APPENDIX H | PROJECT FACTSHEETS

CONNECTING TO THE ONE WATER PLAN

This appendix provides additional detailed information that correlates to the following sections and figures.

CORRELATING SECTIONS AND INFORMATION		
Section 7 Project Development and Prioritization	**7.1 Project Development** **7.2 Prioritization Criteria** **7.3 Project Opportunities and Benefits**	**App. H** contains the project factsheets for the identified near-, mid-, and long-term projects.

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SECTION H.1: INTRODUCTION

Project factsheets were developed for each of the 49 prioritized projects that came out of the One Water Honolulu Plan planning effort. Project details vary based on the timeframe and existing work on each project idea. The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

SECTION H.2: FACTSHEET COMPONENTS

Each of the factsheets has the same structure with some standard components. The standard components largely come from the project prioritization scoring, as described in Plan Section 7 and Appendix D. Standardized components across the factsheets are described in the following sections.

H.2.1 CONCEPT DETAILS

The concept details component lists identifying information about the project. Each project has a unique identification (ID) number that is referenced throughout. The project timeframe, as defined in Plan Section 7, is either near-term, mid-term, or long-term. Near-term projects have listed a champion agency that has agreed to lead the project, and mid- and long-term projects have potential champion agencies assigned based on the project concept. Potential partners are listed for all projects, referencing other agencies that would be anticipated to have a collaborative role, as defined in the One Water requirements in Section 5. Each project has an adaptation strategy type, either Plan/Study, Program, or Physical Infrastructure. The project location is within a certain hotspot and planning region. The area classification is based on the specific hotspot, as defined in Plan Section 5. The location of the project is placed into various districts: Congressional, Legislative, Council, and Neighborhood Board. These districts can be used to inform project funding and implementation. Finally, the project area falls within an O‘ahu Social Vulnerability Index (SoVI) area.

H.2.2 ASSETS AT RISK

Infrastructure and community assets at risk are drawn from each project’s respective hotspot profile, presented in Appendix F. Risk scores are based on the risk analysis presented in Appendix D. All assets in the relevant area are listed if they are affected by the relevant hazards, regardless of the risk reduction that is anticipated from the project.

H.2.3 CLIMATE RESILIENCE

The climate resilience score from Low to High is given based on the project prioritization definition given in Plan Section 7. Each climate hazard that is relevant to the hotspot is listed with the anticipated climate impacts to the relevant project infrastructure, along with a description of the

anticipated risk reduction provided by the project described. While Plan/Study project types do not have direct anticipated risk reduction, they generally have Medium resilience and are described based on what future infrastructure they will enable and what hazards will be considered in the particular Plan/Study.

H.2.4 ADAPTATION STRATEGIES

Relevant project adaptation strategies that are employed by each project are listed, coming from the full list of adaptation strategies presented in Appendix D Attachment D-1. Generally, the adaptation strategies focus on the main project components.

H.2.5 COMMUNITY BENEFITS

Community benefits are selected from the list of benefits that were considered for project prioritization, as described in Plan Section 7. A particular community benefit is only selected if it received a point (i.e., if it is a core component of the project). While projects may have additional add-on benefits, if it is not central to the main project description, that benefit point is generally not given. Potential benefits are represented by a question mark "?" to indicate that it should be considered in project design or scoping phases but is not a certain component. On each factsheet, there is a space for "Other" benefits to be described. An additional described benefit helps to document project components that may help to qualify for funding or to get project support, but this category was not included in project scores and does not correspond to any category in the project prioritization.

H.2.6 GOALS, OBJECTIVES, AND STRATEGIES

Hotspot goals come from the workshops described in Section 5 of the Plan. Each hotspot has three to six identified goals, and those that are addressed by the specific project are listed in this section. In addition, the One Water Honolulu Objectives—as defined in Plan Section 1—that are addressed by the particular project are included in the factsheet. Because all projects came from a collaborative process, the overall process achieves the One Water Honolulu Objectives, Mission, and Vision, but specific projects are also tied to these objectives. Finally, the Climate Ready Oʻahu strategies are connected to each project by listing those that apply to the particular project.

SECTION H.3: PROJECT FACTSHEETS

Project factsheets were developed for near-, mid-, and long-term projects, with varying levels of detail associated with each. Stakeholders may have preferences for how they use this Section to identify projects relevant to them. Tables H-1 through H-5 list the projects by climate threat, timeframe, and region. Tables H-6 through H-8 list the projects by timeframe, region, and proposed lead agency.

Table H-1. Projects addressing SLR

SEA LEVEL RISE

Near Term (2026-2035)	• #35 Road Raising Strategy (Islandwide) • #33 Managed Retreat Legal and Policy Investigation Study (Islandwide) • #150 Expand Tidal Groundwater Well Monitoring Network (Islandwide) • #122 Adapt Waikīkī Phase 2 (PUC) • #101 Iwilei Area Adaptation Plan (PUC) • #115 Māpunapuna Area Adaptation Plan (PUC)
Mid Term (2035-2050)	• #92 Haleʻiwa Area Adaptation Plan (North Shore) • #64 Beach Park Erosion and Flood Resilience (Koʻolau Loa) • #53 Coastal Management Plan for Erosion and Flooding (Koʻolau Poko) • #110 Māpunapuna Flood Improvements (PUC) • #104 Kapālama Canal Linear Park (PUC) • #105 Resilience Corridors and Road Raising (PUC)
Long Term (Beyond 2050)	• #60 Resilience Corridor and Pedestrian Accessibility Study (Koʻolau Poko) • #8 Regional Shoreline Adaptation (East Honolulu) • #26 Long-Range Post-Retreat Study (ʻEwa) • #19 Raise Main Arterials Further Inland (ʻEwa) • #132 Dry Flood Proof Waiʻanae High Risk Areas (Waiʻanae)

Table H-2. Projects addressing drought

DROUGHT

Near Term (2026-2035)	• #106 Reuse Strategy for Redevelopment Areas (Islandwide) • #169 Expand Non-Potable Water to Large Parks and Water Loss Control (Islandwide) • #75 Waimānalo Effluent R-1 Reuse Feasibility Study (Koʻolau Poko) • #162 New Aloha Stadium Entertainment District (NASED) Regulatory Requirements for Reuse (PUC) • #155 Ala Wai Golf Course Non-Potable Irrigation Study (PUC) • #163 Nuʻuanu Reservoir Hydro Managed Aquifer Recharge (PUC) • #168 Reuse and Potable Water Services for Whitmore Agriculture (Central Oʻahu) • #167 Central Oʻahu Water Recycling Facilities, Mililani (Central Oʻahu) • #164 Potable Reuse Pilot at Honouliuli (ʻEwa)
Mid Term (2035-2050)	• #4 Honouliuli R-1 Distribution System Expansion (Central Oʻahu) • #61 Marine Corps Base Hawaiʻi (MCBH) R-1 Recycled Water Upgrade (Koʻolau Poko) • #90 Stormwater Retention, Recharge, and Reuse in Mauka Lands (North Shore)
Long Term (Beyond 2050)	• #67 State Agriculture Water System Connection to Future R-1 (Koʻolau Poko)

