A Climate Adaptation Approach to One Water Honolulu's CIP

October 15, 2025

HWWA ANNUAL CONFERENCE

Rachel Duncan and Tess Sprague

ONE WATER HONOLULU

contents

Project Overview

One Water Honolulu Project Team

Team Members

Susan Mukai, PE
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PROJECT OVERSIGHT

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ONE WATER SUBJECT MATTER EXPERT

Tess Sprague, PhD
CLIMATE AND RESILIENCE SUBJECT MATTER EXPERT

Wendy Broley, PE
TECHNICAL ADVISOR

Tyler Oshiro, PE
PROJECT ENGINEER

Rachel Duncan, ENV SP
SENIOR ENGINEER

Inge Wiersema, PE
TECHNICAL ADVISOR

Sunshine Saucedo, EIT
PROJECT ENGINEER

Seema Chavan, PE
FUNDING SUBJECT MATTER EXPERT

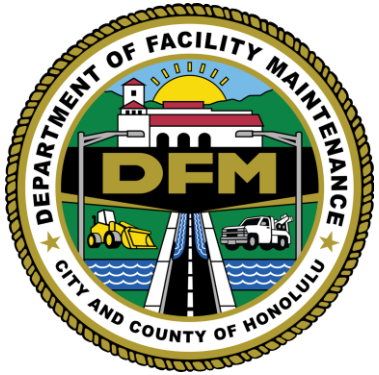
Cami Kloster
G70

Ian Monahan
KATZ & ASSOCIATES

● Brown and Caldwell ● Carollo ● Subconsultants

One Water Panel

The One Water Panel includes, but is not limited to, representatives from 8 City departments



OWH Technical Advisory Committee

Purpose: Provide input and guidance on the One Water Honolulu project's methodology, project development, and coordination between City and State efforts.

TAC Members:

- **Dr. Chip Fletcher**, UH SOEST
- **Dr. Victoria Keener**, ASU & East-West Center
- **Genevieve Sullivan**, State DOT, Highways Div
- **Joanna Seto**, State of Hawaii Department of Health
- **Wendy Meguro**, UH School of Architecture
- **Neal Fujii**, CWRM (recently retired; new TAC member TBD)
- **Mary Alice Evans**, State Office of Planning and Sustainable Development
- **Dr. Bradley Romine**, Pacific Islands Climate Adaptation Science Center, UH Sea Grant

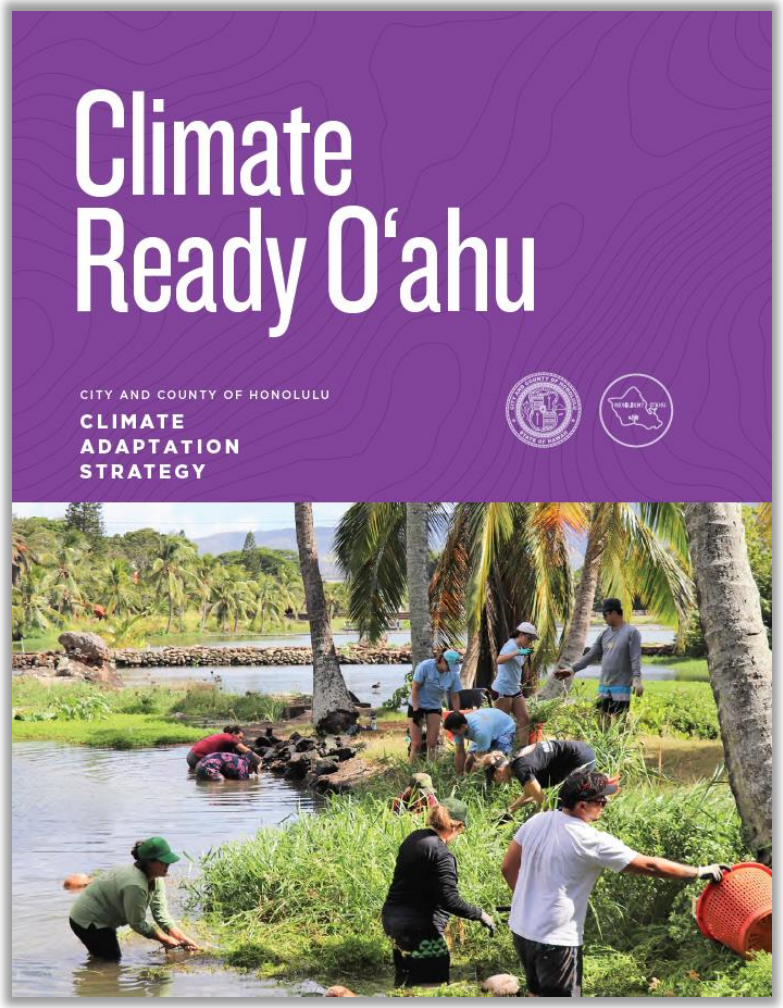
Climate Ready O‘ahu Vision Statement

A *Climate Ready O‘ahu* is one where:

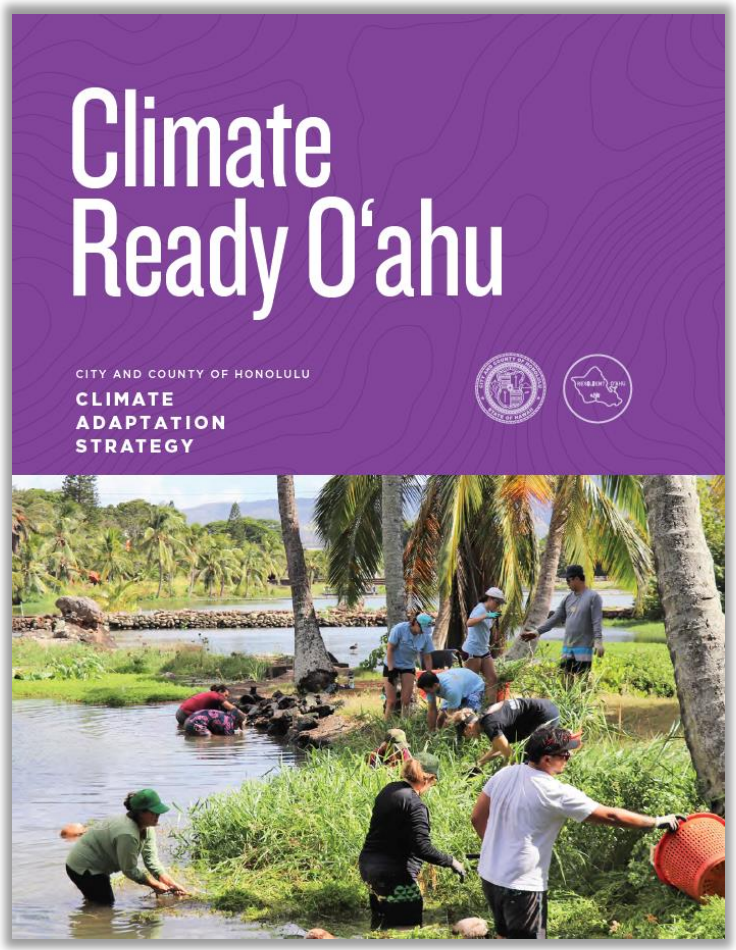
All people are empowered with the knowledge, tools, and resources to prepare for climate impacts;

Connections between people and native ecosystems are cultivated so the ***‘āina is safeguarded for generations*** to come; and

Infrastructure works with natural systems to keep residents safe from climate hazards at home, at work, and everywhere in between.



Building from Climate Ready O‘ahu



Strategies, Actions & Stakeholder Input

ONE WATER HONOLULU

OWH Project

- **Vision:** Collaborating for a thriving and climate resilient O‘ahu

- **Mission:** One Water Honolulu champions cost-effective and climate-resilient infrastructure services and natural systems for the people, culture, and sustainability of O‘ahu through integration and innovation in planning, implementation, and maintenance.

Collaboration and Climate Change Adaptation Frameworks

Collaboration Framework:

- Provides a clear and effective process of **who should be working together and how to build resilience** into the ongoing and planned projects, programs, and policies related to water management.

Climate Change Adaptation Framework:

- Represents the **approach for determining vulnerabilities and adaptation strategies** (based on water infrastructure type and climate risk) and **their prioritization.**

OWH Plan Outcomes

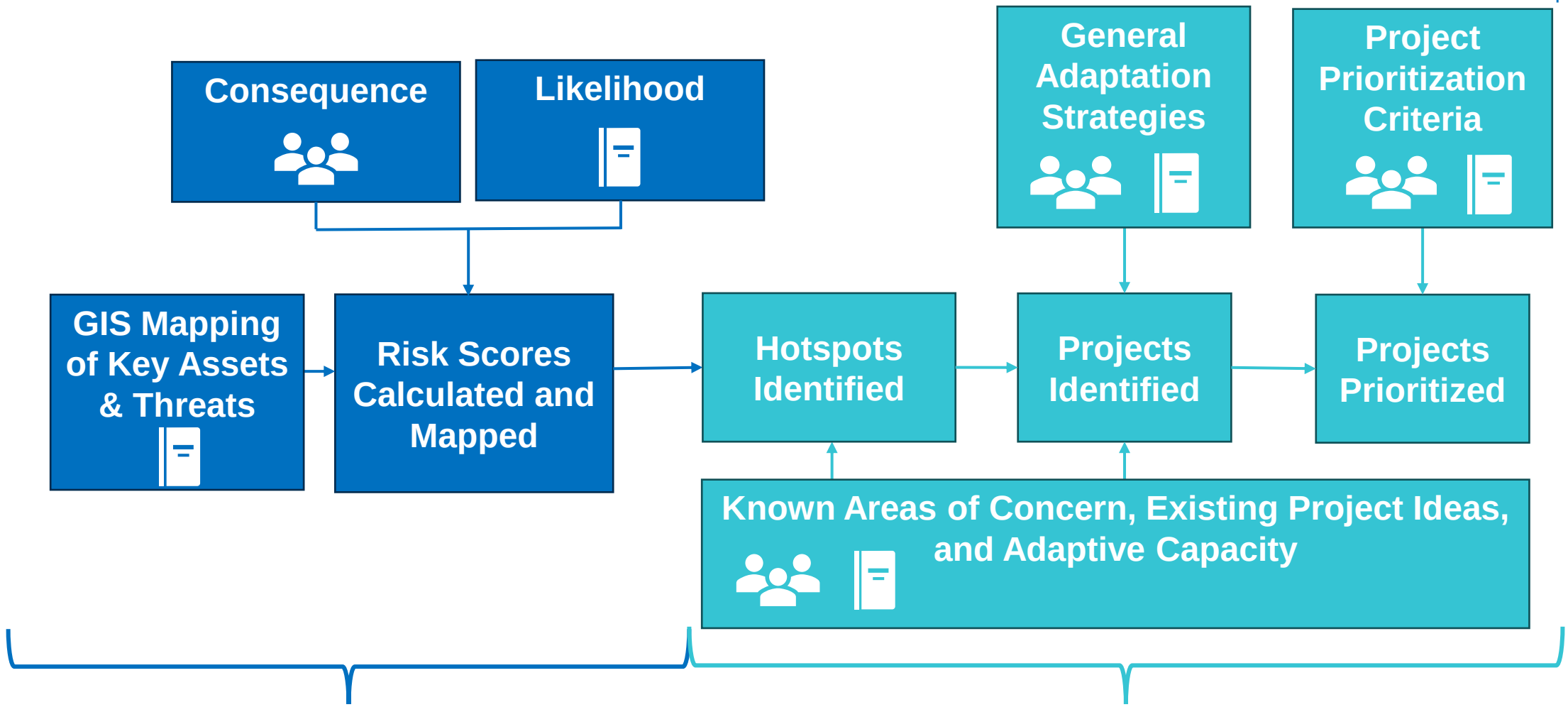
- Frameworks support: One Water CIP, Funding Strategy, Trigger-based Implementation Plan, Policies and Recommendations, and Private Sector Guidelines

Climate Change Adaptation Framework

Climate Change Adaptation Framework

Collaboration framework questions and information used to drive decision making

Input from past planning efforts and document review, including stakeholder input



Part 1: Wide scope, low detail spatial assessment. Mostly automated
Purpose: Screen thousands of threat-asset pairs to identify highest risk areas

Part 2: Focused scope, higher detail assessment. More manual
Purpose: Develop and group prioritized list of projects to support phased CIP

