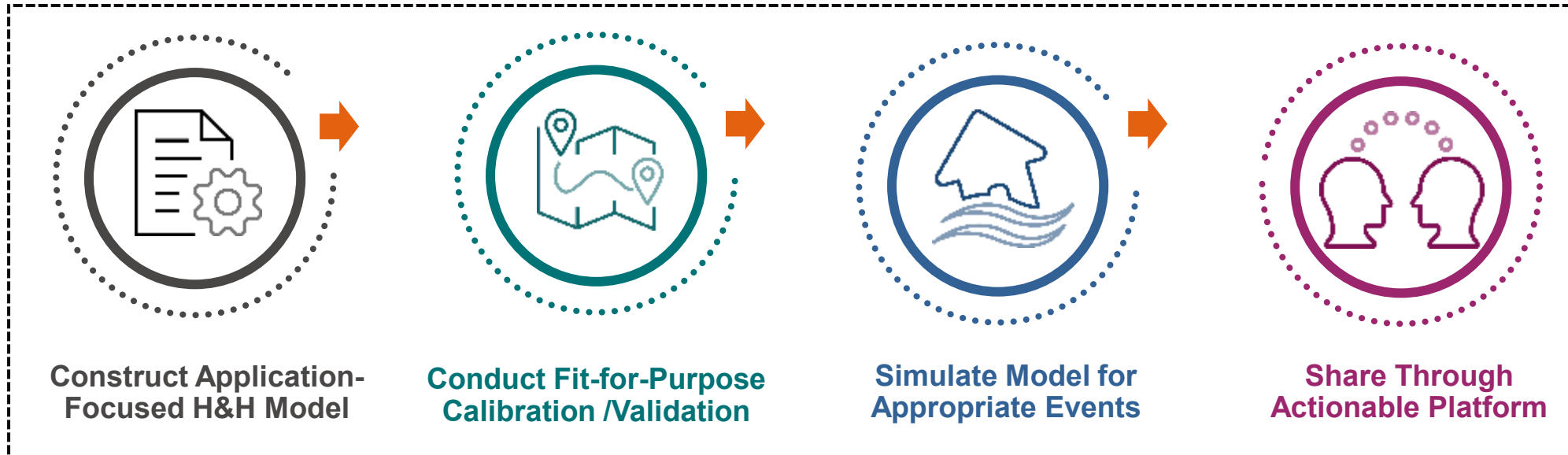
# Bring Stakeholders Along



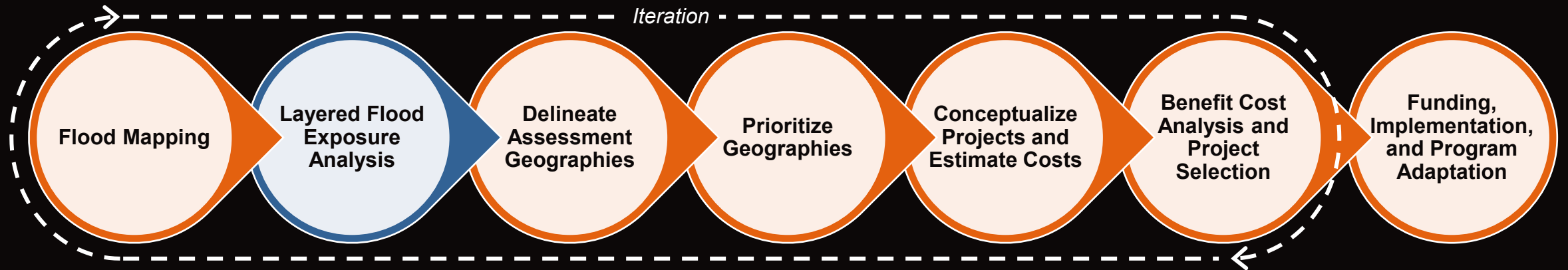
# Flood Mapping



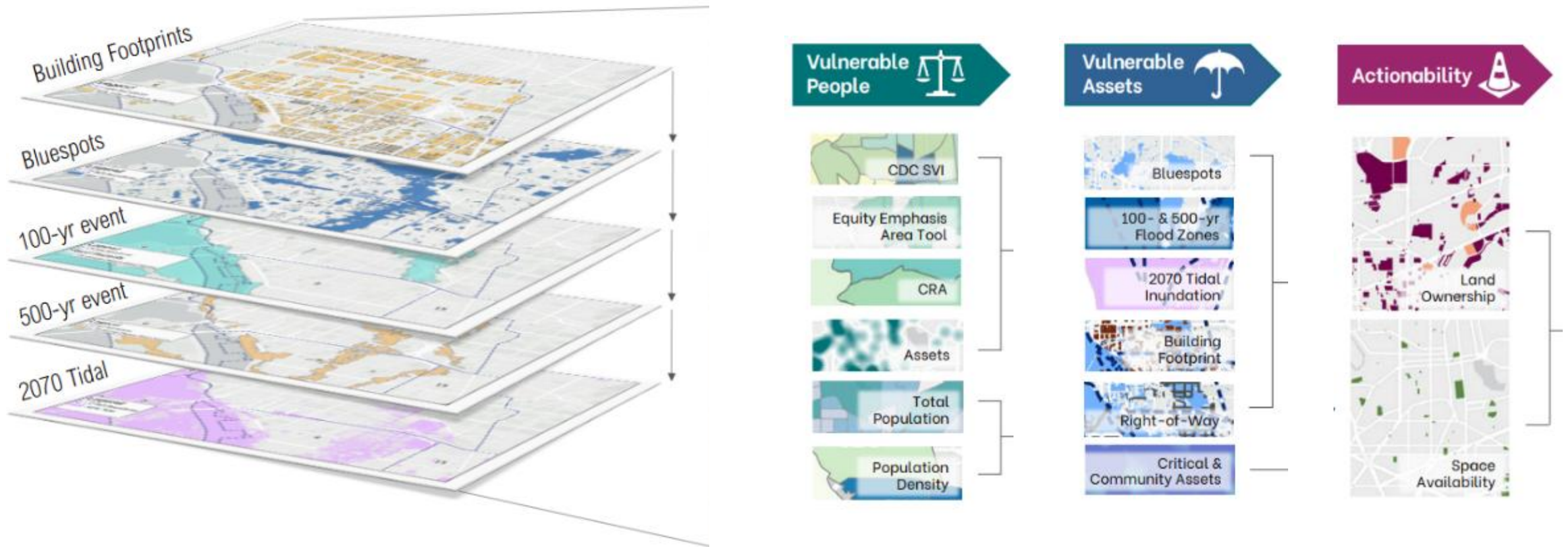
# Approach to H&H Model-Based Flood Mapping



# Layered Flood Exposure Analysis



# Example: DC Resilience Focus Areas Strategy



Learn more at:

[https://doee.dc.gov/sites/default/files/dc/sites/doee/service\\_content/attachments/Resilience%20Focus%20Area%20Strategy\\_FINAL.pdf](https://doee.dc.gov/sites/default/files/dc/sites/doee/service_content/attachments/Resilience%20Focus%20Area%20Strategy_FINAL.pdf)

# Example: FiDi-Seaport Climate Resilience Master Plan

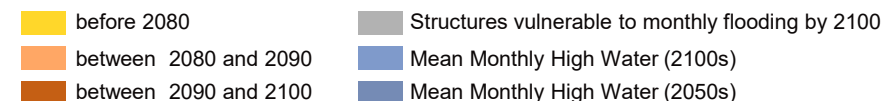