Table H-3. Projects addressing heavy rain

HEAVY RAIN

Near Term (2026-2035)	• #165 Stormwater Master Plan (Islandwide) • #109 Green Infrastructure Implementation Plan (Islandwide) • #30 Stormwater Utility Fee (Islandwide) • #39 Onsite Stormwater Management Incentives (Islandwide) • #172 Country Town Resilient Sidewalk & Path Improvements for Unimproved Roadways (Islandwide) • #170 University Avenue Urban Complete Streets and Green Infrastructure (PUC) • #101 Iwilei Area Adaptation Plan (PUC) • #115 Māpunapuna Area Adaptation Plan (PUC) • #122 Adapt Waikīkī Phase 2 (PUC) • #123 Ala Wai Watershed Integrated Stormwater Management (PUC)
Mid Term (2035-2050)	• #166 Projects from the Integrated Plan (Islandwide) • #92 Haleʻiwa Area Adaptation Plan (North Shore) • #64 Stormwater Retention, Recharge, and Reuse in Mauka Lands (North Shore) • #59 Stormwater Retention along Kamoʻaliʻi Stream (Koʻolau Poko) • #68 Waimānalo Roads Drainage Study and Improvements (Koʻolau Poko) • #70 Kahawai Stream Restoration Strategy (Koʻolau Poko) • #9 Stream Restoration and Rehabilitation (East Honolulu) • #102 Pilot Floodable Spaces (PUC) • #103 Iwilei Drainage Improvements (PUC) • #105 Resilience Corridors and Road Raising (PUC)
Long Term (Beyond 2050)	• #130 Increase Green Infrastructure and Green Space (Waiʻanae) • #132 Dry Flood Proof Waiʻanae High Risk Areas (Waiʻanae) • #145 Mākaha Roads Drainage Study and Improvements (Waiʻanae) • #141 Mākaha Stormwater Infrastructure (Waiʻanae)

Table H-4. Projects addressing extreme heat

EXTREME HEAT

Near Term (2026-2035)	• #109 Green Infrastructure Implementation Plan (Islandwide) • #172 Country Town Resilient Sidewalk & Path Improvements for Unimproved Roadways (Islandwide) • #101 Iwilei Area Adaptation Plan (PUC) • #115 Māpunapuna Area Adaptation Plan (PUC) • #170 University Avenue Urban Complete Streets and Green Infrastructure (PUC)
Mid Term (2035-2050)	• #92 Haleʻiwa Area Adaptation Plan (North Shore) • #105 Resilience Corridors and Road Raising (PUC)
Long Term (Beyond 2050)	• #130 Increase Green Infrastructure and Green Space (Waiʻanae)

Table H-5. Projects addressing wildfire

WILDFIRE

Near Term (2026-2035)	• #129 Develop Cooperative Fireshed Partnerships (Waiʻanae)
Mid Term (2035-2050)	• #92 Haleʻiwa Area Adaptation Plan (North Shore)
Long Term (Beyond 2050)	• No current projects identified

The project factsheets are listed after Table H-8 and are in the order noted in Tables H-6 through H-8 by timeframe.

Table H-6. Near-Term Factsheets

PROJECT NAME	REGION	LEAD AGENCY
#150 Expand Tidal Groundwater Well Monitoring Network	Islandwide	BWS
#106 Reuse Strategy for Redevelopment Areas	Islandwide	BWS
#30 Stormwater Utility Fee	Islandwide	DFM
#165 Stormwater Master Plan	Islandwide	DFM
#41 Beach Shower NPDES Compliance Improvements	Islandwide	DFM
#109 Green Infrastructure Implementation Plan	Islandwide	DFM
#39 Onsite Stormwater Management Incentives	Islandwide	DFM/DDC
#33 Managed Retreat Legal and Policy Investigation Study	Islandwide	DPP
#169 Expand Non-Potable Water to Large Parks and Water Loss Control	Islandwide	DPR/DDC/BWS
#172 Country Town Resilient Sidewalk & Path Improvements for Unimproved Roadways	Islandwide	DTS
#35 Road Raising Strategy	Islandwide	DTS/DFM/DDC
#75 Waimānalo Effluent R-1 Reuse Feasibility Study	Koʻolau Poko	ENV
#163 Nuʻuanu Reservoir Hydro Managed Aquifer Recharge	PUC	BWS
#155 Ala Wai Golf Course Non-Potable Irrigation Study	PUC	BWS/DDC
#162 NASED Regulatory Requirements for Reuse	PUC	BWS/ENV
#122 Adapt Waikīkī Phase 2	PUC	DPP
#101 Iwilei Area Adaptation Plan	PUC	DPP/DFM/CCSR
#115 Māpunapuna Area Adaptation Plan	PUC	DPP/DFM/CCSR
#123 Ala Wai Watershed Integrated Stormwater Management	PUC	DFM/BWS
#170 University Avenue Urban Complete Streets and Green Infrastructure	PUC	DTS/DDC/DFM
#167 Central Oʻahu Water Recycling Facilities, Mililani	Central Oʻahu	BWS/ENV
#168 Reuse and Potable Water Services for Whitmore Agriculture	Central Oʻahu	BWS/ENV
#164 Potable Reuse Pilot at Honouliuli	ʻEwa	BWS/ENV/DOH
#129 Develop Cooperative Fireshed Partnerships	Waianae	BWS

Table H-7. Mid-Term Factsheets

PROJECT NAME	REGION	POTENTIAL LEAD AGENCY
#166 Projects from the Integrated Plan	Islandwide	ENV/DFM
#90 Stormwater Retention, Recharge, and Reuse in Mauka Lands	North Shore	DFM
#92 Haleʻiwa Area Adaptation Plan	North Shore	DPP/CCSR
#64 Beach Park Erosion and Flood Resilience	Koolau Loa	DPR/CCSR
#61 MCBH R-1 Recycled Water Upgrade	Koʻolau Poko	BWS
#68 Waimānalo Roads Drainage Study and Improvements	Koʻolau Poko	DFM
#70 Kahawai Stream Restoration Strategy	Koʻolau Poko	DFM
#59 Stormwater Retention along Kamoʻoaliʻi Stream	Koʻolau Poko	DFM, DDC, BWS
#53 Coastal Management Plan for Erosion and Flooding	Koʻolau Poko	DPP
#9 Stream Restoration & Rehabilitation	East Honolulu	DFM
#102 Pilot Floodable Spaces	PUC	DFM/BWS
#103 Iwilei Drainage Improvements	PUC	DFM/DDC
#110 Māpunapuna Flood Improvements	PUC	DFM/DDC
#104 Kapālama Canal Linear Park	PUC	DPP
#105 Resilience Corridors and Road Raising	PUC	DTS/DFM/DDC
#4 Honouliuli R-1 Distribution System Expansion	Central Oʻahu	BWS

Table H-8. Long-Term Factsheets

PROJECT NAME	REGION	POTENTIAL LEAD AGENCY
#60 Resilience Corridor and Pedestrian Accessibility Study	Koʻolau Poko	DTS
#67 State Agriculture Water System Connection to Future R-1	Koʻolau Poko	ENV
#8 Regional Shoreline Adaptation	East Honolulu	DDC, BWS, ENV, DPR
#26 Long-Range Post-Retreat Study	ʻEwa	CCSR
#19 Raise Main Arterials Further Inland	ʻEwa	DTS
#132 Dry Flood Proof Waiʻanae High Risk Areas	Waiʻanae	BWS, ENV, DFM, DDC
#145 Mākaha Roads Drainage Study and Improvements	Waiʻanae	DFM
#141 Mākaha Stormwater Infrastructure	Waiʻanae	DFM
#130 Increase Green Infrastructure and Green Space	Waiʻanae	DFM

EXPAND TIDAL GROUNDWATER WELL MONITORING NETWORK

PROJECT CONCEPT

GENERAL DESCRIPTION

This near-term program focuses on tracking changing groundwater levels to identify emergent groundwater trends across the island of Oʻahu. Emergent groundwater can cause chronic surface inundation, reduced infrastructure performance, and impacts to public spaces and cultural resources. The project will expand the existing network of groundwater monitoring wells to produce this data, which will ultimately be used to update and calibrate the UH SOEST Sea Level Rise Viewer to inform future efforts related to water supply and infrastructure impacts.

More specifically, the project will deploy and operate a dense, island-wide coastal groundwater monitoring network, providing continuous measurements of groundwater elevation, salinity, temperature, pH, dissolved oxygen, and other parameters governing corrosion processes. These observations will be integrated into high-resolution groundwater and inundation models to resolve tidal, seasonal, and long-term drivers of groundwater emergence under present and future SLR scenarios.

