Adapt Waikīkī 2050

Mayor Rick Blangiardi

Charrette #2

August 14, 2024 | 8:30 AM – 11:30 AM
St. Andrews

Adapt Waikīkī 2050
Charrette 2

August 14, 2024

Project Team

Client	Lead Consultant		
	TETRA TECH	SSFM International	Workshop Green, LLC
Noelle Cole	**Kitty Courtney**	**Melissa May**	**Wendy Meguro**
Dina Wong	Carol Hufnagel	Ollie Lau	
Imelda Fernandez		Erin Emerson	
Min Bu			

Project Manager
Team member

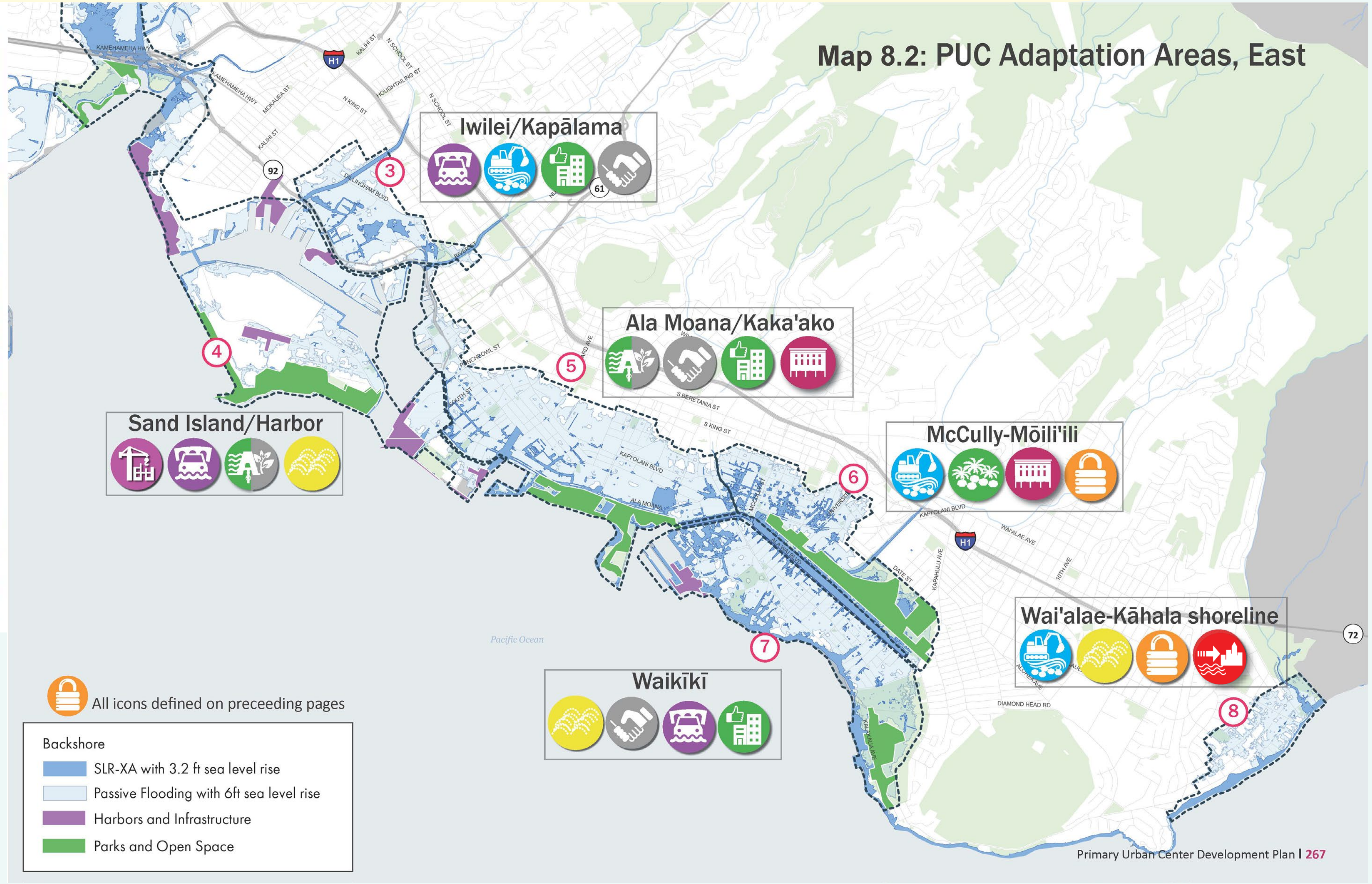
Meeting Objectives

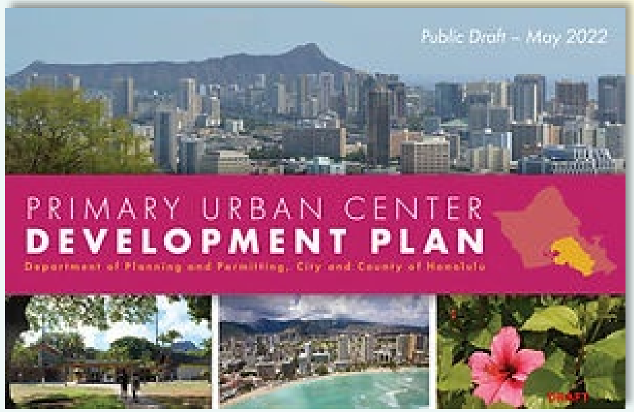
- Introduce the project and consultant team
- Present Climate Change impacts facing public infrastructure and private development in Waikīkī through four scenarios
- Identify and discuss the feasibility and relevance of potential adaptation solutions to mitigate flood risk.

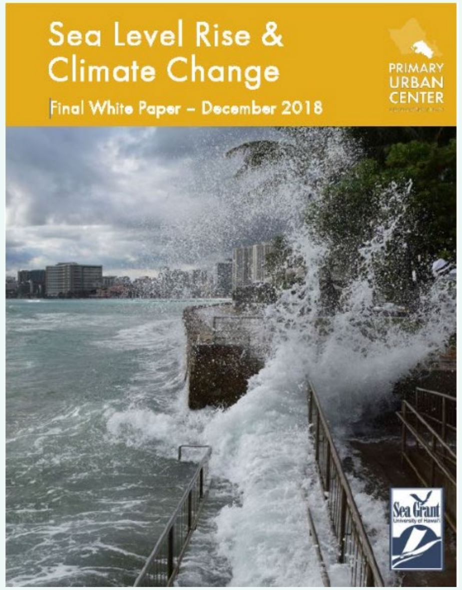
Where does Climate Change fit in the City's Land Use Planning?

Oʻahu's Eight Planning Regions

AW2050 is a Special Area Plan for the Primary Urban Center…







…and a pilot project of the One Water Honolulu Panel, (ROH 2-10.13(b)

Office of Climate Change, Sustainability and Resiliency

Honolulu Board of Water Supply

Department of Environmental Services

Department of Facility Maintenance

Department of Budget and Fiscal Services

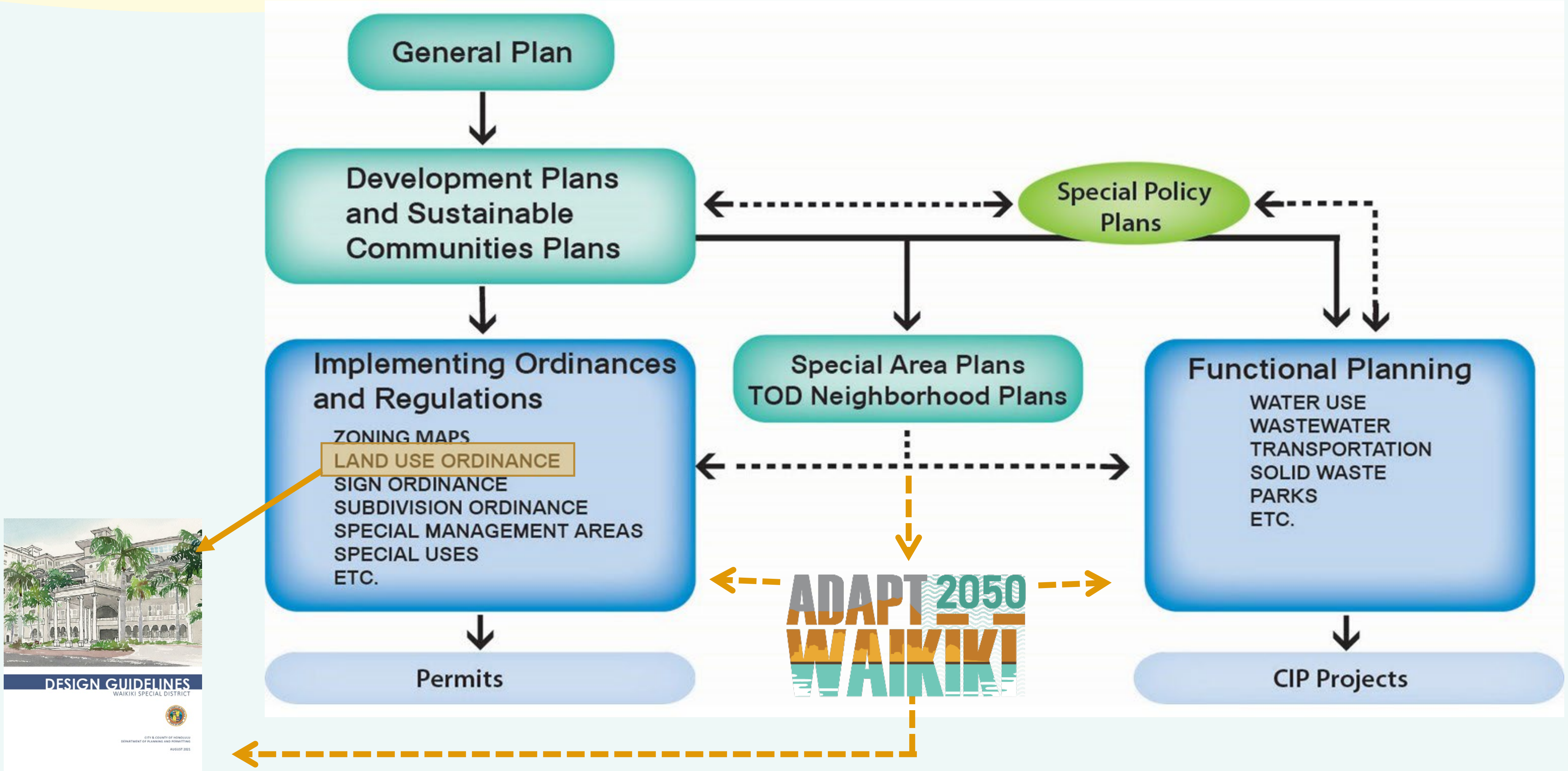
Department of Design and Construction

Department of Planning and Permitting

Department of Parks and Recreation

Department of Transportation Services

Integration Among City Plans



AW2050 Project Overview

Project Objectives

- Identify near-term (2050) adaptation measures for the Waikīkī Special District
  - Voluntary
  - Regulatory
- Identify potential City adaptation projects for near-term infrastructure resilience
- Provide a long-term (2100) outlook for the Waikīkī Special District
- Identify needed studies and institutional capacity assessments related to:
  - Long-term land use planning
  - Infrastructure and design guidelines and regulations
  - Shoreline development

AW2050 Special Area Plan – Theory of Change

***IF** recommendations have been evaluated, planned for, and implemented within the next 25 years, **THEN** the following results are expected in the WSD:*

- Adaptation solutions extend the useful life of existing roads and subsurface infrastructure in a cost-effective manner;
- Stormwater management reduces flood impacts through grey/green infrastructure and;
- Land use and redevelopment plans, based on climate risks and City-wide infrastructure service determinations, enable viable adaptation pathways through the end of the century.
- Emergency response to extreme rainfall-driven flood and heat events protects public safety;

Charrette 1

Focused on public infrastructure

Ala Wai Canal over-topping during a King Tide

Image Source: UH SOEST King Tides Project

Engage with public agencies to:

- Identify current climate related impacts to surface and subsurface infrastructure
- Brainstorm/share information on near-term public resilience measures
- Explore projected impacts to infrastructure beyond 2050

