

SEA LEVEL, STORMWATER, AND LAND USE: INUNDATION IN CITY PLANNING FOR COOS BAY, OREGON

C Stillman, MLA 2019

A misty landscape with a river and trees. The scene is overcast and hazy, with a river flowing through a valley. The background shows a line of trees and hills under a grey sky. The foreground features some bare branches on the right side.

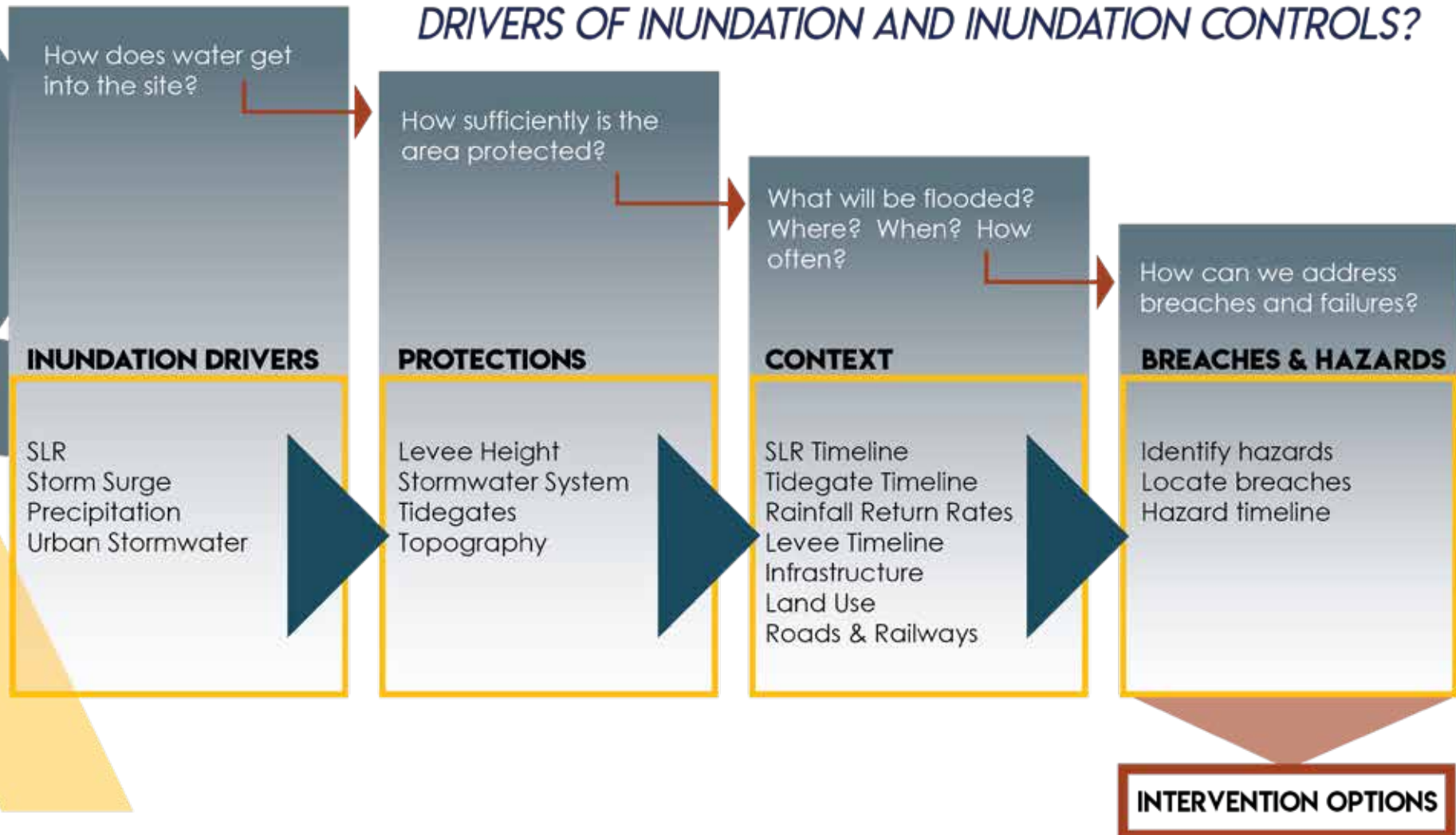
This research leans on contemporary, well-respected work from...

Structures of Coastal Resilience (Nordenson, Nordenson, and Chapman, 2018)

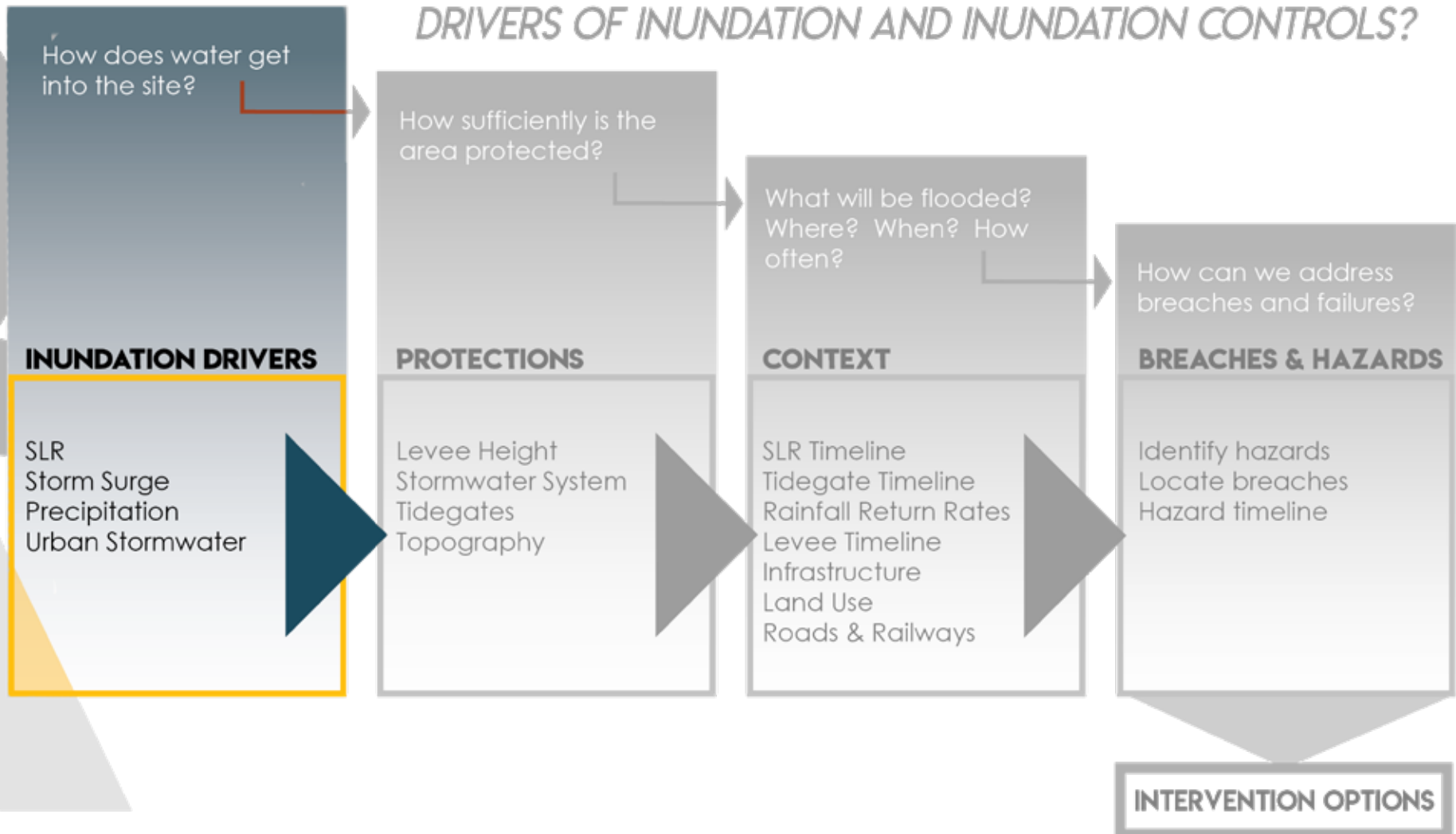
Adapting Cities to Sea Level Rise (AI, 2018)

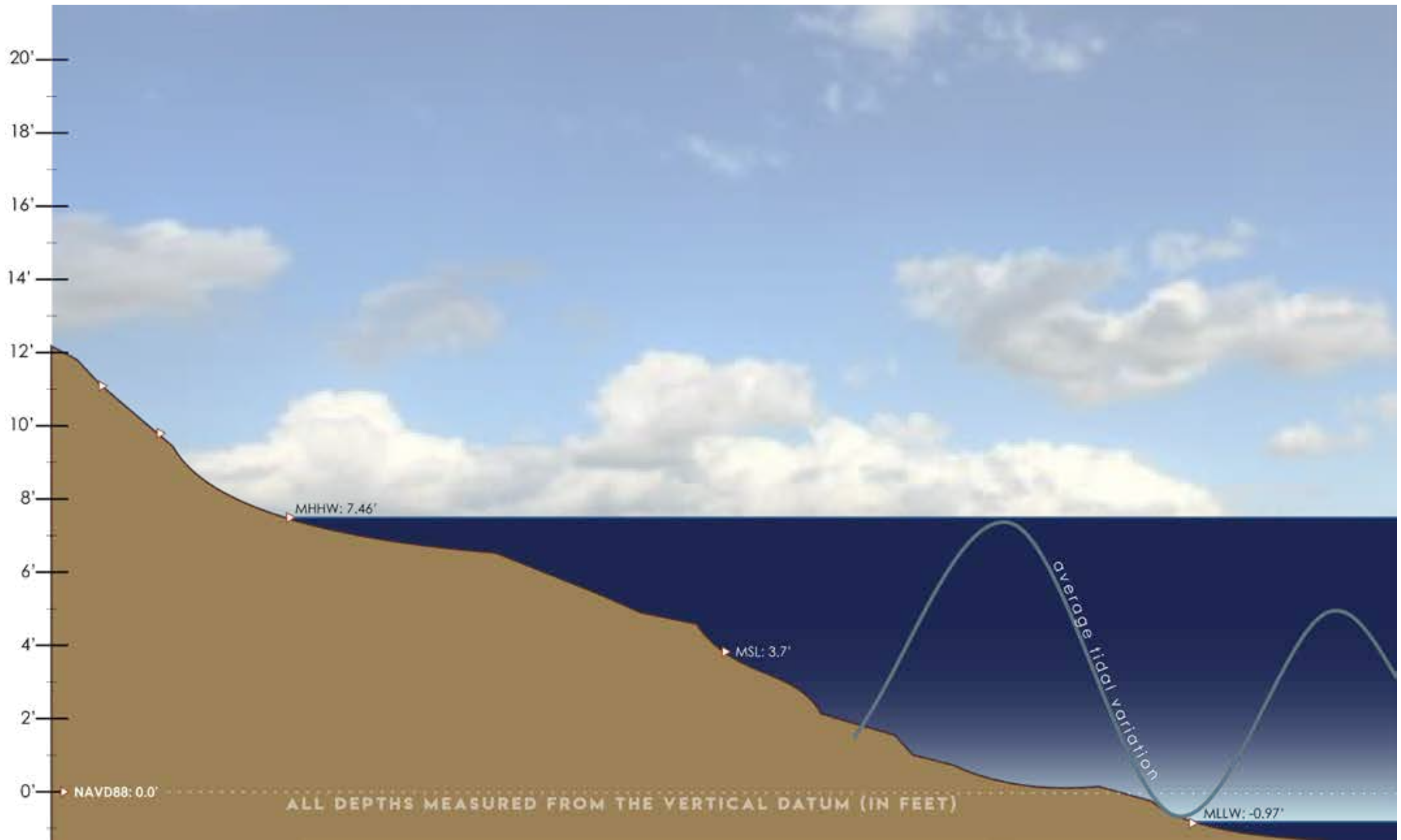
Synthesis of Adaptation Options for Coastal Areas (EPA, 2009)

WHAT OPPORTUNITIES FOR FLOOD MITIGATION EMERGE BY MAPPING DRIVERS OF INUNDATION AND INUNDATION CONTROLS?

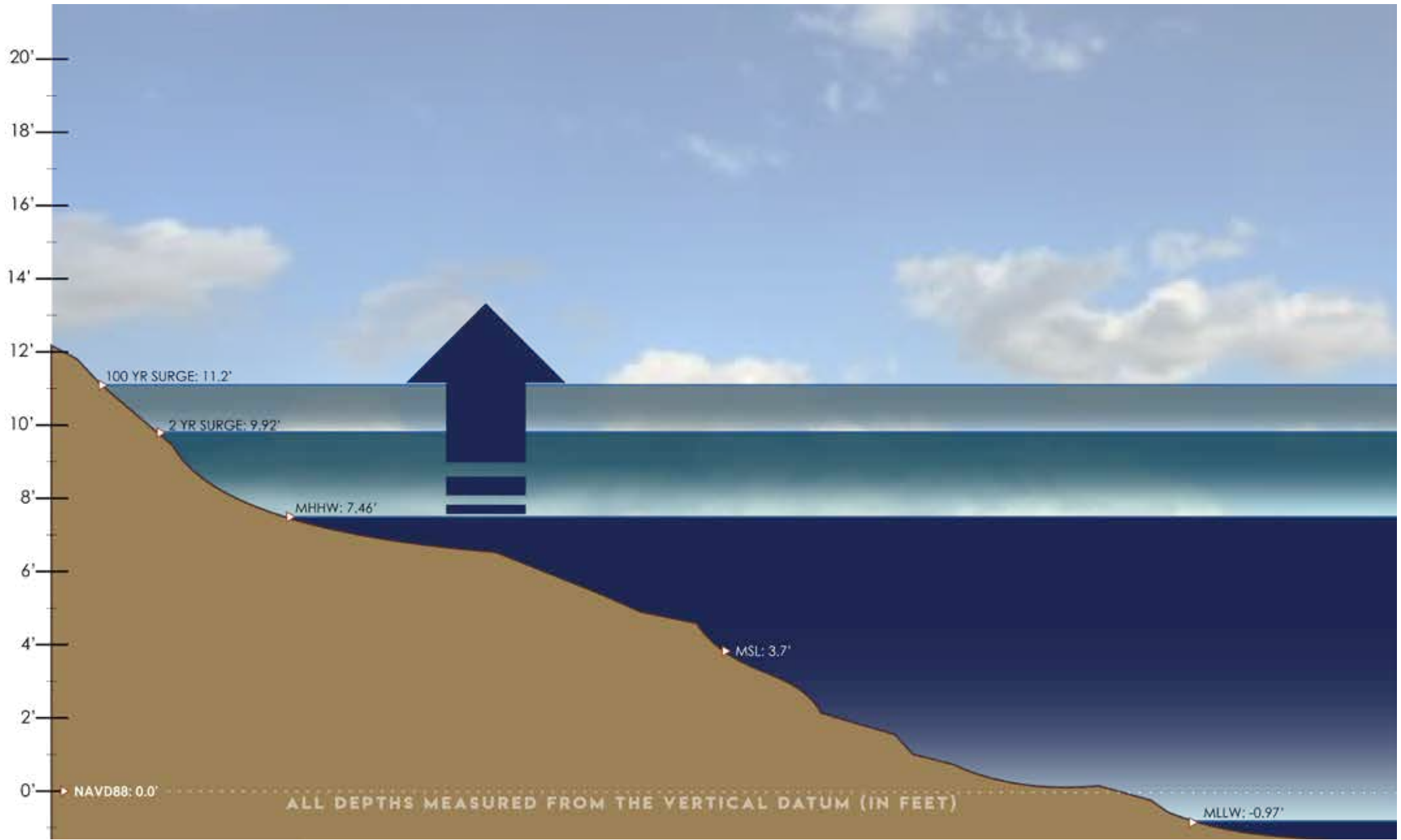


WHAT OPPORTUNITIES FOR FLOOD MITIGATION EMERGE BY MAPPING DRIVERS OF INUNDATION AND INUNDATION CONTROLS?