To accomplish this, the existing network of 7 wells in Honolulu's Primary Urban Center will be expanded by 12 strategically distributed sites across Oʻahu, bringing the total to up to 19 wells. If Green Fee funding (Act 96, SLH 2025) is secured, pending legislative approval, this network could grow by an additional 6 wells, reaching 25 total sites across Oʻahu.

Monitoring locations will be selected to capture Oʻahu's broad range of hydrogeologic settings, land uses, and infrastructure exposure. In coastal environments, aquifers are generally shallow, tidally influenced, and brackish, reflecting dynamic interactions among ocean water, groundwater, and surface drainage systems. Continuous monitoring will characterize spatial and temporal variability in groundwater elevation and salinity, providing essential inputs for numerical model calibration, validation, and long-term infrastructure vulnerability assessments.

ID #:	150
Timeframe:	Near-term

PROJECT CONCEPT

Champion Agencies:	BWS
Potential Partnerships:	CCSR, UH, DFM, ENV
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

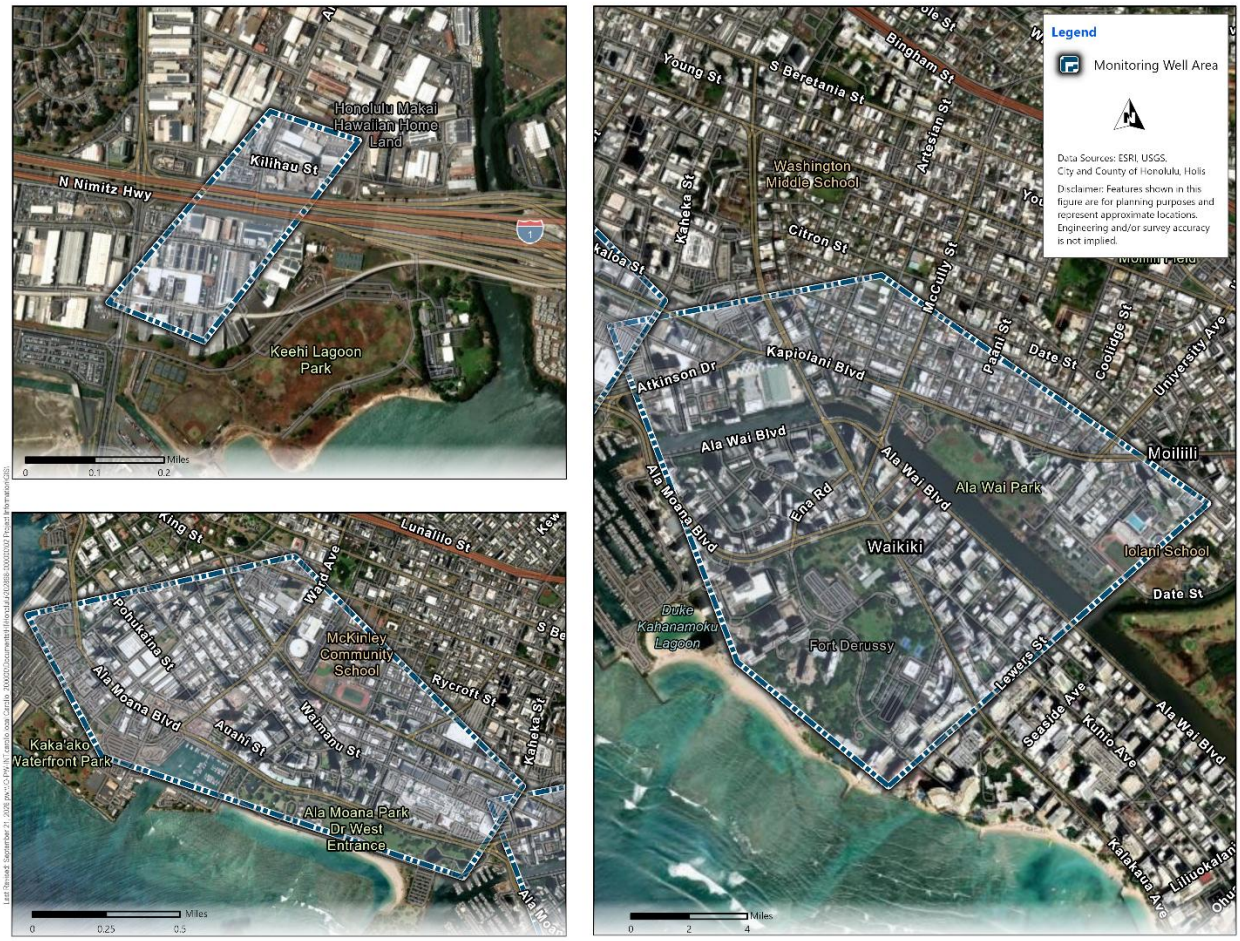


Figure 1. Overview of Monitoring Well Areas

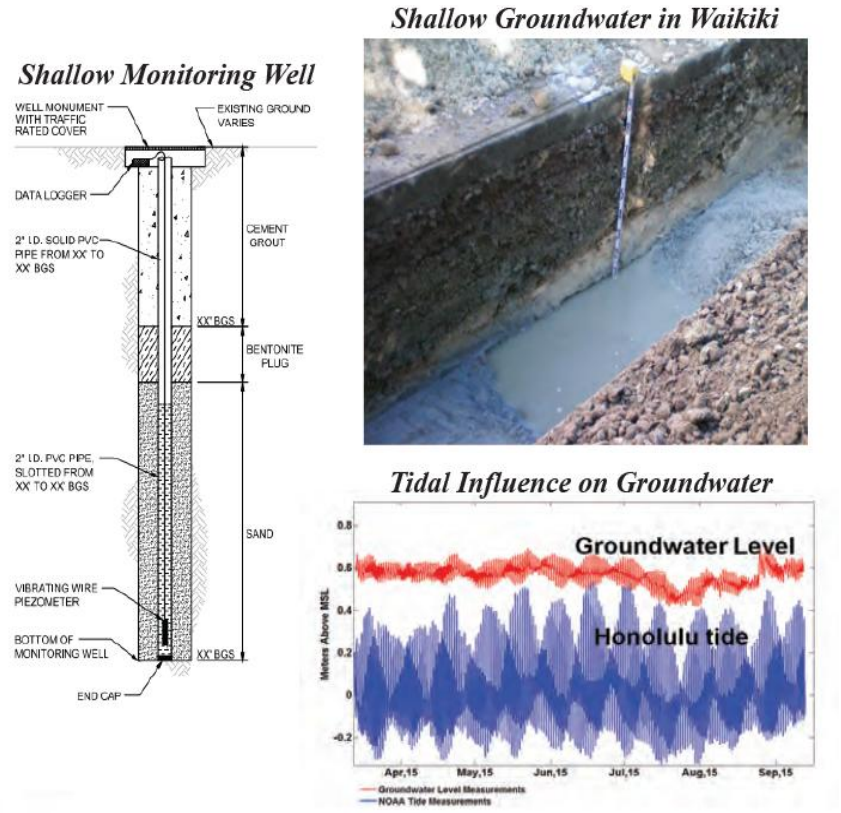


Figure 2. Shallow Groundwater in Waikiki



Image 1: Monitoring well cover. Flush with ground surface to mitigate obstruction.



Image 2: Submersible water level sensor. Approx. 6 inches in length.

Figure 3. Monitoring Equipment

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Waterlines and valves **Wastewater:** Sewer lines, pump stations **Stormwater:** Storm drains **Roads:** Low-lying transportation corridors, bridges
Community Assets at Risk:	Schools and educational facilities, hospitals and medical facilities, fire and police stations, recreational and community centers, cultural and historical resources, coastal parks and public gathering spaces.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Sea Level Rise (Groundwater):** Shallow, coastal groundwater rise driven by SLR can cause persistent surface flooding in areas not captured by rainfall-based flood models, reduce functional lifespan and reliability of infrastructure, compound coastal and storm impacts by limiting drainage and infiltration, and disrupt access to schools, parks, cultural sites, and transportation corridors. Increasing monitoring of tidally influenced groundwater will contribute to understanding and mapping groundwater changes with SLR. This increased knowledge can inform future infrastructure and other coastal projects.