Figure 6: Repetitively Flooded Buildings

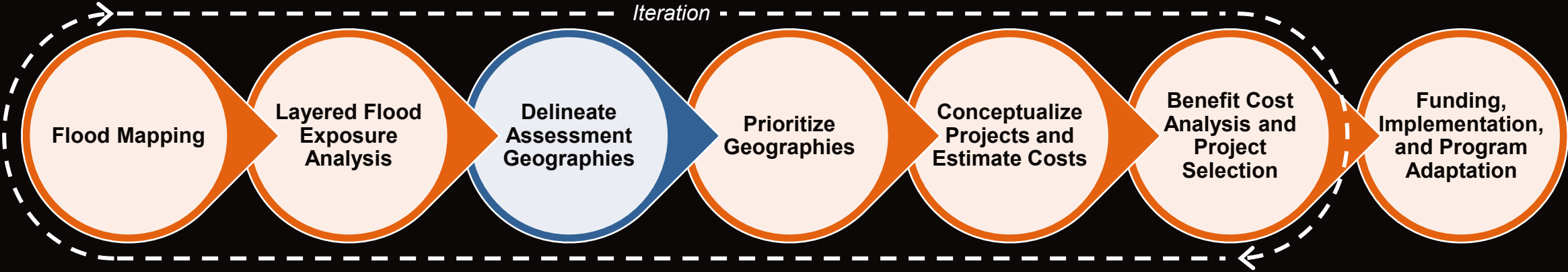
Modelling suggests that if nothing is done to protect the area, estimated quantified losses would include:

- **\$8.4 billion** in **direct economic impacts**<sup>iii</sup> to businesses in the study area
- **\$6.7 billion** in **indirect and induced economic impacts** to businesses within the New York City Metropolitan Statistical Area (MSA)
- **\$2.5 billion** in **building damages**
- **\$1.7 billion** in **relocation costs**
- **\$770 million** in **contents damage**
- **\$264 million**<sup>iv</sup> in **social disruption**, including health costs from injuries and mental stress, and lost income due to health issues