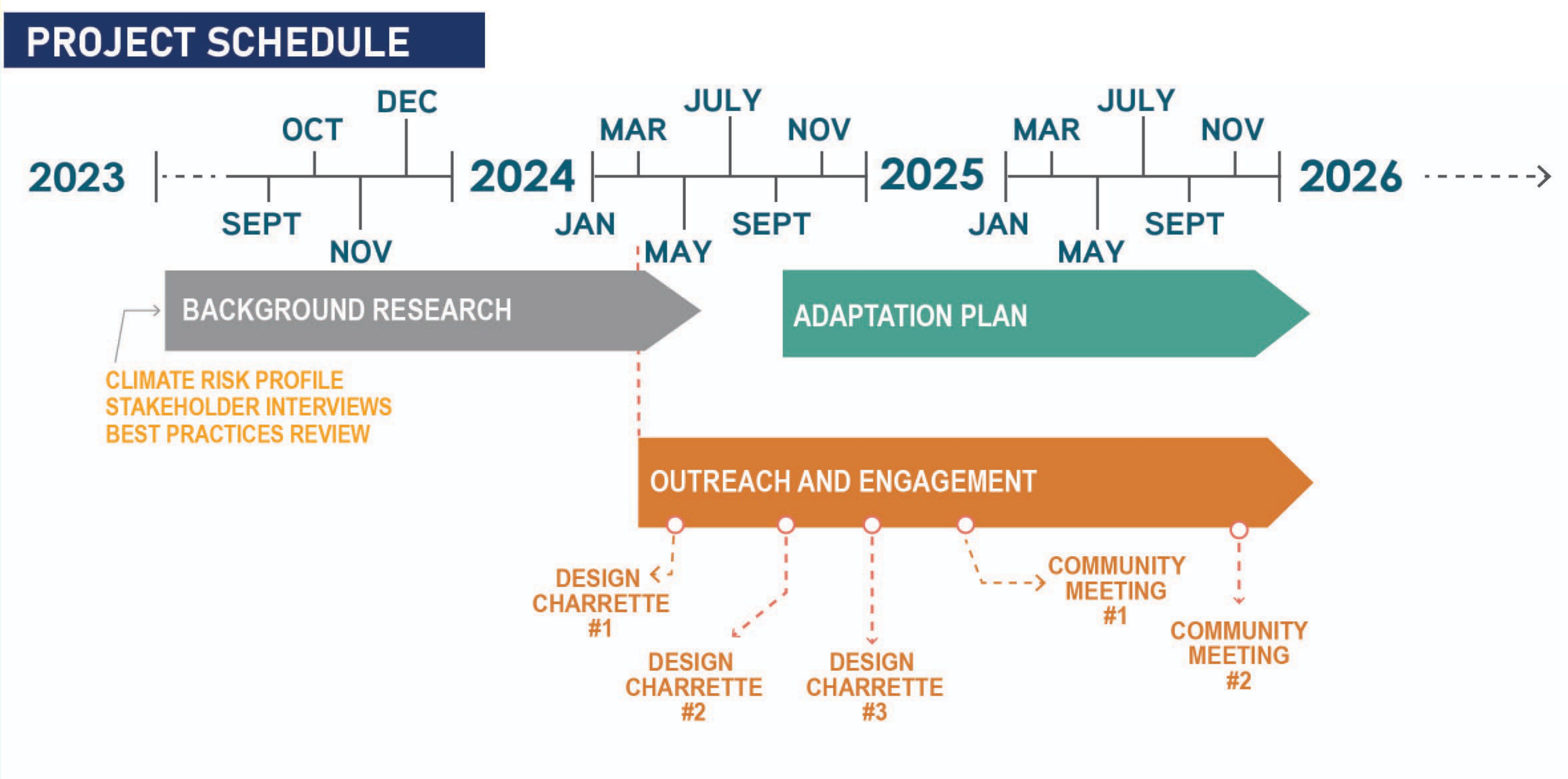
Charrette 2

Focus on the interface between public infrastructure and private development

High-wave sand movement along a Waikīkī Beach walkway
Image Source: HHF for DPP

- Engage with the Waikīkī business community to:
- Identify current climate related impacts to property and operations and any current private sector adaptation(s)
- Brainstorm near-term (2050) public and private solutions and best practices
- Explore projected impacts and adaptation needs beyond 2050

Scope, Schedules and Tasks



Polling

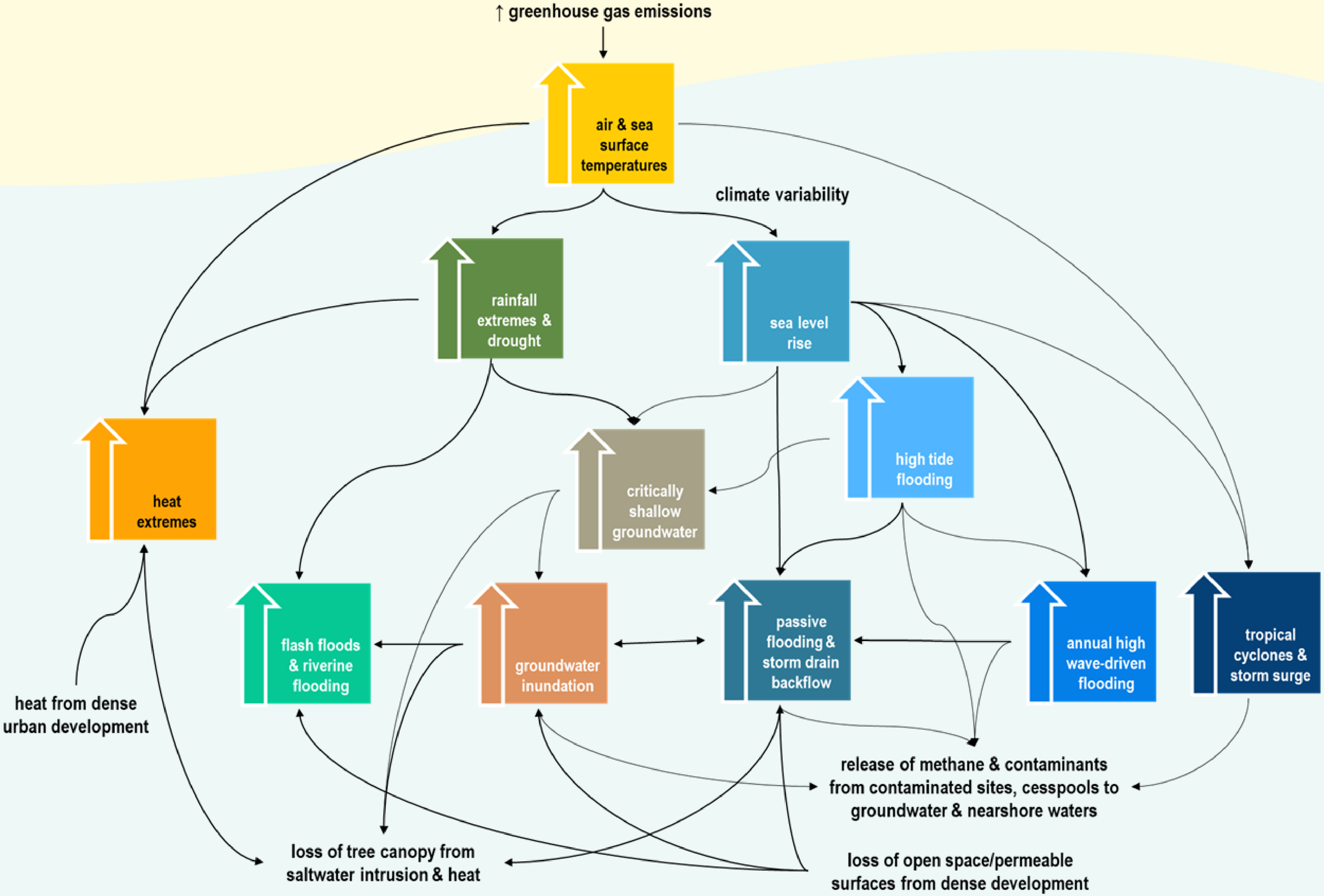
Mentimeter

- We will be conducting polling during todays meeting using Mentimeter.

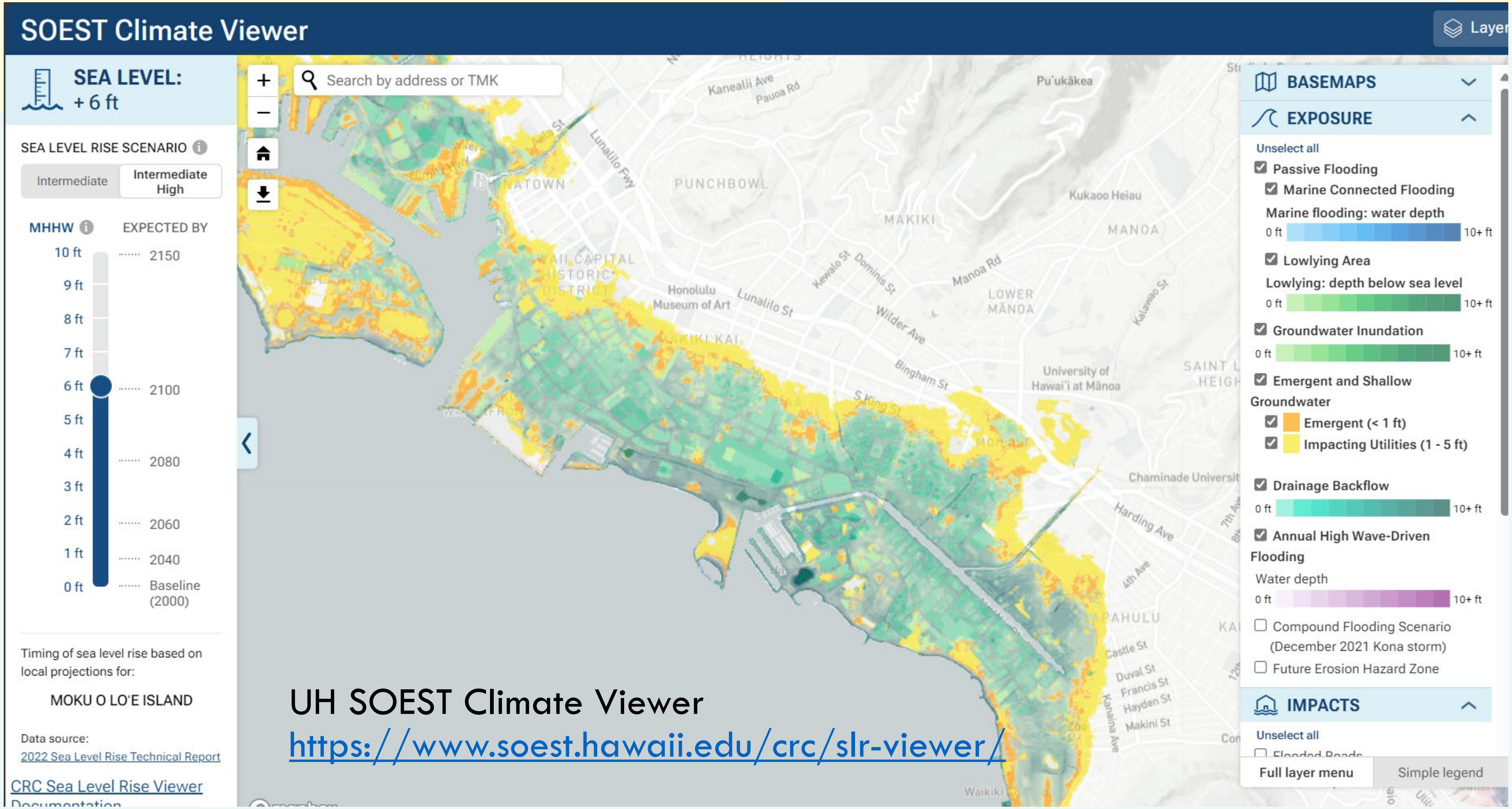
- To participate please either
  - Open a new browser window and enter: menti.com and add the code 7224 7237
  - Or scan the QR code below that will take you to the polling questions

Climate Risk Profile

CASCADING & COMPOUNDING EFFECTS OF KEY CLIMATE HAZARDS IN THE WAIKĪKĪ SPECIAL DISTRICT



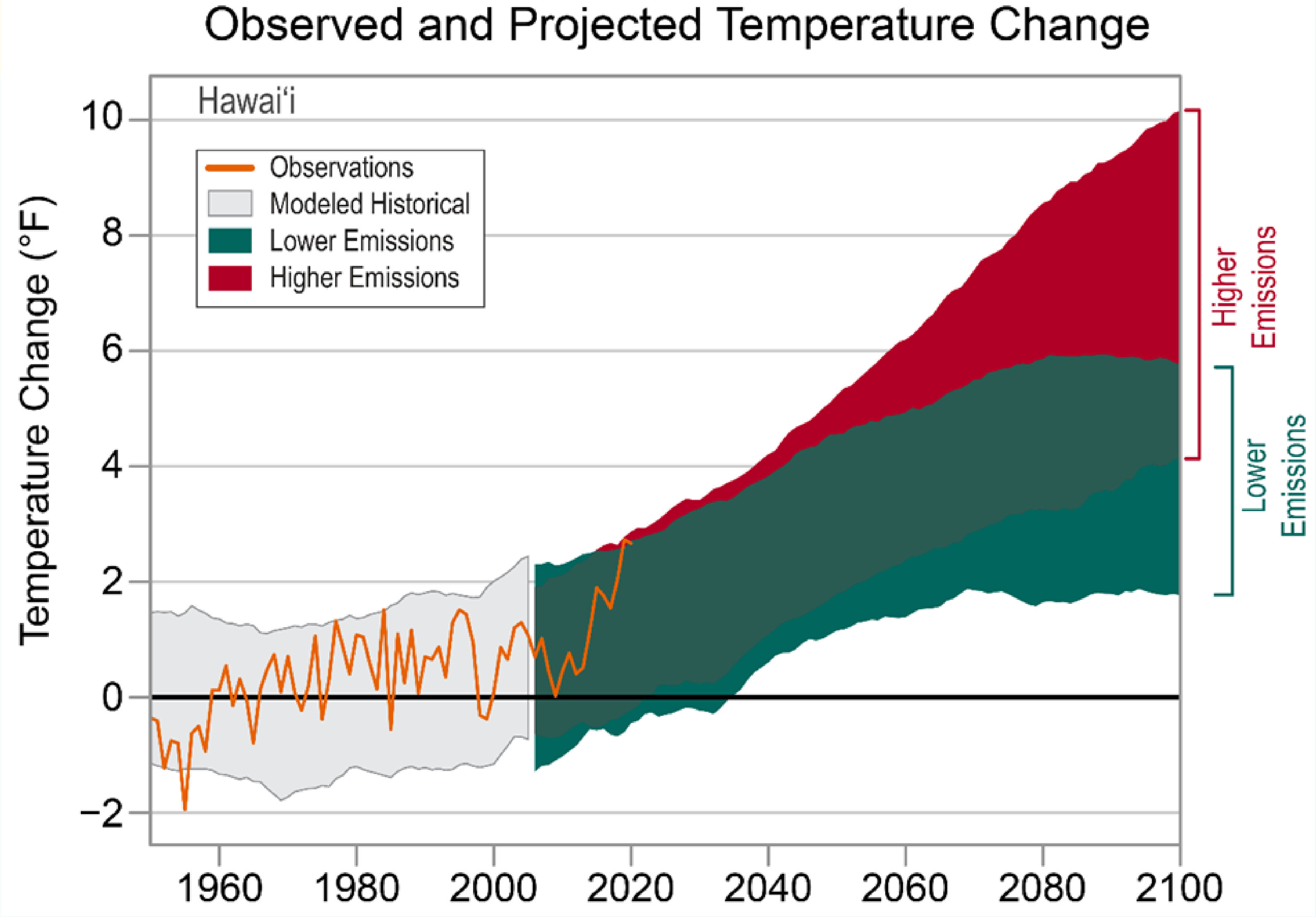
Mahalo UH SOEST Climate Resilience Collaborative!