Climate Change Adaptation Framework

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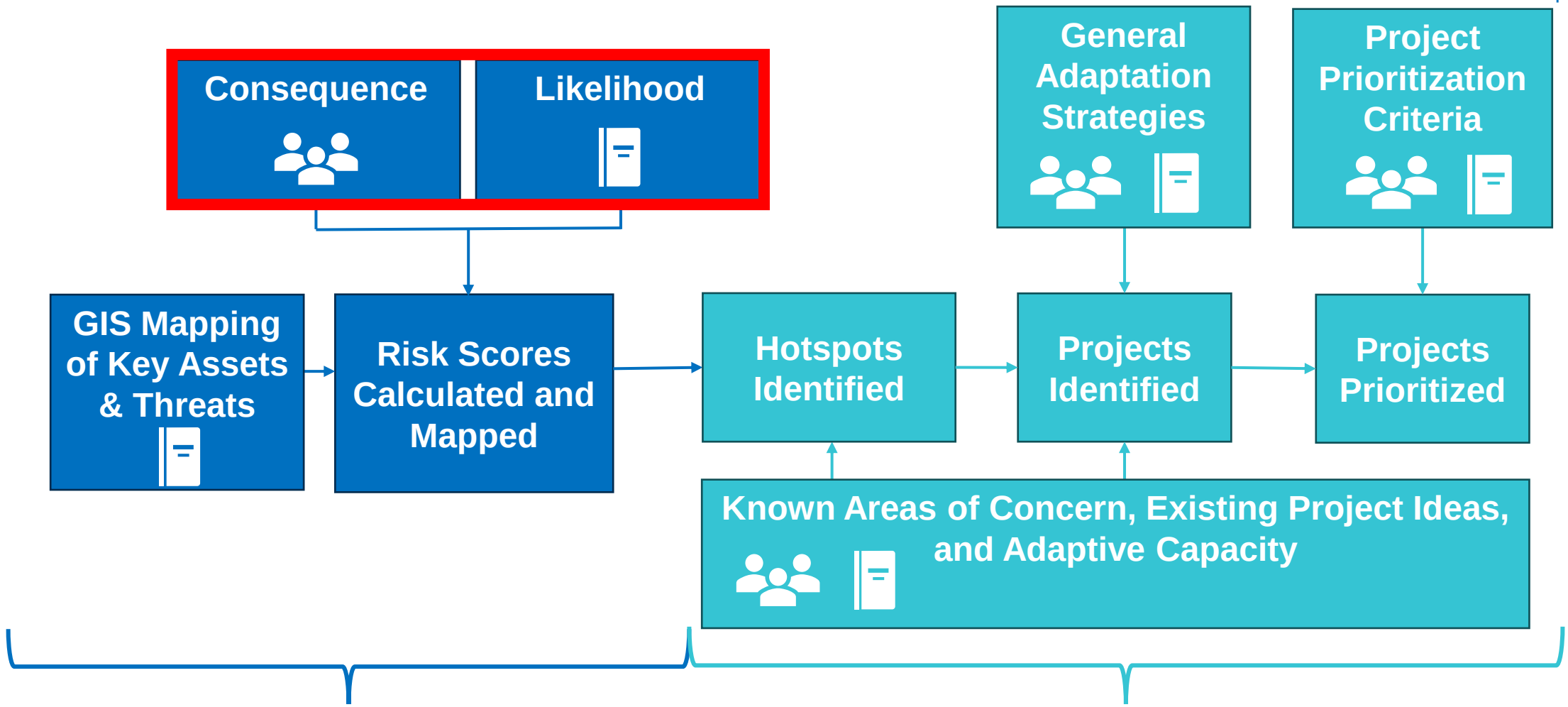

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Risk = Consequence x Likelihood

Risk Score = **Consequence Scores** How badly a threat would impact an asset type  x **Likelihood Scores** Probability of a threat occurring in the planning horizon 

Likelihood Scores

Likelihood scale represented by percent chance of occurring over planning horizon

0 = Asset not exposed to threat

1 = Extremely unlikely, <5%

2 = Unlikely, 5-33%

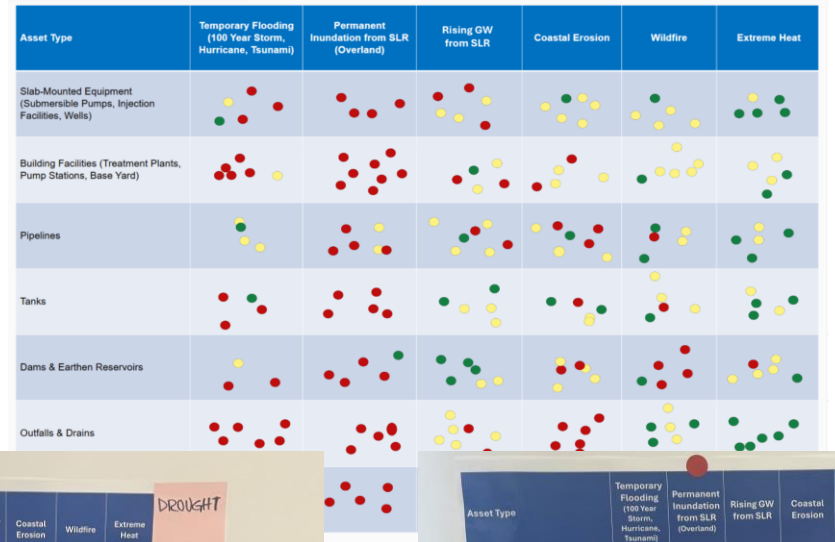
3 = Possible, 33-66%

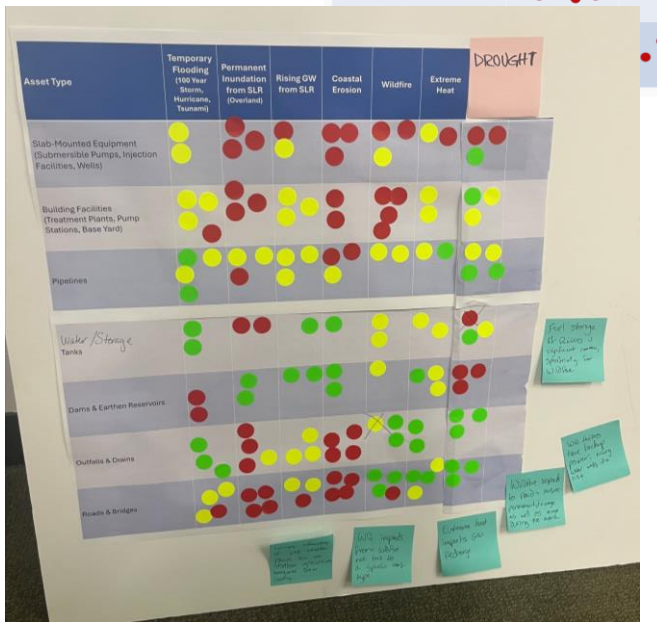
4 = Likely, 66-95%

5 = Extremely likely, >95%

Threat	Score (2055)	Score (2100)	Source
SLR & Coastal Erosion – 1 ft	5	5	National Oceanic and Atmospheric Administration (NOAA) likelihood by scenario
SLR & Coastal Erosion – 3 ft	3	4	
SLR & Coastal Erosion – 8 ft	1	1	
Hurricane - Category 1	3	5	American Water Works Association (AWWA) J100 Historical Record + Projected Climate Change Increase
Hurricane - Category 2	3	5	
Hurricane - Category 3	1	1	
Hurricane - Category 4	1	1	
Tsunami Evac Zone	5	5	Historical Record
Extreme Tsunami Evac Zone	1	1	
100 Year Storm	3	4	AWWA J100 Historical Record + Projected Climate Change Increase
Wildfire – Low Risk	2	2	Qualitative
Wildfire – Medium Risk	3	3	
Wildfire – High Risk	4	4	
Drought – Low Risk	5	5	Department of Land and Natural Resources (DLNR) Drought Risk and Vulnerability Assessment
Drought – Medium Risk	5	5	
Drought – High Risk	4	5	
Extreme Heat – 2019 > 90	5	5	Historical Record + Projected Climate Change Increase
Extreme Heat – 2019 > 85	3	4	

Consequence Scores: Input from One Water Panel





Consequence Scale:

= **Minimal**: Minimal or no impact to operations, little or no repair required

= **Moderate**: Reduced operation, meaningful repair or some replacement needed

= **Significant**: Complete failure or inoperable for a long period, significant or total replacement needed

Consequence Scores: Translating Input into Consequence Scores

Panel Input:

Averaged Scores

Consequence Scores :

Asset Type	Temporary Flooding	SLR – Above Ground	SLR - GW	Coastal Erosion	Wildfire	Extreme Heat	Drought
Slab-Mounted Equipment	4	5	4	4	3	1	3
Building Facilities	4	5	3	4	3	2	2
Pipelines	2	4	4	4	3	2	1
Tanks	4	5	3	4	3	2	2
Dams & Earthen Reservoirs	5	4	1	4	4	3	2
Outfalls & Drains	5	5	3	5	2	1	1
Roads & Bridges	5	5	3	5	4	2	1

Note: Scores only applied to assets that have exposure to threat. If no exposure, risk = 0.

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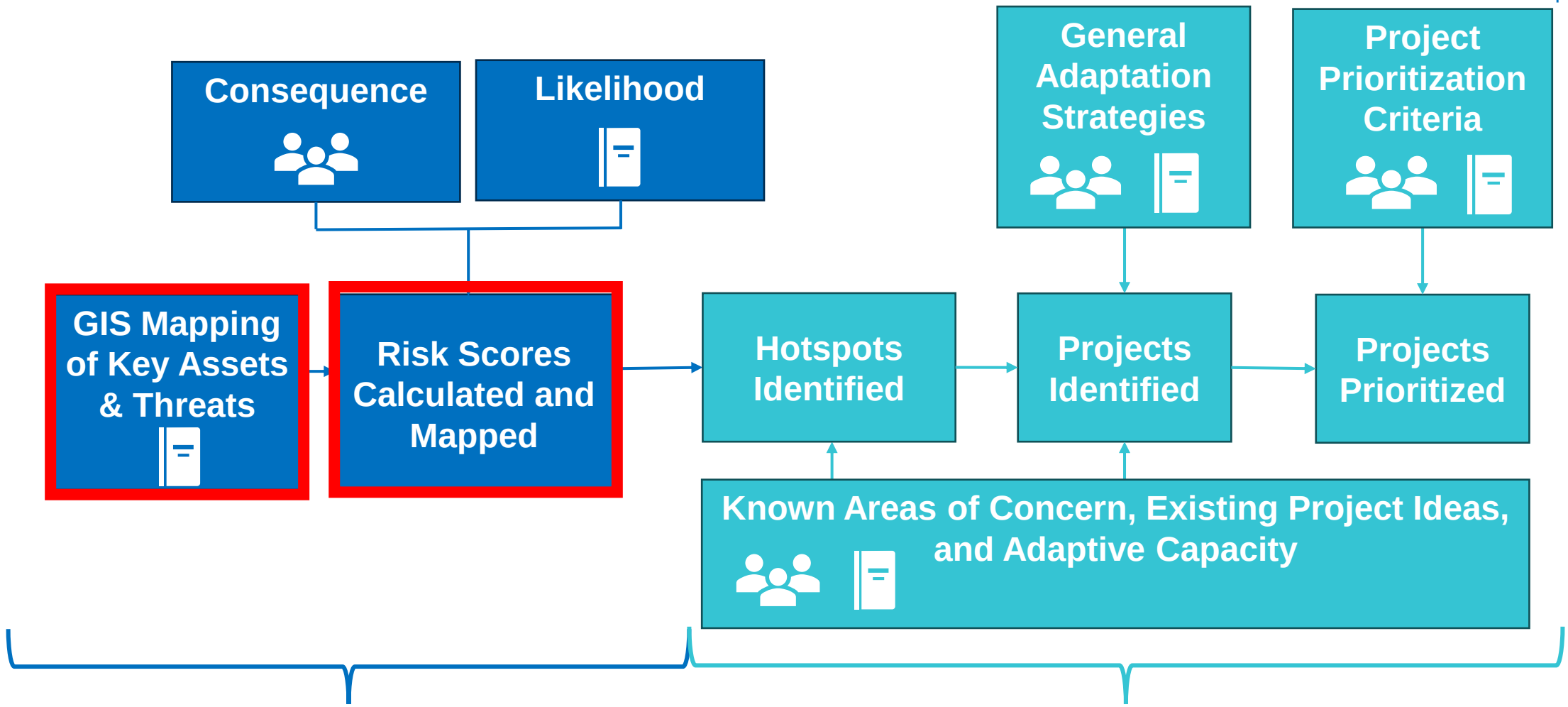