Repetitive loss triggered by building replacement value



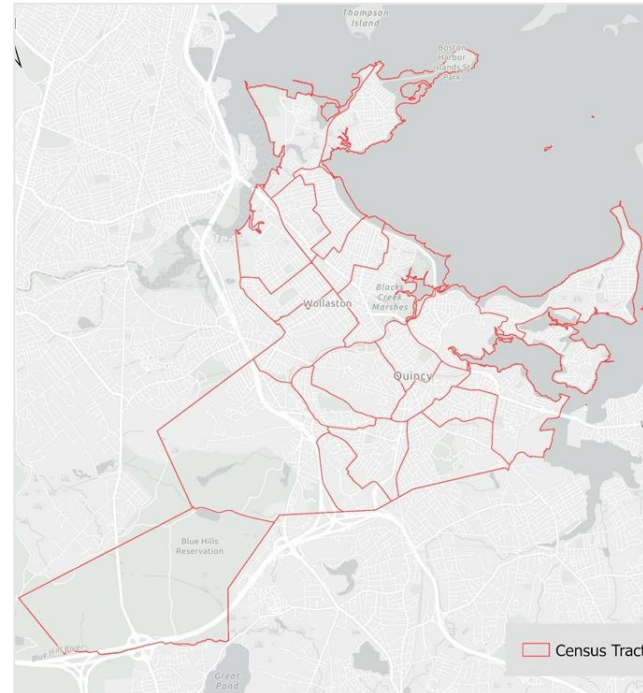
# Delineate Assessment Geographies



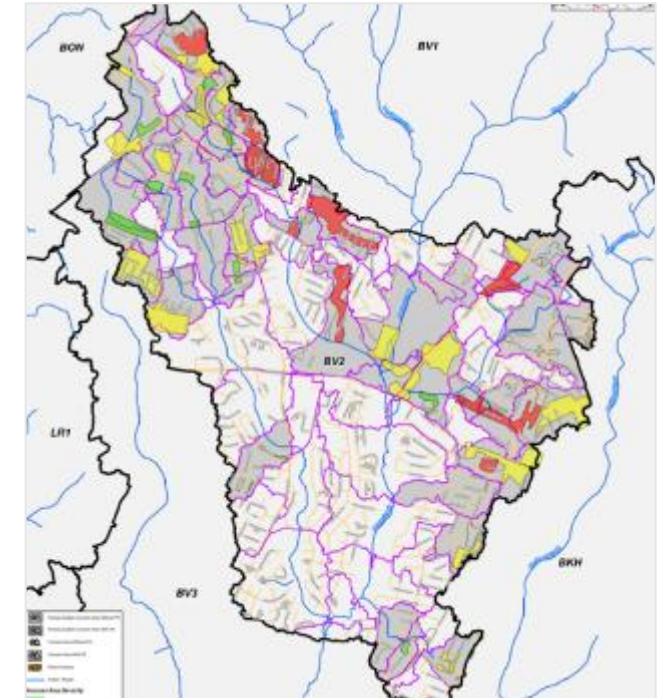
# Spatial Boundaries Facilitate Comparisons

## Geography Options:

- Watershed / sewershed boundaries
- Planning or growth districts
- Regulatory boundaries
- Community boundaries / council districts
- Homogeneous blocks/shapes