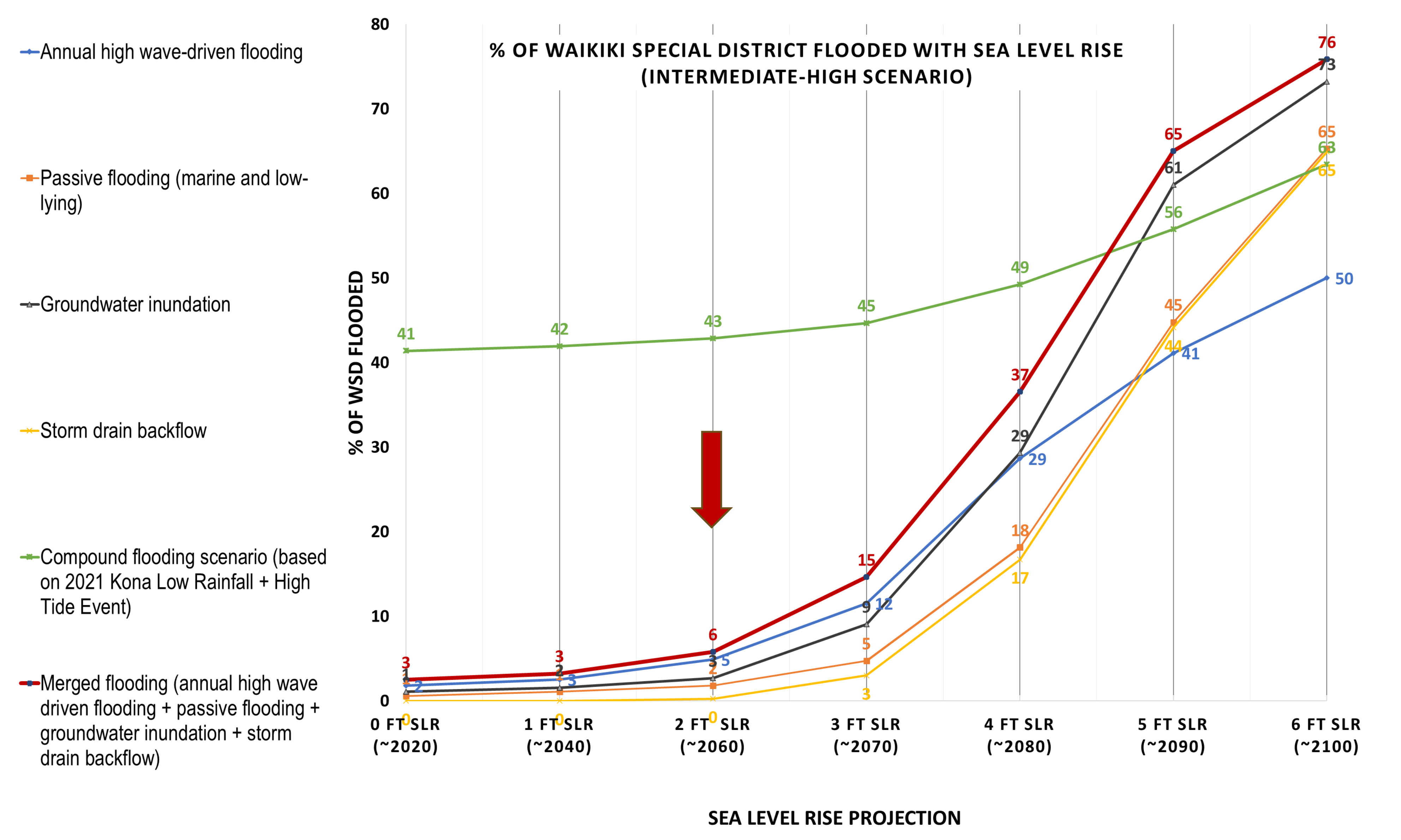
UH SOEST Climate Viewer

https://www.soest.hawaii.edu/crc/slr-viewer/

Accelerating Extreme Temperature Risk



Accelerating Flood Risk



Climate Risk Thresholds

APPROXIMATE THRESHOLD DECADE

	NEAR-TERM						LONG-TERM	
				1 FT SLR		2 FT SLR	3 FT SLR	4 FT SLR
	~2010	~2020	~2030	~2040	~2050	~2060	~2070	~2080
Air Temperature/Heat Extremes	Hawai'i Threshold 3 deg F increase over 1951 - 1980 avg							
Crtically Shallow Groundwater Depth (<5 ft below land surface)		WSD Threshold ~58% WSD at depth		69% WSD at depth				
Compound Flooding (Kona Low + High Tide Flooding)		WSD Threshold ~40% WSD flooded		~42% WSD flooded				
High Tide-Driven Flooding			Honolulu Threshold 2 days HTF/yr	~65 days HTF/yr				
Sea Surface Temperature Extremes/Coral Bleaching					WSD Threshold Onset of severe annual coral bleaching			
Groundwater Inundation						WSD Threshold ~3% WSD inundated	~9% WSD inundated	~30% WSD inundated
Annual High Wave-Driven Flooding						WSD Threshold ~5% WSD flooded	~12% WSD flooded	~29% WSD flooded
Passive Flooding							WSD Threshold ~5% WSD flooded	~18% WSD flooded
Storm Drain Backflow							WSD Threshold ~3% WSD flooded	~17% WSD flooded

Legend			
Legend	Varying Localized Impacts	Threshold to Accelerated Impacts	Widespread Impacts

Scenario Overview

1 – Heat Extremes
Strategy Objective: Mitigate temporary and widespread extreme heat events

2 – Rainfall-Driven Compound Flooding (1 ft SLR, ~2040)
Strategy Objective: Mitigate temporary and widespread flooding from extreme rainfall events compounded by high tides and storm surge

3 – SLR-Driven Shallow Groundwater Exposure (1 ft SLR, ~2040)
Strategy Objective: Extend the useful life of subsurface infrastructure exposed to permanent and widespread shallow (<5 ft below land surface) groundwater

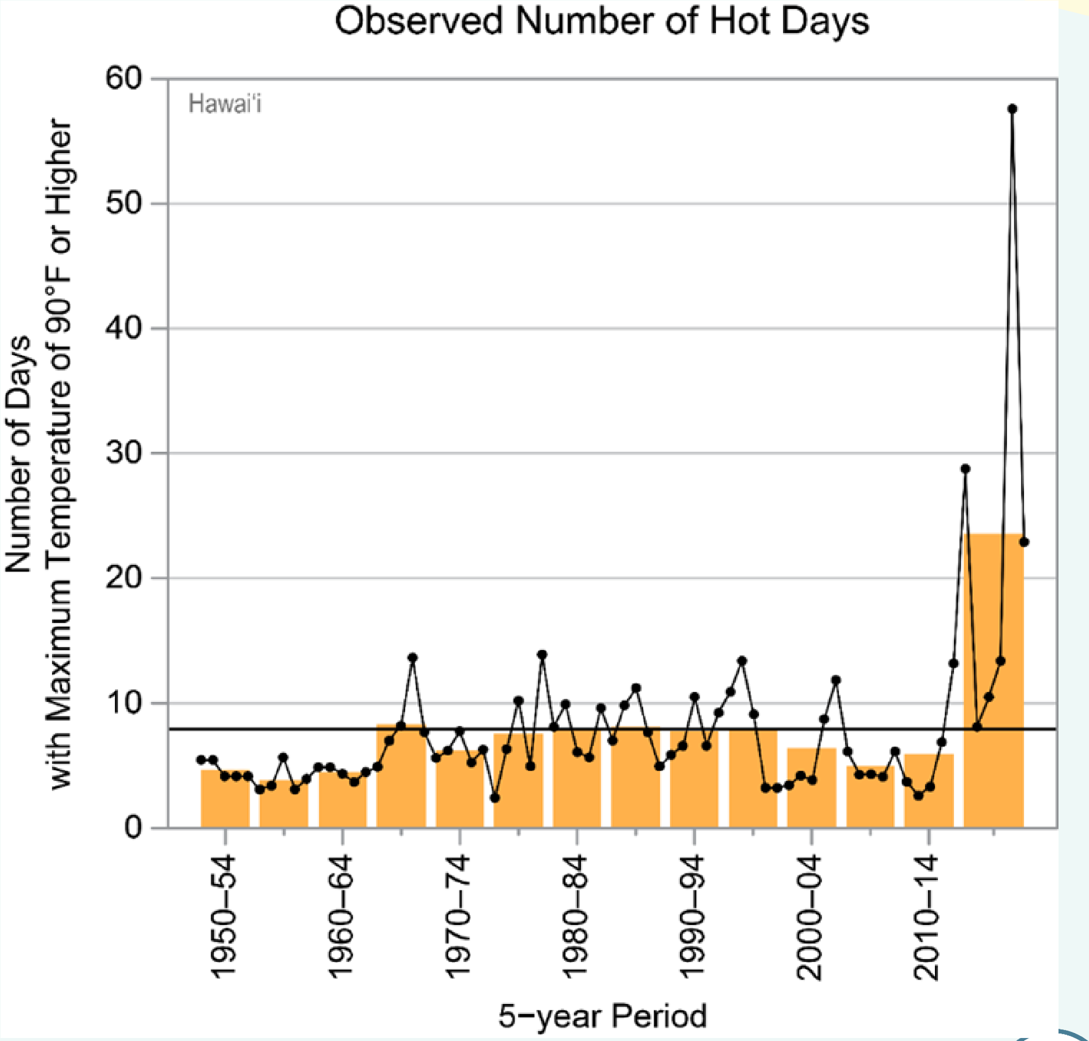
4 – SLR-Driven Groundwater Inundation (4 ft SLR, ~2080)
Strategy Objective: Address permanent and localized flooding from groundwater above land surface

5 – SLR-Driven Groundwater Inundation (6 ft SLR, ~2100)
Strategy Objective: Address permanent and widespread flooding from groundwater above land surface

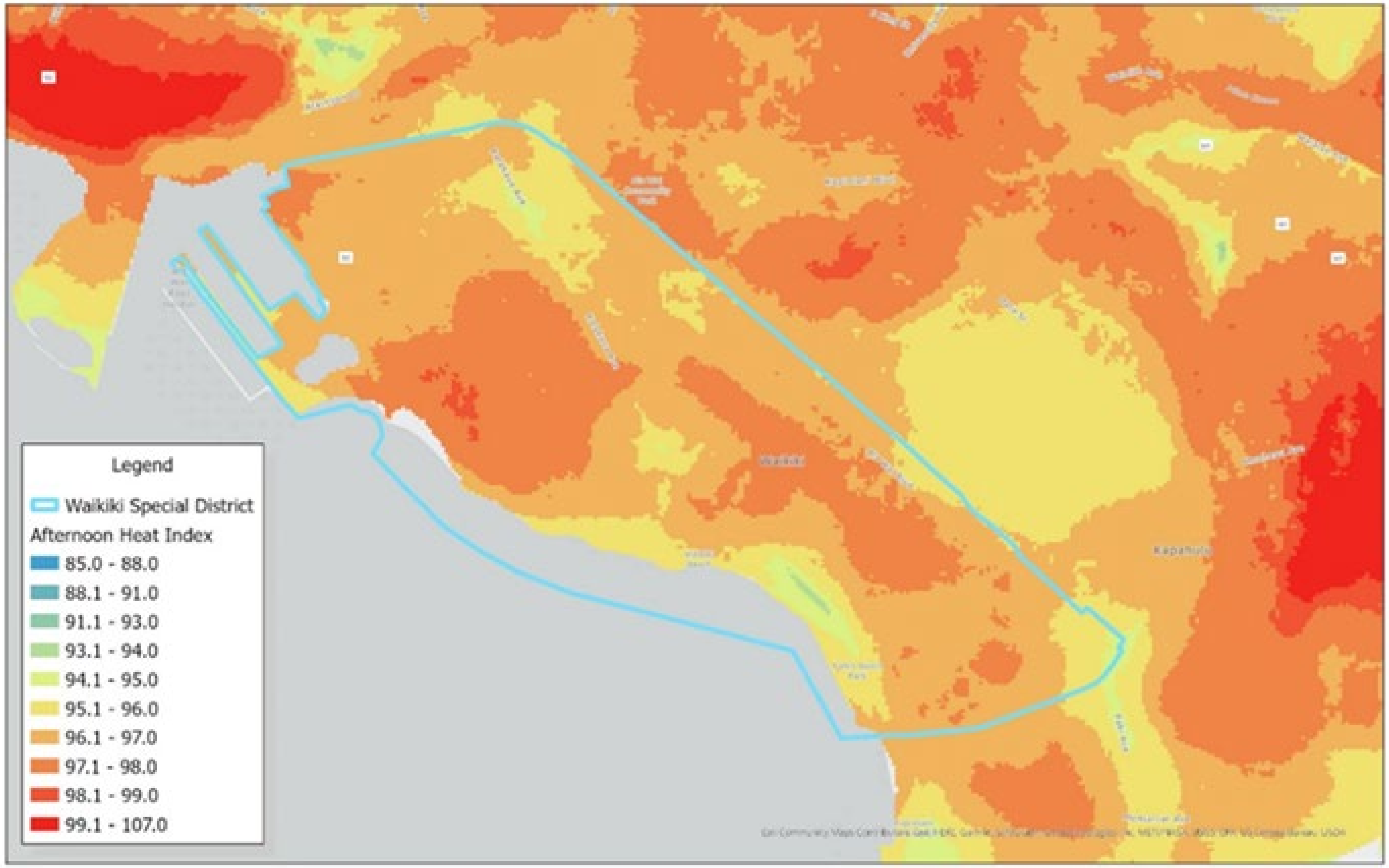
1 HEAT EXTREMES

IMPACTS

- <u>Widespread</u>, <u>temporary</u> extreme heat
- Respiratory illnesses, heatstroke, and cardiovascular and kidney disease
- Overwhelms to emergency services, health services, need for cooling centers
- Increasing energy costs with increased demand for air conditioning
- Damage to above ground infrastructure from heat
- Trees and vegetation stressed by heat extremes and drought-related water limitations