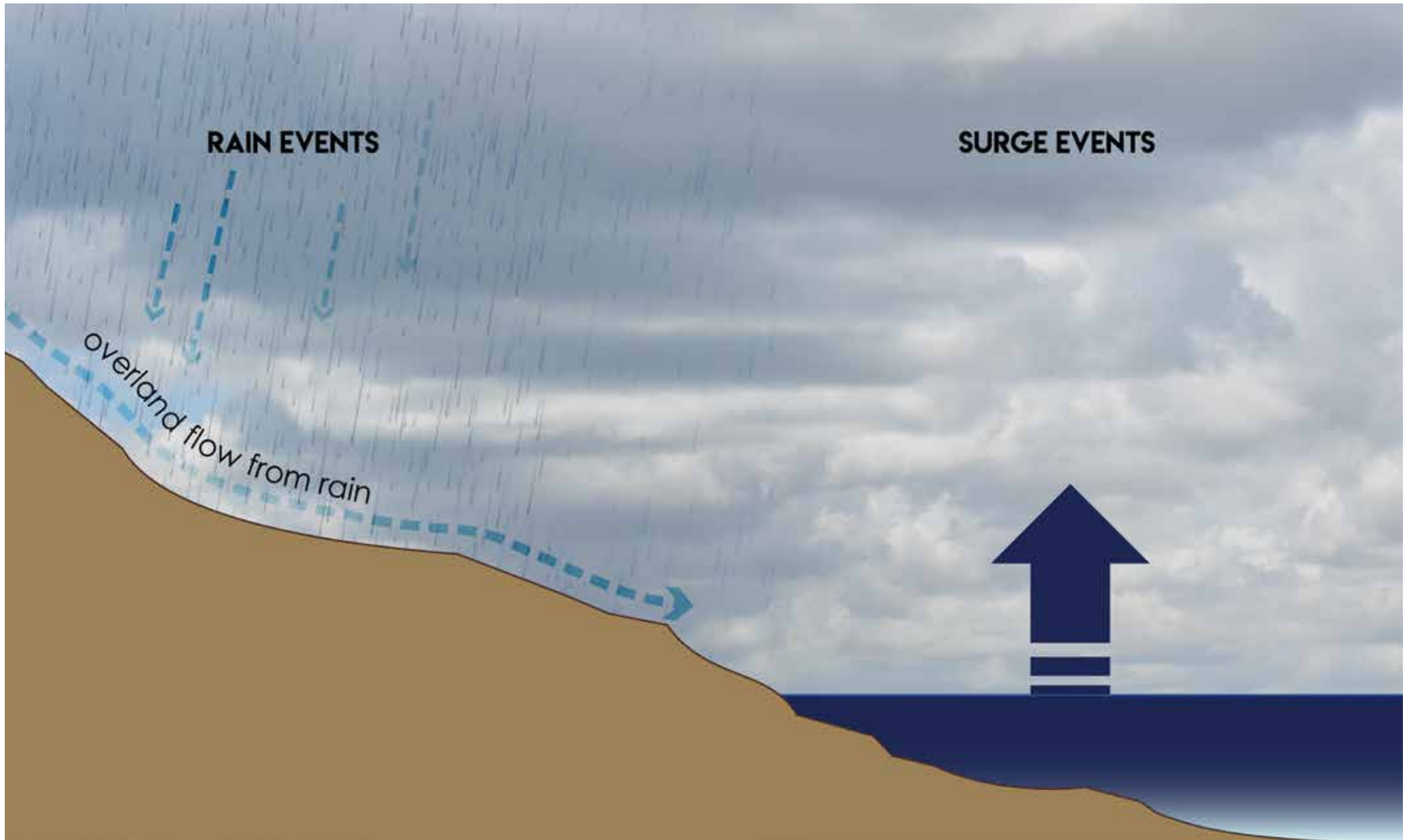




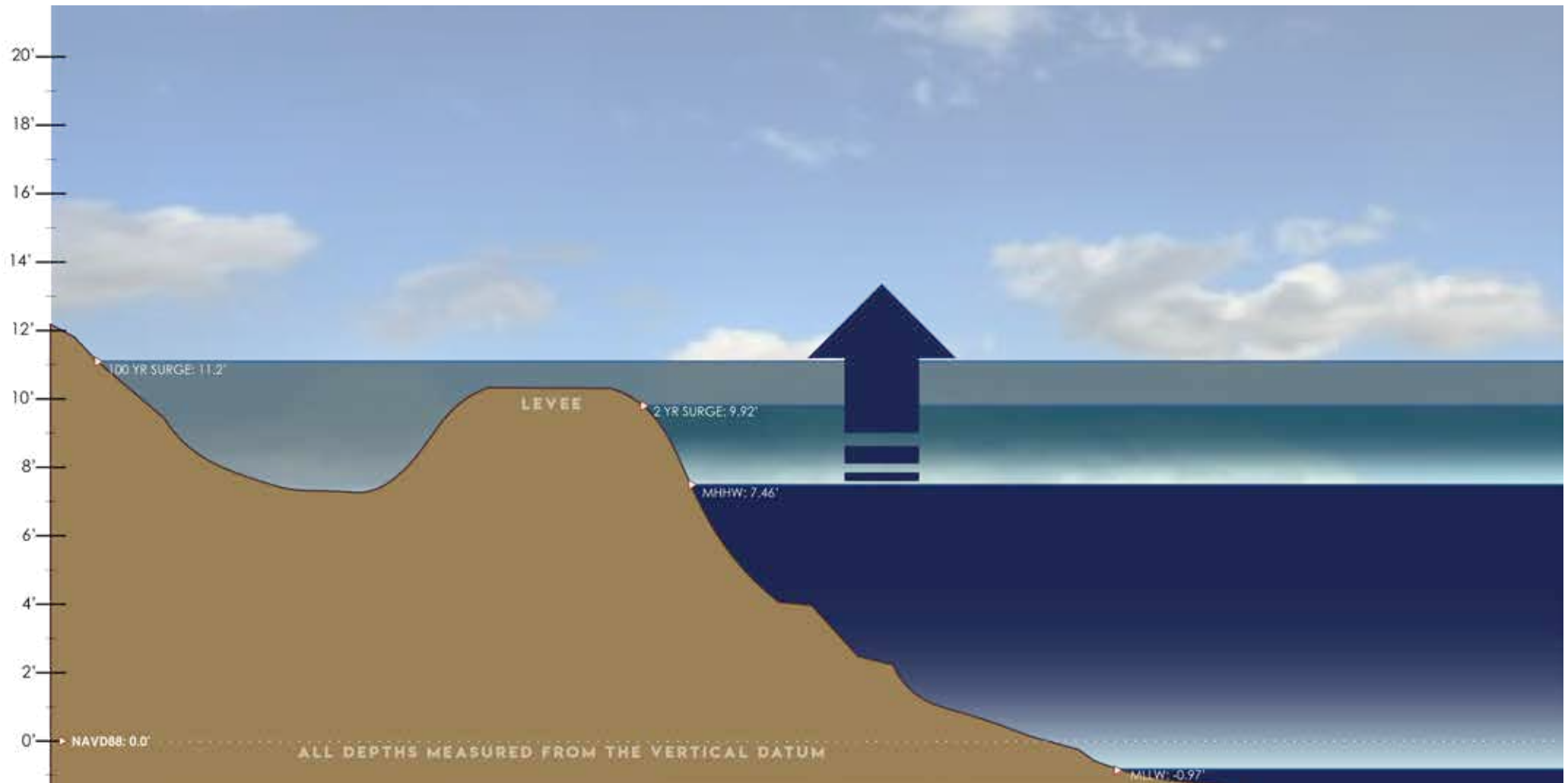
TERMS AND PROCESS: **PRIMER**



TERMS AND PROCESS:
PRIMER



TERMS AND PROCESS: **PRIMER**



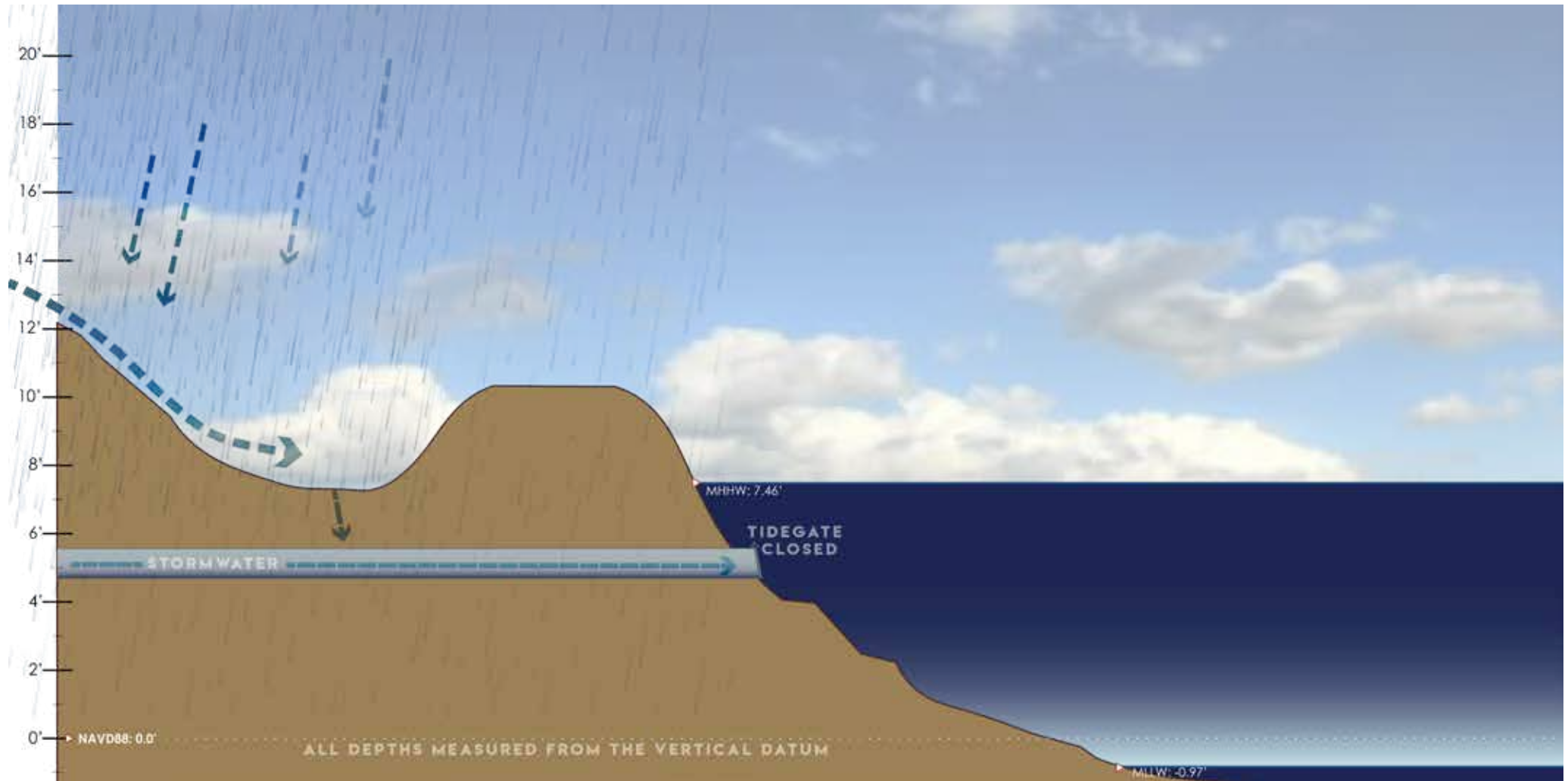
TERMS AND PROCESS: **PRIMER**



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TERMS AND PROCESS: **PRIMER**