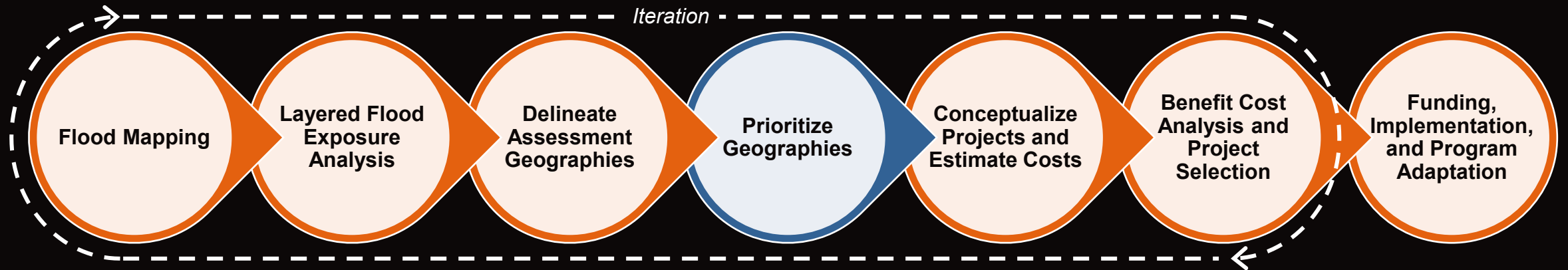


**Census Tracts in Quincy, MA**

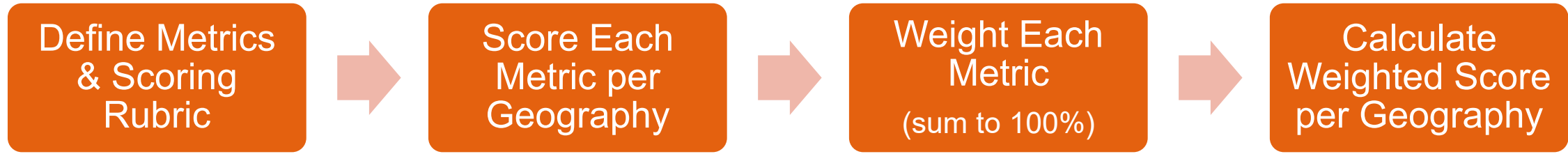



**Hydrologic Subbasins & Concern Areas in Fayetteville, NC**


# Prioritize Geographies

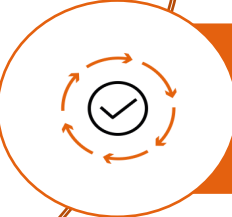


# Prioritization Approach



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Apply stakeholder-informed weighting