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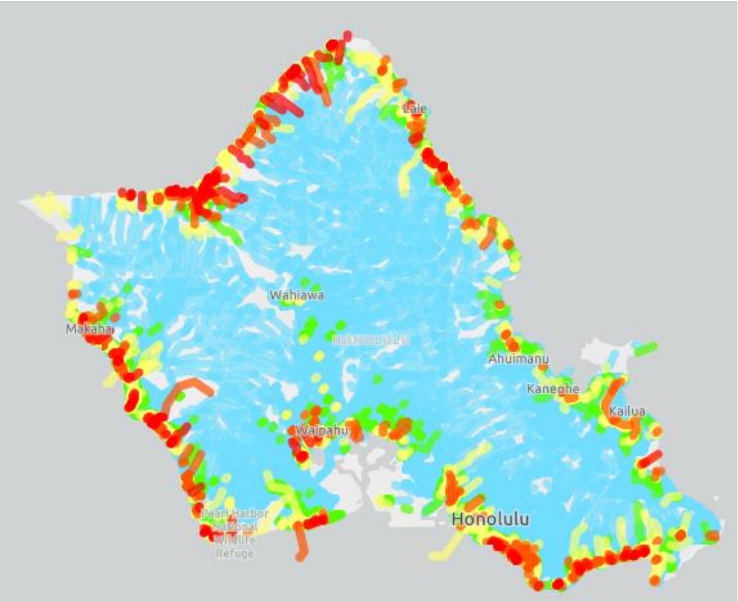
Infrastructure Risk Scores Calculated and Mapped

	Very Low Risk	Low Risk	At Risk	High Risk	Very High Risk
Risk Score	<35	36-45	46-60	61-70	>70
# Assets	150K	60K	15K	4K	1K
% of Assets	66%	26%	6%	1.5%	0.5%

Risk Score = Likelihood x Consequence

Asset Type	Tsunami Evac Zones	Hurricane Surge Cat 2	100-yr Flood - VE	Coastal Erosion 1 ft	Drought Risk - Medium	Annual High-Wave Driven Flooding 1 FT	Ground Water Inundation 1 FT	Extreme Heat	Fire Risk - High	Total Risk
Major Streets	20	12	12	25	0	25	20	5	16	103
Major Streets	20	12	0	25	5	25	20	5	16	101
Major Streets	20	12	12	25	0	25	20	5	16	101
Major Streets	20	12	12	25	0	25	20	5	16	101
Major Streets	20	12	12	25	0	25	20	5	16	100
Major Streets	20	12	12	25	0	25	20	5	16	98
Major Streets	20	0	0	25	0	25	20	5	16	95
Stormwater Conduits	20	12	12	20	5	25	15	5	8	94
Stormwater Conduits	20	12	12	20	5	25	15	5	8	94
Stormwater Conduits	20	12	12	20	5	25	15	5	8	94
Stormwater Conduits	20	12	12	20	5	25	15	5	8	94
Stormwater Conduits	20	12	12	20	5	25	15	5	8	94
Stormwater Conduits	20	12	12	20	5	25	15	5	8	94
Wells	20	12	0	0	0	25	25	6	0	94
Sewer PumpStation	20	0	0	20	5	25	20	10	16	94
Major Streets	20	0	0	25	0	25	20	5	16	93
Major Streets	20	0	12	25	0	25	20	5	16	93
Major Streets	20	12	12	25	0	25	20	5	0	93
Major Streets	20	12	0	25	0	25	20	5	0	93
Major Streets	20	12	12	25	0	25	20	5	0	93
Major Streets	20	0	12	25	0	25	20	3	16	93
Major Streets	20	0	12	25	0	25	20	3	16	93
Major Streets	20	12	12	25	0	25	20	5	0	93
Major Streets	20	12	12	25	0	25	20	5	0	93
Major Streets	20	12	12	25	0	25	20	5	16	93
Major Streets	20	12	12	25	0	25	20	5	0	93
Major Streets	20	12	12	25	0	25	20	5	0	93
Streams	20	12	12	15	5	20	15	5	12	92



Note: Subset of climate threats shown for illustrative purposes

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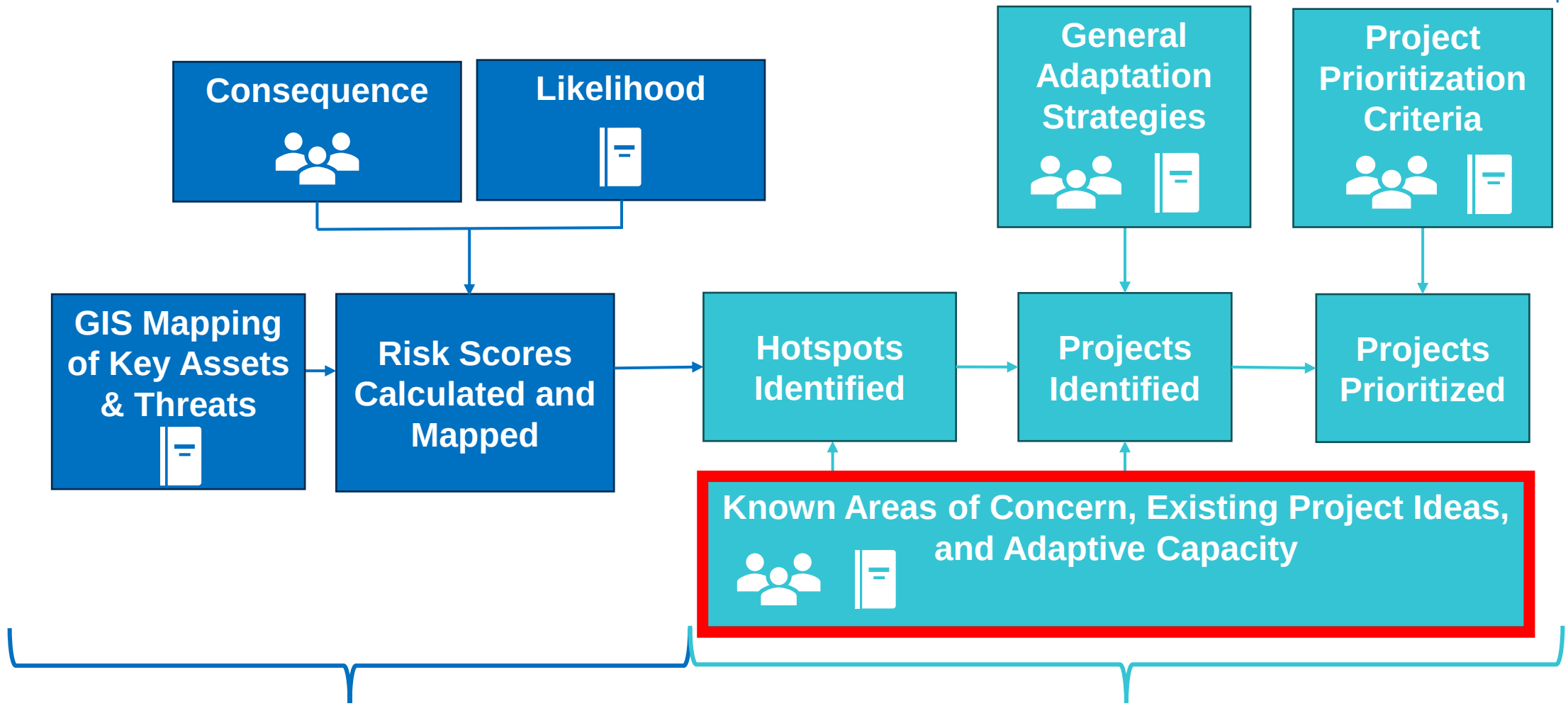

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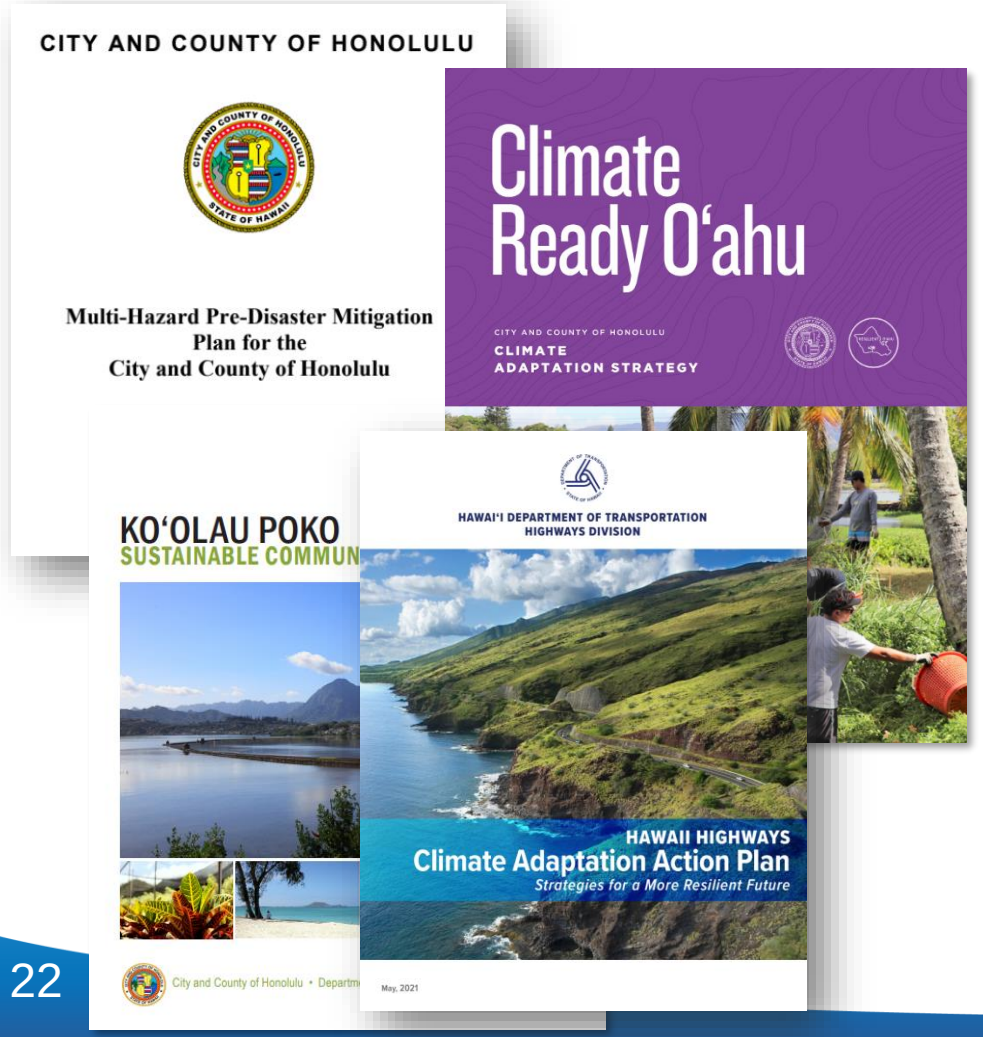
Plans, Policies, and Studies - Data Sources

This helps us build from previous stakeholder engagement feedback!