MHHW

2019

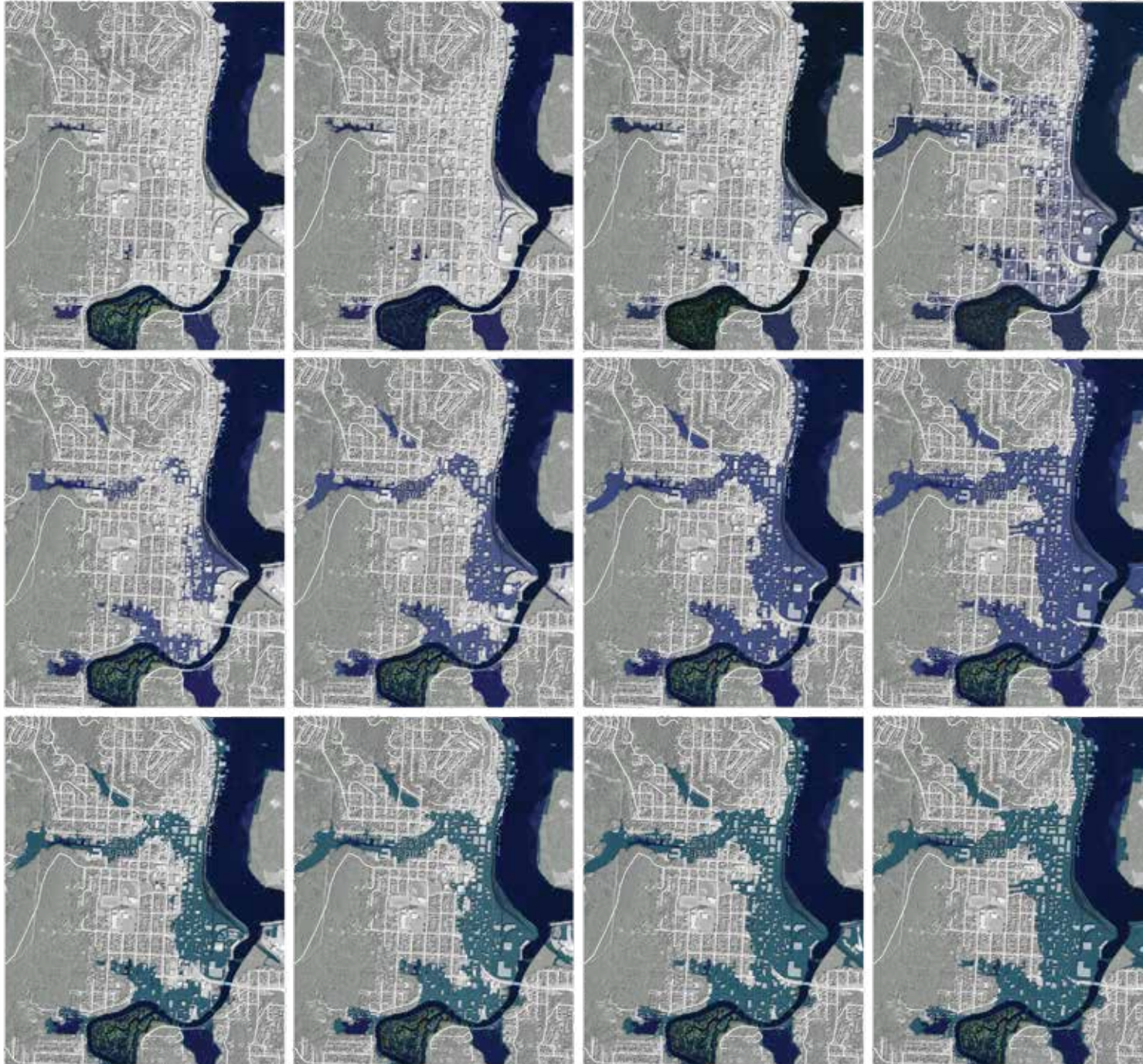
2030

2050

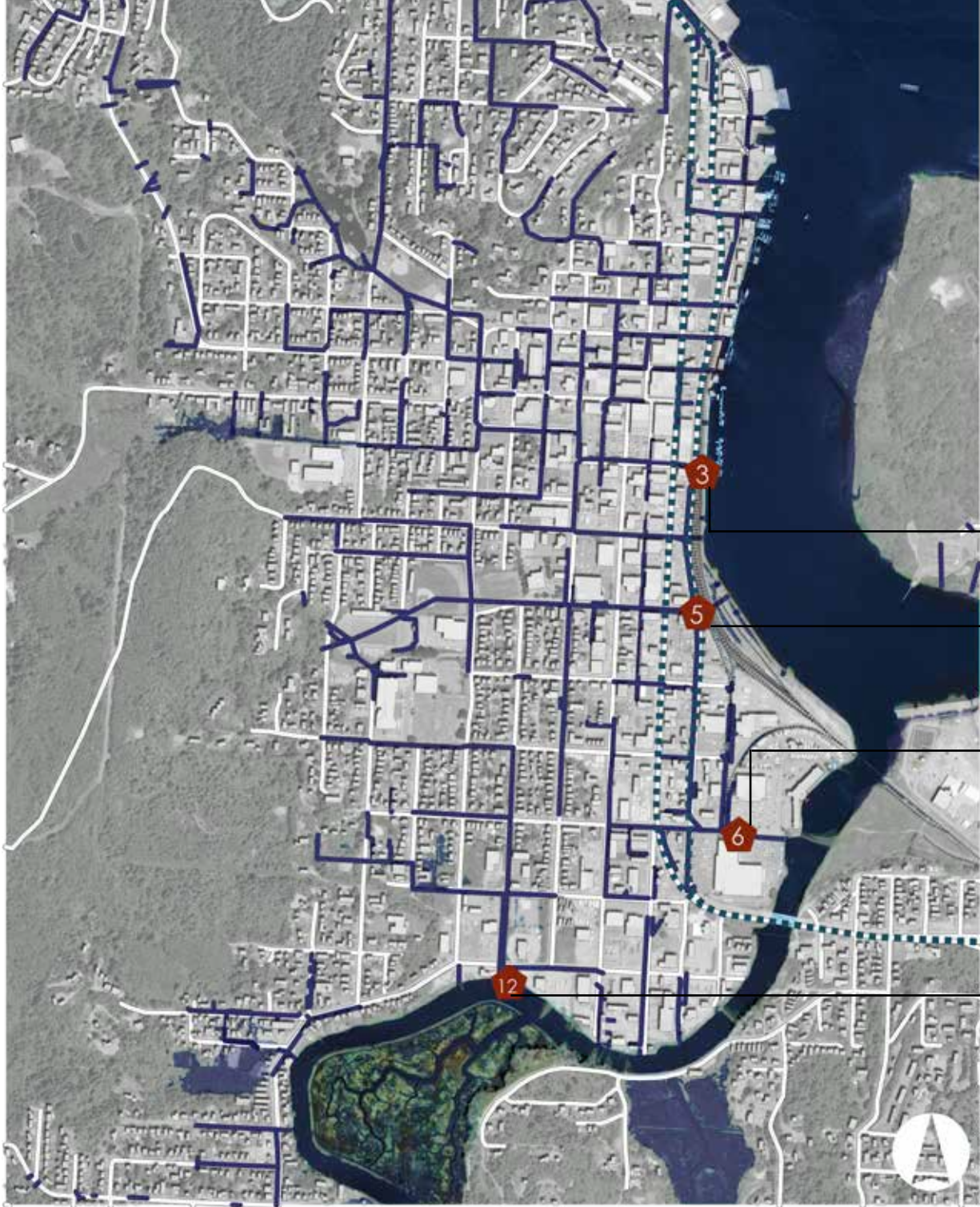
2100

+2-YR SURGE

+100-YR SURGE



SURGE / SLR
INUNDATION



◆ tidegate
 — stormwater pipes

2yr Rain event /
 100yr Rain event
 (in acre*feet)

31 / 53

22 / 37

11 / 18

19 / 33

31 AF

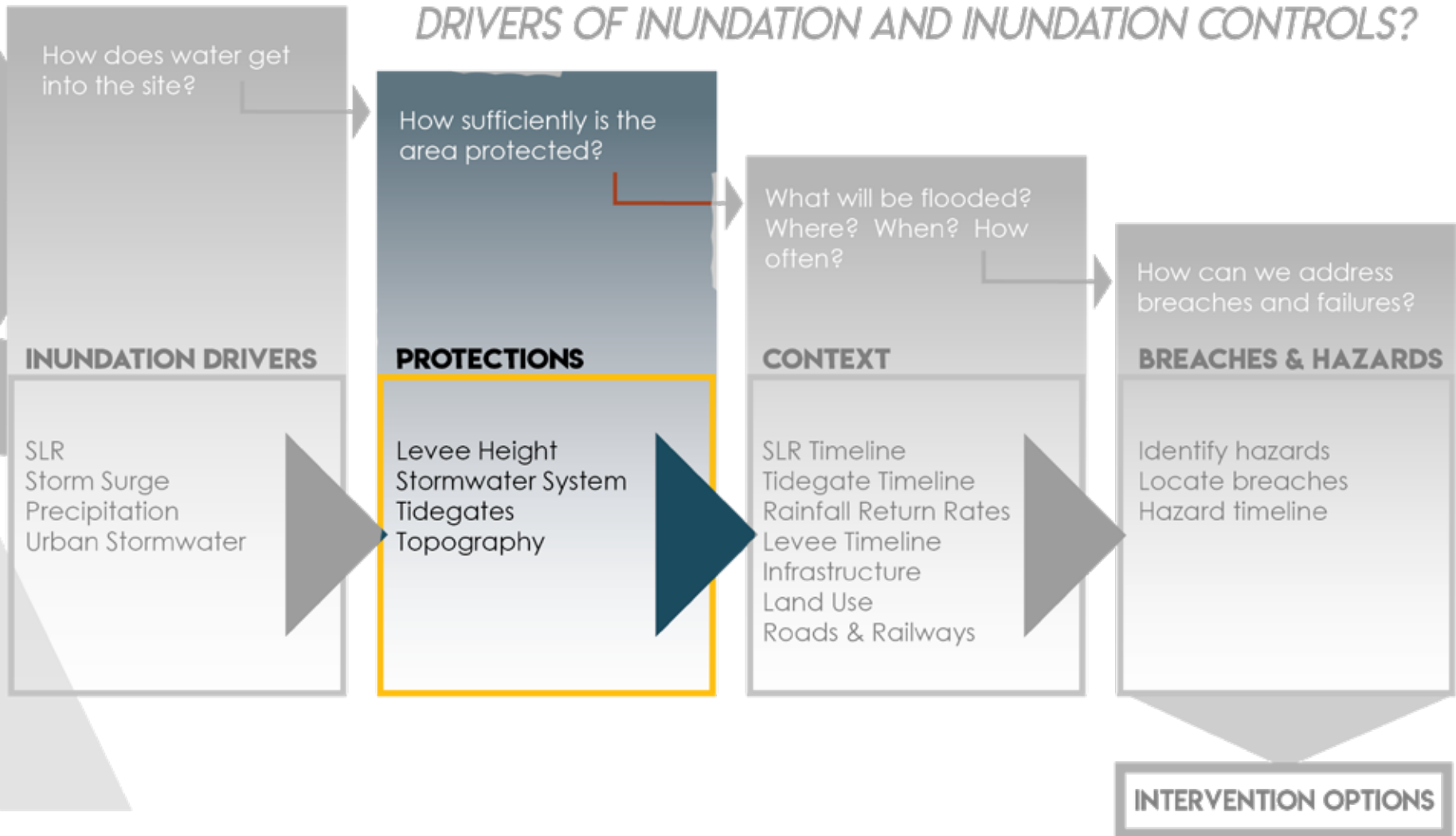
22 AF

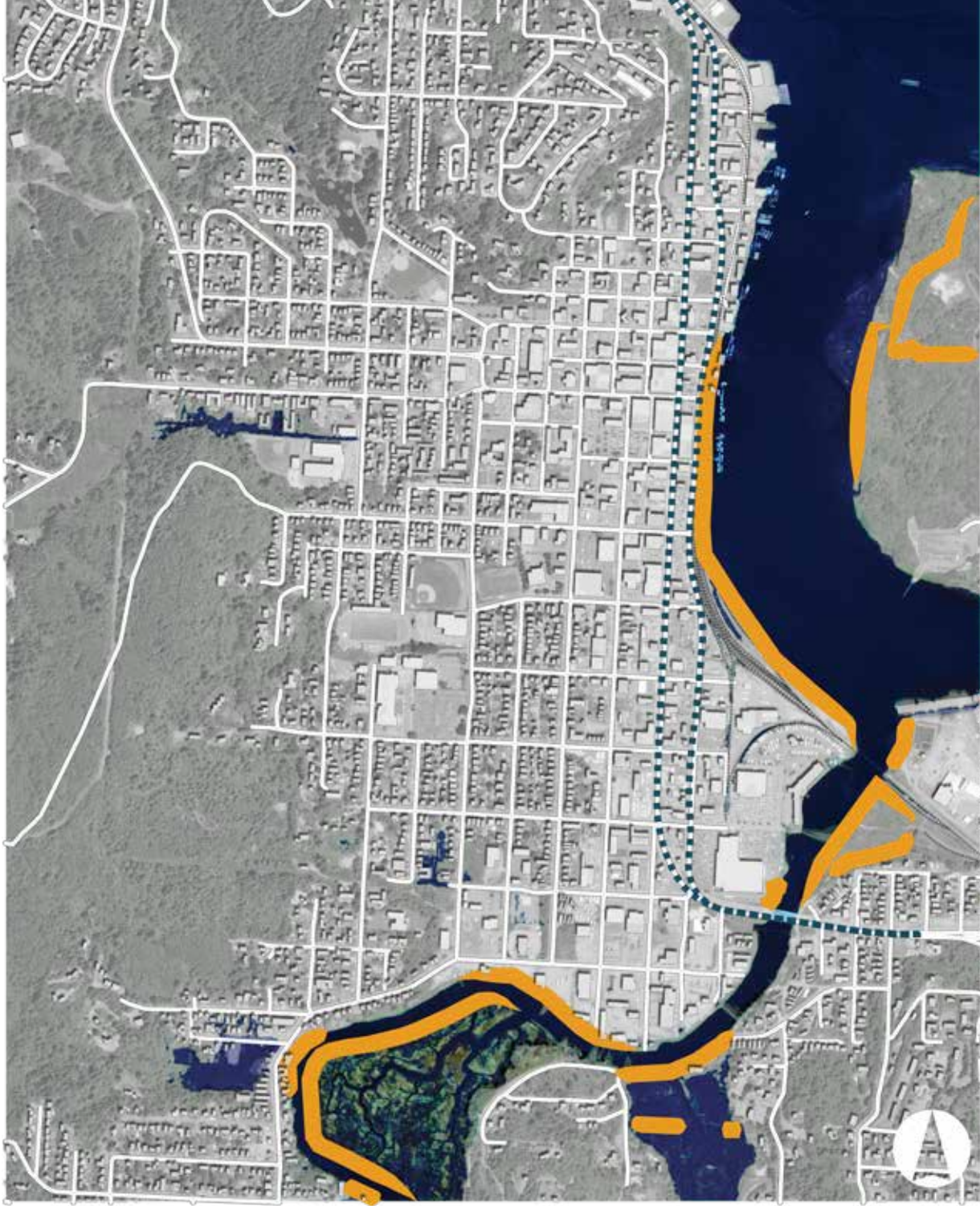
11 AF

19 AF

RAIN / STORMWATER INUNDATION

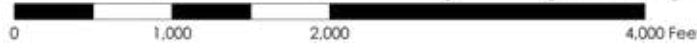
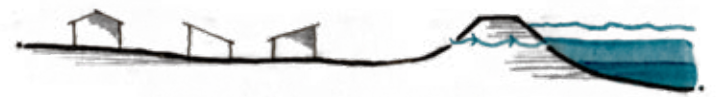
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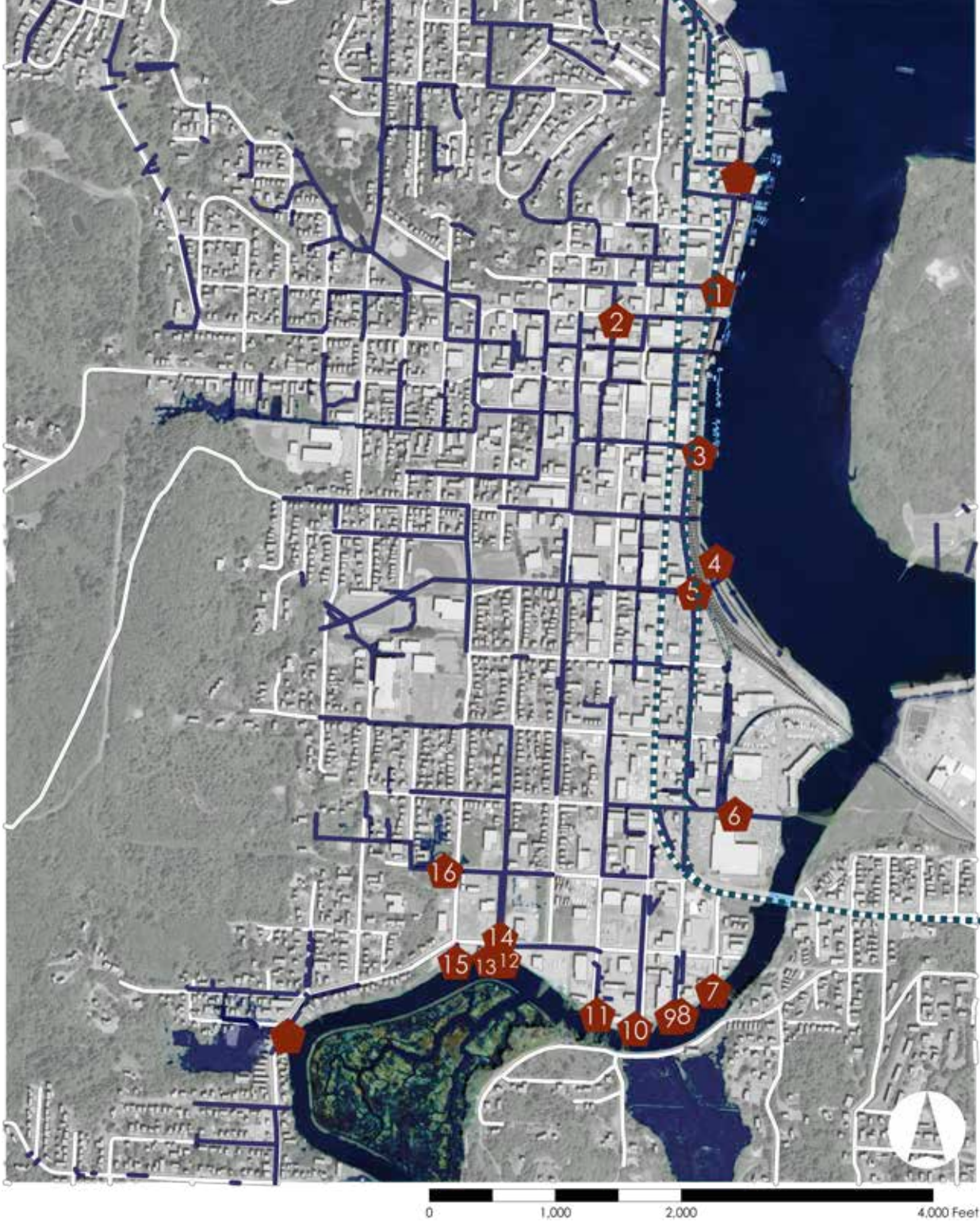