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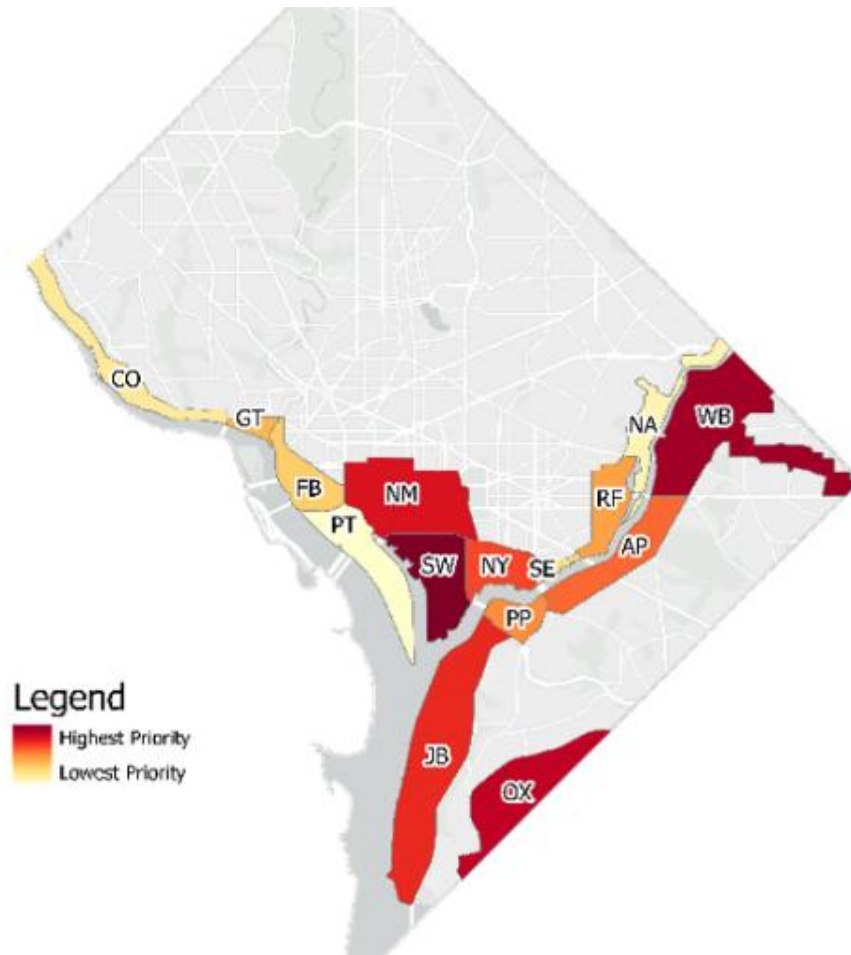
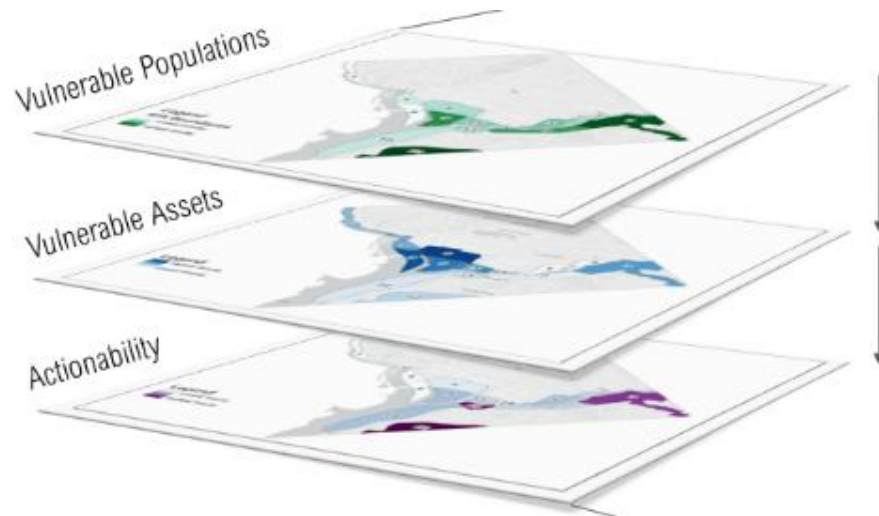
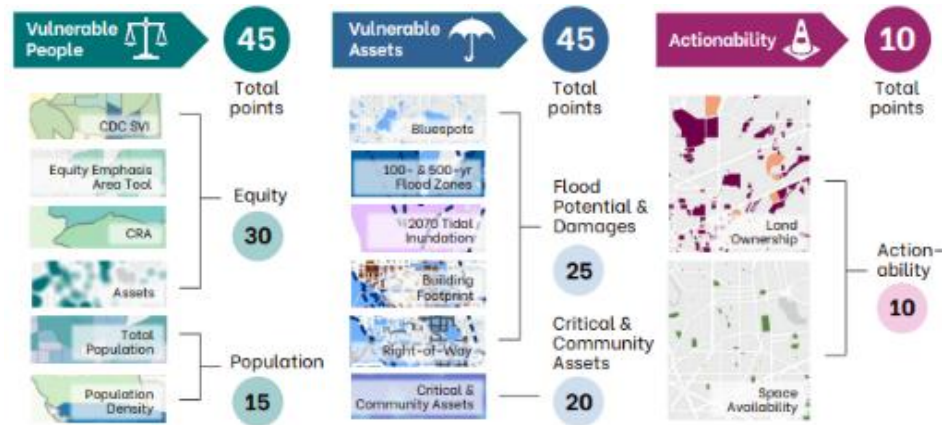
Accept subjectivity – not necessarily a “right” or “wrong”
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Iterate