Nearly 100 different documents compiled and reviewed to create a Digital Library



OWH Planning Documents List

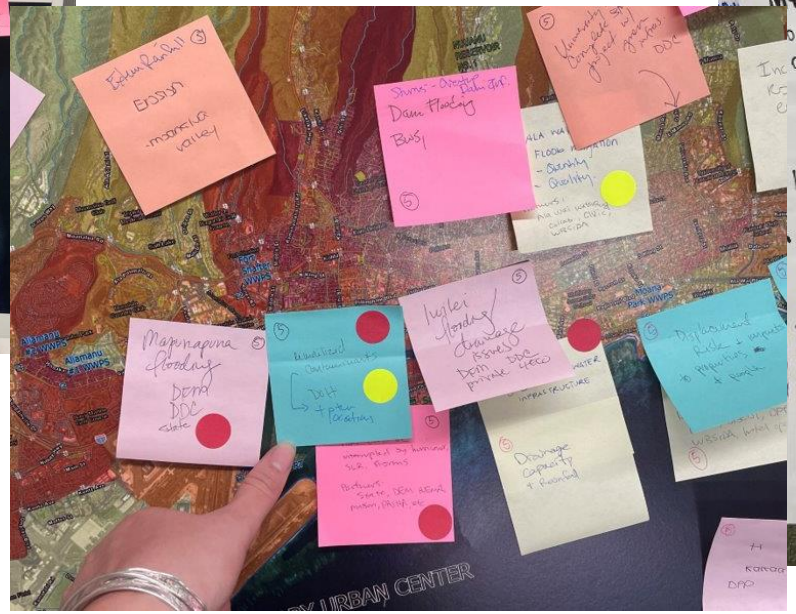
Last Revised: 10/1/2024

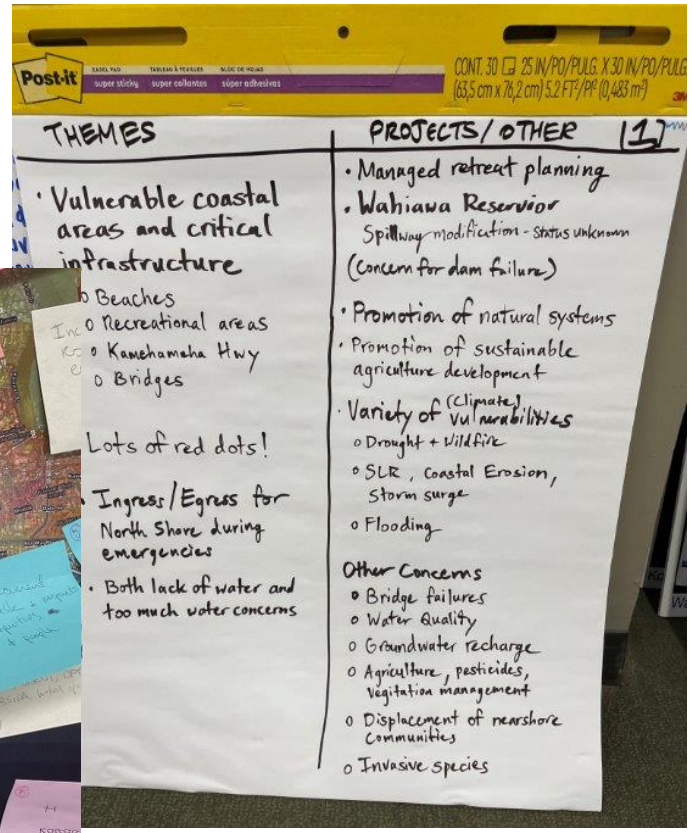
	Plan Name	Authoring Entity	Year	Link to Plan	Description
12	Effects of Drought and Cloud-Water Interception on Groundwater Recharge and Wildfire Hazard for Recent and Future Climate Conditions, Kaua'i, O'ahu, Moloka'i, Maui, and the Island of Hawai'i	USGS/Pacific Islands Climate Adaptation Science Center	2023	Effects of drought and cloud-water interception on groundwater recharge and wildfire hazard for recent and future climate conditions, Kaua'i, O'ahu, Moloka'i, Maui, and the Island of Hawai'i (usgs.gov)	The report employs the Water-budget Accounting for Tropical Regions Model (WATRMod)
13	Estimated Groundwater Recharge for Mid-Century and End-of-Century Climate Projections, Kaua'i, O'ahu, Moloka'i, Lāna'i, Maui, and the Island of Hawai'i	USGS/State of Hawai'i Commission on Water Resource Management and the Pacific Islands Climate Adaptation Science Center and in collaboration with Pūlama Lāna'i	2023	Estimated groundwater recharge for mid-century and end-of-century climate projections, Kaua'i, O'ahu, Moloka'i, Lāna'i, Maui, and the Island of Hawai'i (usgs.gov)	The document titled "Estimated Groundwater Recharge for Mid-Century and End-of-Cent
14	The City Storm Water BMP Guide for New and Redevelopment	Honolulu, HI Code of Ordinances	2017	CHAPTER 16: BUILDING CODE (amlegal.com)	Provides Storm Water BMP Design Guidelines for CCH DPP. These guidelines require the
15	Hawai`i Sea Level Rise Vulnerability and Adaptation Report 2022 Update	Hawaii Climate Commission	2022	Sea-Level-Rise-Adaptation-and-Vulnerability-2022-Update_Final2-1.pdf	Aim to address the threat posed by climate change to the economic well-being, public he
16	ROH Chapter 16 Building Code	Honolulu, HI Code of Ordinances	1990	CHAPTER 16: BUILDING CODE (amlegal.com)	16-1.1 Hawaii State Building Code: The Hawaii State Building Code, as adopted by the Sta
17	ROH Chapter 17 Electrical Code.	Honolulu, HI Code of Ordinances	1990	CHAPTER 17: ELECTRICAL CODE (amlegal.com)	The State Electrical Code, as adopted with modifications the National Electrical Code (N
18	ROH Chapter 18A Grading, Soil Erosion, and Sediment Control	Honolulu, HI Code of Ordinances	1990	CHAPTER 18A: GRADING, SOIL EROSION, AND SEDIMENT CONTROL (amlegal.com)	18A-1.1 The purpose to provide standards to protect property and to promot the public he
19	ROH Chapter 19 Plumbing Code	Honolulu, HI Code of Ordinances	2018 (ad	CHAPTER 19: PLUMBING CODE (amlegal.com)	19-1.1 The Hawaii State Plumbing Code adopted by the State Building Code Council with
20	City Rules Related to Water Quality	City & County of Honolulu Department of Planning & Permitting	2018	DPP Rules Relating to Water Quality (honolulu.gov)	Provides water Design Guidelines and Requirements which is reviewed and approved by
21	Honolulu Complete Streets Design Manual (September 2016).	City and County of Honolulu	2016	160908 Honolulu Complete Streets Design Manual_Final.pdf	This Manual provides guidance to plan and design streets that adhere to the legal framew
22	Revised Ordinance of Honolulu (ROH) Chapter 14 Public Works Infrastructure	Honolulu, HI Code of Ordinances	1990	CHAPTER 14: PUBLIC WORKS INFRASTRUCTURE (amlegal.com)	Infrastructure Policy in the public ROW including landscaping, streets and sidewalks, cur
23	ROH Chapter 21 Land Use Ordinance	Honolulu, HI Code of Ordinances	1990	CHAPTER 21: LAND USE ORDINANCE (amlegal.com)	This chapter, inclusive of any amendments, shall be known as the land use ordinance (LU
24	ROH Chapter 21A Flood Hazards Areas	Honolulu, HI Code of Ordinances	1990	CHAPTER 21A: FLOOD HAZARD AREAS (amlegal.com)	Within the City and County of Honolulu, certain areas are subject to periodic inundation

One Water Panel & Leadership Group Input

Collaboration and informational inputs across agencies

Input gather system specific experience from One Water Panel and Leadership Group via workshops and working group meetings.





Data (+) synthesized for Regional Summaries for each Regional Planning District. These identified areas with…

City projects/current efforts

Flooding issues

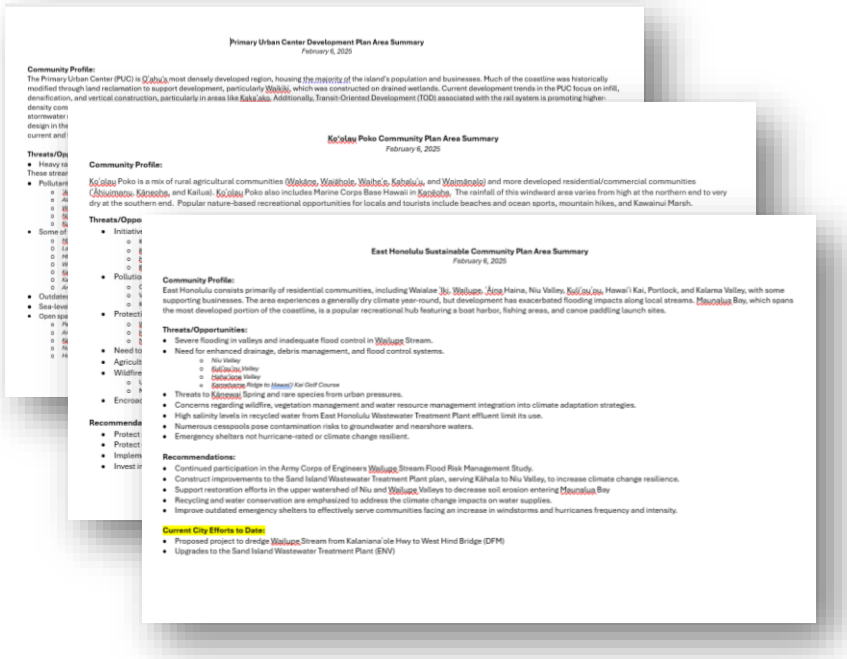
Community isolation/roadway accessibility issues

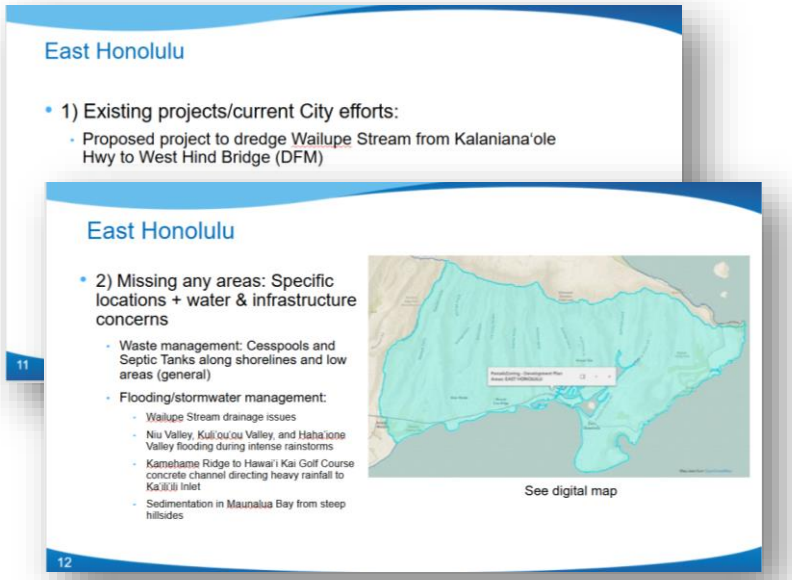
Improvements/rehabilitation needs

Water quality issues

Ecological resources & cultural sites

Known Areas of Concern





Known Areas of Concern

Regional Summaries (8)

Working Group Meetings Feedback

Climate Change Adaptation Framework

Collaboration framework questions and information used to drive decision making

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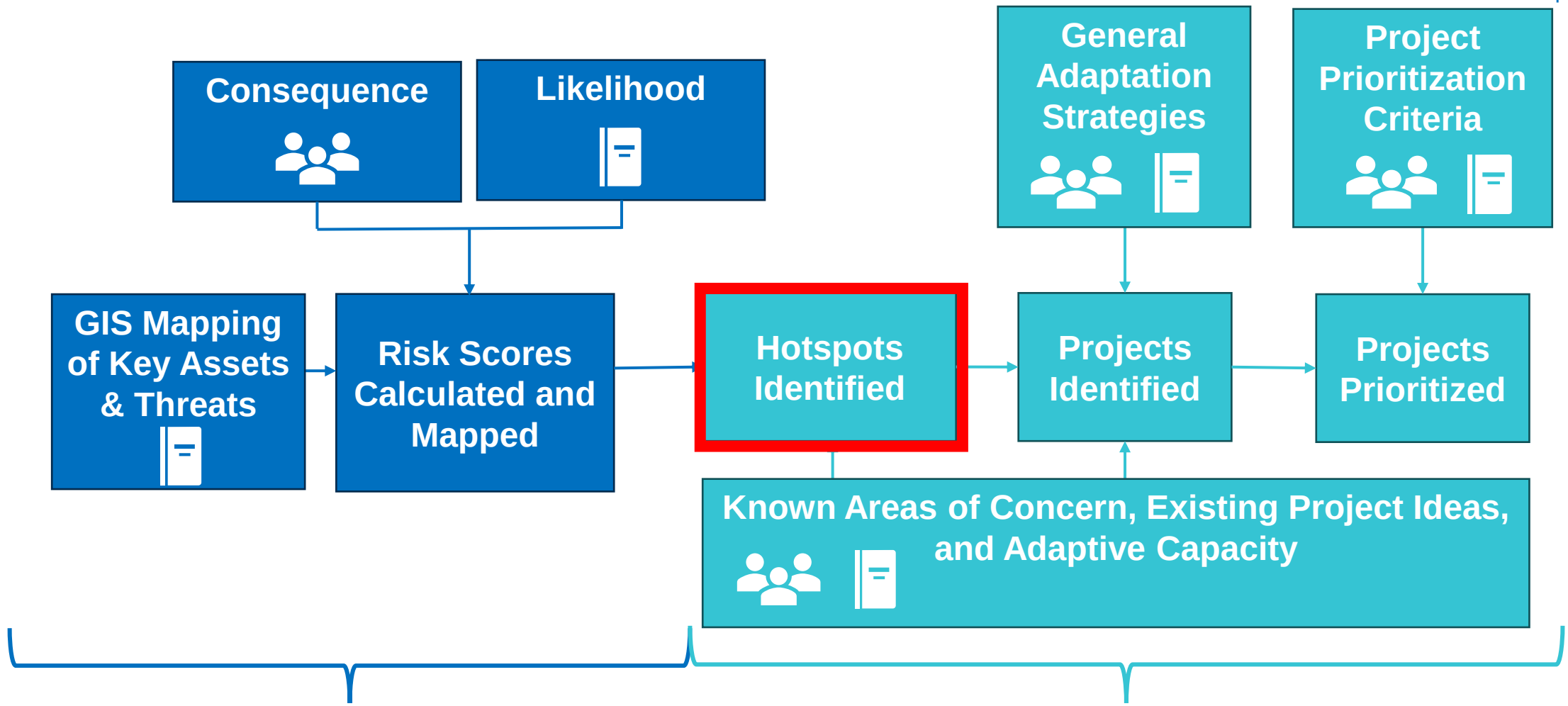