— levee

LEVEE

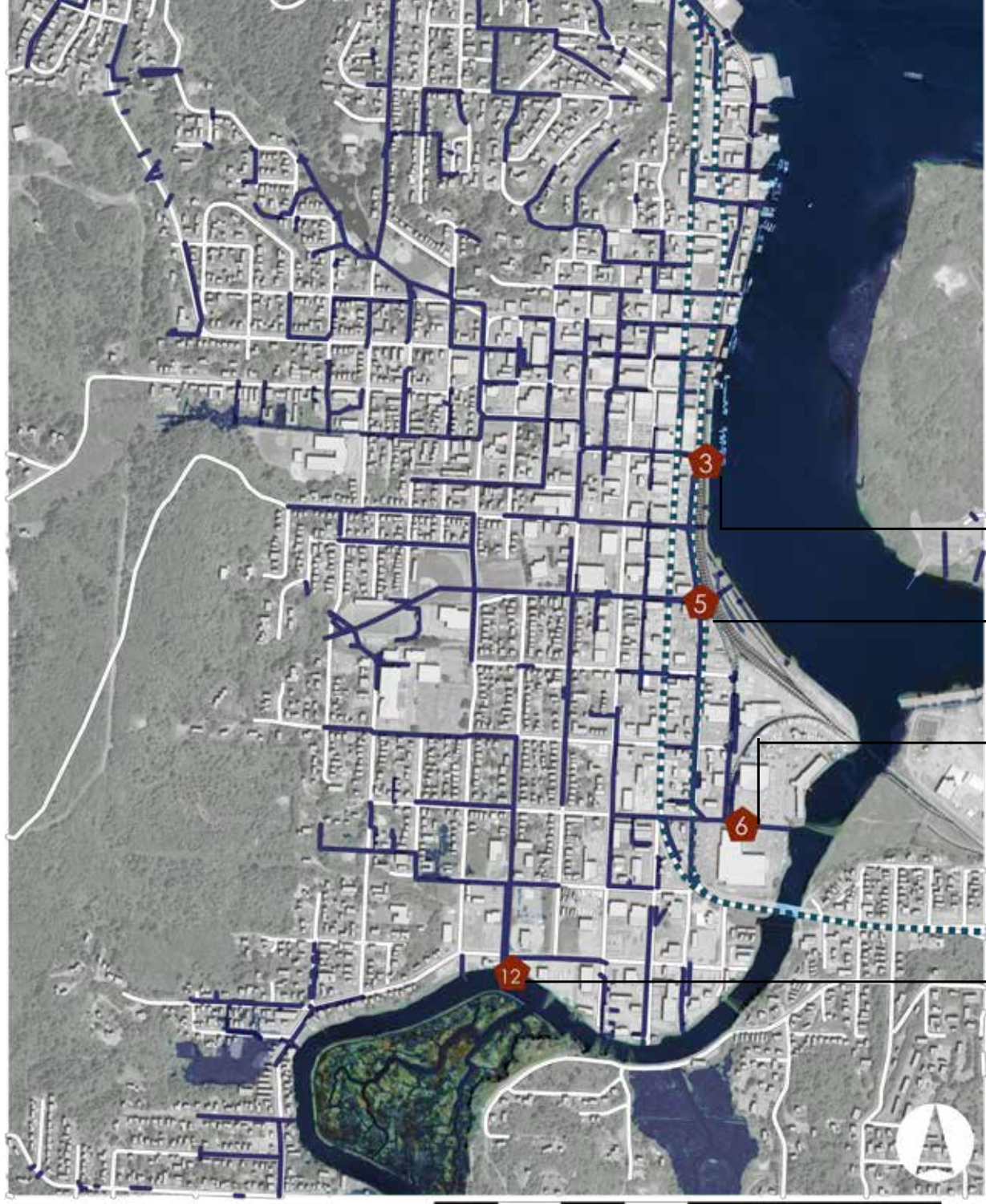




◆ tidegate
— stormwater pipes



TIDEGATES+STORMWATER



2yr Rain event /
100yr Rain event
(in acre*feet)

31 / 53

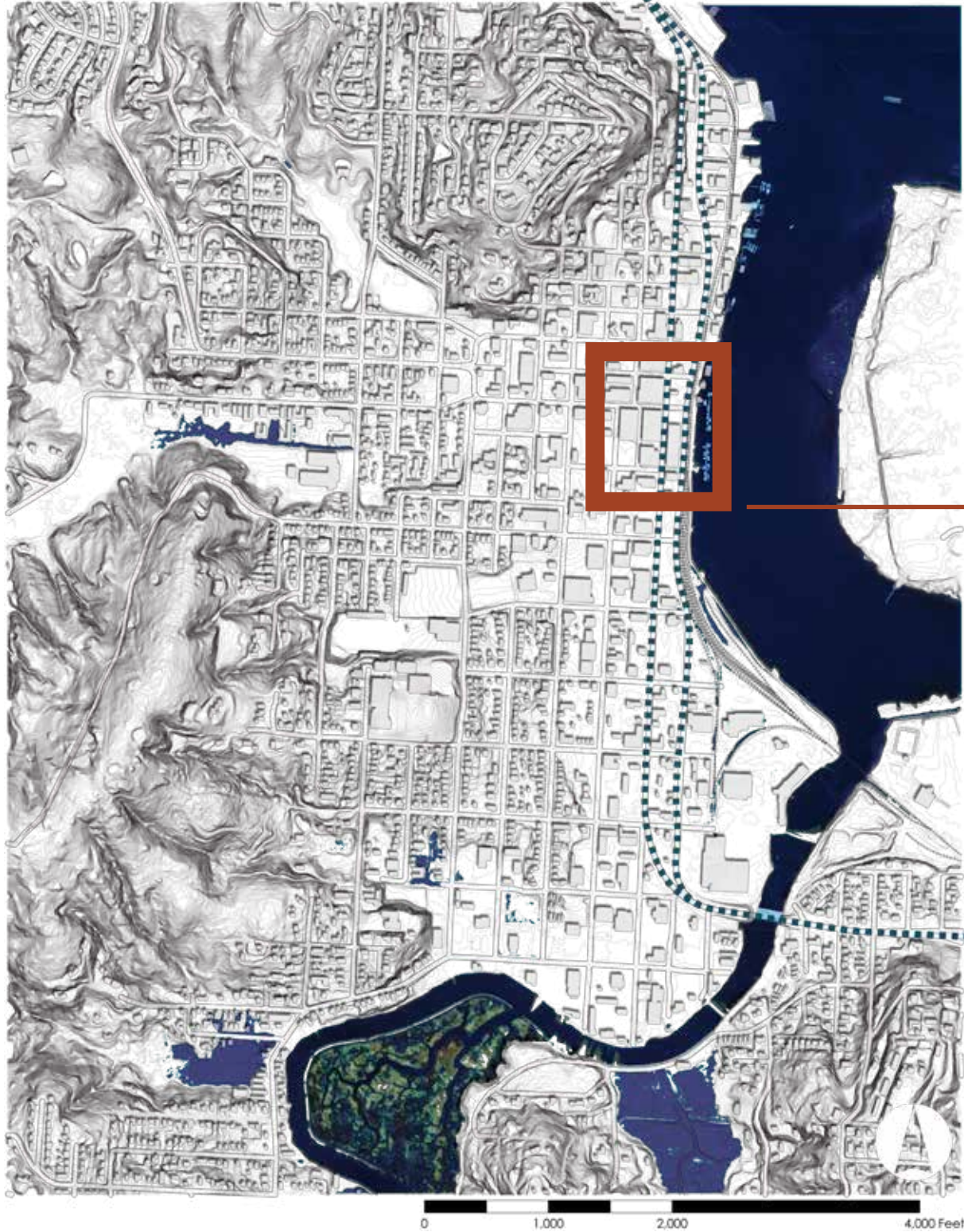
22 / 37

11 / 18

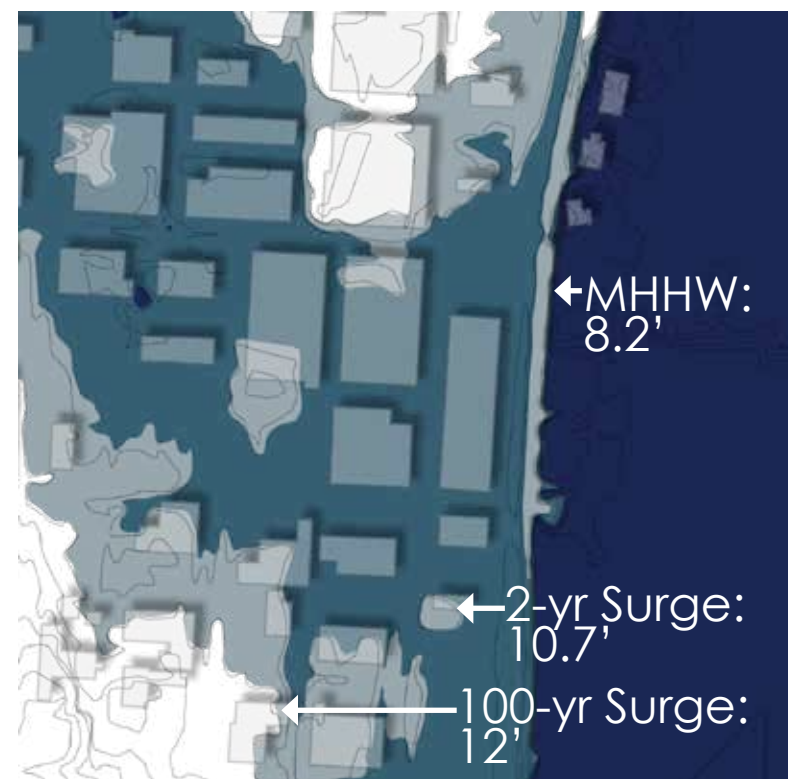
19 / 33

TIDEGATES+STORMWATER

0 1,000 2,000 4,000 Feet

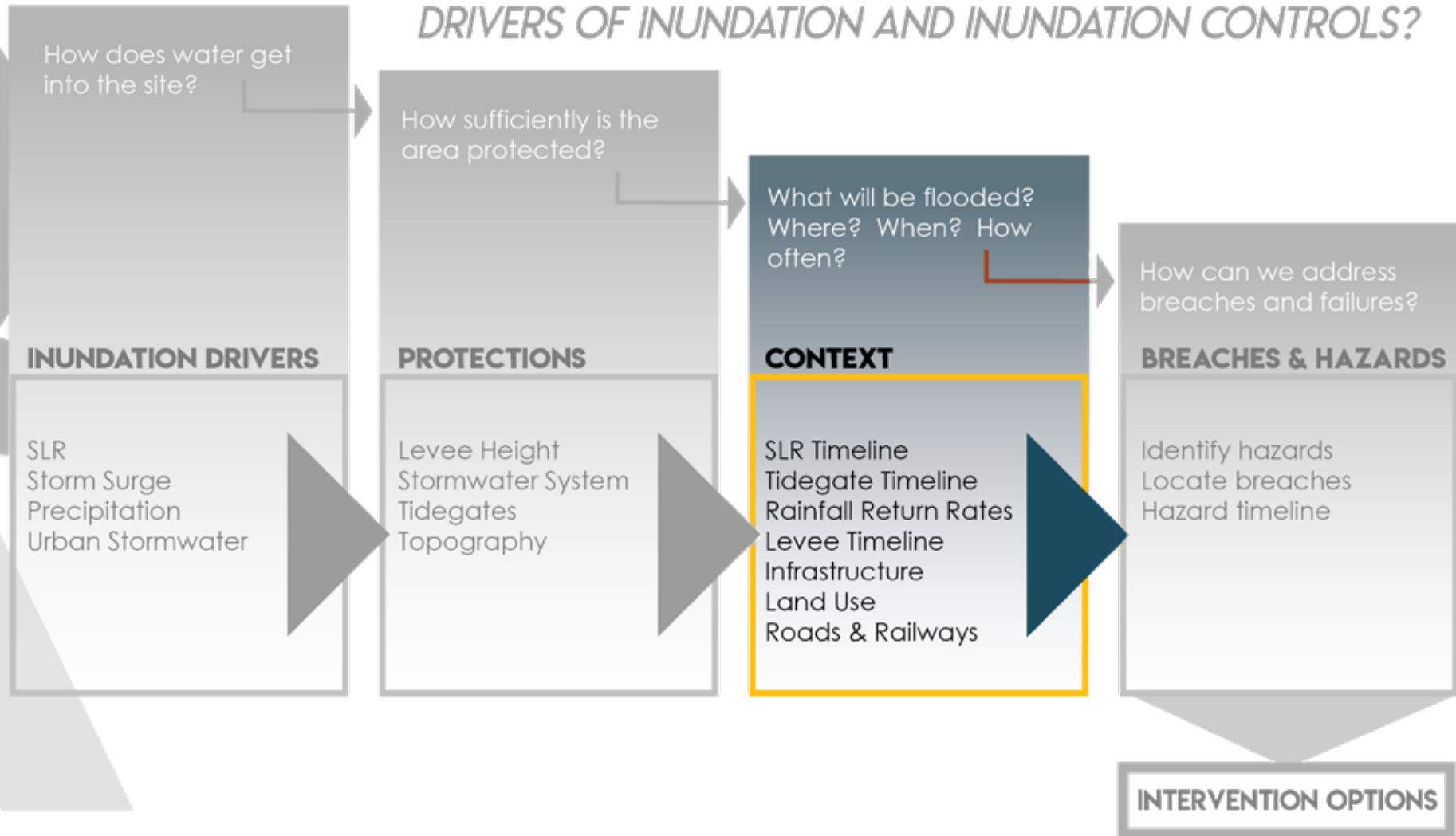


~1' contours



TOPOGRAPHY

WHAT OPPORTUNITIES FOR FLOOD MITIGATION EMERGE BY MAPPING DRIVERS OF INUNDATION AND INUNDATION CONTROLS?





LEVEES

+



2019 SLR + 100-YR SURGE

**LEVEES +
RISING SEAS**



— levee breach

■ inundation extent

2019 SLR + 100-YR SURGE LEVEE BREACHES



— levee breach

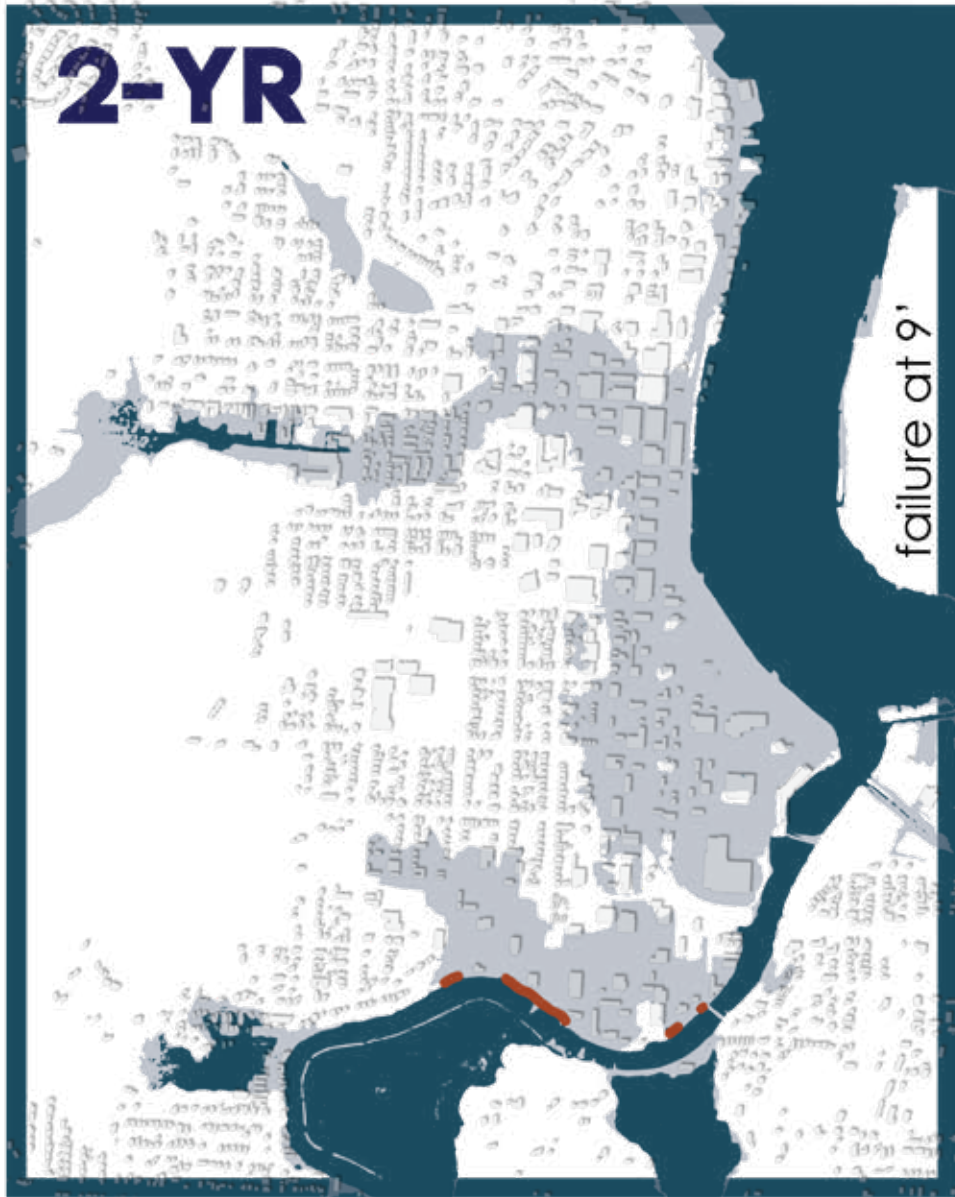
■ inundation extent

where?

when?