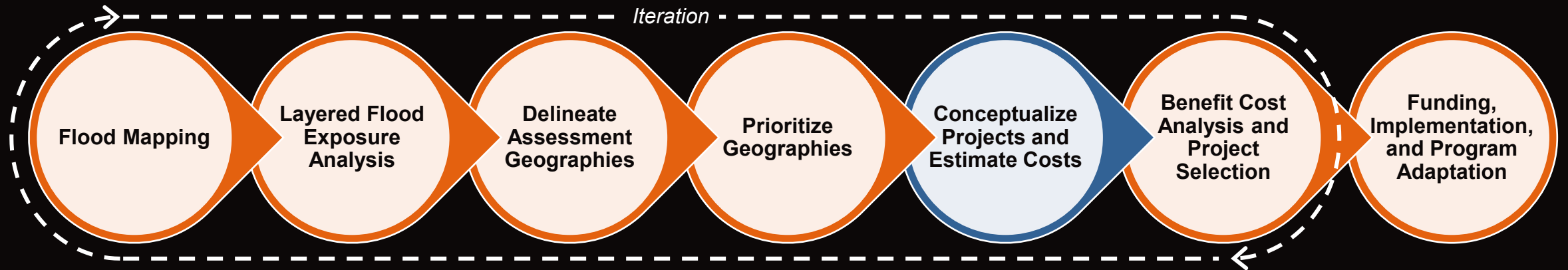
## Example: Fayetteville, NC Weighting Table

Concern Area ID	Type(s) of Concern Area (1,2, 3, and/or 4)	Criteria Scores					Final Outcomes			
		Impacted Lane Length (10%)	Summary AEP for Impacted Structures (10%)	Number of Essential Facilities (30%)	Number of Disconnected Dwelling Units and Other Structures (30%)	Traverse Road Crossing Risk Rating (20%)	Total Score	Weighted Score	Severity	Flowchart Recommendations
BV2_CA01	1	5	0	0	0	0	5	5	Med	Evaluation for Potential Projects
BV2_CA02	1, 2, 4	5	3	0	0	3	11	14	High	Evaluation for Potential Projects
BV2_CA03	1	5	0	0	0	0	5	5	Med	Evaluation for Potential Projects
BV2_CA04	1, 2, 4	5	1	0	0	1	7	8	Med	Evaluation for Potential Projects
BV2_CA05	1, 4	5	1	0	0	1	7	8	Med	Evaluation for Potential Projects
BV2_CA07	1, 3, 4	3	5	0	0	1	9	10	Med	Evaluation for Potential Projects
BV2_CA08	1, 4	5	1	0	0	1	7	8	Med	Evaluation for Potential Projects
BV2_CA10	1, 2, 4	3	3	0	0	0	6	6	Med	Evaluation for Potential Projects
BV2_CA11	1, 4	0	0	0	0	1	1	2	Low	No Further Action
BV2_CA14	1, 2, 4	5	5	0	0	1	11	12	High	Evaluation for Potential Projects
BV2_CA15	1	0	1	0	3	1	5	12	High	Evaluation for Potential Projects
<b>BV2_CA17</b>	<b>1, 4</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>11</b>	<b>20</b>	<b>High</b>	<b>Evaluation for Potential Projects</b>
BV2_CA18	1, 2, 4	3	1	0	0	0	4	4	Low	No Further Action
BV2_CA19	1, 4	3	0	0	0	1	4	5	Med	Evaluation for Potential Projects
BV2_CA22	1, 4	5	1	0	0	1	7	8	Med	Evaluation for Potential Projects
BV2_CA24	1, 3	1	1	0	0	0	2	2	Low	No Further Action
BV2_CA28	3, 4	0	1	0	0	0	1	1	Low	No Further Action
BV2_CA30	1,4	1	1	0	0	0	2	2	Low	No Further Action