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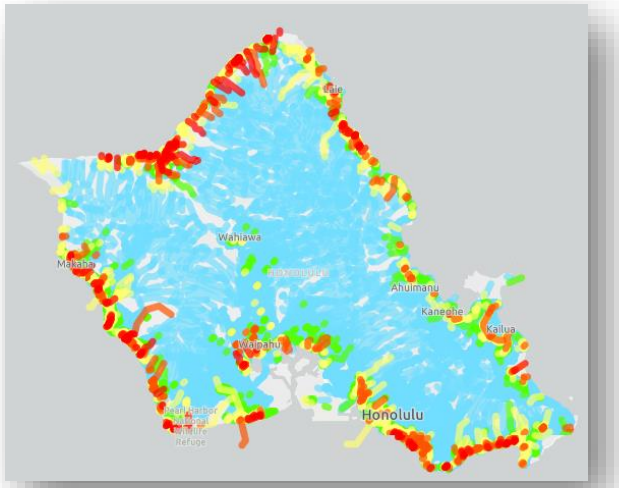
How Did We Get from Data Gathering to Hotspot Identification?

Risk Score Mapping



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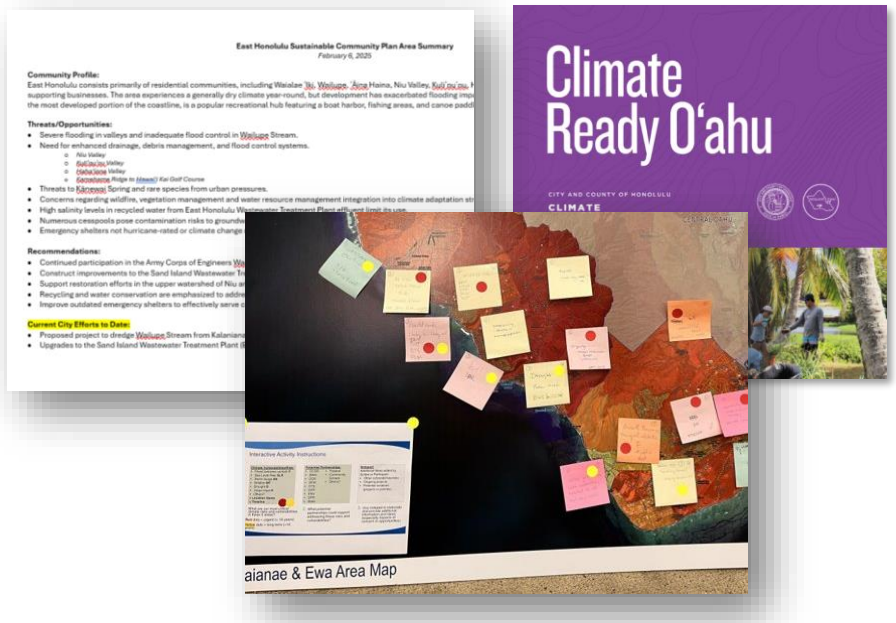
Known Areas of Concern



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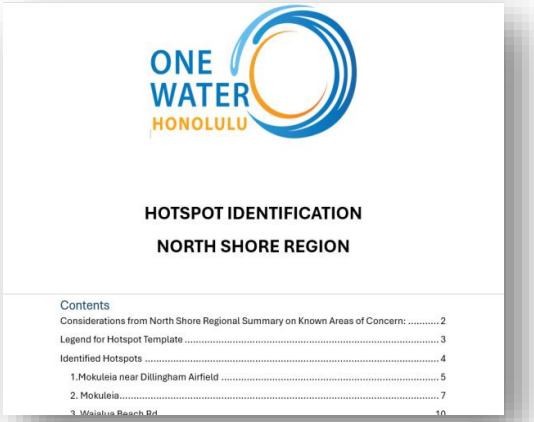
Hotspot Profiles



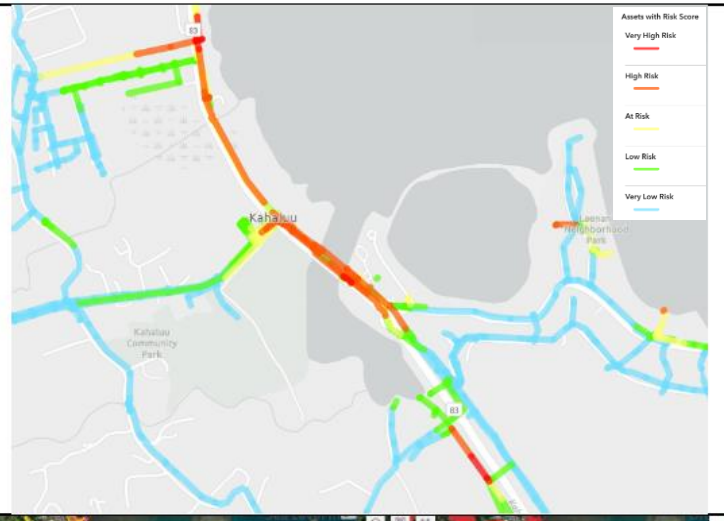
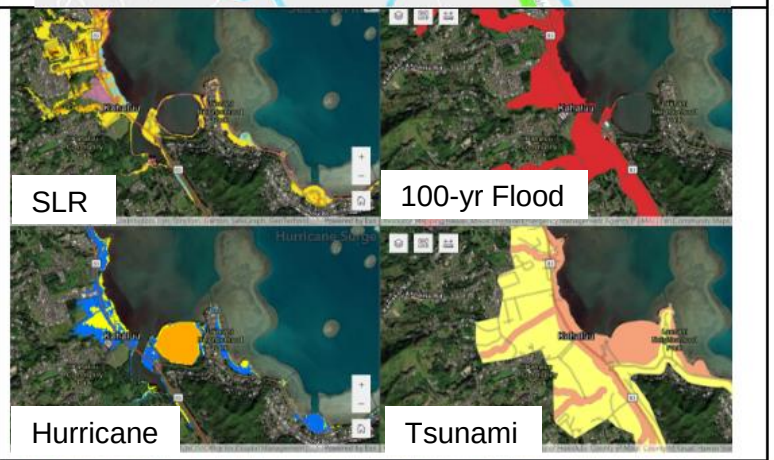
Hotspot Profiles

Mapping Tool/Risk Screening Inputs

- **Key Assets**
- **Climate Threats**

Known Areas of Concern Inputs

- **Community Assets**
- **Other Risks/Issues**
- **Ongoing/Planned Projects**
- **Potential Gaps**

1. Kahaluu	
Location Information and Maps	
Location	
Risk Score Map	
Threat Maps	
Key Assets	
Wastewater	Kahalu'u & Laenani WWPSs, 12-in Sewer Mains
Stormwater	18-in, 36-in, 48-in major SW conduits, Kahalu'u Flood Control Lagoon, Ahuimanu & Waihee Stream
Water	Waihee Line Booster, High to Med-High priority waterlines (Waihee Rd and 42-in Transmission Mains) that supply potable water to Kaneohe, Kailua, Waimanalo, and Kalama Valley, nearby critical wells
Major Streets	Kam Hwy & Kam Hwy bridge

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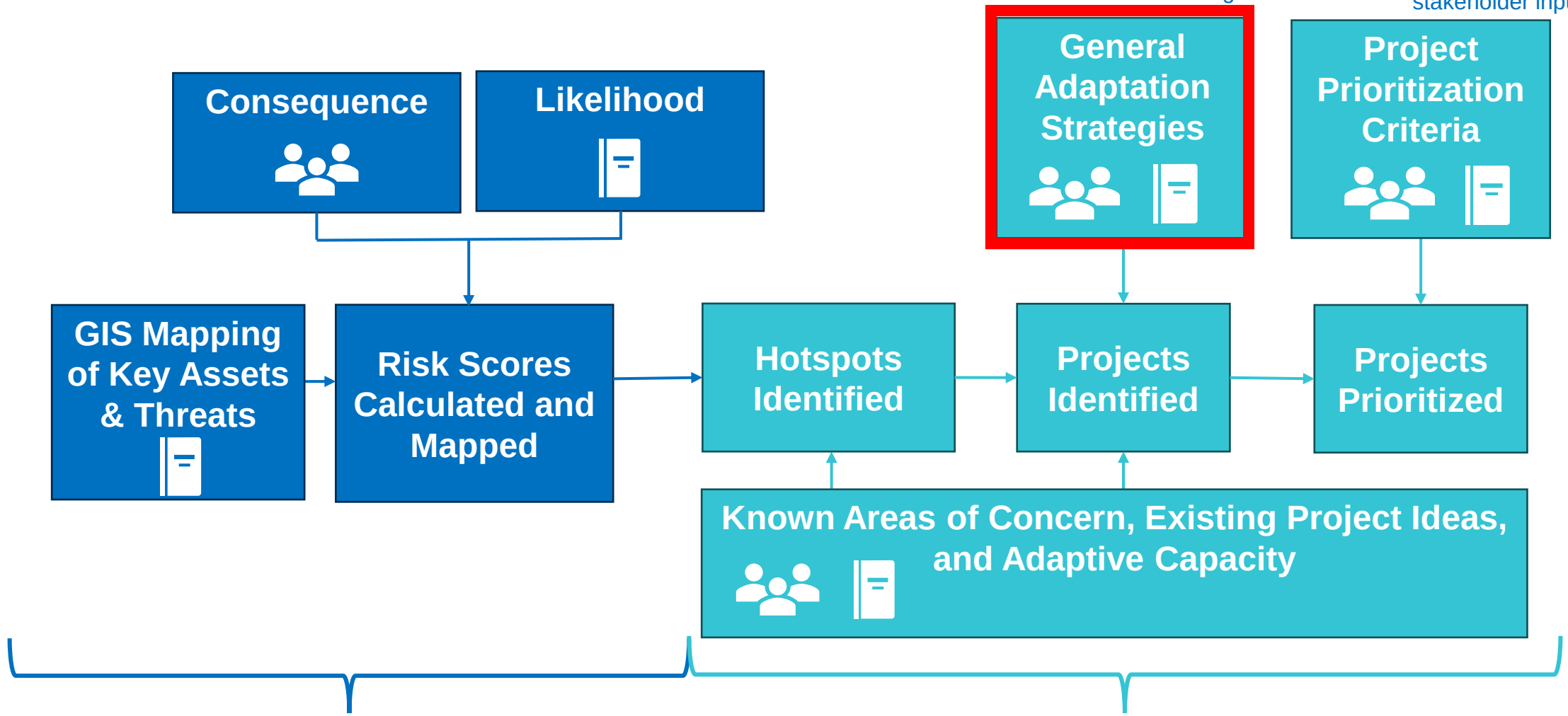