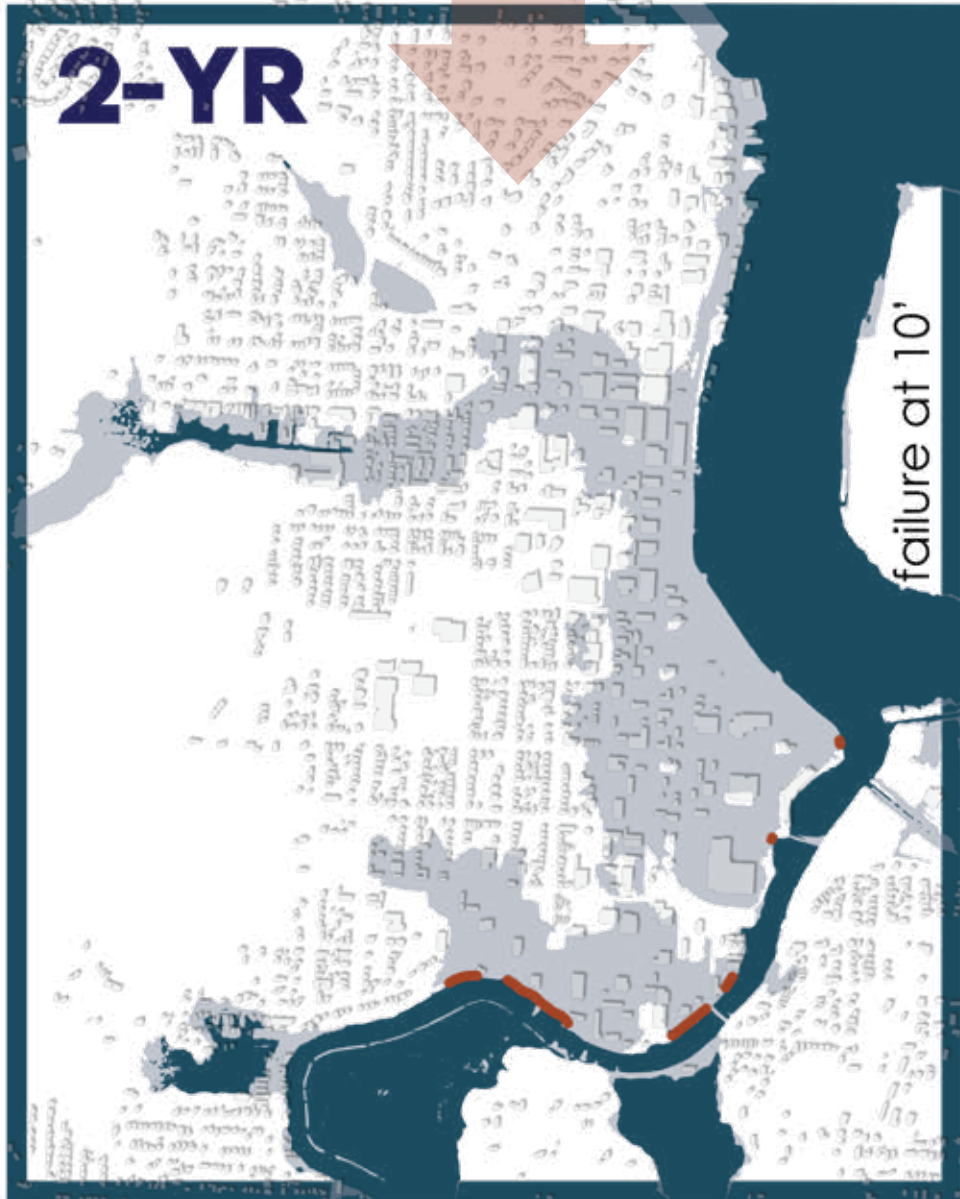
how often?

**2019 SLR + 100-YR SURGE
LEVEE BREACHES**



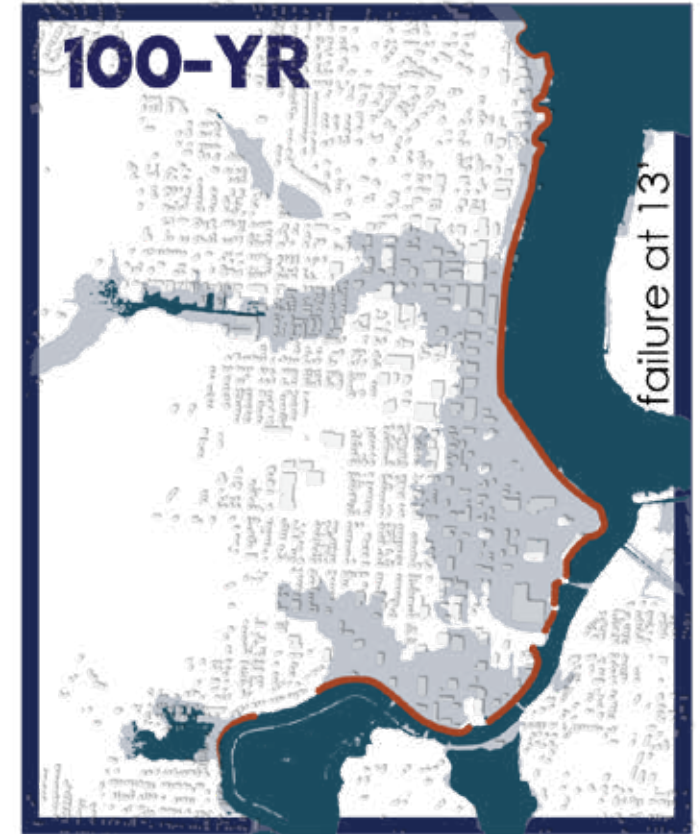
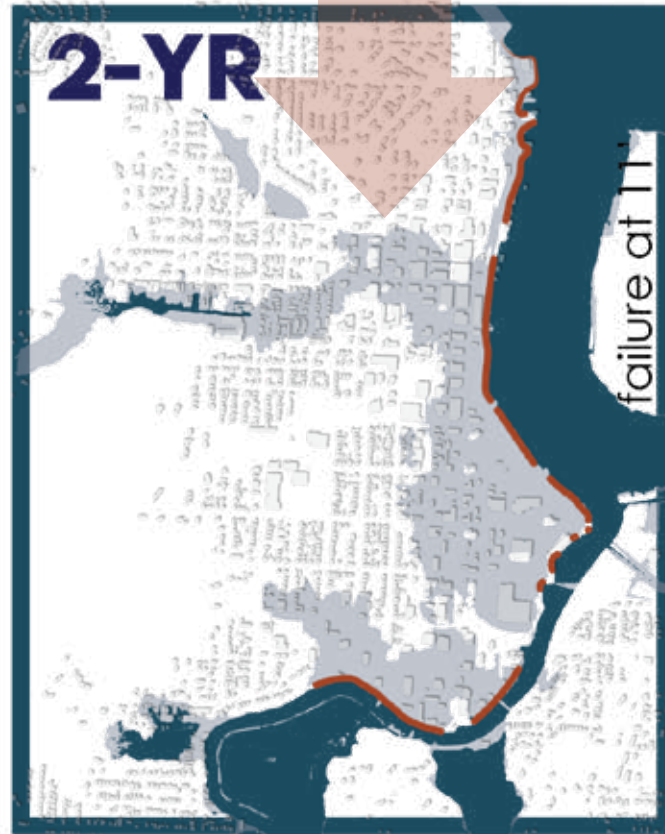
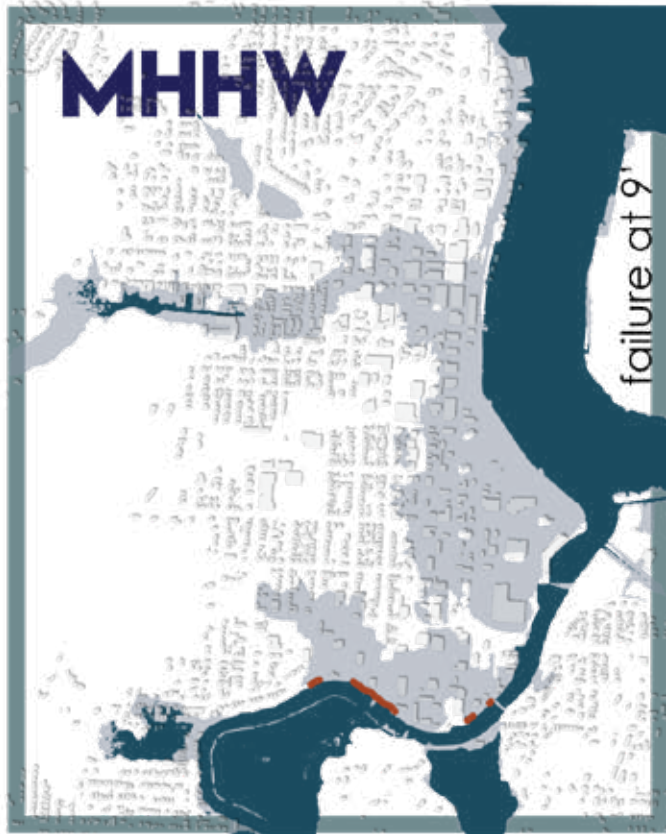
2030