# Example: DC Resilience Focus Area Strategy



# Conceptualize Projects and Estimate Costs

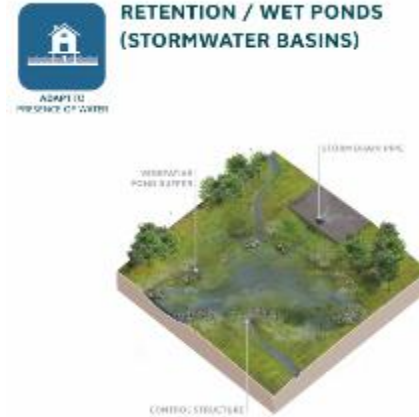


# Types of Solutions

## Expand Drainage Capacity



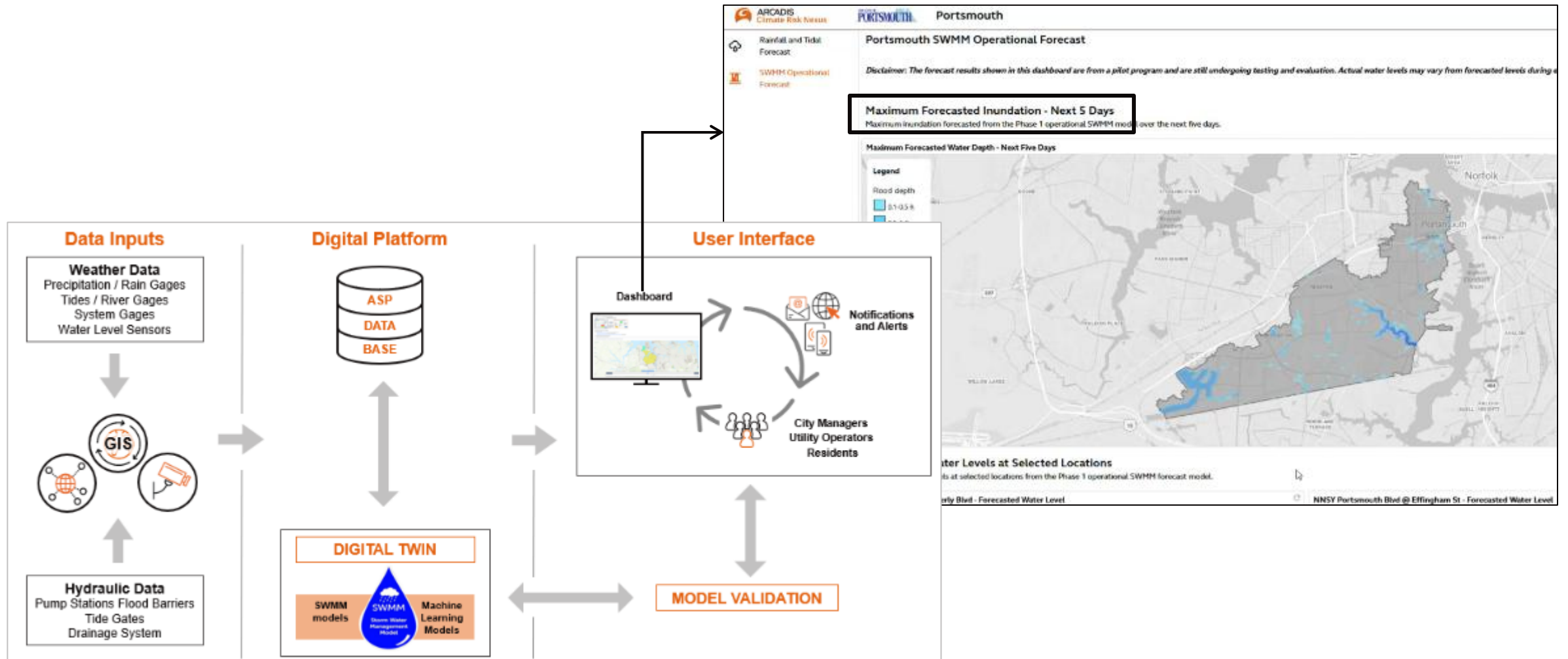
## Nature-Based Solutions



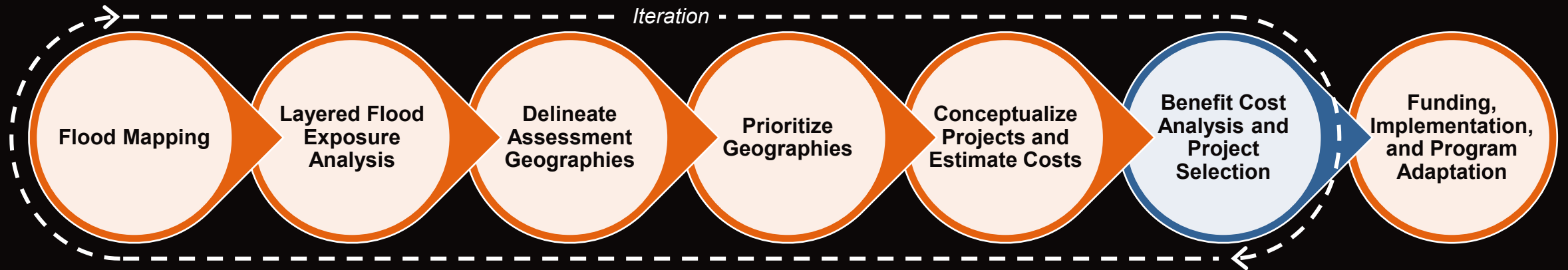
## Adapt Infrastructure and Improve Response