Poll



Legend
Waikiki Special District
Afternoon Heat Index
85.0 - 88.0
88.1 - 91.0
91.1 - 93.0
93.1 - 94.0
94.1 - 95.0
95.1 - 96.0
96.1 - 97.0
97.1 - 98.0
98.1 - 99.0
99.1 - 107.0
Waikiki
Kapahulu

Heat Extremes

What impacts from heat events have you experienced

- Increased report of heat-related health issues
- Increased energy usage/higher utility bills
- Power failure/brown outs
- Physical damage to infrastructure (i.e. asphalt, metal structures)
- Loss of vegetation/landscaping
- Increased water usage/cost to maintain grounds and cooling towers

Have you taken any of the following actions?

- Distributed educational material on heat stroke to employees/residents
- Modified outdoor workers schedules
- Added more awnings and trees to increase shading
- Planted more heat tolerant species
- Increased permeable surfaces for evaporative cooling
- Used lighter colored/solar reflective surfaces/coatings (e.g. paving, structures)
- Other
- No action

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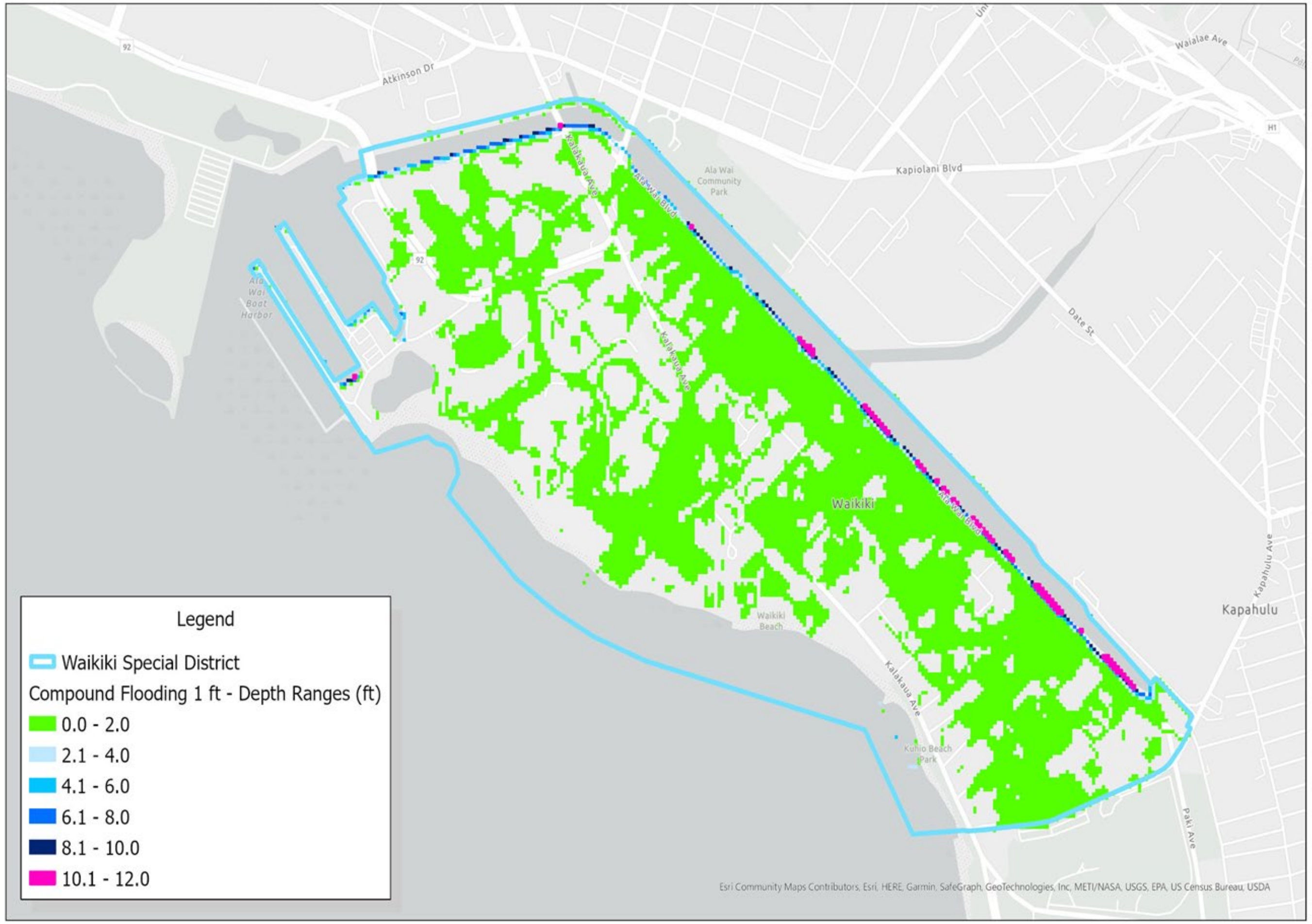
❷ RAINFALL-DRIVEN COMPOUND FLOODING (1 FT SLR, ~2040)

IMPACTS

- Widespread, temporary flooding from ~1 extreme rainfall event annually (>3 in rainfall/24 hrs)
- Road flood depths >1 and >2 ft localized along the Ala Wai Canal
- Disruption of transportation for residents, visitors, & emergency vehicles
- Disruption of electrical systems, storm drains, & wastewater systems



Flood modeling from UH SOEST Climate Resilience Collaborative (2023)

1 RAINFALL-DRIVEN COMPOUND FLOODING (1 FT SLR, ~2040)

Poll

2021 and 2024 Kona Low Events

What flood impacts were experienced?

- ❑ Staff could not get to work
- ❑ Damaged property
- ❑ Flooded roads impeded transportation
- ❑ Flooded structures/parking areas at grade
- ❑ Flooded structures/parking areas below grade
- ❑ Flooded electrical systems
- ❑ Power outage
- ❑ Other

What actions were taken?

- ❑ Pumped water from flooded below grade structures
- ❑ Protected building openings (e.g., sandbags)
- ❑ Hired clean up crew/specialized personnel
- ❑ Other

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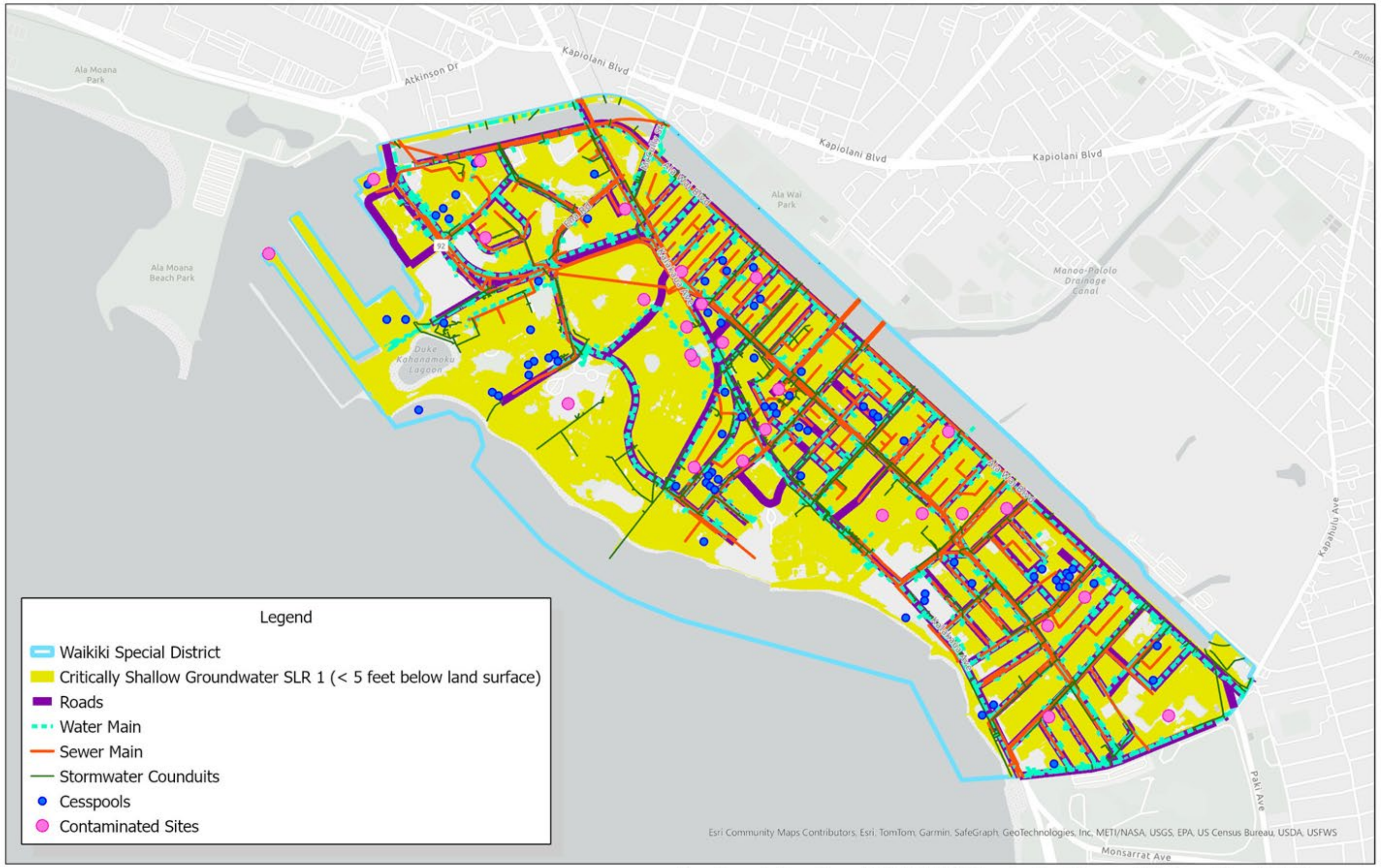
③ SLR-DRIVEN SHALLOW GROUNDWATER EXPOSURE (1 FT SLR, ~2040)

IMPACTS

- <u>Widespread</u>, <u>permanent</u> exposure of below-ground infrastructure
- Damage to below-ground infrastructure
  - Below grade parking/building foundations
  - Road base instability and potholes
  - Corrosion of subsurface utilities
- Difficulty in subsurface construction



Flood modeling from UH SOEST Climate Resilience Collaborative (2023)

Poll

credit: UH Mānoa Coastal Geology Group

Shallow groundwater (< 5 feet below ground surface)

What impacts from shallow groundwater have you experienced?

- ❑ Damaged subsurface structures/foundation
- ❑ Corroding/damaged subsurface infrastructure
- ❑ Roadbed damage
- ❑ Water accumulated during digging for construction or infrastructure repairs
- ❑ Other

What actions have been taken?