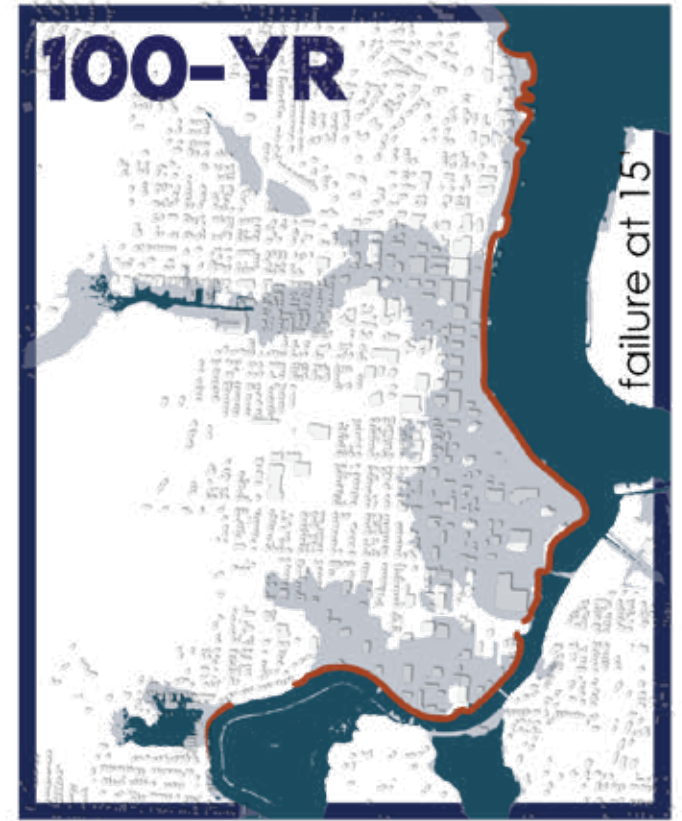
LEVEE BREACH TIMELINE

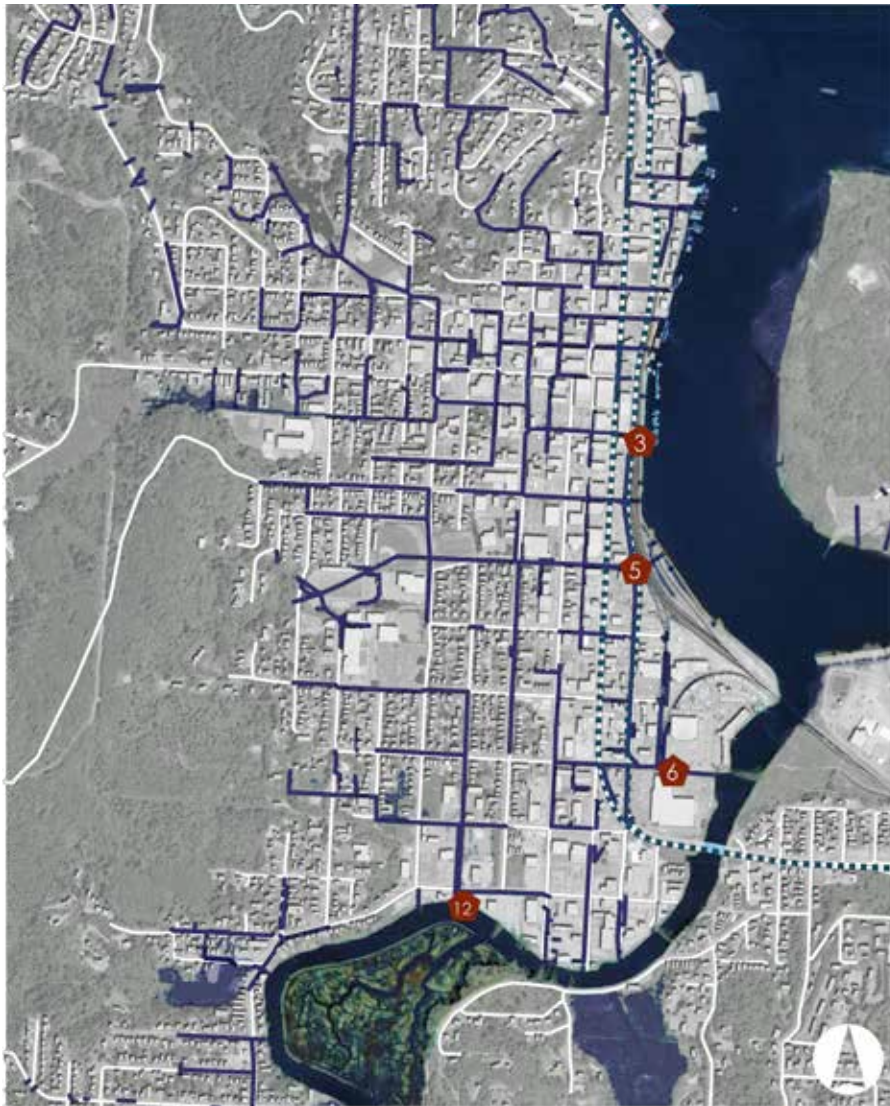


2050

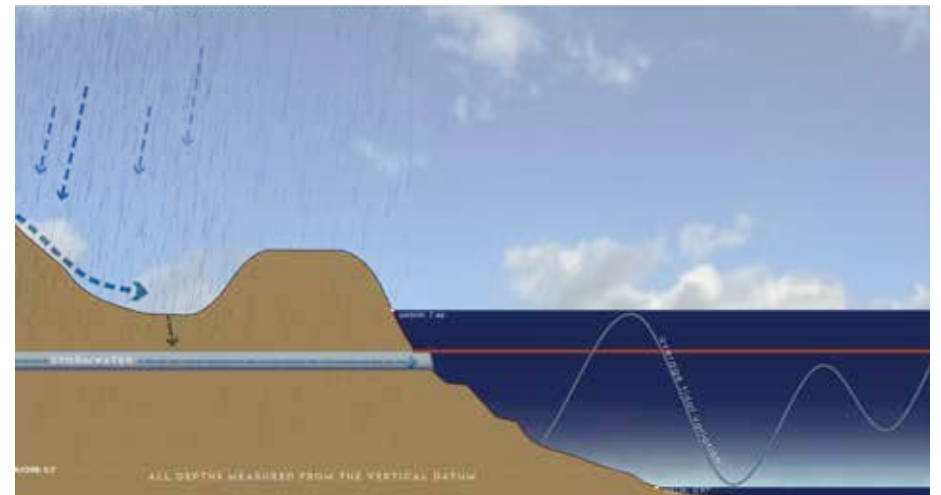
LEVEE BREACH
TIMELINE







+

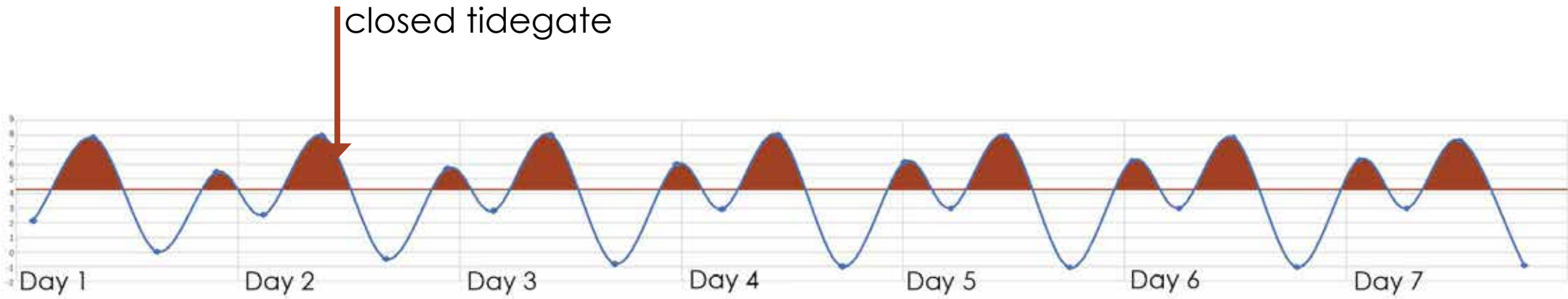


TIDEGATES + RISING SEAS

depth of tidegate



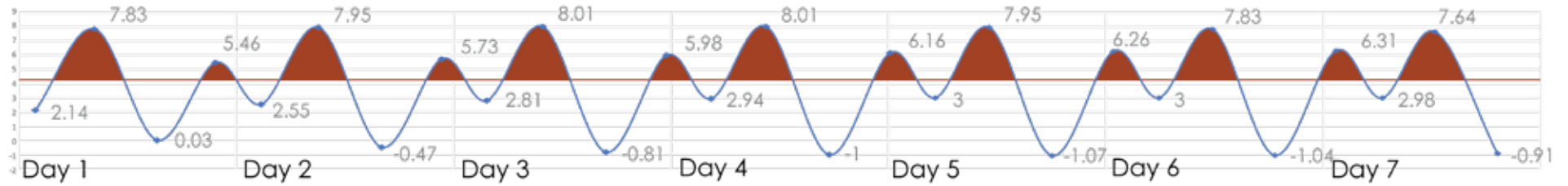
**TIDEGATE +
RISING SEAS**



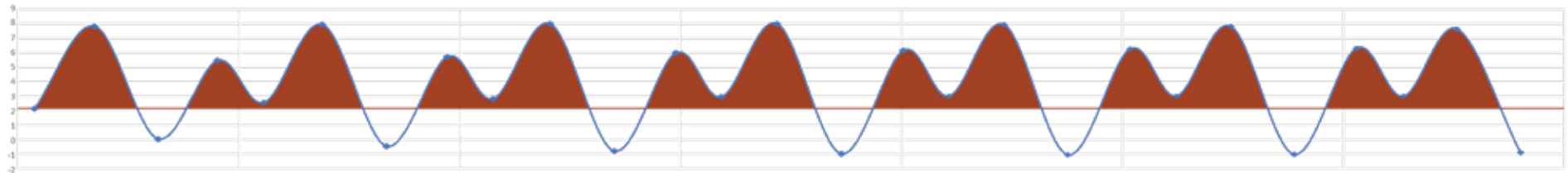
**TIDEGATE +
RISING SEAS**

2019

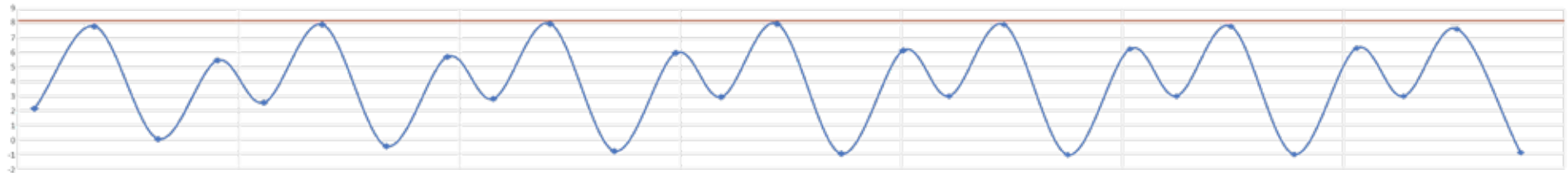
FLOW FOR TIDEGATE 3



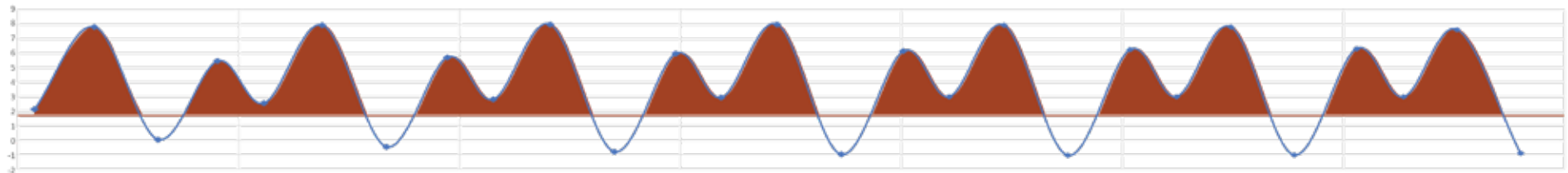
FLOW FOR TIDEGATE 5



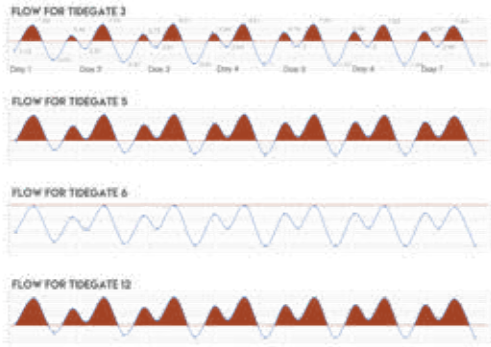
FLOW FOR TIDEGATE 6



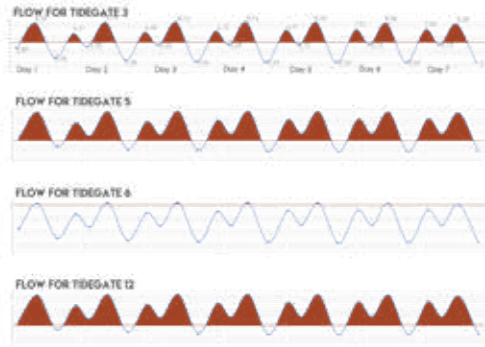
FLOW FOR TIDEGATE 12



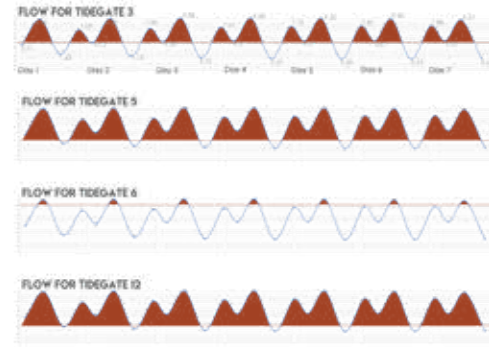
2019



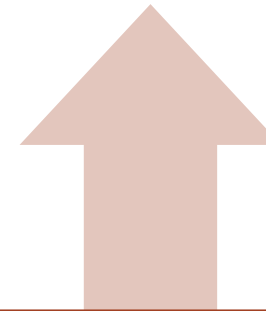
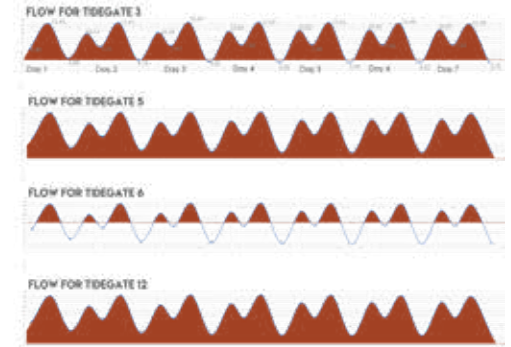
2030