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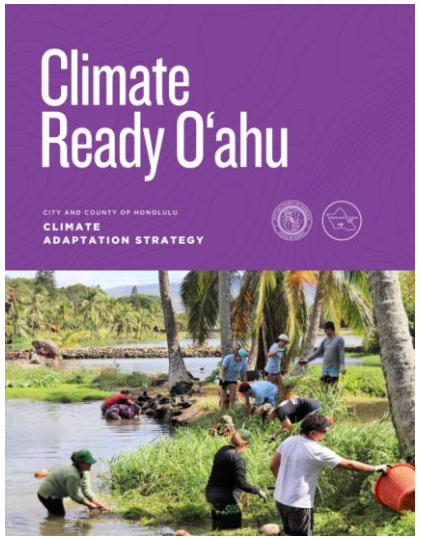
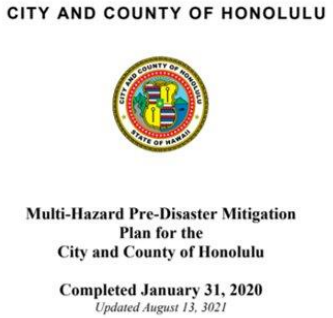
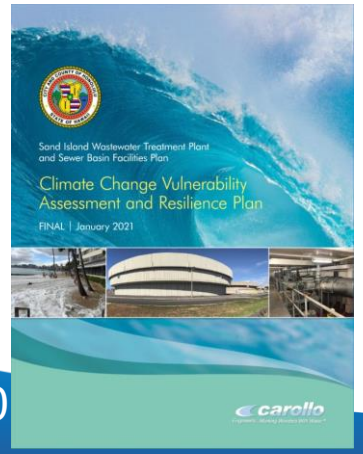
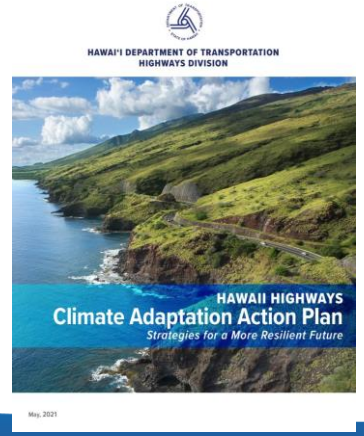
Adaptation Strategy Development

Adaptation Strategy Sources









Adaptation Strategy "Menu of Options"

- Flood Barriers
- Green Infrastructure
- Elevate Infrastructure
- Create Floodable Space
- Alternative Water Supplies
- … And Many More!

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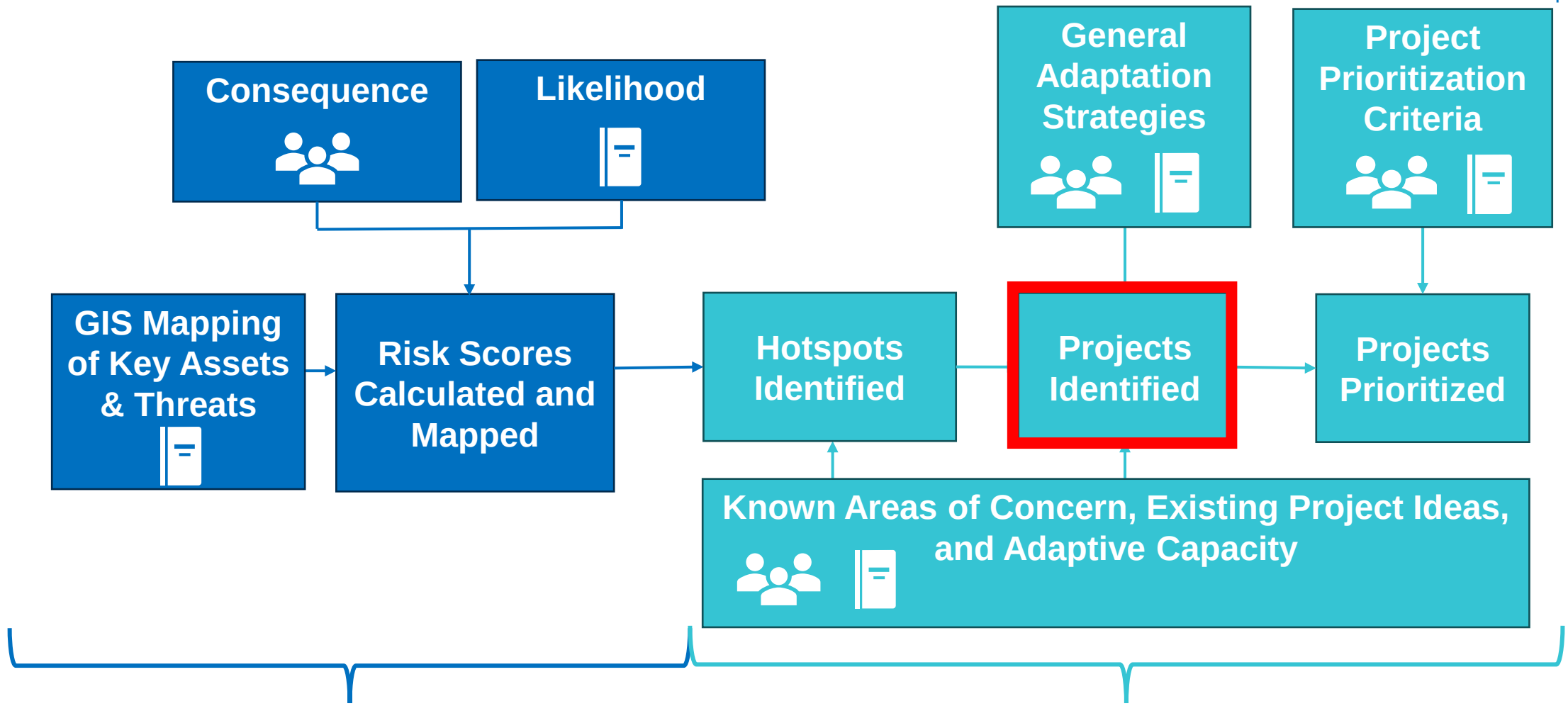

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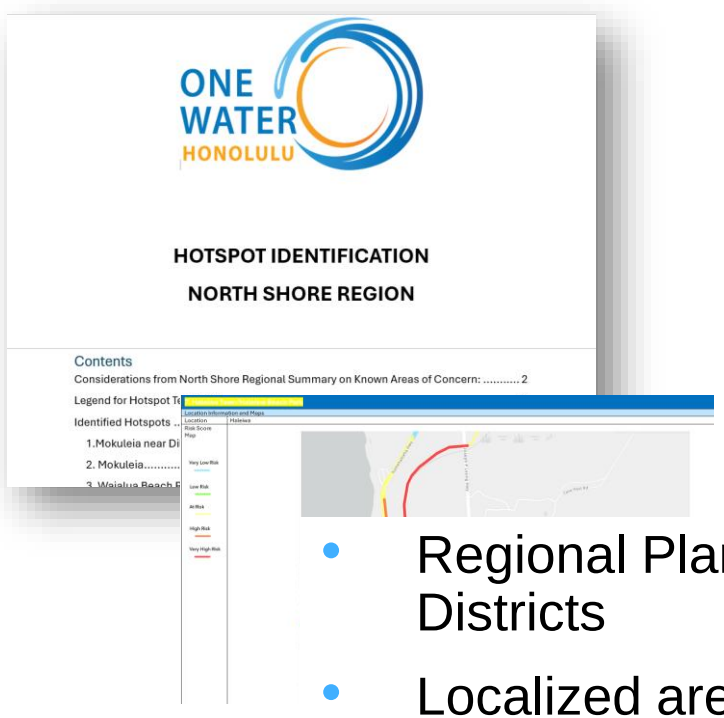
Purpose: Screen thousands of threat-asset pairs to identify highest risk areas

Part 2: Focused scope, higher detail assessment. More manual
Purpose: Develop and group prioritized list of projects to support phased CIP

Applying Adaptation Strategies to Hotspots to Identify Projects

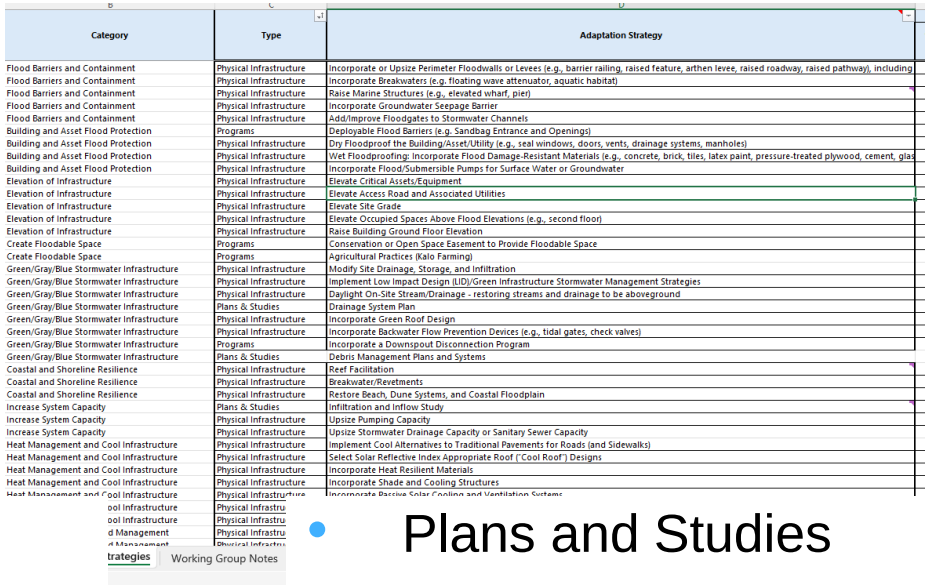
Hotspots



- Regional Planning Districts
- Localized areas (e.g., communities, roads, clusters of assets)

+

Adaptation Strategies



Category	Type	Adaptation Strategy
Flood Barriers and Containment	Physical Infrastructure	Incorporate or Upsize Perimeter Floodwalls or Levees (e.g., barrier railing, raised feature, arthen levee, raised roadway, raised pathway), including
Flood Barriers and Containment	Physical Infrastructure	Incorporate Breakwaters (e.g. floating wave attenuator, aquatic habitat)
Flood Barriers and Containment	Physical Infrastructure	Raise Marine Structures (e.g., elevated wharf, pier)
Flood Barriers and Containment	Physical Infrastructure	Incorporate Groundwater Seepage Barrier
Flood Barriers and Containment	Physical Infrastructure	Add/Improve Floodgates to Stormwater Channels
Building and Asset Flood Protection	Programs	Deployable Flood Barriers (e.g. Sandbag Entrance and Openings)
Building and Asset Flood Protection	Physical Infrastructure	Dry Floodproof the Building/Asset/Utility (e.g., seal windows, doors, vents, drainage systems, manholes)
Building and Asset Flood Protection	Physical Infrastructure	Wet Floodproofing: Incorporate Flood Damage-Resistant Materials (e.g., concrete, brick, tiles, latex paint, pressure-treated plywood, cement, glas
Building and Asset Flood Protection	Physical Infrastructure	Incorporate Flood/Submersible Pumps for Surface Water or Groundwater
Elevation of Infrastructure	Physical Infrastructure	Elevate Critical Assets/Equipment
Elevation of Infrastructure	Physical Infrastructure	Elevate Access Road and Associated Utilities
Elevation of Infrastructure	Physical Infrastructure	Elevate Site Grade
Elevation of Infrastructure	Physical Infrastructure	Elevate Occupied Spaces Above Flood Elevations (e.g., second floor)
Elevation of Infrastructure	Physical Infrastructure	Raise Building Ground Floor Elevation
Create Floodable Space	Programs	Conservation or Open Space Easement to Provide Floodable Space
Create Floodable Space	Programs	Agricultural Practices (Kalo Farming)
Green/Gray/Blue Stormwater Infrastructure	Physical Infrastructure	Modify Site Drainage, Storage, and Infiltration
Green/Gray/Blue Stormwater Infrastructure	Physical Infrastructure	Implement Low Impact Design (LID)/Green Infrastructure Stormwater Management Strategies
Green/Gray/Blue Stormwater Infrastructure	Physical Infrastructure	Daylight On-Site Stream/Drainage - restoring streams and drainage to be aboveground
Green/Gray/Blue Stormwater Infrastructure	Plans & Studies	Drainage System Plan
Green/Gray/Blue Stormwater Infrastructure	Physical Infrastructure	Incorporate Green Roof Design
Green/Gray/Blue Stormwater Infrastructure	Physical Infrastructure	Incorporate Backwater Flow Prevention Devices (e.g., tidal gates, check valves)
Green/Gray/Blue Stormwater Infrastructure	Programs	Incorporate a Downspout Disconnection Program
Green/Gray/Blue Stormwater Infrastructure	Plans & Studies	Debris Management Plans and Systems
Coastal and Shoreline Resilience	Physical Infrastructure	Reef Facilitation
Coastal and Shoreline Resilience	Physical Infrastructure	Breakwater/Revetments
Coastal and Shoreline Resilience	Physical Infrastructure	Restore Beach, Dune Systems, and Coastal Floodplain
Increase System Capacity	Plans & Studies	Infiltration and Inflow Study
Increase System Capacity	Physical Infrastructure	Upsize Pumping Capacity
Increase System Capacity	Physical Infrastructure	Upsize Stormwater Drainage Capacity or Sanitary Sewer Capacity
Heat Management and Cool Infrastructure	Physical Infrastructure	Implement Cool Alternatives to Traditional Pavements for Roads (and Sidewalks)
Heat Management and Cool Infrastructure	Physical Infrastructure	Select Solar Reflective Index Appropriate Roof ("Cool Roof") Designs
Heat Management and Cool Infrastructure	Physical Infrastructure	Incorporate Heat Resilient Materials
Heat Management and Cool Infrastructure	Physical Infrastructure	Incorporate Shade and Cooling Structures