- ❑ Inspected structures for subsurface damages
- ❑ Repaired/replaced corroded subsurface infrastructure
- ❑ Fixed roadbed damage
- ❑ Pumped water out of construction/repair sites
- ❑ Other

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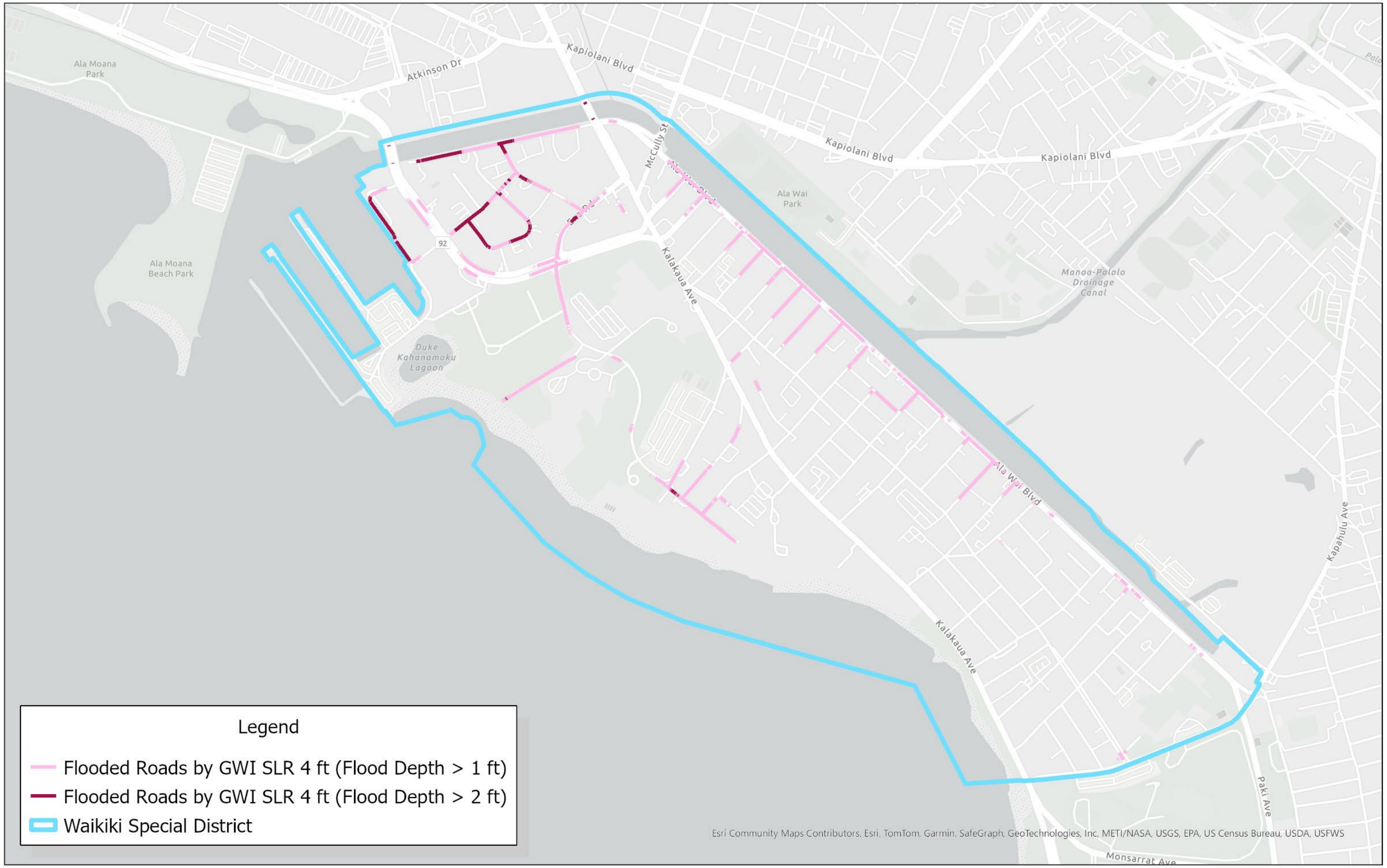
④ SLR-DRIVEN GROUNDWATER INUNDATION (4 FT SLR, ~ 2080)

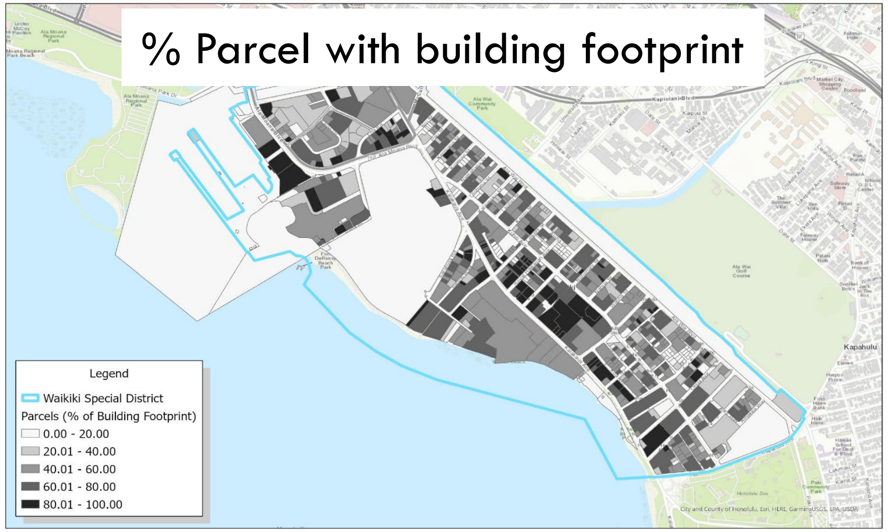
IMPACTS

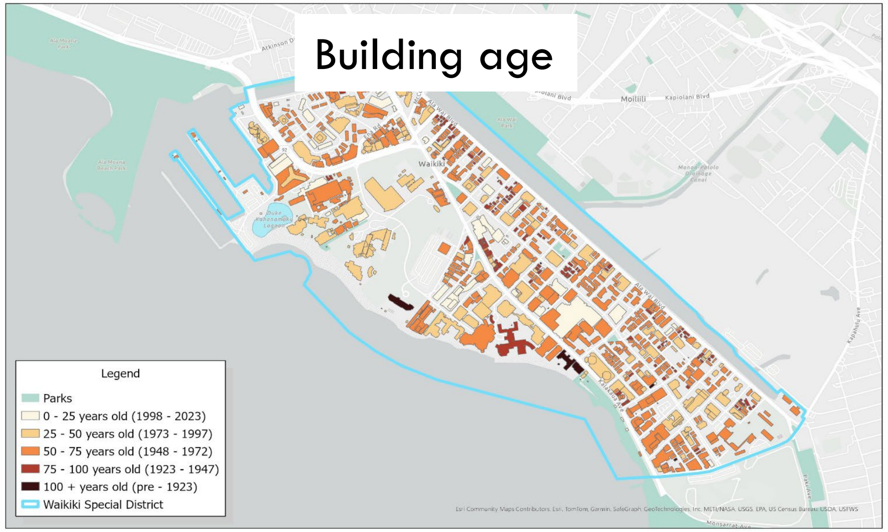
- <u>Permanent</u>, <u>localized</u> flooding of the WSD
- Road flood depths >1 and >2 ft localized in West Waikīkī (Hobron) and along the Ala Wai Canal

3 SLR-DRIVEN GROUNDWATER INUNDATION (4 FT SLR, ~ 2080)

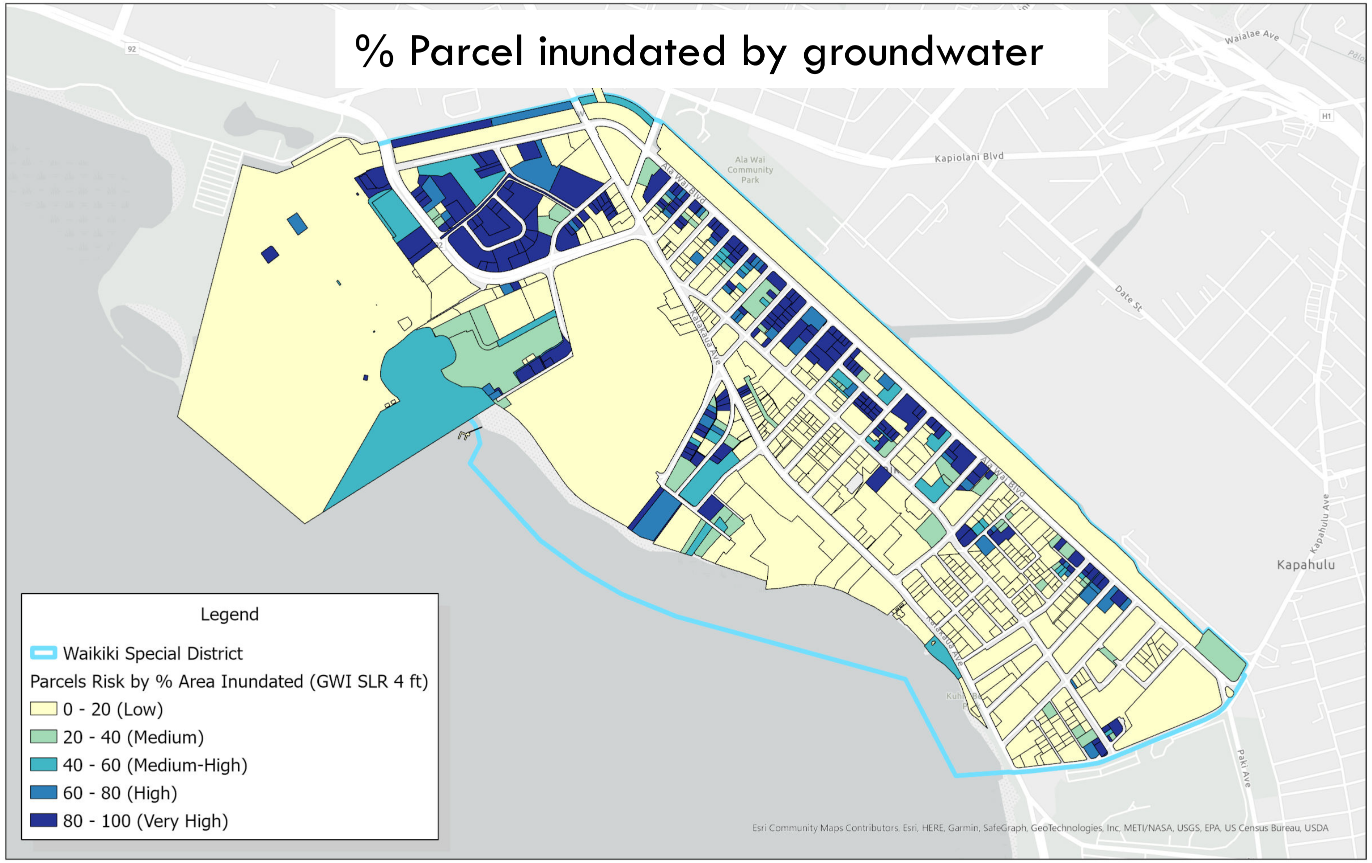


③ SLR-DRIVEN GROUNDWATER INUNDATION (4 FT SLR, ~ 2080)

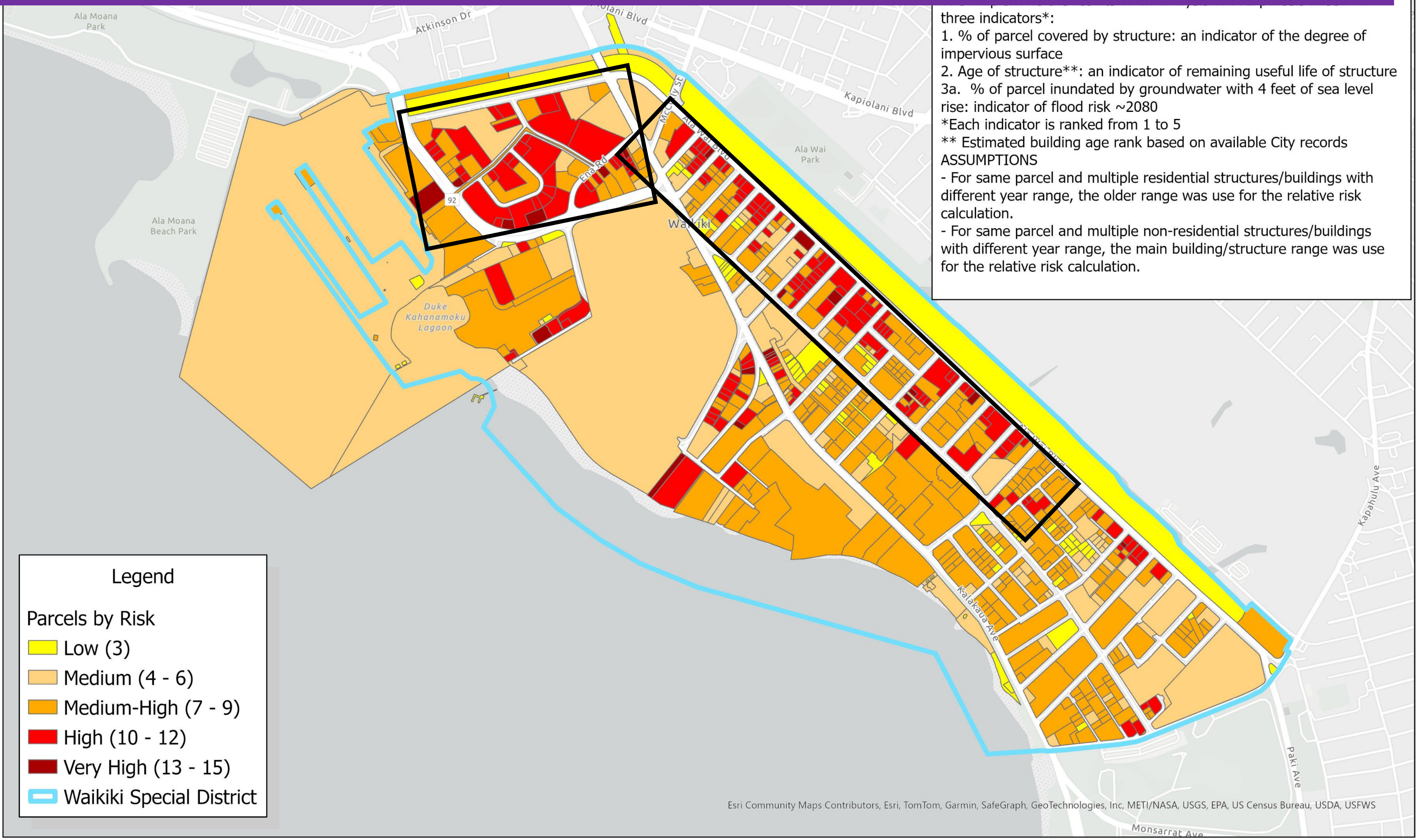




FLOOD RISK INDEX: Function of groundwater inundation, building footprint, and building age