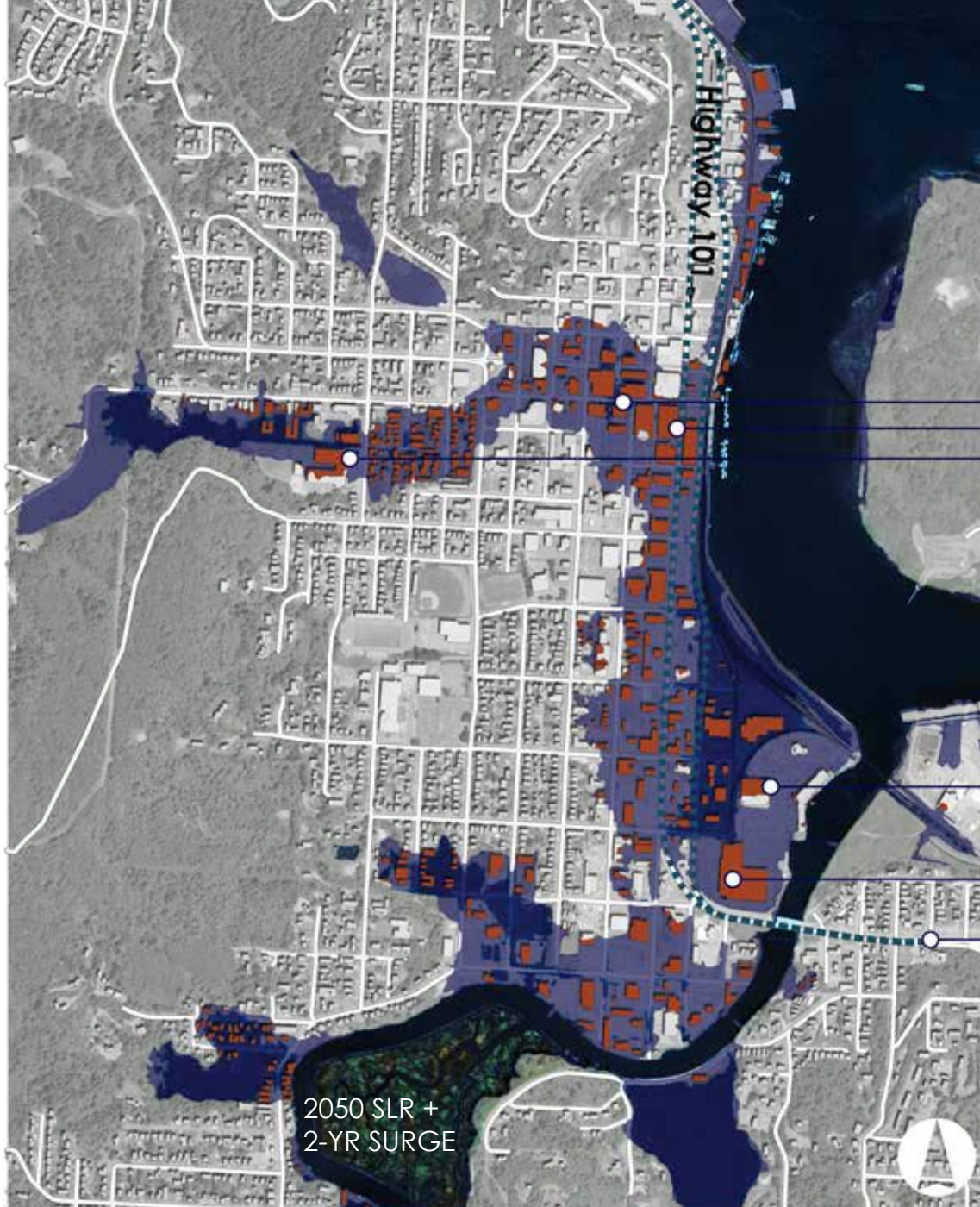
2050



2100



**TIDEGATE +
RISING SEAS**



2050 SLR
+ 2yr Surge

flooded buildings

Art Museum
Egyptian Theater
Elementary School

Safeway

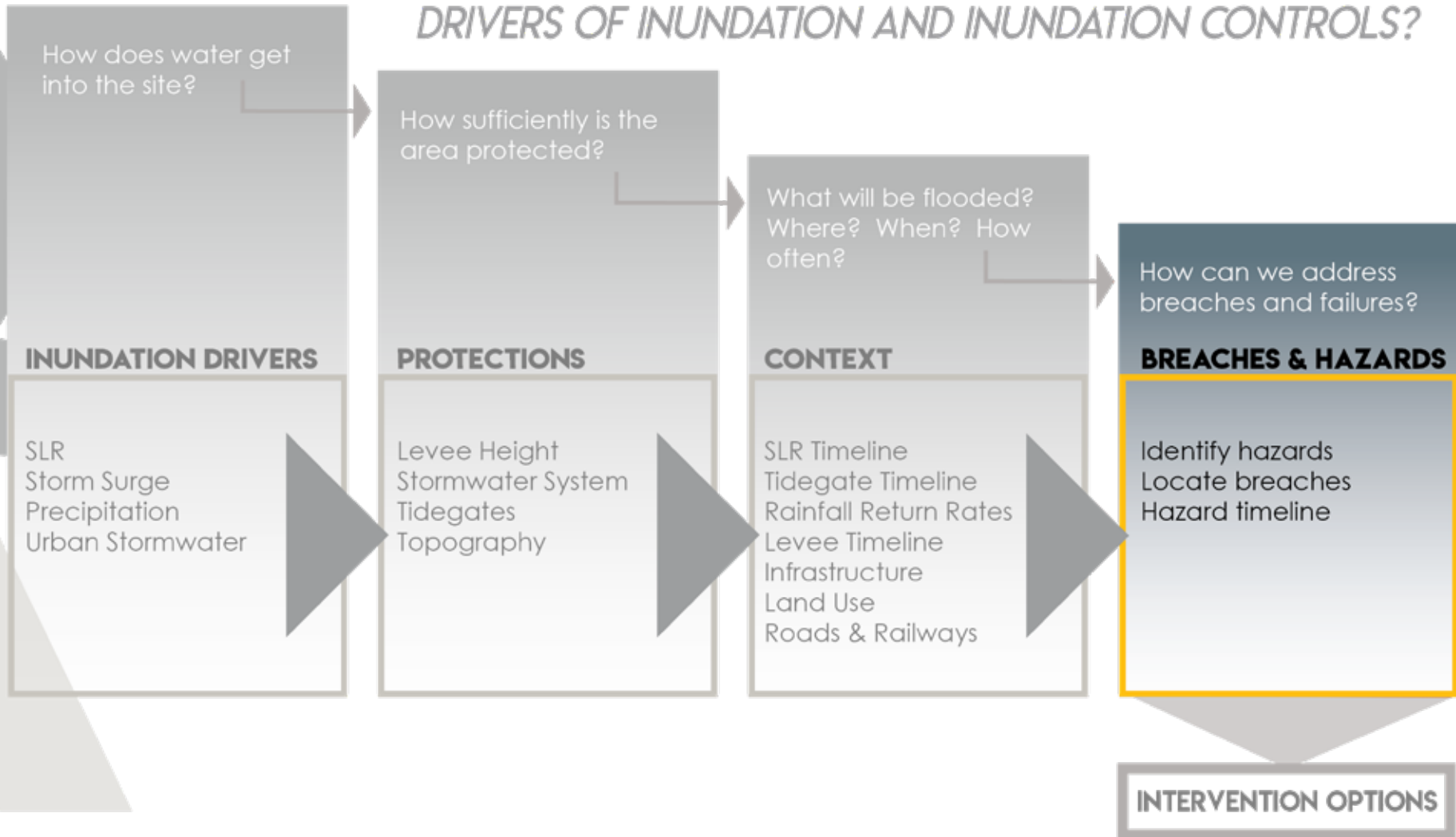
Fred Meyer

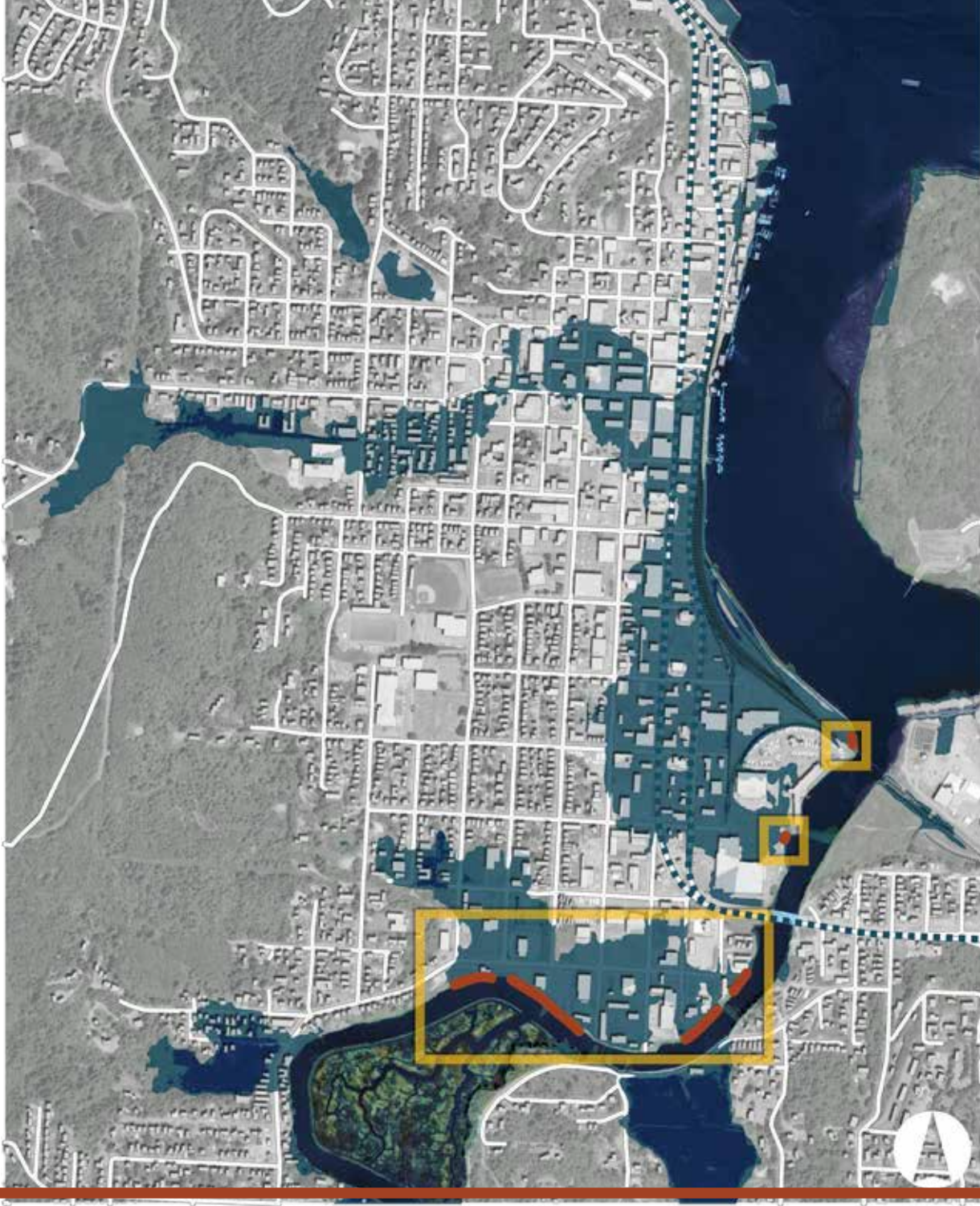
Highway 101

2050 SLR +
2-YR SURGE

URBAN CONTEXT + INUNDATION

WHAT OPPORTUNITIES FOR FLOOD MITIGATION EMERGE BY MAPPING DRIVERS OF INUNDATION AND INUNDATION CONTROLS?





- MHHW
- 2-yr Surge
- levee breach

intervention target

2030 + 2YR SURGE: LEVEE BREACHES

0 1,000 2,000 4,000 Feet

GOALS FOR CLIMATE-READY ESTUARIES

(Synthesis of Adaptation Options for Coastal Areas, EPA, 2009)

- plan and build for SLR
- redefine flood zones to match SLR frequency and extent
- remove impervious surfaces
- fortify levees to accommodate SLR and precipitation change
- incentivize land exchanges that relocate residents *out* of floodplains
- protect, maintain, and restore wetlands

Managed Retreat



(Netherlands)

retreat deliberately allows flooding and is paired with levee fortification

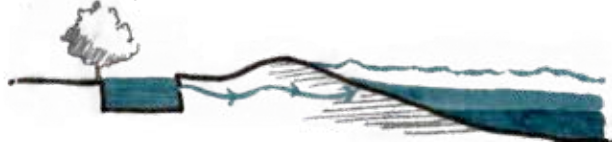
Floodable Public Space



(Tennessee)

stormwater storage can also provide urban amenity

Store & Pump



(Netherlands)

a short-term option to channel flows and prevent flooding in low-lying lands

Fortify Levees



(Netherlands)

selectively raising levee heights protects key infrastructure

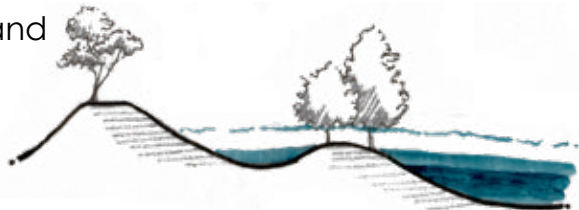
Multi-purpose Levees



(Vietnam)

high-value parts of the city are protected with levees topped with roads

Wetland



(Louisiana)

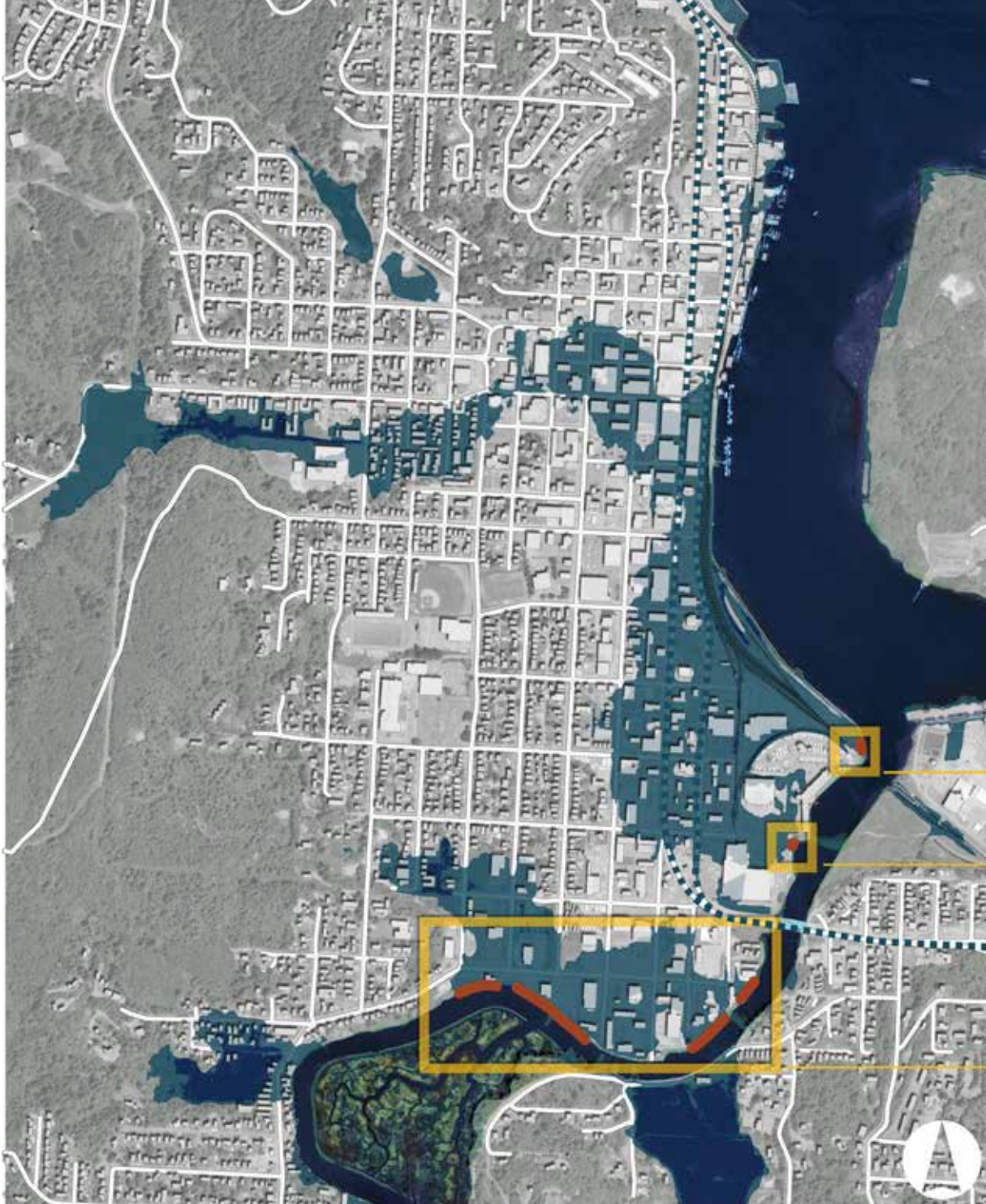
wetlands are restored at a regional scale for natural flood protection

Street Trees

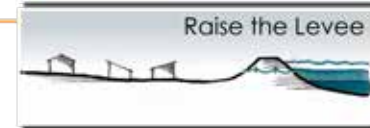
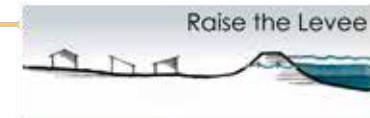


(varied precedents)

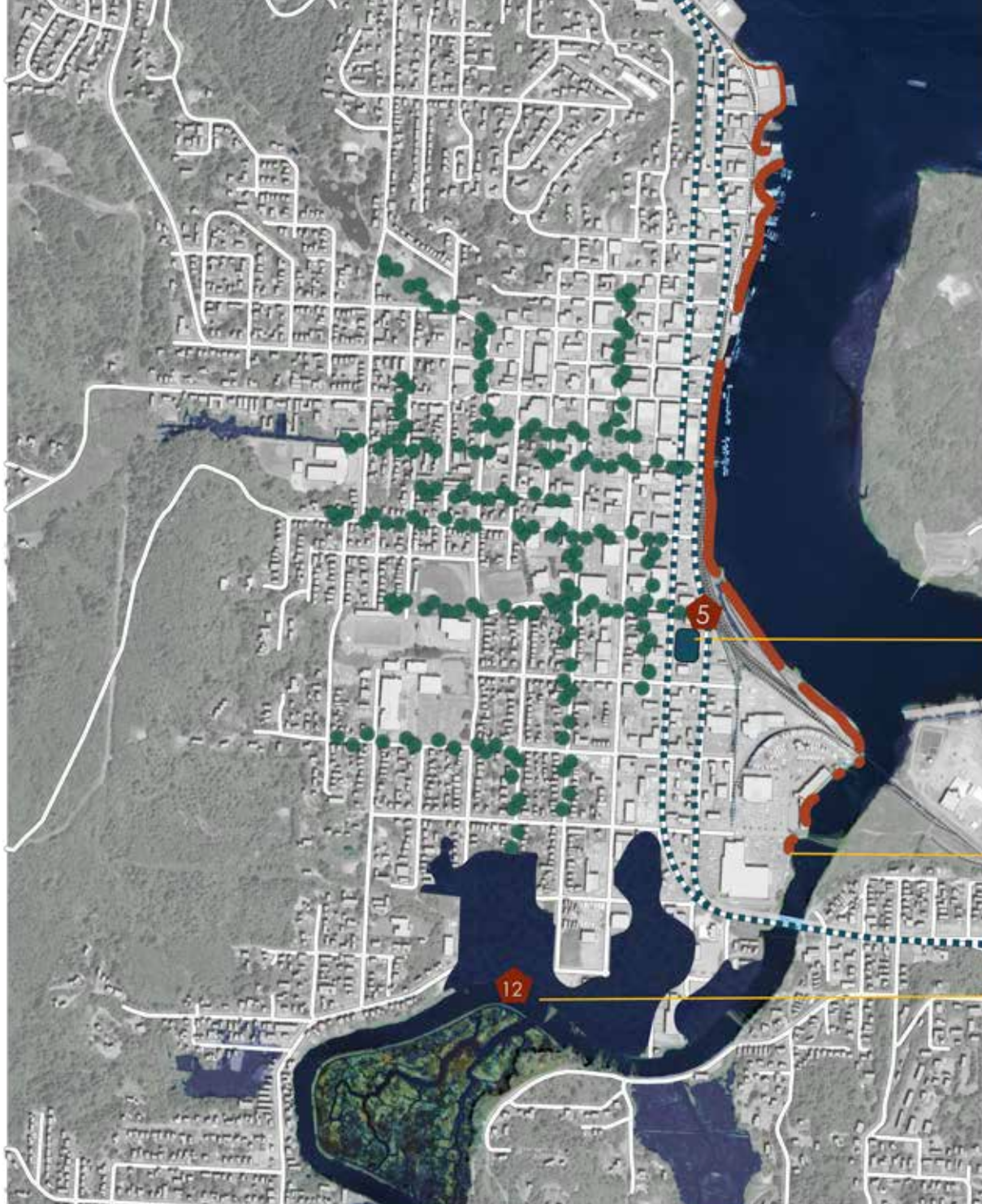
intercept rain and decrease the volume of urban runoff