trategies | Working Group Notes

- Plans and Studies
- Physical Infrastructure
- Programs

=

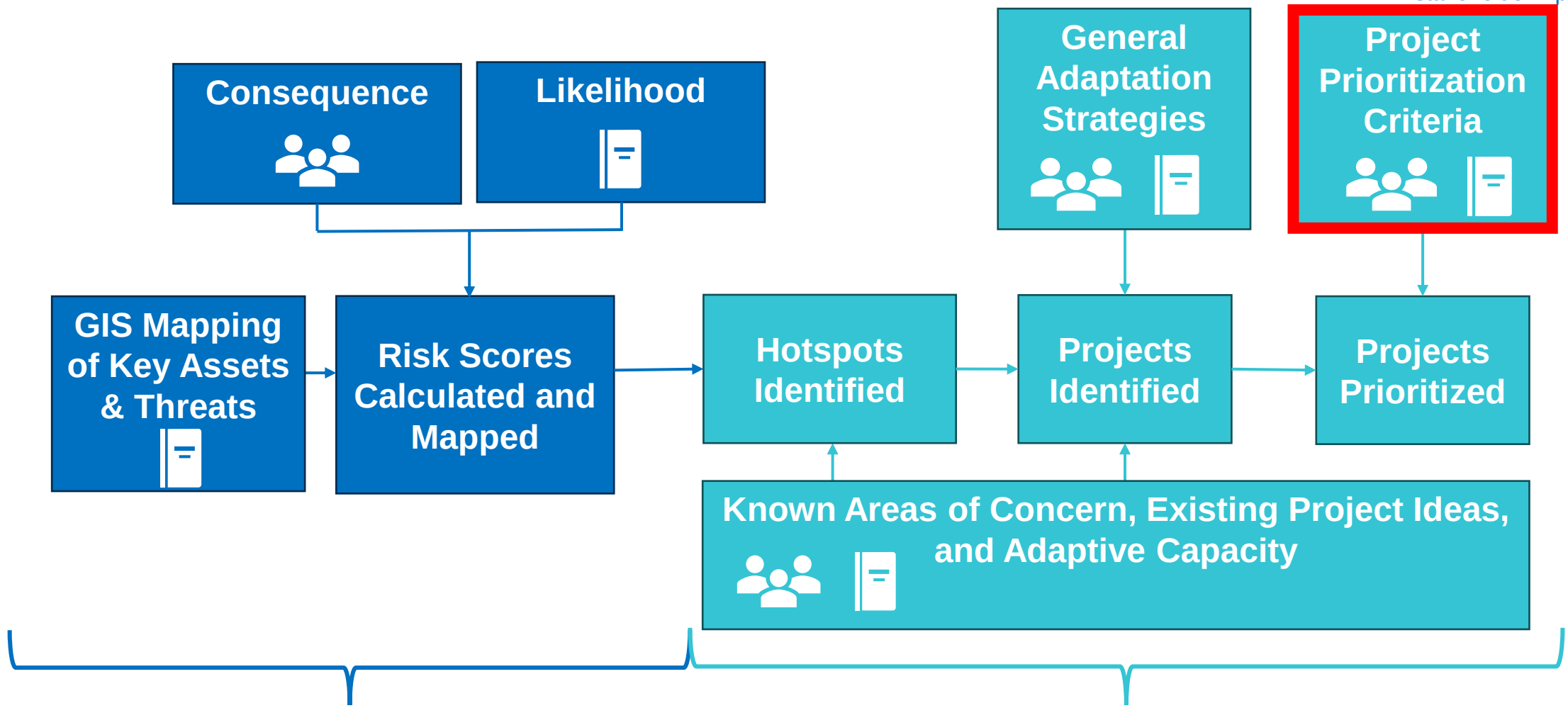
50 Projects for One Water CIP

First Project Development Workshop – Oct 14th

Climate Change Adaptation Framework

Collaboration framework questions and information used to drive decision making

Input from past planning efforts and document review, including stakeholder input



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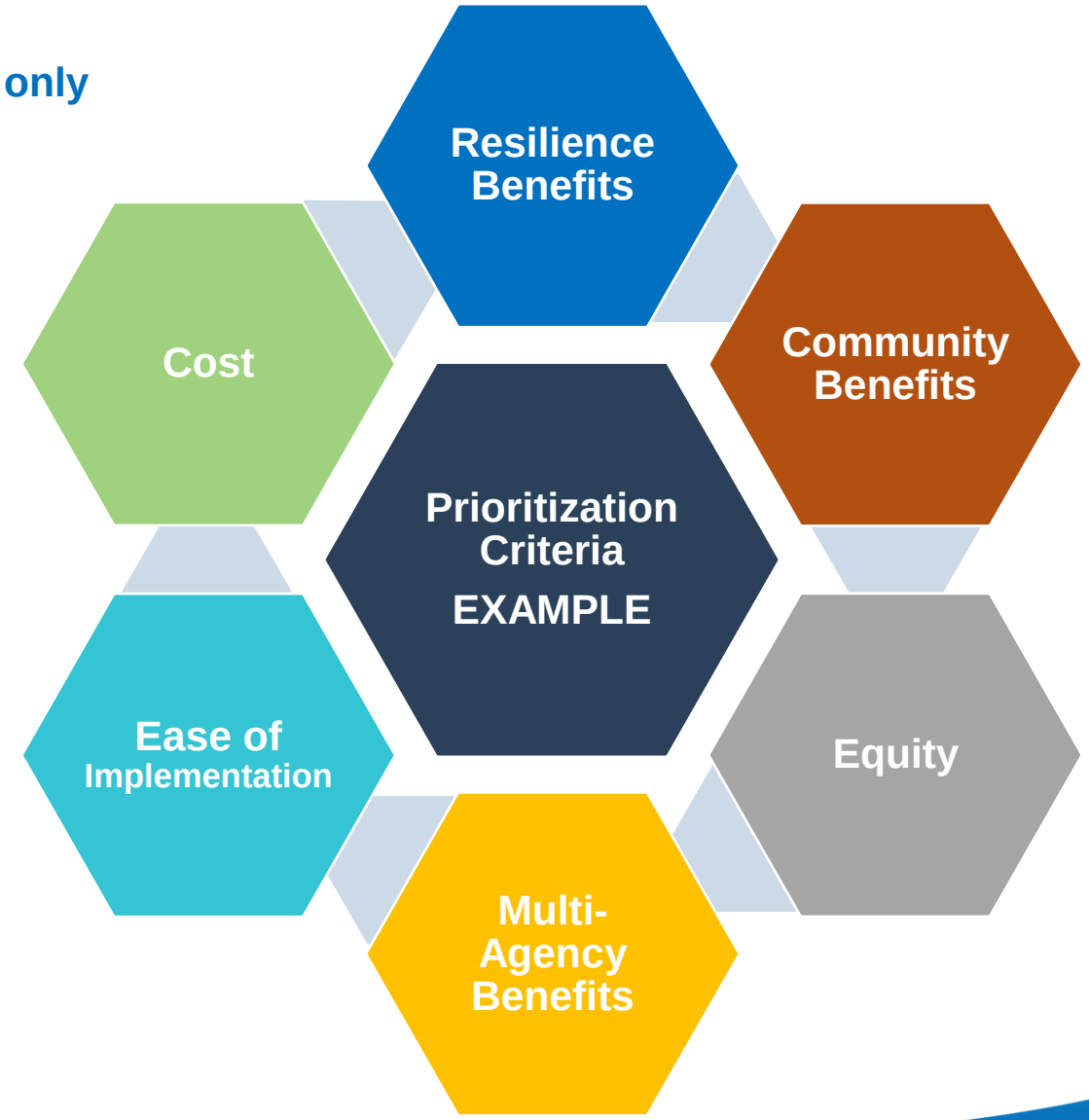
Purpose: Develop and group prioritized list of projects to support phased CIP

Prioritization Criteria

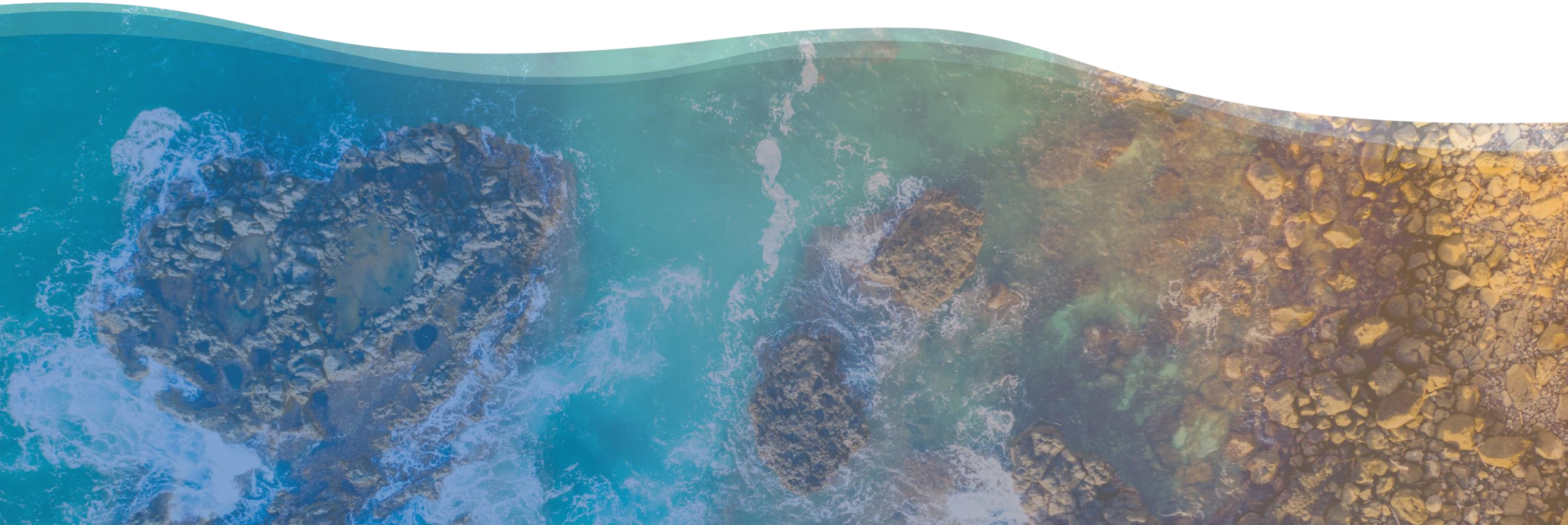
Example criteria are shown here for demonstration purposes only

- Develop based on panel input and data review
- Used to help prioritize hotspots and projects for developing the OWH CIP



Collaborative decision-making: Criteria selection and use

Working Toward the OWH CIP



Working Toward the OWH CIP

Setting the Foundation

Data Gathering and Review

Establishing Direction

Collaboration Framework

Climate Adaptation Framework

Part 1 Foundations & Information Gathering
Part 2 Applying Foundation & Information for Collaborative Decision Making & Project Development

Developing the OWH Plan

One Water CIP

Trigger-Based Implementation Plan

Funding Strategy

Policies and Recommendations

Private Development Guidelines

One Water CIP

One Water CIP
(prioritized projects list)

INFLUENCED BY

- Collaboration and Climate Change Adaptation Frameworks
- Trigger-based Implementation Plan
- Funding Strategy
- Policies and Recommendations