PROJECT COMPONENTS

PLAN/STUDY

Expand O‘ahu’s coastal groundwater monitoring network by expanding the existing network of 7 monitoring wells in Honolulu’s Primary Urban Core by adding up to 12 strategically distributed coastal sites, with the potential to expand to as many as 25 total wells island-wide if Green Fee funding is secured. Place monitoring sites across diverse land uses, aquifer conditions, and infrastructure settings to better understand how tidal influence, rainfall, seasonal variability, and sea level rise affect shallow coastal groundwater systems island-wide. In addition to these factors, researchers will identify these monitoring locations in areas that currently lack well coverage, through collaboration with a local geotechnical firm with well experience.

Monitor emergent groundwater and coastal flooding trends – collect continuous groundwater elevation, salinity, temperature, pH, dissolved oxygen, conductivity, and corrosion-related data to track how rising groundwater levels may contribute to chronic flooding, infrastructure impacts, and risks to public spaces and cultural resources across O‘ahu.

Support sea level rise modeling and infrastructure vulnerability assessments – use monitoring data to calibrate and validate high-resolution groundwater and inundation models, including updates to the UH SOEST Sea Level Rise Viewer, to improve understanding of future impacts to water supply, infrastructure, and coastal communities.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ☒ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☐ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☐ Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

PROJECT COMPONENTS

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	• Practice a shared kuleana for a climate resilient Oʻahu • Enhance coordination and recognize interconnections to develop and implement projects and strategies • Develop a unified roadmap and decision making process under a One Water approach • Work together to leverage resources and enable climate readiness • Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#9:** Integrate climate resilience into City capital planning, operations, and policies **#10:** Make buildings, homes, and infrastructure more climate resilient **#11:** Reduce flood risk and coastal erosion by directing development to safer and higher ground
Relevant Adaptation Strategies:	• Monitoring groundwater levels and related SLR impacts
Expected Timeline:	**There is a need for this project now, so it should be prioritized in the near-term.**
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-5M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Roadway ROWs contain many utilities, including gravity mains for sewer and stormwater. Redesign of these gravity systems will be necessary and may be costly, particularly if new elevations require pump stations and force mains. • Miami experienced lawsuits from homeowners due to the increased flooding experienced on private property along raised roads. Public support and accessibility may be a challenge for roads that will be raised above the grade of homes or properties.
Additional Considerations:	• Translating technical groundwater monitoring and modeling results into actionable land use, infrastructure, and capital planning decisions may require new coordination frameworks between scientists, utilities, planners, emergency managers, and asset owners. • Emergent groundwater impacts are often less visible and less intuitive than coastal inundation or wave flooding, creating challenges in communicating risks to stakeholders, justifying investments, and integrating groundwater hazards into existing resilience policies and permitting processes. • Groundwater levels can vary significantly across short distances due to differing elevations, geology, drainage infrastructure, tidal influence, and fill conditions, requiring careful interpretation of localized monitoring results and uncertainty ranges.

REFERENCES

UH Project Factsheet: Groundwater Monitoring Study to Determine Impacts of Sea Level Rise Related Groundwater Inundation in Honolulu

ACRONYMS

BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
SLH	Session Laws of Hawaiʻi
SLR	Sea Level Rise
SOEST	School of Ocean and Earth Science and Technology
SoVI	Social Vulnerability Index
UH	University of Hawaiʻi

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

REUSE STRATEGY FOR REDEVELOPMENT AREAS

PROJECT CONCEPT

GENERAL DESCRIPTION	To enhance long-term water security and reduce reliance on limited freshwater aquifers, this project evaluates regional water reuse strategies across Oʻahu. The initiative encompasses a comprehensive feasibility study and a subsequent pilot program, likely centered in the Iwilei Transit-Oriented Development (TOD) area. The study will analyze alternatives for reuse including decentralized treatment at the community or district scale, onsite (building-scale) reuse requirements for new developments include gray water reuse and centralized reuse for both potable and non-potable distribution. By performing a robust cost-benefit analysis and identifying high-payoff implementation strategies, the City will establish a framework for integrating recycled water into a long-term sustainable water supply.
ID #:	106
Timeframe:	Near-term
Champion Agencies:	BWS
Potential Partnerships:	ENV, DPP, DOH, DHLM
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide, with pilot in Iwilei (PUC)
Oʻahu SoVI Index:	High

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nuʻuanu Stream **Roads:** N/A
Community Assets at Risk:	Honolulu Community College, Honolulu Harbor, Aloha Tower, Aʻala Park, Nearby Waterfront Fire Station 45, nearby Chinatown Substation Police Station

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-LOW** **Drought:** Water resources on Oʻahu are limited, and water reuse is central to continued sustainable development. Iwilei has a low physical exposure to drought conditions, but the PUC area has known water supply constraints that redevelopment and growth exacerbate. A reuse plan and pilot would reduce potable water demand on limited resources. **Extreme Heat:** Increased heat increases water demand. Planning for reuse in redevelopment areas will reduce the additional demand and supply recycled water to fill non-potable needs.

PROJECT COMPONENTS

PLAN/STUDY

The focus of this project is a feasibility study designed to evaluate potential policies and technologies to increase water reuse in redevelopment areas, reducing demands on limited freshwater sources. Both potable and non-potable reuse will be considered, through centralized, decentralized (community or district scale), or onsite (building scale) treatment.

Questions for the Plan to address:

1. Economic & Resource Analysis: What are the lifecycle costs and community benefits associated with onsite, decentralized, and centralized reuse?
2. Potable Offset Potential: To what extent can each alternative reduce demand on existing potable water supplies? Given known PUC supply constraints, the volume and timing of offset are primary evaluation criteria.
3. Implementation Timelines: What are the realistic schedules for the design, permitting, and construction of each alternative, relative to the immediacy of supply constraints?
4. Policy & Technical Barriers: What regulatory hurdles exist for each model, and what participation rates have been observed in similar onsite reuse programs nationally?
5. TOD Integration: How can recycled water infrastructure be strategically integrated into high-density Transit-Oriented Development (TOD) and other redevelopment areas?
6. User Profiles & Adoption: Who are the primary end-users for recycled water, and what are the projected adoption levels for each program?

Specific tasks or chapters may include island-wide guidance:

Tasks for this project may include surveys to understand the buy-in from developers, comparison of incentives and mandate programs, and technical feasibility analysis and cost estimating. Important factors will include the volume of potable water needed to be offset, and the immediacy of water shortage concerns- both of which weigh toward alternatives that deliver larger volumes sooner, given that BWS has already notified PUC developers that supply is not guaranteed. While centralized reuse and distribution poses the largest cost to the City, it also likely has the fastest implementation time and offsets the most potable water use. The City will need to decide the role it will take in this program.

For the selected strategy, an implementation plan will be proposed, including timing, required policies or triggers, anticipated reuse customers, and necessary infrastructure.

PROGRAM

A program phase of this project will depend on the highest benefit/cost alternative. If onsite reuse is deemed the best alternative, incentives programs or policy drafts will be the second stage. This program would potentially begin with Iwilei as a pilot location.

INFRASTRUCTURE

An infrastructure phase of this project will depend on the highest benefit/cost alternative. If centralized reuse is deemed the best alternative, reuse infrastructure will be designed and constructed at an existing WWTP, along with distribution pipelines for non-potable water. This infrastructure project would potentially begin with Iwilei as a pilot location, incorporating reuse at Sand Island WWTP.