- MHHW
- 2-yr Surge
- levee breach



2030 + 2YR SURGE: LEVEE INTERVENTION

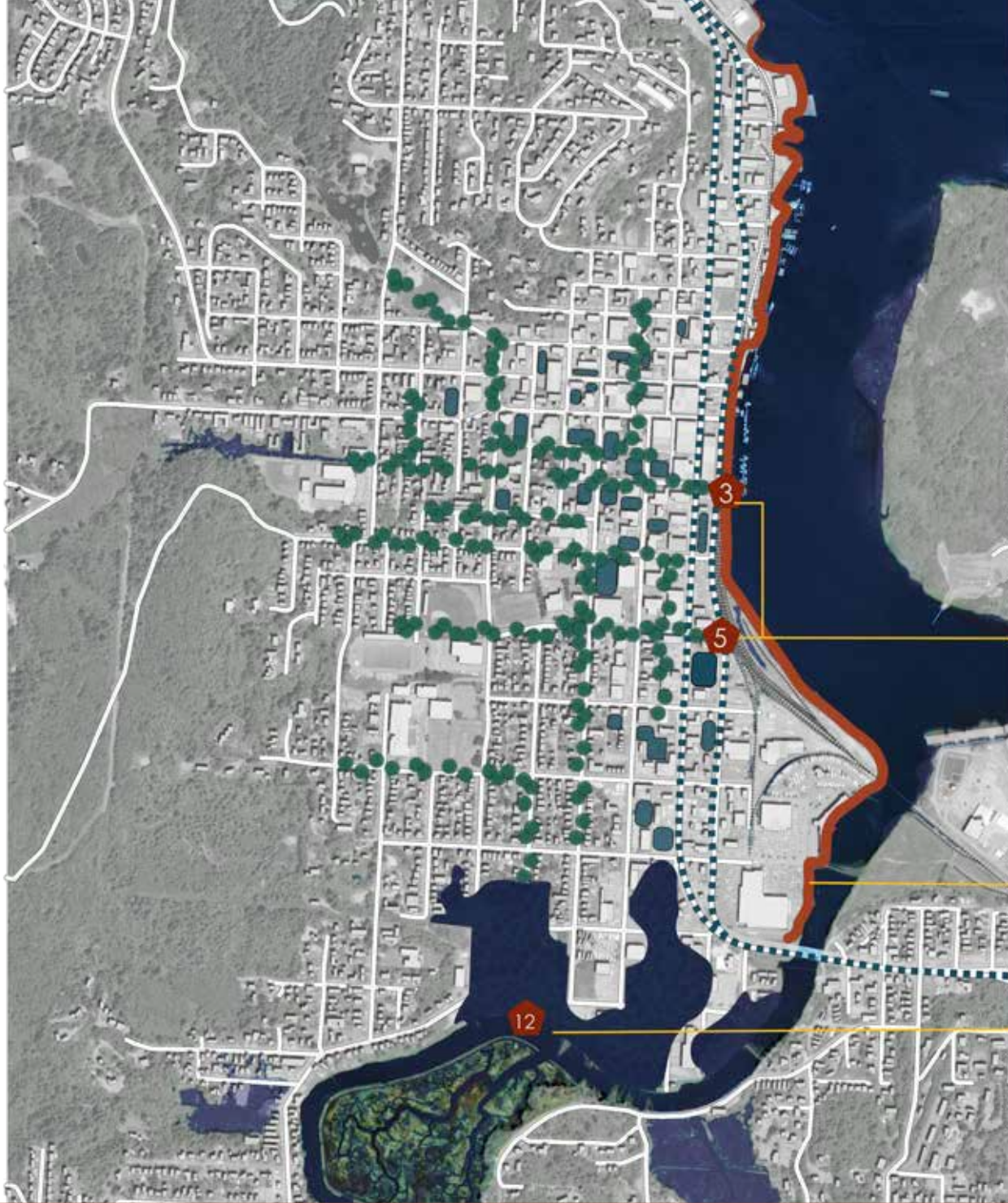


- MHHW
- 2-yr Surge
- ◆ tidegate
- trees
- storage facilities
- levee breach

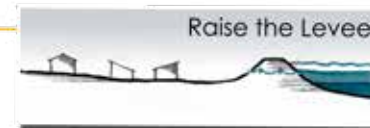


2050 SLR + 2-YR SURGE INTERVENTIONS

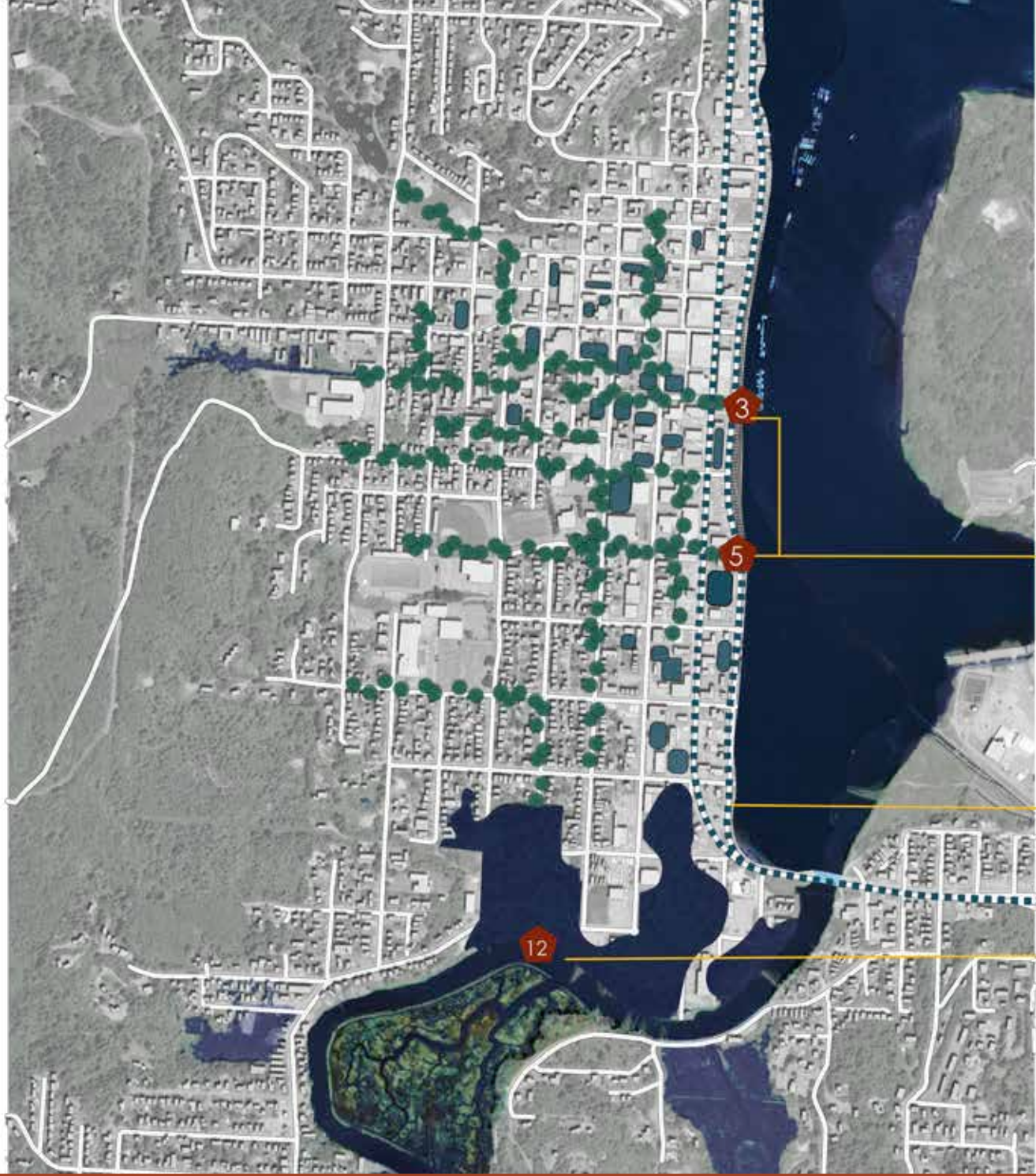




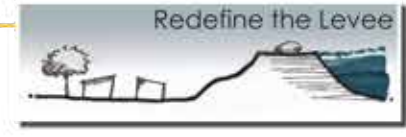
- ◆ tidegate
- trees
- storage facilities



2100 SLR + 100-YR SURGE INTERVENTION OPTION

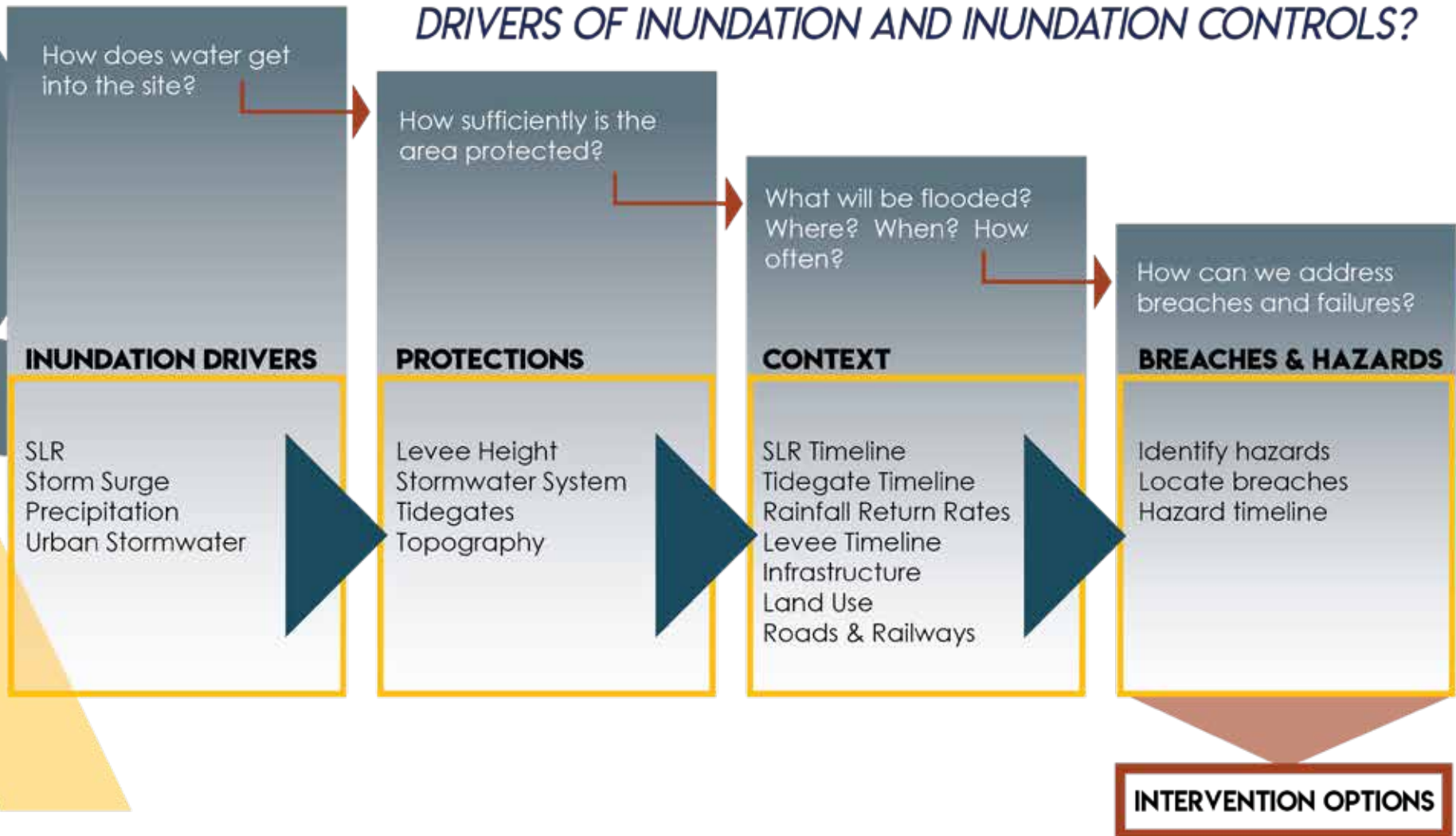


- ◆ tidegate
- trees
- storage facilities



2100 SLR + 100-YR SURGE INTERVENTION OPTION

WHAT OPPORTUNITIES FOR FLOOD MITIGATION EMERGE BY MAPPING DRIVERS OF INUNDATION AND INUNDATION CONTROLS?





**THANK YOU.
QUESTIONS?**

GATHER, RE-PRESENT, GENERATE: SPATIAL DATA

DATA COLLECTED FROM EXISTING RESEARCH:	source	date
2030, 2050, 2100 SLR + Storm Surge	Sea Level Rise Exposure Inventory for Oregon's Estuaries	2017
Levee	Department of Land Conservation and Development (DLCD)	2011
Stormwater Infrastructure	City of Coos Bay	2019
Tidegate locations	City of Coos Bay	2005
Stormwater Pipe Diameter	City of Coos Bay	2019
Land Use	Department of Land Conservation and Development (DLCD)	2017
Stormwater Pipe Location	City of Coos Bay	2019
Business and Industry ID	Google Maps	2019
Building Footprints	City of Coos Bay	2019
Railroads	Oregon Department of Transportation (ODOT)	2015
Roads	Oregon Department of Transportation (ODOT)	2017
Digital Elevation Model	Department of Geology and Mineral Industries (DOGAMI)	2009

EXISTING DATA SPATIALLY •RE•PRESENTED:	original representation	date
Topography	from Digital elevation Model	2009
MHHW 2019, 2030, 2050, 2100	from Tides & Currents: Datums for 9432895	2004
2019 + Storm Surge	MHHW + Storm Surge	2004
		2017

DATA GENERATED FOR THIS REPORT: process-details documentation

Tidegate Depths	Appendix C
Tidegate Flow Timelines	Appendix C
Sub-basins	Appendix B
Sub-basin Volumes 2-yr rainfall	Appendix B
Sub-basin Volumes 100-yr rainfall	Appendix B
Levee Breach Timeline	Appendix D

- Al, S. (2018). *Adapting Cities to Sea Level Rise: green and gray strategies*. Washington, DC: Island Press.
- Cornu, C. E., & J. Souder (eds). (2015). *Communities, Lands & Waterways*
- Data Source. Partnership for Coastal Watersheds, South Slough National Estuarine Research Reserve, and Coos Watershed Association. Coos Bay, OR.
- Dahl, A. (2018). "Sea Level Rise Will Make Oregon's Existing Flooding Problems Worse." Union of Concerned Scientists Blog: Science for a healthy planet and safer world. Accessed at <https://blog.ucsusa.org/kristy-dahl/sea-level-rise-will-make-oregons-existing-flooding-problems-worse>.
- Dalton, M.M., Dello, K.D., Hawkins, L., Mote, P.W. & Rupp, D.E. (2017). *The Third Oregon Climate Assessment Report*, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR.
- Kimmelman, M. (2017). Foreword. In *Structures of Coastal Resistance* (p. x). Washington DC: Island Press.
- Moriarty, L. (2017). Jefferson Public Radio. Coos Bay Suit Over Flood Insurance Rules Could Have a Nationwide Impact. <https://www.ijpr.org/post/coos-bay-suit-over-flood-insurance-rules-could-have-nationwide-impact#stream/0> Accessed 25 April 2019.
- National Research Council. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington*, Washington, DC: National Academies Press.
- Neumann, B., Konrad, O., & Kenchington, R. (2017). "Strong sustainability in coastal areas: a conceptual interpretation of SDG 14." *Sustainability Science*, March 2016, Vol. 11, Issue 2, pp. 177-178.
- National Oceanic and Atmospheric Administration (NOAA). 2018. "Is sea level rising?" Accessed at <https://oceanservice.noaa.gov/facts/sealevel.html>
- NOAA Tides and Currents. (2018). Datums for 9432895, North Bend, Coos Bay OR. Accessed 08 February 2019 at https://www.tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=9432780.
- Nordenson, C.S., Nordenson, G., & Chapman, J. (2018). *Structures of Coastal Resistance*. Washington DC: Island Press.
- Pacific Legal Foundation. N.D. Town of Coos Bay, Oregon v. National Marine Fisheries Service: Endangered Species Act abuse forces federal zoning control on local communities. <https://pacificlegal.org/case/town-of-coos-bay-oregon-v-national-marine-fisheries-service/> Accessed 25 April 2019.
- Sepanik, J., Lanier, A., Dana, R., & Haddad, T. (2017). *Sea Level Rise Exposure Inventory for Oregon's Estuaries*. Oregon Coastal Management Program, Department of Land Conservation and Development, National Oceanic and Atmospheric Administration Office for Coastal Management, and Tridac.
- US Environmental Protection Agency. (2009) "Synthesis of Adaptation Options for Coastal Areas" (US EPA 430-F-08-024, January 2009). Climate Ready Estuaries Program. Washington, DC: US.