③ RELATIVE RISK INDEX - SLR-DRIVEN GROUNDWATER INUNDATION (4 FT SLR)

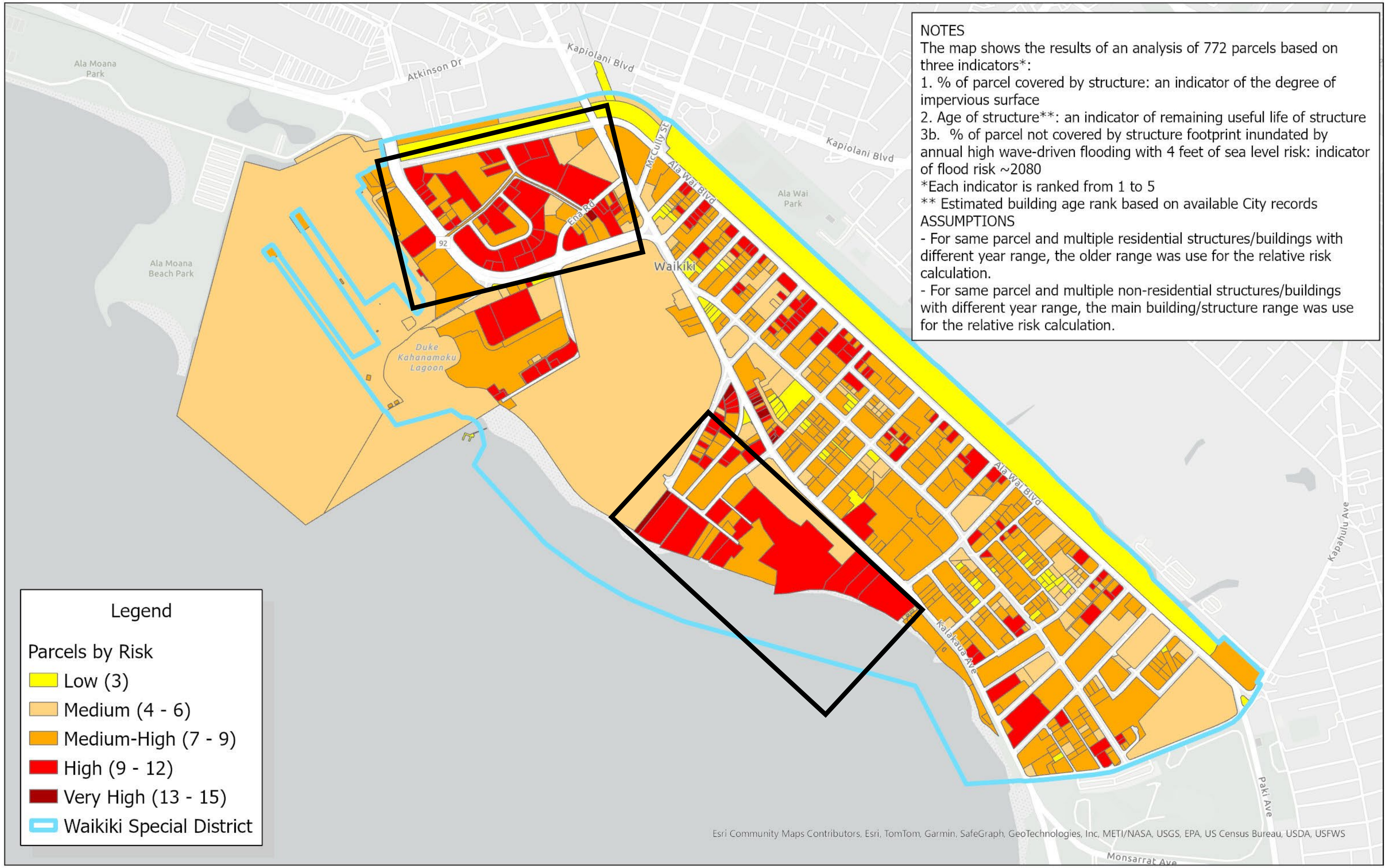


three indicators*:
1. % of parcel covered by structure: an indicator of the degree of impervious surface
2. Age of structure**: an indicator of remaining useful life of structure
3a. % of parcel inundated by groundwater with 4 feet of sea level rise: indicator of flood risk ~2080
*Each indicator is ranked from 1 to 5
** Estimated building age rank based on available City records
ASSUMPTIONS
- For same parcel and multiple residential structures/buildings with different year range, the older range was use for the relative risk calculation.
- For same parcel and multiple non-residential structures/buildings with different year range, the main building/structure range was use for the relative risk calculation.

RELATIVE RISK INDEX - ANNUAL HIGH WAVE-DRIVEN FLOODING (4 FT SLR)

ADAPT 2050 WAIKIKI

Risk Index for Annual High Wave-Driven Flooding (4ft SLR)



Poll

Groundwater Inundation/Sunny Day High Tide Flooding/High Waves

What impacts have you experienced?

- ❑ Flooded structures/parking areas at grade
- ❑ Storm drain backflow
- ❑ Overtopping of Ala Wai Canal
- ❑ Structures/walkways impacted by wave energy
- ❑ Beach/shoreline erosion
- ❑ Other

What actions have been taken?

- ❑ Hired clean up crew/specialized personnel
- ❑ Protected building openings (e.g., sandbags)
- ❑ Protected public walkways or outdoor areas (e.g., sandbags)
- ❑ Pumped water from flooded areas
- ❑ Other

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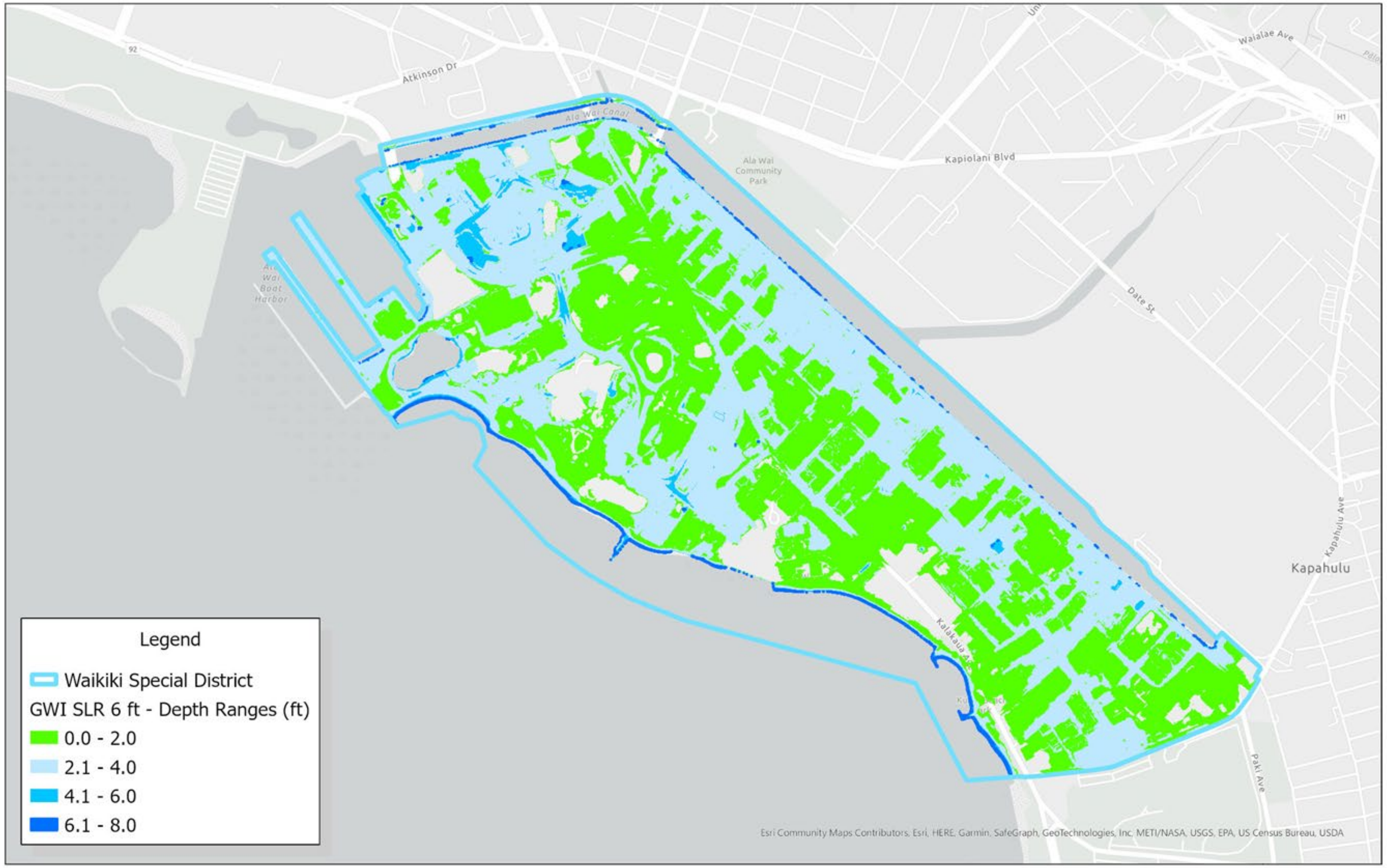
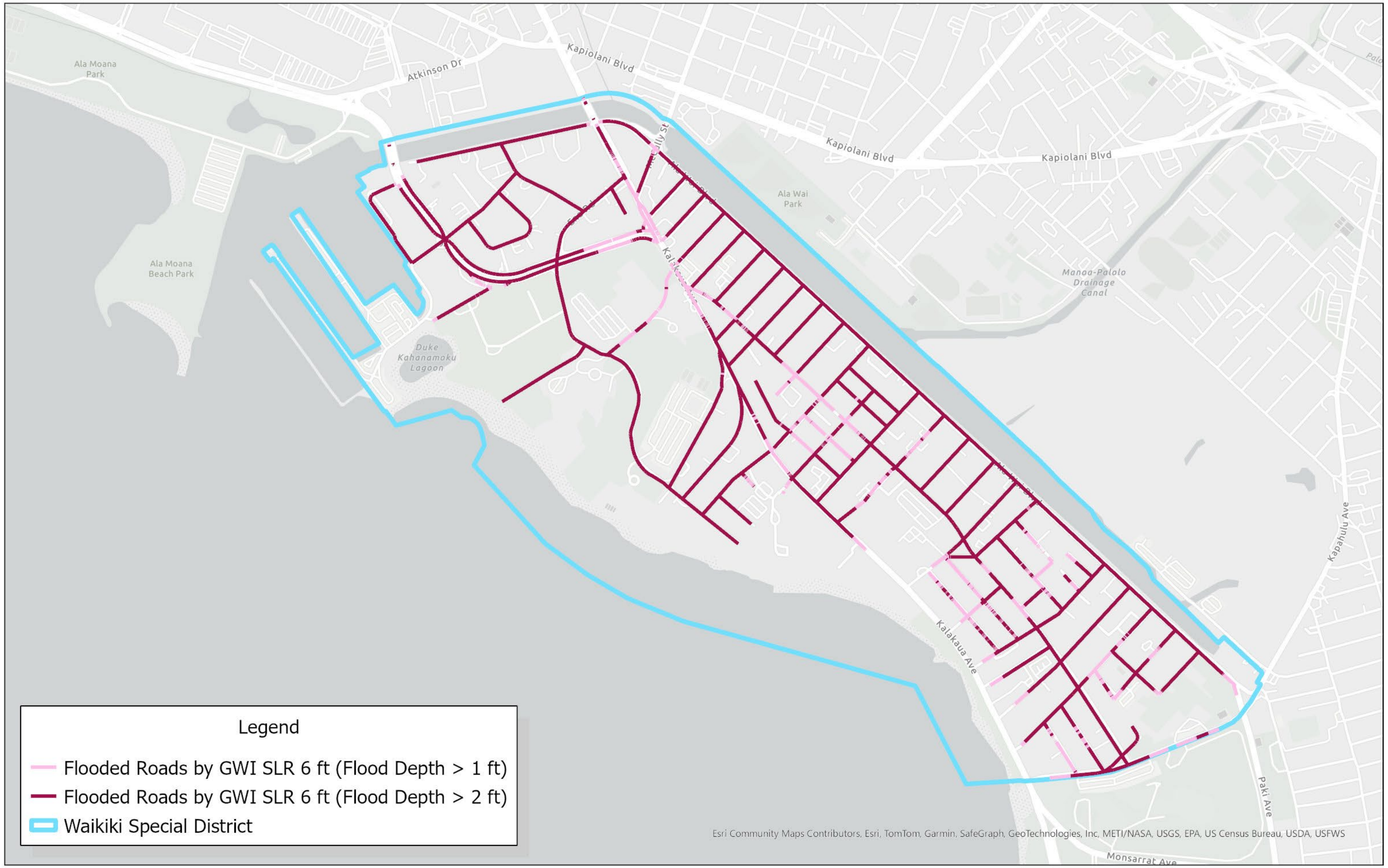
❺ SLR-DRIVEN GROUNDWATER INUNDATION (6 FT SLR, ~2100)