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☒ Improves water quality ☐ Improves public access to community spaces **?** Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☒ Other: Sustainable water supply

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Reduce pressure on water resources to support local water supply reliability
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination • Stormwater Capture and Use • Developer Guidelines • On-site Reuse Policy for New Development
Expected Timeline:	**There is a need for this study now, so it should be prioritized in the near-term.** This project will likely need to be coordinated/interact with the following other projects:

	• OWH Project #4 Honouliuli R-1 Distribution System Expansion • OWH Project #30 Stormwater Utility Fee • OWH Project #39 Onsite Stormwater Management Incentives • OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study • OWH Project #101 Iwilei Area Adaptation Plan • OWH Project #104 Kāpālama Canal Linear Park • OWH Project #115 Māpunapuna Area Adaptation Plan • Iwilei, Chinatown, Downtown TOD Stations • OWH Project #155 Ala Wai Golf Course Non-Potable Irrigation Study • OWH Project #162 NASED Regulatory Requirements for Reuse • OWH Project #169 Expand Non-Potable Water to Large Parks and Water Loss Control
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$500,000-$1M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Evidence from comparable onsite reuse programs indicates limited aggregate supply benefit. In San Francisco, 58 development projects have used onsite reuse over more than 10 years of the SFPUC program. The actual savings of this program are relatively low and on a long timeframe, considering the significant development occurring in San Francisco. SFPUC is considering additional incentives, including a funding mechanism for ongoing O&M, which has been a barrier to implementation. This experience suggests that building-scale mandates alone are unlikely to resolve supply constraints at a regional scale, and that community or district-scale approaches warrant primary consideration.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Due to ongoing concerns around groundwater quality, indirect potable reuse may not be an option in the PUC area. Significant infrastructure would be necessary to pipe and pump treated water mauka to an injection site, and depending on the use of wells and groundwater in PUC, there may not be significant payoff for water supply. Direct potable reuse would decrease the infrastructure cost and contamination concerns. It is anticipated that indirect potable reuse is infeasible and direct potable reuse would be a technically more feasible alternative.
- Public acceptance is well-documented barrier to direct potable reuse. Any DPR alternative will require sustained public education and engagement, and the feasibility study should account for the time and cost of that effort alongside technical and regulatory considerations.

Additional Considerations:

Ongoing Projects:

- Sand Island Wastewater Treatment Plant (SIWWTP) has an ongoing upgrade project to include secondary treatment and R-1 water from a membrane bioreactor facility (MBR). The identified user of R-1 water is the state DLNR; however, the capacity of this plant could be extended, and other users, including within PUC, could be added on. SIWWTP currently processes about 56 mgd of wastewater.
- Due to water source limitations, new developments within the PUC have been given notice from BWS that their water needs are not guaranteed to be met. This permitting mechanism can encourage or require alternative supply as a condition of new development. Currently applied case by case, this mechanism could be expanded to a district-wide requirement.

Additional Considerations:

- It is anticipated that there will be a trade-off between the immediacy and volume of potable water demand replacement and the effort and capital necessary to fund a large-scale, centralized reuse program.
- Cultural considerations may dictate where and how much new infrastructure can be built, particularly around laying new pipelines. A part of the study may need to consider where there are cultural sites or burial grounds that would need to be avoided with new infrastructure construction.

Potential Mechanisms:

- Mandating recycled water for cooling towers and HVAC systems is typically easier and offsets more water use than recycled water for toilet plumbing. Flushing toilets with recycled water can, however, improve public awareness more than cooling systems.
- Example mandates may require onsite reuse based on the square footage or story-height of new constructions.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Stormwater requirements have proven to be the most effective driver of onsite reuse adoption elsewhere. In San Francisco, the stormwater ordinance requires stormwater mitigation for impermeable surfaces, and onsite treatment reduces fees associated with sending that stormwater to the combined sewer system. Most participating projects cite stormwater as the motivating factor rather than water supply. The proposed stormwater utility fee could serve the same function locally, offering fee reduction as an incentive for onsite treatment in large developments.

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ACRONYMS

BWS	Board of Water Supply
CCH	City and County of Honolulu
CRO	Climate Ready Oʻahu
DLNR	Department of Land and Natural Resources
DOH	Department of Health
DPP	Department of Planning and Permitting
DPR	Direct Potable Reuse
ENV	Department of Environmental Services
HVAC	Heating, Ventilation, and Air Conditioning
IPR	Indirect Potable Reuse
MBR	Membrane Bioreactor
mgd	Million Gallons per Day
N/A	Not Applicable
n.d.	No Date
O&M	Operations and Maintenance
OWH	One Water Honolulu
PUC	Primary Urban Center
R-1	R-1 Recycled Water
SFPUC	San Francisco Public Utilities Commission
SIWWTP	Sand Island Wastewater Treatment Plant
SoVI	Social Vulnerability Index
SW	Stormwater
TOD	Transit-Oriented Development
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

STORMWATER UTILITY FEE

PROJECT CONCEPT

GENERAL DESCRIPTION	This project will implement a Stormwater Utility Fee that will charge property owners based on the extent of impermeable surfaces on their property. The Stormwater Utility Fee will create an opportunity for incentives for reduced impervious surfaces including green infrastructure and onsite stormwater capture. In addition, the Stormwater Utility Fee will generate funds to implement many stormwater projects that improve water quality, increase water supply, and improve flood mitigation including many within the OWH Projects List. There has already been significant effort towards establishing a Stormwater Utility Fee for the City. A fee structure has been developed, and a proposal to establish a dedicated Stormwater Utility and Enterprise Fund is being drafted. The stormwater fee and enterprise fund are currently being considered by the City's administration as a bill ordinance, which will require City Council approval. For the next stage of the Stormwater Utility Fee program, there is a need for coordinated engagement with City decision-makers and the public, and for a funding process to determine how funds are allocated to stormwater projects.
ID #:	30
Timeframe:	Near-term
Champion Agencies:	DFM
Potential Partnerships:	BWS, ENV
Adaptation Strategy Type:	Program
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** All water assets **Wastewater:** WW collection system and pump stations **Stormwater:** All SW assets **Roads:** Local roads
Community Assets at Risk:	Streams, beaches, parks, schools, and homes.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **100-Year Flood:** Flooding from extreme precipitation is a significant hazard on Oʻahu. The Stormwater Utility Fee will fund stormwater management projects that will reduce impacts from flood and storm events. Increased stormwater management across Oʻahu will reduce the runoff and impacts from frequent storms as well as reduce the peak flows from major storm events. In addition, a fee based on impervious area will incentivize reduction of impervious surfaces. **Hurricane:** Hurricanes produce significant rainfall, which is a hazard across Oʻahu. Stormwater projects funded by the Stormwater Utility Fee may decrease peak flows and reduce stormwater-related damages from hurricanes. **Drought:** Drought impacts may be reduced by increased stormwater infiltration for groundwater recharge. In addition, stormwater capture and use projects can supplement water demand as a non-potable source.

PROJECT COMPONENTS

PLAN/STUDY

Ongoing work includes public surveys and outreach to establish a fee structure that aligns with public expectations. A cost of services analysis was performed, focusing on operations, CIP, and equipment requirements. While current modeling focuses on known infrastructure needs, the framework is designed to remain adaptable as climate impact costs are further defined. The Stormwater Utility Feasibility Analysis identified the optimal rate structure and included community engagement through Stakeholder Advisory Groups. The City Council has established a Climate Resiliency Fund, through which DFM has secured budget for supporting services including a Stormwater Master Plan that will further inform the utility and fee effort. A proposal to establish a dedicated Stormwater Utility and Enterprise Fund is being drafted and is under consideration by the City's administration as a bill ordinance; formal adoption will require City Council approval.

PROGRAM

Two components are necessary to aid the success of the Stormwater Utility Fee implementation:

- Broadening support for the fee
- Accountability for how funds are used.

To these ends, the next phase of the Stormwater Utility Fee program should focus on coordinated engagement and an operations plan.