# Portsmouth, VA Real Time Flood Forecasting

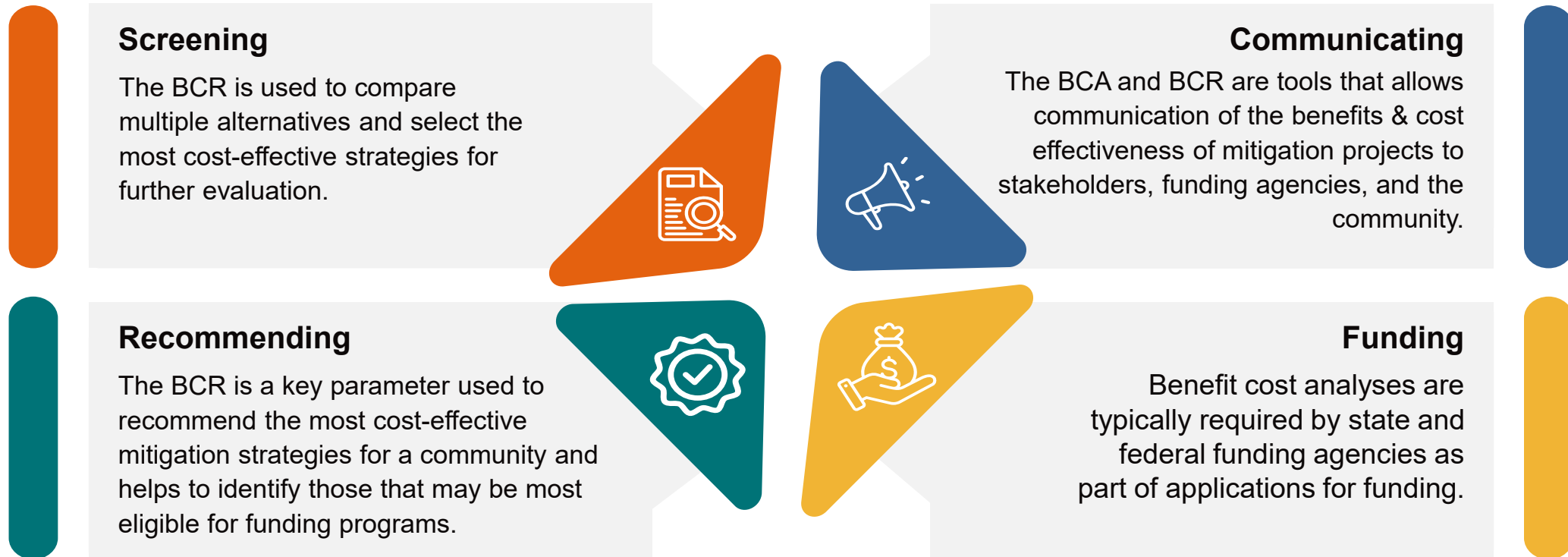


# Benefit Cost Analysis & Project Selection

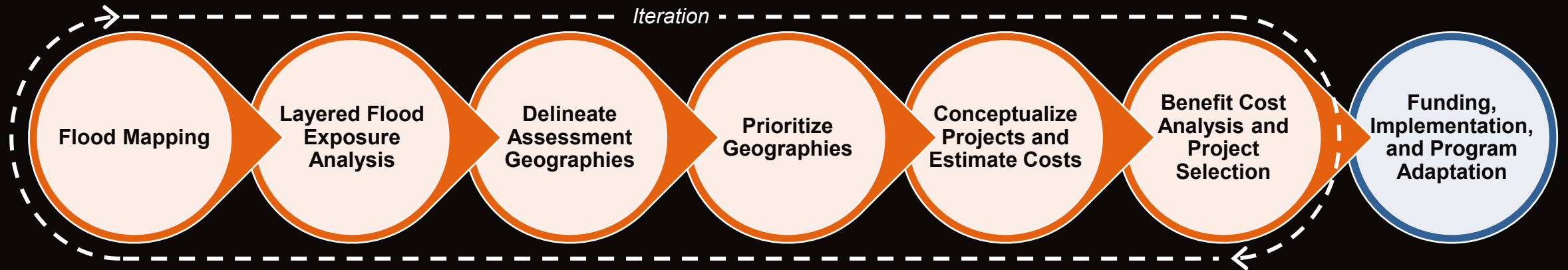


# Why Develop a Benefit Cost Analysis?

Compares the future benefits of a project to its costs. The benefit-cost-ratio, or BCR, is an important decision-making parameter in selecting the **most cost-effective projects and strategies.**



# Funding, Implementation, and Program Adaptation

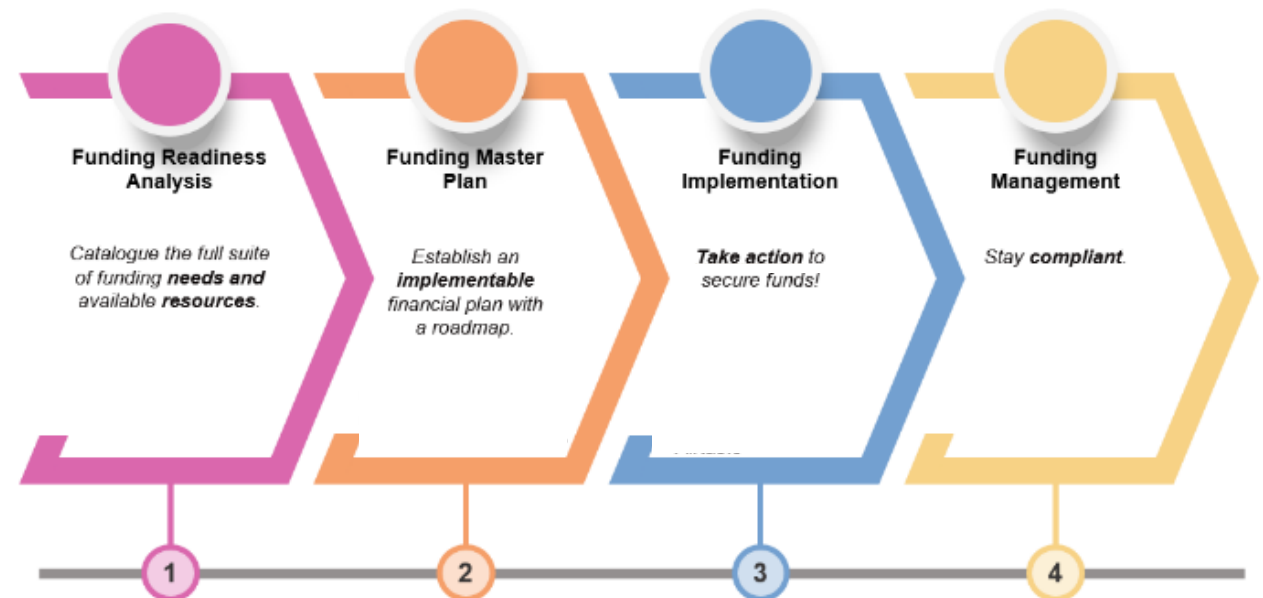


# Funding Streams and Process

## Funding Streams

<b>Dedicated Budget</b>	General Funds
	Capital Improvement Funds
<b>Revenue Generation and Value Capture</b>	Rate Studies and Adjustments
	General Obligation Bonds
	Local Sales or Property Tax
	TIF Districts, Special Service Districts
	User Fees
	Impact Fees and Assessments
<b>Grants and Loans</b>	Federal and State Grants
	Congressional Allocations (formerly earmarks)
<b>Debt Financing</b>	Municipal Bonds
	Clean Water State Revolving Fund (CWSRF)
	State Infrastructure Bank (SIB) Loans
	Public Financing Authority
<b>Partnership and Concessions</b>	Public-Private Partnerships (P3s) paired with Private Activity Bonds
	Asset Concessions

## Funding Process



# Continual Program Adaptation



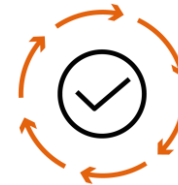
**Deploy Sensors for Ongoing system monitoring and data collection**



**Project performance monitoring**



**Update and maintain investments** (H&H models, BIM models, sensors)



**Plan the next cycle –**  
*Don't let perfect be the enemy of good*

**Thank you!**



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