IMPACTS

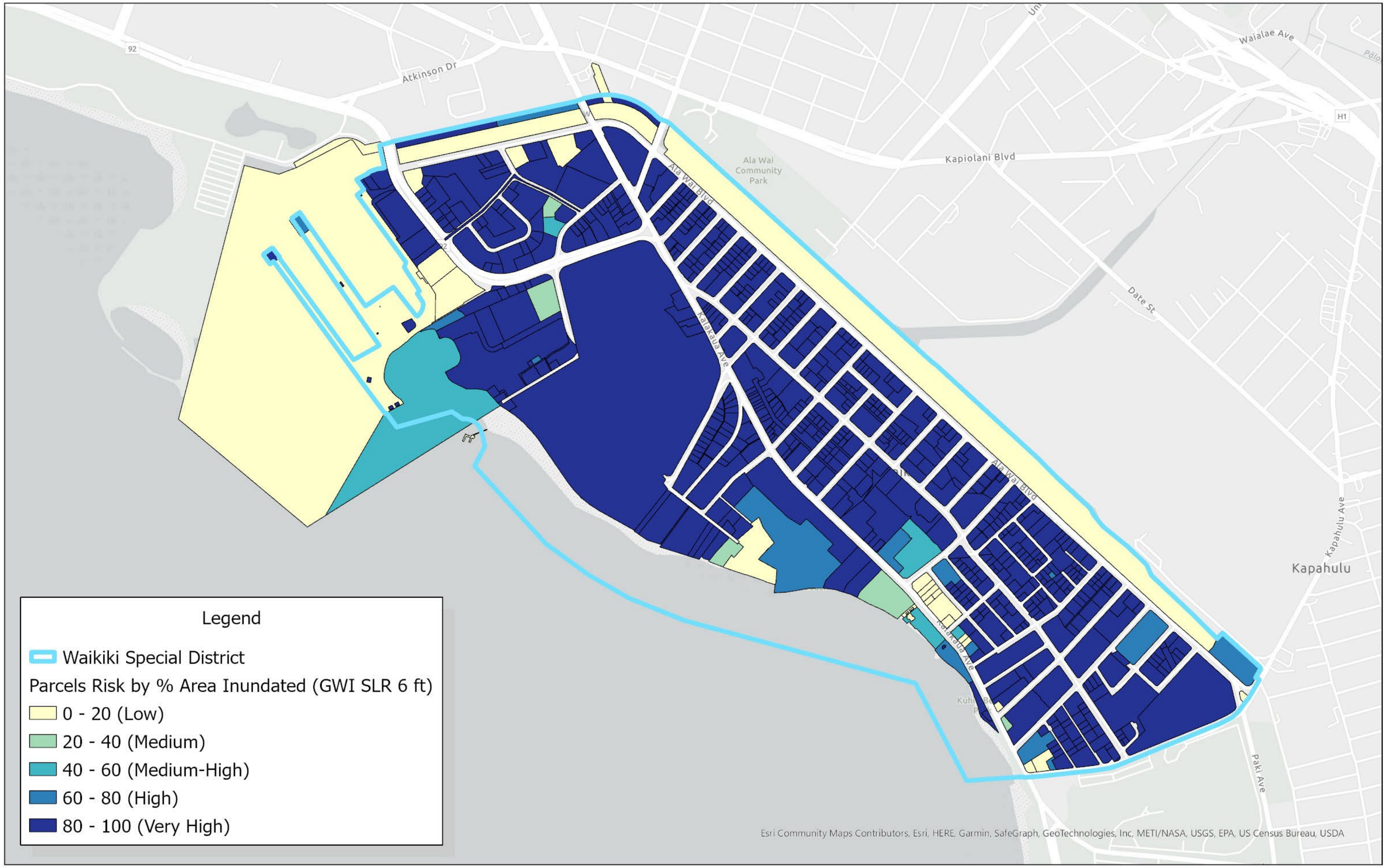
- <u>Widespread</u>, <u>permanent</u> flooding of infrastructure and structures
- Road flood depths greater than 1 and 2 ft throughout WSD



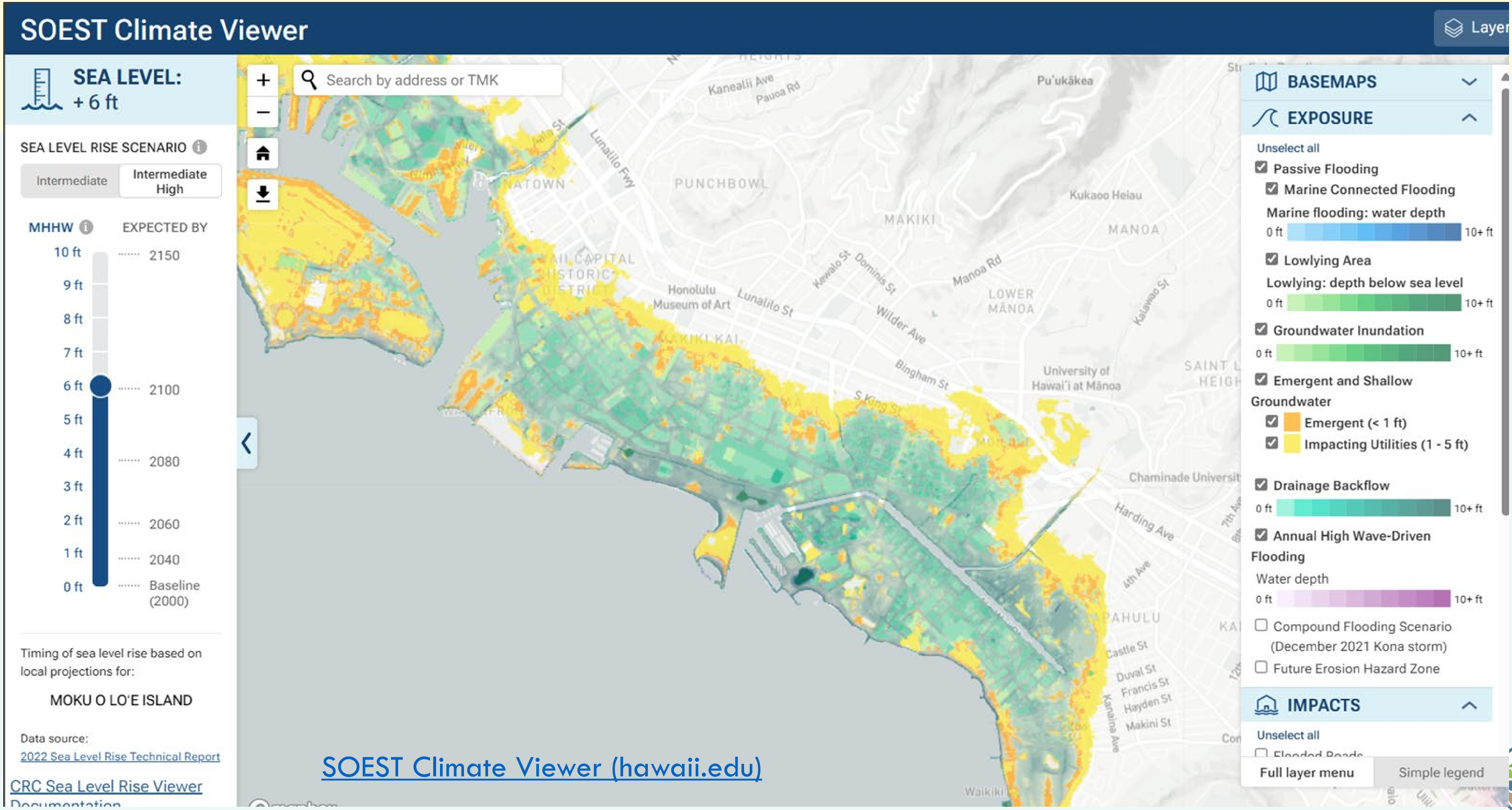
5 SLR-DRIVEN GROUNDWATER INUNDATION (6 FT SLR, ~2100)



⑤ SLR-DRIVEN GROUNDWATER INUNDATION (6 FT SLR, ~2100)



5 SLR-DRIVEN FLOODING (6 FT SLR, ~2100)



[SOEST Climate Viewer (hawaii.edu)]

Potential Adaptation Strategies for Public and Private Sector Investment

❶ HEAT EXTREMES

Strategy Objective: Mitigate <u>temporary</u> and <u>widespread</u> extreme heat events

PUBLIC-PRIVATE ADAPTATION STRATEGIES PLANNED/IMPLEMENTED BY 2050

Adaptation Strategies	Public Investment	Private Investment
Conduct urban heat assessment	X	
Provide shade through trees, awnings, or canopies	X	X
Use high solar reflectance building materials and colors for windows, pavements, and coatings		X
Pilot cool and permeable alternatives to traditional pavements in parking lots, roads, and recreational spaces	X	X
Facilitate cooling solutions and retrofits to protect residents/visitors from increasing temperatures		X
Promote landscaping on rooftops and around buildings for cooling		X

Poll

1 HEAT EXTREMES

Strategy Objective: Mitigate temporary and widespread extreme heat events

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PUBLIC-PRIVATE ADAPTATION STRATEGIES PLANNED/IMPLEMENTED BY 2050

Adaptation Strategies	Public Investment	Private Investment
Conduct urban heat assessment	X	
Provide shade through trees, awnings, or canopies	X	X
Use high solar reflectance building materials and colors for windows, pavements, and coatings		X
Pilot cool and permeable alternatives to traditional pavements in parking lots, roads, and recreational spaces.	X	X
Facilitate cooling solutions and retrofits to protect residents from increasing temperatures.		X

2 RAINFALL-DRIVEN COMPOUND FLOODING (1 FT SLR, ~2040)

STRATEGY OBJECTIVE

Mitigate temporary and widespread flooding from extreme rainfall events compounded by high tides and storm surge

STORMWATER DELAY - STORE - DISCHARGE

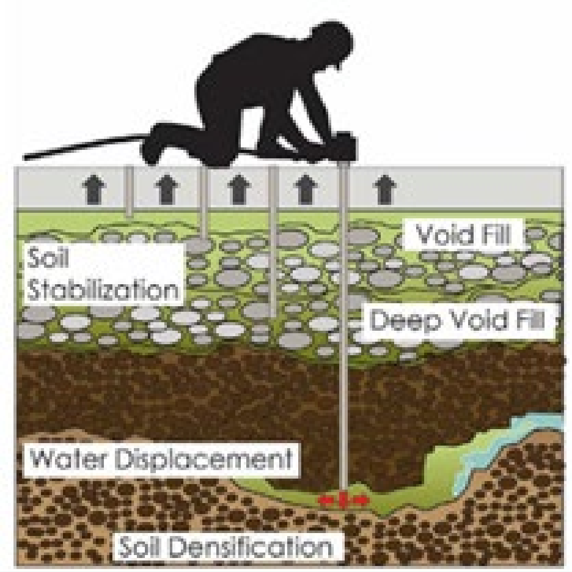
PUBLIC-PRIVATE ADAPTATION STRATEGIES PLANNED/IMPLEMENTED BY 2050

Adaptation Strategies	Public Investment	Private Investment
Prepare stormwater management plan with public and private sector solutions for storage, reuse, & delayed discharge	X	
Implement a system for stormwater storage, reuse, & delayed discharge (eg, pumps, cisterns, green/blue roofs, floodable open spaces)	X	X
Elevate/floodproof facility utility connections & critical equipment		X
Develop emergency response routes & procure high-water emergency vehicles	X	
Install tidal backflow preventor	X	
Use permeable pavers and trench drains	X	X
Dry floodproof at-grade buildings		X
Install passive flood barriers		X

③ SLR-DRIVEN SHALLOW GROUNDWATER EXPOSURE (1 FT SLR, ~2040)

STRATEGY OBJECTIVE

Extend the useful life of subsurface infrastructure exposed to permanent and widespread shallow (<5 ft below land surface) groundwater



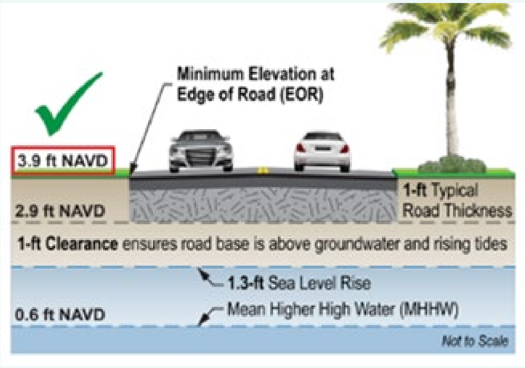
PUBLIC-PRIVATE ADAPTATION STRATEGIES PLANNED/IMPLEMENTED BY 205

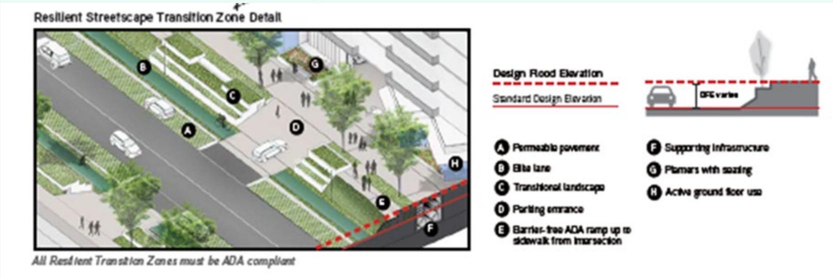
Adaptation Strategies	Public Investment	Private Investment
Conduct an integrated road/subsurface infrastructure adaptation/engineering/ economic study	X	
Line public storm and sanitary sewer pipes & private laterals	X	X
Improve roadway strength and durability	X	X
Establish standards for subsurface building structure inspections	X	X
Assess potential revisions to standards for dry floodproofing buildings' below-grade areas	X	
Repurpose or fill below-grade spaces/increase building height/density		X