The next phase requires engagement on two fronts. The first is coordination with the City's administration and City Council: briefings that connect the fee to the aging stormwater infrastructure and regulatory compliance needs the Council has already recognized through the Climate Resiliency Fund, and alignment on the timing and content of the bill ordinance. The findings of the DFM Stormwater Master Plan will support this effort by documenting the scale of need the fee would address. The second is public outreach and education, whose timing must be strategically aligned with public and decision-maker readiness. Following ENV's sewer rate restructuring as of January 1, 2026, it is vital to evaluate the cumulative impact on constituents. Public engagement will focus on coordinating with the Stakeholder Advisory Groups, detailing fee-reduction credits and incentive programs, and demonstrating the tangible community benefits of the projects this fee would fund. Public engagement should include polling on key issues and messaging, with results reflected in clear, graphical materials suited to a general audience.

INFRASTRUCTURE

N/A

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality **?** Improves public access to community spaces ☒ Increases public awareness/education **?** Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Work together to leverage resources and enable climate readiness Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#2**: Amplify and create capacity for community-led climate adaptation
Relevant Adaptation Strategies:	• Stormwater Utility Fee
Expected Timeline:	**There is a need for this study now, so it should be prioritized in the near-term.** This is a near-term program that could fund or incentivize many other projects. It will likely need to be coordinated/interact with the following other projects: • Green infrastructure improving water quality and increasing water supply for TOD • OWH Project #165 Stormwater Master Plan • OWH Project #9 Stream Restoration & Rehabilitation

PROJECT COMPONENTS

	• OWH Project #39 Onsite Stormwater Management Incentives • OWH Project #59 Stormwater Retention along Kamoʻoaliʻi Stream • OWH Project #68 Waimānalo Roads Drainage Study and Improvements • OWH Project #70 Kahawai Stream Restoration Strategy • OWH Project #90 Stormwater Retention, Recharge, and Reuse in Mauka Lands • OWH Project #102 Pilot Floodable Spaces • OWH Project #103 Iwilei Drainage Improvements • OWH Project #104 Kapālama Canal Linear Park • OWH Project #105 Resilience Corridors and Road Raising • OWH Project #109 Green Infrastructure Implementation Plan • OWH Project #110 Māpunapuna Flood Improvements • OWH Project #123 Ala Wai Watershed Integrated Stormwater Management • OWH Project #130 Increase Green Infrastructure and Green Space • OWH Project #141 Mākaha Stormwater Infrastructure • OWH Project #145 Mākaha Roads Drainage Study and Improvements
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$200,000-$400,000 *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- The Stormwater Utility and Enterprise Fund must be adopted by the City Council as a bill ordinance in order to move forward. The technical basis for the stormwater fee is in place; securing administration and City Council support is the gating step, and sustained advocacy will be needed to reach adoption.
- Prior efforts to advance a stormwater utility fee have not yet resulted in an introduced Council measure, which underscores the importance of aligning technical readiness with administrative and legislative support.
- Timing of public outreach depends strongly on the timing that the bill will be introduced to city council. The information should not be presented to the public if the stormwater utility is not moving forward yet. Preparations should be put in place, however, to be prepared for outreach once the administration gives the 'go-ahead.'
- Public support for a stormwater utility fee is necessary for success. In other locations, there has been pushback by the public or local governments (e.g., Maryland), including lack of compliance. However, many cities have successfully implemented a stormwater utility fee (e.g., Los Angeles County, Detroit, Charlotte, Seattle, Boulder, Philadelphia, Minneapolis).

Additional Considerations:

Additional Resources:

- The LA Safe Clean Water program is a useful starting point regarding structure, project scoring criteria and process, and program oversight and accountability.

Future Phase:

- Once the fee is approved, it will be necessary to have an operations plan in place. This plan will contain the structure for how funding can be used, and what benefits projects should include to justify using funds from the fee. A plan for an approval process will include setting up committees, reporting and scoring criteria, and programs to categorize the funding.
- One option is to follow the model of Los Angeles County's Safe Clean Water program: committees may include a regional oversight committee, a scoring committee, and ahupuaʻa or moku-based steering committees to provide local relevance.
- Projects will be evaluated based on their verified contributions to improve water quality, increase water supply, provide community investment benefits, implement nature-based solutions, and leverage funding and community support. The criteria can differ based on whether the project is an infrastructure project, a scientific study, or a technical resource. The funding will be broken out into three primary tiers: a Regional Program for large-scale impact, a Municipal Program providing proportional returns to contributing departments or agencies, and a Utility Program to support essential administrative and operational overhead.

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ACRONYMS

BWS	Board of Water Supply
CCH	City And County Of Honolulu
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
SW	Stormwater
WW	Wastewater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

STORMWATER MASTER PLAN

PROJECT CONCEPT

GENERAL DESCRIPTION	The Stormwater Master Plan is an islandwide planning effort for long-range stormwater planning including mapping and modeling existing infrastructure, prioritizing capital improvements, identifying operations & maintenance needs, and determining funding pathways. The Master Plan will result in an actionable projects list with implementation strategies, similar to BWS or ENV functional plans. The Stormwater Utility Fee would fund the Plan, which will be the first islandwide stormwater master plan and create a foundational framework to inform how projects are identified, prioritized, and included in the capital improvement program (CIP).
ID #:	165
Timeframe:	Near-term
Champion Agencies:	DFM
Potential Partnerships:	DDC, ENV, DTS, DPP, BWS, CCSR, DPR, DES, BFS
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** All water assets **Wastewater:** All WW assets **Stormwater:** All SW assets **Roads:** Local roads
Community Assets at Risk:	Beaches, schools, critical facilities (hospitals, fire stations, police stations), low-lying developed areas, and flood prone neighborhoods

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **100-year Flood:** The Stormwater Master Plan will prioritize projects that address impacts from the 100-year flood. **Hurricane:** The Stormwater Master Plan will consider extreme rainfall potentially including hurricane impacts. **Sea Level Rise:** The Stormwater Master Plan will address future conditions including functioning of drainage infrastructure and inundation under future sea level rise.

PROJECT COMPONENTS

PLAN/STUDY

The Stormwater Master Plan will identify and prioritize stormwater projects islandwide to inform a CIP. The level of analysis will balance detail with the broad geographic scope of the Plan. The Stormwater Master Plan will be developed with input from a Technical Advisory Committee, including ENV personnel, to draw on the experience of City agencies that have already built and maintained comparable programs. ENV's experience with GIS asset databases, hydraulic modeling, and long-range asset condition assessment, maintenance, and rehabilitation planning is directly applicable to the challenges DFM will face in developing equivalent capabilities for the stormwater system.

The following tasks or chapters, based on the City of Pacifica and Flagler County Stormwater Master Plans, could be included:

1. **Background Data Review.** These data may include stormwater programs, regulations, existing infrastructure, past studies, and past flooding events. Locations with known flooding issues that are not identified in past studies or the hydraulic and hydrologic analysis may require additional data collection and improved modeling. Data review will also include water quality review including pollutant loadings and recommendations for water quality.
2. **System Inventory and Condition Assessment.** The plan will compile a system-wide inventory of existing stormwater infrastructure, including storm drains, culverts, inlets, manholes, channels, detention/retention facilities, pump stations, and outfalls. Inventory data may include location, size, material, age, and connectivity, consolidated into the existing GIS geodatabase to support modeling and long-range asset management. Where the existing inventory is incomplete, this task will identify data gaps and may include field verification or additional data collection in priority areas. The plan will also assess the condition and criticality of key assets, considering structural state, remaining service life, and the consequence of failure, to distinguish deficiencies driven by deterioration and age from those driven by hydraulic under-capacity. The resulting inventory and condition data will inform the Hydraulic and Hydrologic Analysis, the identification of deficiencies and projects, and the Operations & Maintenance Plan.
3. **Hydraulic and Hydrologic Analysis.** This modeling will include present-day and future climate/precipitation conditions. Due to the wide geographic range of this islandwide Stormwater Master Plan, modeling may focus on smaller, developed areas. Modeling will focus on capacity and flooding, with additional assessment of water quality where possible.
4. **Identified Deficiencies and Projects.** Deficiencies will be identified through the Hydraulic and Hydrologic Analysis and System Inventory and Condition Assessment to find locations where infrastructure improvements are most urgent. Projects will be identified to remove the deficiencies. Projects will include green infrastructure (GI) and low impact development (LID) to reduce flooding and improve water quality where possible or based on the recommendations identified in the Background Data Review.