CONTAINS

- Prioritized Projects List addressing range of:
  - Project Types
  - Climate Hazards
  - Infrastructure Types
  - Planning Horizons

50 Projects

15 Near-Term

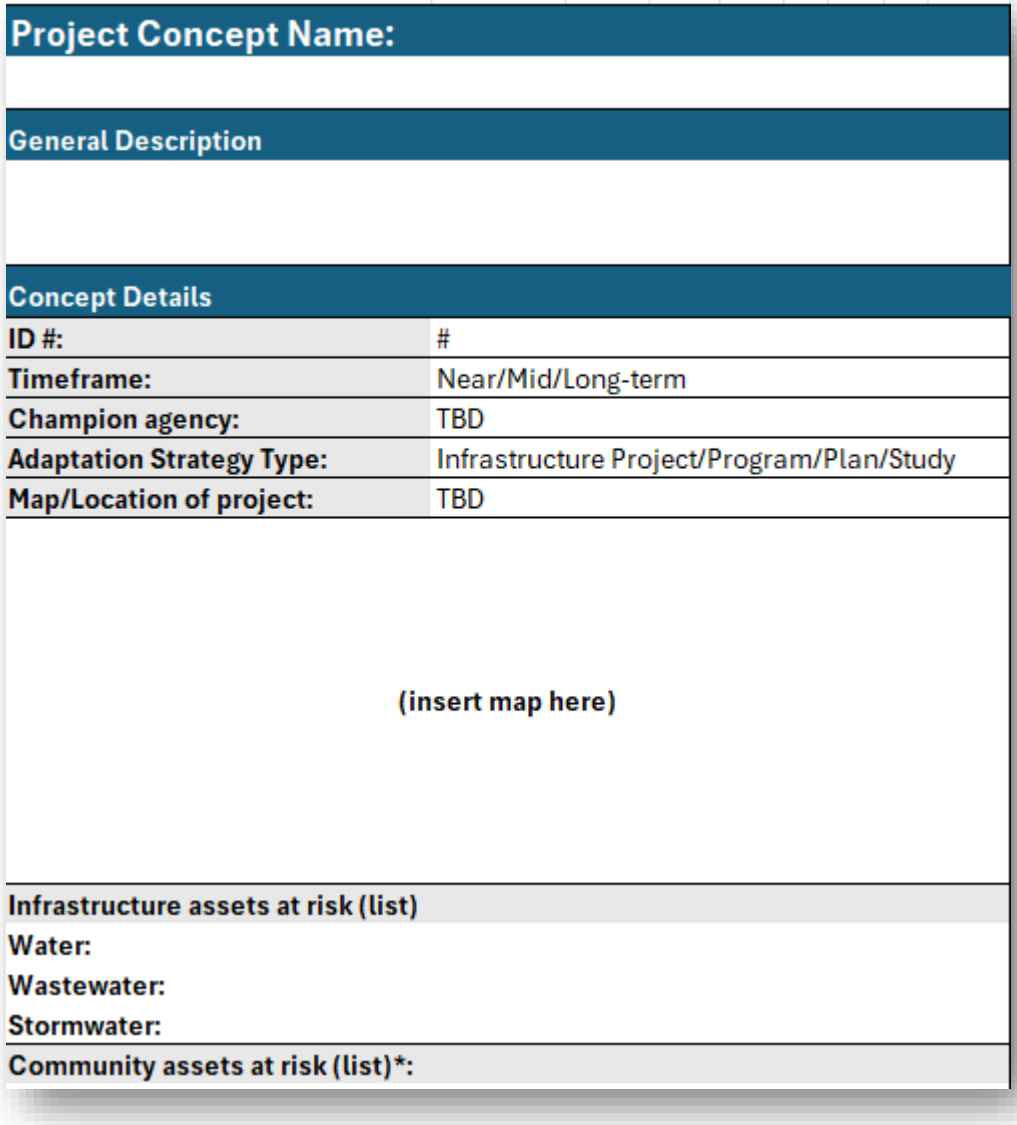
15 Mid-Term

20 Long-Term

Project Concept Fact Sheets

Each CIP project/study/plan/program description will have their own fact sheet that may include:

- Climate threats addressed (acute/chronic)
- Infrastructure assets at risk
- Community assets at risk
- Identified as near-, mid-, or long-term project
- Adaptation strategies applied
- Co-benefits (for infrastructure, ‘aina, people)
- Potential partnerships (CCH, state, community, and private entities)
- OWH objectives supported
- CRO objectives supported
- Map/location of project
- Potential challenges & considerations
- Expected timeline & triggers (potential adaptation pathway)



Project Concept Name:	
General Description	
Concept Details	
ID #:	#
Timeframe:	Near/Mid/Long-term
Champion agency:	TBD
Adaptation Strategy Type:	Infrastructure Project/Program/Plan/Study
Map/Location of project:	TBD
(insert map here)	
Infrastructure assets at risk (list)	
Water:	
Wastewater:	
Stormwater:	
Community assets at risk (list)*:	

Note: Cost estimates Included for near-term projects

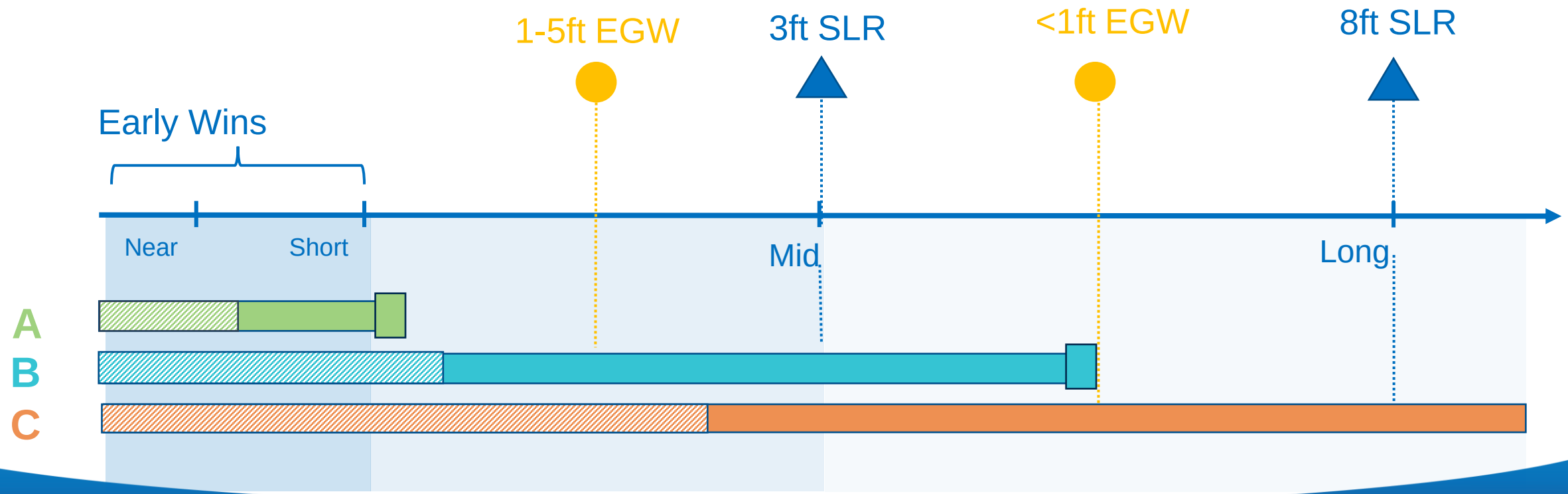
Implementation Planning: Trigger-based Approach

EXAMPLE CONTENTS

List of triggers (▲ SLR levels, ● Emergent groundwater [EGW])
List of Actions for Implementation

- **Projects (A. B. C.)**
- **Policy Recommendations**

Key:
- **Engagement & Planning**
- **Implemented**
- **No longer effective**



Collaboration and Partnerships

Engagement and Planning for Project Development includes:

- Identification of stakeholders
- Investing in partnerships
- Building upon community takeaways from previous engagement
- Consideration of multi-benefit projects realized through collaboration

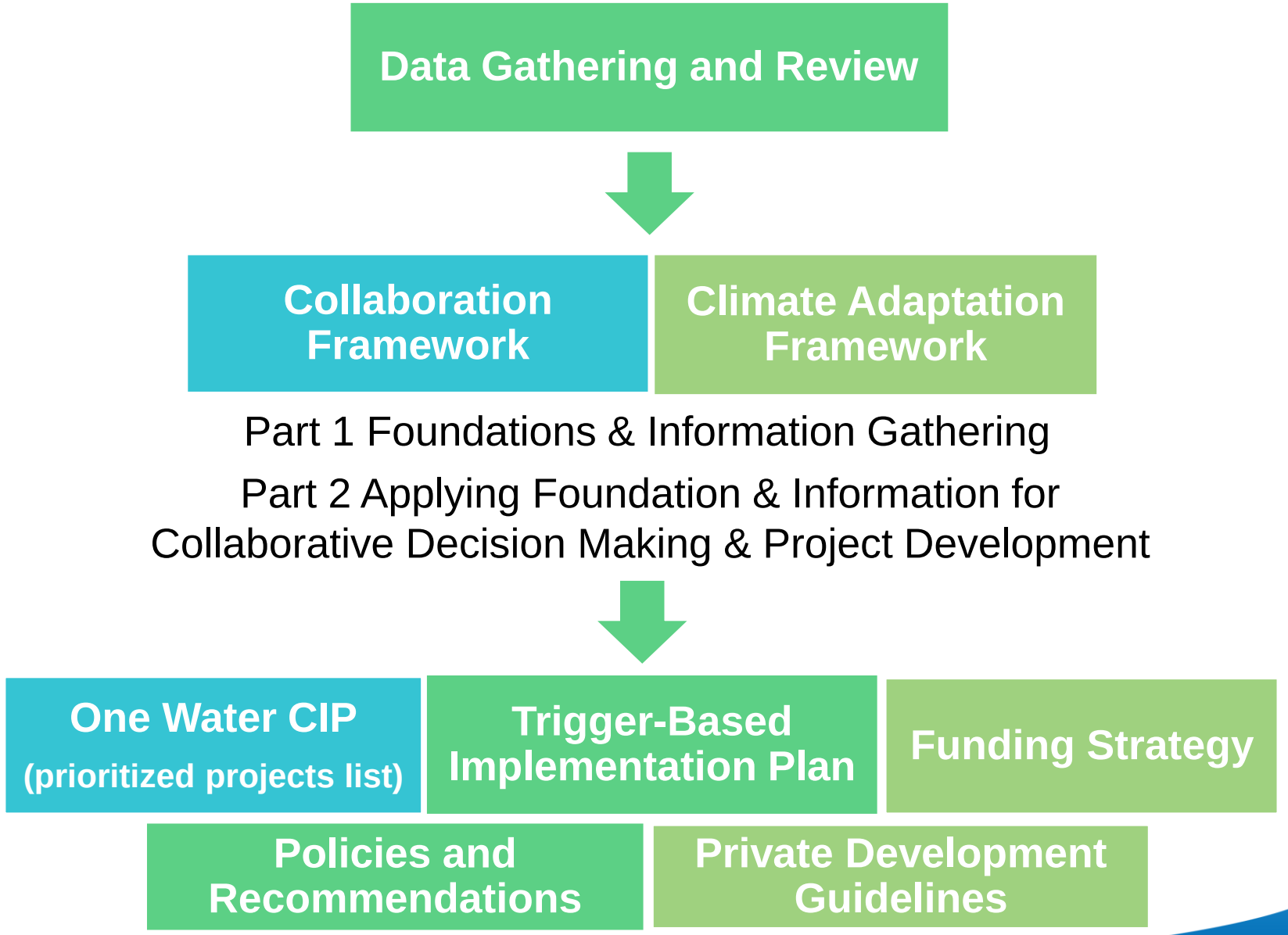
Adds clarity the “When? What? Who? And how?” we need to address to develop and prioritize projects.

Next Steps

Next Steps

Ongoing efforts:

- Develop prioritization criteria for hotspots and projects
- Refine process for developing projects in high-risk areas
- Continued progress on all OWH outputs



Next Steps

Oct. 2025

Progress Project Development in October Panel Meeting

Feb. 2026

Projects List, draft triggers and prioritization

Summer 2025

Final One Water Honolulu Plan

Apr. 2026

Final Phased One Water CIP

Sept. 2026

Project Completion

One Water Honolulu

October 15, 2025

Mahalo for your time!

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