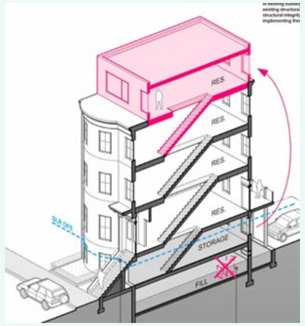
4 SLR-DRIVEN GROUNDWATER INUNDATION (4 FT SLR, ~ 2080)

STRATEGY OBJECTIVE

Address <u>permanent</u> and <u>localized</u> flooding from groundwater above land surface







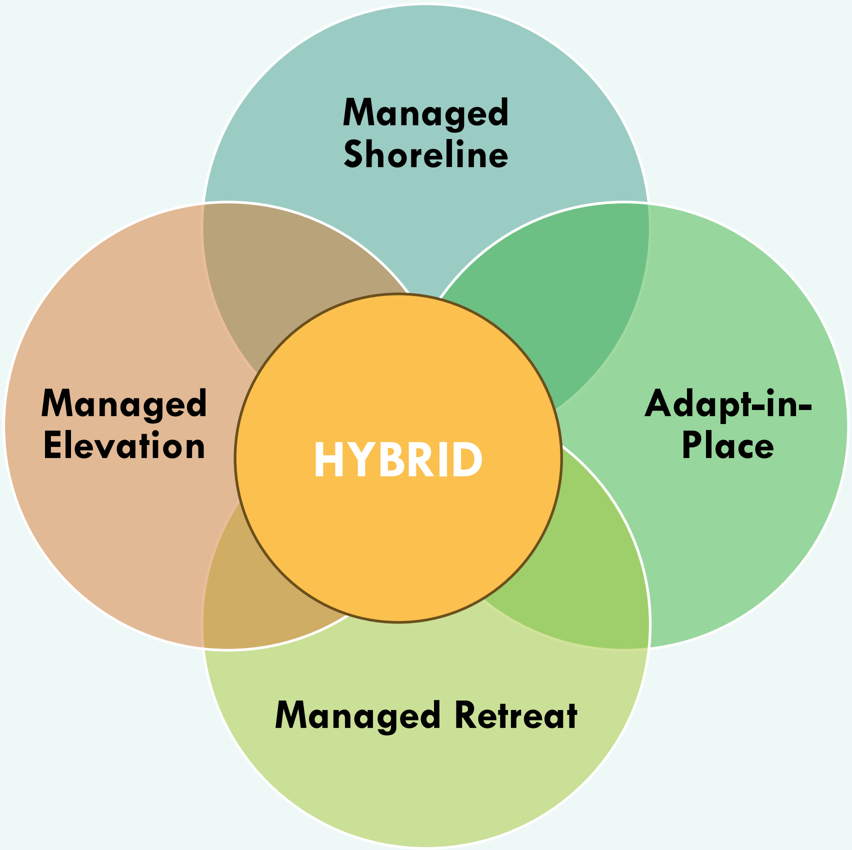
PUBLIC-PRIVATE ADAPTATION STRATEGIES PLANNED/IMPLEMENTED BY 2050

Adaptation Strategies	Public Investment	Private Investment
Conduct infrastructure services phasing study	X	
Revise WSD design guidelines/Develop overlay district to promote WSD-wide & localized flood resilience	X	X
Elevate roads and associated utilities for a localized area with early flood risk	X	
Require Right-of-Way Harmonization Agreements at elevated roads	X	X
Prepare standards for transition zones at elevated roads	X	X
Repurpose or fill below-grade spaces/increase building height/density		X
Elevate buildings on open foundation/fill to new Design Flood Elevation		X
Conduct incremental retreat study: easements, TDR, public lands	X	

5 SLR-DRIVEN GROUNDWATER INUNDATION (6 FT SLR, ~2100)

STRATEGY OBJECTIVE

Address permanent and widespread flooding from groundwater above land surface



IMPLEMENT RECOMMENDATIONS FROM SCENARIO 3, BASED ON:

- Feasibility/infrastructure services determinations
- Areas identified for protection, accommodation, or retreat
- Ala Wai Flood Control Project
- Beach Restoration and Maintenance Project
- Shoreline management and jurisdiction
- Availability of insurance
- Other yet known factors

Break out in Small Groups

SMALL GROUP DISCUSSION

- Polling Question
- Sticker Exercise
  - You have a 4-sticker budget which you use however you like. You can put all four on one strategy or one sticker on individual strategies.
- Discussion
  - Has anyone had experience with/or employed this adaptation strategy?
  - What are obstacles for implementation?
  - How likely do you think property owners are to utilize this strategy by 2050 if the City provides guidance but does not require it?

Poll

2 RAINFALL-DRIVEN COMPOUND FLOODING (1 FT SLR, ~2040)

STRATEGY OBJECTIVE

Mitigate temporary and widespread flooding from extreme rainfall events compounded by high tides and storm surge

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Or scan the QR code

To what extent is the strategy relevant/appropriate as an adaptation for Waikīkī? Please adjust the slider from 1 (very relevant) to 5 (not relevant)

Adaptation Strategies	Public Investment	Private Investment
Prepare stormwater management plan with public and private sector solutions for storage, reuse, & delayed discharge	X	
Implement a system for stormwater storage, reuse, & delayed discharge (eg, pumps, cisterns, green/blue roofs, floodable open spaces)	X	X
Elevate/floodproof facility utility connections & critical equipment		X
Develop emergency response routes & procure high-water emergency vehicles	X	
Install tidal backflow preventor	X	
Use permeable pavers and trench drains	X	X
Dry floodproof at-grade buildings		X
Install passive flood barriers		X

SMALL GROUP DISCUSSION

- Polling Question
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  - Has anyone had experience with/or employed this adaptation strategy?
  - What are obstacles for implementation?
  - How likely do you think property owners are to utilize this strategy by 2050 if the City provides guidance but does not require it?

Poll

3 SLR-DRIVEN SHALLOW GROUNDWATER EXPOSURE (1 FT SLR, ~2040)

STRATEGY OBJECTIVE

Extend the useful life of subsurface infrastructure exposed to permanent and widespread shallow (<5 ft below land surface) groundwater

Please go to menti.com and enter code 7224 7237
Or scan the QR code

To what extent is the strategy relevant/appropriate as an adaptation for Waikīkī? Please adjust the slider from 1 (very relevant) to 5 (not relevant)

Adaptation Strategies	Public Investment	Private Investment
Conduct an integrated road/subsurface infrastructure adaptation/engineering/ economic study	X	
Line public storm and sanitary sewer pipes & private laterals	X	X
Improve roadway strength and durability	X	X
Establish standards for subsurface building structure inspections	X	X
Assess potential revisions to standards for dry floodproofing buildings' below-grade areas	X	
Repurpose or fill below-grade spaces/increase building height/density		X

SMALL GROUP DISCUSSION

- Polling Question
- Sticker Exercise
  - You have a 4-sticker budget which you use however you like. You can put all four on one strategy or one sticker on individual strategies.
- Discussion
  - Has anyone had experience with/or employed this adaptation strategy?
  - What are obstacles for implementation?
  - How likely do you think property owners are to utilize this strategy by 2050 if the City provides guidance but does not require it?

Poll

4 SLR-DRIVEN GROUNDWATER INUNDATION (4 FT SLR, ~ 2080)

ADAPT 2050 WAIKĪKĪ

To what extent is the strategy relevant/appropriate as an adaptation for Waikīkī?
Please adjust the slider from 1 (very relevant) to 5 (not relevant)

STRATEGY OBJECTIVE

Address permanent and localized flooding from groundwater above land surface

Please go to menti.com and enter code 7224 7237
Or scan the QR code

Adaptation Strategies	Public Investment	Private Investment
Conduct infrastructure services phasing study	X	
Revise WSD design guidelines/Develop overlay district to promote WSD-wide & localized flood resilience	X	X
Elevate roads and associated utilities for a localized area with early flood risk	X	
Require Right-of-Way Harmonization Agreements at elevated roads	X	X
Prepare standards for transition zones at elevated roads	X	X
Repurpose or fill below-grade spaces/increase building height/density		X
Elevate buildings on open foundation/fill to new Design Flood Elevation		X
Conduct incremental retreat study: easements, TDR, public lands	X	

SMALL GROUP DISCUSSION

- Polling Question
- Sticker Exercise
  - You have a 4-sticker budget which you use however you like. You can put all four on one strategy or one sticker on individual strategies.
- Discussion
  - What are your expectations from the top voted strategy?
  - What are your expectations for public and private investment for these strategies?
  - What are your expectations from a hybrid scenario?

Poll

5 SLR-DRIVEN GROUNDWATER INUNDATION (6 FT SLR, ~2100)

Given the impacts with 6 feet of sea level rise, please rank the factors you are most concerned about (first = most concerned)

- Feasibility of continued infrastructure
- Cost to private landowners to adapt in place
- Loss of useable land area/shoreline erosion
- Loss of recreational beaches
- Increased flooding from the Ala Wai Canal/major storm events
- Property insurance costs and availability
- Other

Given the impacts with 6 feet of sea level rise, how much do you favor each adaptation strategy?

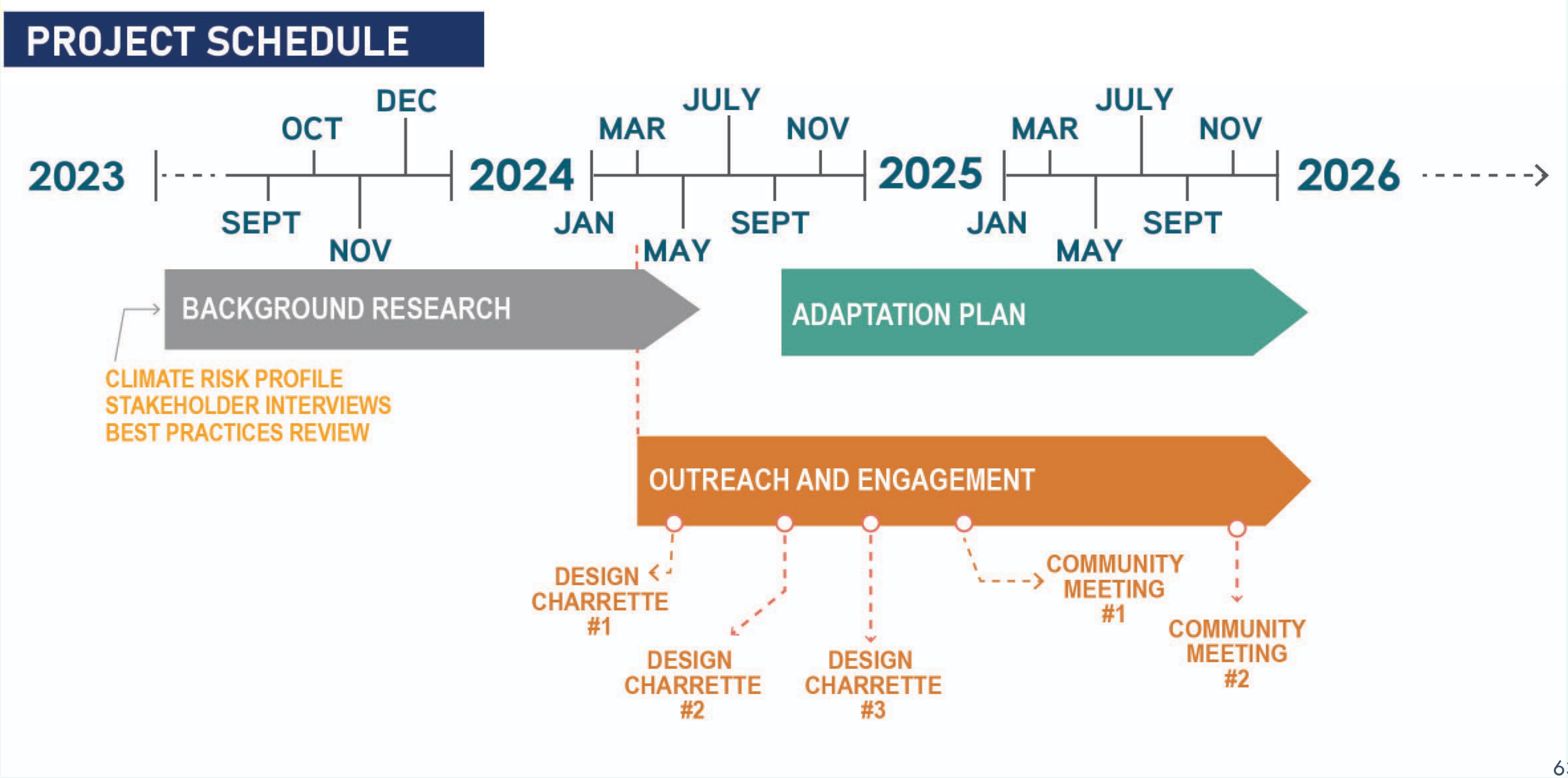
Please adjust the slider from 1 (highly favor) to 5 (do not favor)

- Managed Shoreline
- Adapt-in-Place
- Managed Retreat
- Managed Elevation
- Hybrid Approach

Please go to menti.com and enter code 7224 7237

Next Steps

Scope, Schedules and Tasks



Next Steps

- Charrette #3 –
- *Waikiki Residential Community Focus*

  - Identify adaptation strategies/flood mitigation measures for residential properties/structures
  - Format: presentation and facilitated small group scenario discussions

Resources

Project Website:

https://www.honolulu.gov/dpp/planning/planning-documents/area-adaptation-plans/waikiki2050.html

- Climate Risk Profile
- Project Fact Sheet

Adapt Waikīkī 2050

Mahalo
Q&A