PROJECT COMPONENTS

5. **CIP with Costs and Funding Strategy.** Identified projects will be prioritized, given planning level cost estimates, and included in the capital improvement program. CIP detail sheets will include project descriptions, locations, components, maps, and cost summaries.
6. **O&M Plan.** Finally, the Stormwater Master Plan should include Operations & Maintenance (O&M) needs for existing and proposed infrastructure. This task may include O&M for GI best management practices (BMPs) along with grey infrastructure O&M and include information about staff requirements, typical procedures, equipment needs, maintenance schedules, needs for easements, and budgets.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ? Protects cultural sites
- ? Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☐ Improves public access to community spaces
- ? Increases public awareness/education
- ☒ Provides ecosystem restoration
- ? Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported: N/A

OWH Objectives Supported:

- Practice a shared kuleana for a climate resilient Oʻahu
- Work together to leverage resources and enable climate readiness
- Collectively advocate for and pursue funding to support multi-benefit projects

PROJECT COMPONENTS

CRO Strategies Supported:	**#9:** Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	• Drainage System Plan • Incorporate Low Impact Design/Green Infrastructure Stormwater Management Strategies
Expected Timeline:	**There is a need for this study now, so it should be prioritized in the near-term.** This near-term, islandwide plan will identify longer-term studies and infrastructure projects. This project will likely need to be coordinated/interact with the following other projects: • OWH Project #19 Raise Main Arterials Further Inland • OWH Project #30 Stormwater Utility Fee • DFM/ENV Integrated Plan • OWH Project #35 Road Raising Strategy • OWH Project #39 Onsite Stormwater Management Incentives • OWH Project #59 Stormwater Retention along Kamoʻaliʻi Stream • OWH Project #60 Resilience Corridor and Pedestrian Accessibility Study • OWH Project #68 Waimānalo Roads Drainage Study and Improvements • OWH Project #90 Stormwater Retention, Recharge, and Reuse in Mauka Lands • OWH Project #102 Pilot Floodable Spaces • OWH Project #103 Iwilei Drainage Improvements • OWH Project #105 Resilience Corridors and Road Raising • OWH Project #109 Green Infrastructure Implementation Plan • OWH Project #110 Māpunapuna Flood Improvements • OWH Project #123 Ala Wai Watershed Integrated Stormwater Management • OWH Project #130 Increase Green Infrastructure and Green Space • OWH Project #141 Mākaha Stormwater Infrastructure • OWH Project #145 Mākaha Roads Drainage Study and Improvements
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A

PROJECT COMPONENTS

Planning Level Cost Estimate:

Pending estimate based on final project components

Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Funding will be a challenge to implement the associated CIP. The CIP relies on the passage of a Stormwater Utility Fee that will be able to fund many of the proposed projects and O&M activities.
- The quality of the Plan depends on the completeness of existing stormwater infrastructure data. As the first islandwide effort, the City may lack a complete system-wide asset inventory; establishing or completing that inventory may be a prerequisite and could affect schedule and cost.
- Establishing a stormwater asset database, hydraulic model, and condition assessment program represents a substantial undertaking for DFM. ENV has developed comparable capabilities for the wastewater system and will participate through the Technical Advisory Committee, providing an opportunity to apply lessons learned rather than developing approaches independently.

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ACRONYMS

BFS	Department of Budget and Fiscal Services
BMP	Best Management Practice
BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CIP	Capital Improvement Program
CRO	Climate Ready Oʻahu
DES	Department of Enterprise Services
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
ENV	Department of Environmental Services
FEMA	Federal Emergency Management Agency
GI	Green Infrastructure
GIS	Geographic Information System
LID	Low Impact Development
N/A	Not Applicable
O&M	Operations and Maintenance
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
SW	Stormwater
WW	Wastewater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

BEACH SHOWER NPDES COMPLIANCE IMPROVEMENTS

PROJECT CONCEPT

GENERAL DESCRIPTION	Many beach showers on Oʻahu require redesign so that shower wash water effluent (greywater) does not flow directly into the ocean. The primary purpose is regulatory compliance under the City and County of Honolulu MS4 NPDES permit (HIS000002), which prohibits beach shower wash water effluent as a non-stormwater discharge to the storm drain system and receiving waters. Additional important factors include reduced operations & maintenance, increased durability, and community satisfaction. Since beach showers are also subject to coastal erosion and inundation from sea level rise, the project includes relocation to higher ground. A beach shower redesign project, the Kūhiō Beach Showers project, is currently in the conceptual design phase. Replication of the Kūhiō Beach Showers Project will be necessary at beach parks across Oʻahu with similar regulatory and water quality challenges. The conceptual design framework and alternatives developed as part of the Kūhiō Beach Showers project can be adapted and applied across the island. Options for effluent treatment and management include subsurface infiltration, overflow to the sewer system, and/or onsite treatment and non-potable reuse for comfort stations (public restrooms) or irrigation. Since site conditions, like groundwater depth, sewer proximity, erosion exposure, and available land, vary considerably, each location will require site-specific evaluation of which alternative is feasible. Future beach shower projects will require community outreach and stakeholder engagement as a central part of the design process, conceptual design and a Design-Build implementation strategy.
ID #:	41
Timeframe:	Near-term
Champion Agencies:	DFM
Potential Partnerships:	ENV, BWS, DPR

PROJECT CONCEPT

Adaptation Strategy Type:	Infrastructure
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

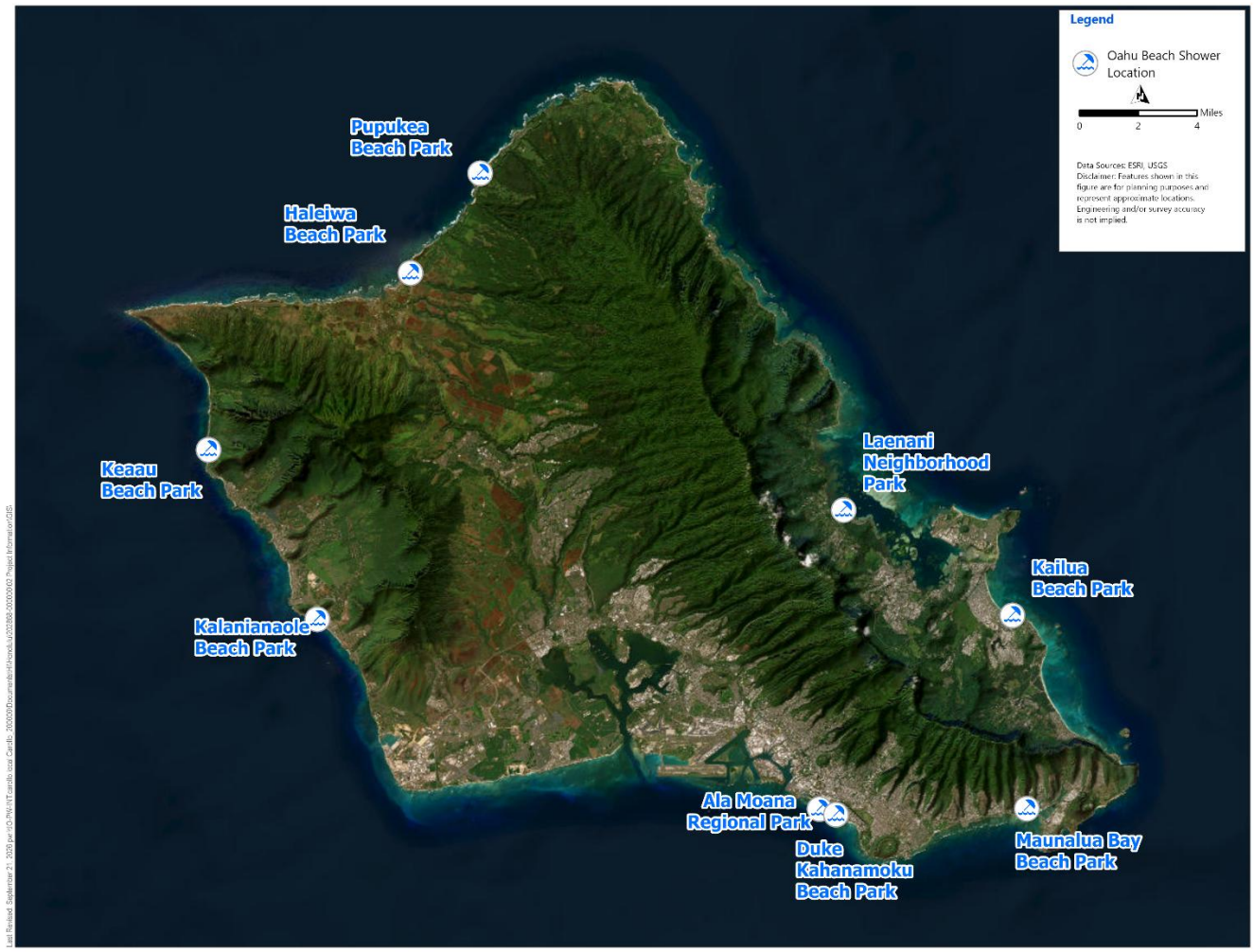


Figure 1. Map of Beach Parks with Priority Beach Showers in Need of Improvements



Figure 2. Example of Shower Wash Water Effluent Discharging to Ocean

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Waterlines, shower trees **Wastewater:** N/A **Stormwater:** Shower wash water effluent management assets **Roads:** N/A
Community Assets at Risk:	Beach parks, comfort stations, and public beaches

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: Low** **Sea Level Rise (Above-ground Flooding):** Many beach parks will be affected by 1-2 feet of SLR. City-wide planning considers 3.2 feet of SLR; however, since the beaches will be inundated by that elevation of SLR, the beach showers will be relocated above more moderate SLR. **Coastal Erosion:** Many beach parks will be affected by coastal erosion. Redesigned beach showers will be located outside of the coastal erosion zone, to reduce risk. **100-Year Flood:** Following relocation outside of SLR and coastal erosion zones, redesigned beach showers will have a reduced risk of inundation from the 100-year flood, king tides, and storm surge. **Drought:** The potential to reuse shower wash water effluent for irrigation or comfort stations could offset potable water demand.

PROJECT COMPONENTS

PLAN/STUDY

A 2012 Outdoor Showers Assessment Engineering Report (Fukunaga & Associates) was developed to assess high priority showers that require improvements to meet regulatory compliance. This assessment provides foundational priority ranking; however, given the intervening years, priorities should be re-verified against current site conditions, including shoreline change and any showers since modified or removed. Based on the 2012 Assessment's results, beach parks with the highest and most priority showers are Kapiʻolani Regional Park (2 high, 9 low, currently in the permitting phase and not included in this project), Ala Moana Regional Park (1 high, 2 medium, 7 low), Kailua Beach Park (1 high, 1 medium, 1 low), Duke Kahanamoku Beach Park (1 high), Haleʻiwa Beach Park (1 high, 1 low), Laenani Neighborhood Park (1 high), Maunalua Bay Beach Park (1 high), Pūpūkea Beach Park (1 high), Keaʻau Beach Park (2 medium), and Kalanianaʻole Beach Park (2 medium, 3 low). A number of additional parks have 1 medium priority shower.

Building on the Kūhiō Beach Showers project, conceptual designs can be adapted and replicated across Oʻahu at other beach parks, with site-specific updates to developed shower alternatives.

Stakeholder and community engagement: Engagement is a continuous thread across every phase of each replication project, not a discrete planning task. Engagement begins at project initiation and continues through conceptual design, design-build procurement, construction, and into operation, with the format and intensity shifting by phase rather than concluding at any milestone. Participants include elected officials, local businesses, lifeguards, and other community members, particularly regular users of the beach showers. By phase: during planning and conceptual design, engagement shapes the alternatives analysis and the recommended design, including through charrettes and other structured feedback formats; during final design and construction, engagement confirms that design-build detail decisions remain consistent with what the community reviewed, and provides notification of park access changes and construction impacts; following construction, outreach supports appropriate use of the new showers, including the prohibition on soap and shampoo, and gathers feedback that informs subsequent replications.

Key technical aspects of the planning phase include:

1. **Site evaluation and alternatives screening**. Each site needs to identify a potential area to move or construct the new shower and connection points to the sewer system, or locations for onsite non-potable reuse infrastructure. Site-specific conditions- groundwater depth, sewer proximity, erosion exposure, and available land, determine which of the alternatives are feasible at each location.
2. **Conceptual design.** The end goal of the study phase is a Concept Design Report with a recommended shower design based on a conceptual alternatives analysis and stakeholder feedback. Alternatives from the Kūhiō Beach shower project can be applied to other locations.

PROGRAM

N/A

INFRASTRUCTURE

Design and construction of each project will occur using a Design-Build model. Stakeholder engagement continues through this phase as described above. The infrastructure components will include new shower trees

PROJECT COMPONENTS

and trench drains, sand catchment basins, subsurface infiltration units, potential overflow connections to sewer pipelines, potential onsite UV treatment and non-potable reuse (NPR) infrastructure, and signage prohibiting the use of soap and shampoo at the showers. The new shower trees will include low flow showerheads that are tamper-proof to reduce water use. If the shower is connected to the sewer system, a shower canopy and adequate sand management are required to keep stormwater and sand out of the sewer system. NPR infrastructure would potentially include upgrades or rehabilitation of comfort stations at the park. This rehabilitation could include elevating the comfort station above tidal or sea level rise elevations. NPR alternatives will thus be significantly more expensive than the infiltration design with overflow connections to the sewer system.

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☒ Improves water quality **?** Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration **?** Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	• Amplify the voices of Oʻahu's people through meaningful stakeholder engagement • Streamline permitting processes to efficiently advance project implementation
CRO Strategies Supported:	**#1:** Increase public understanding of climate change hazards to foster individual and community preparedness **#2:** Amplify and create capacity for community-led climate adaptation **#5:** Strengthen climate resilience of beach and wetland ecosystems through preservation and restoration **#7:** Strengthen fresh water security by improving water conservation and reuse **#11:** Reduce flood risk and coastal erosion by directing development to safer and higher ground

PROJECT COMPONENTS

Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination • Elevate Critical Assets/Equipment • Modify Site Drainage, Storage, and Infiltration • Debris Management Plans and Systems • Relocate or Abandon Facility • Water Conservation and Leak Detection Improvements
Expected Timeline:	This near-term project will include replication in beach parks across Oʻahu. This project will likely need to be coordinated/interact with the following other projects: • Kūhiō Beach Showers NPDES Improvements Project • OWH Project #53 Coastal Management Plan for Erosion and Flooding • OWH Project #64 Beach Park Erosion and Flood Resilience • OWH Project #92 Haleʻiwa Area Adaptation Plan • OWH Project #101 Iwilei Area Adaptation Plan • OWH Project #115 Māpunapuna Area Adaptation Plan • OWH Project #150 Expand Tidal Groundwater Well Monitoring Network • OWH Project #169 Expand Non-Potable Water to Large Parks and Water Loss Control
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$10-20 million (per grouping of shower trees, approximately 5-10 showers) *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Additional Considerations:

- Previous beach shower improvements lacked durability and had issues with ponding. These lessons learned should inform future design of beach shower improvements.
- Many shower users use soap and shampoo, which is not the intended use of the showers and degrades water quality. Even in locations without beach shower improvements, signage prohibiting use of soap and shampoo should be installed.
- Long-term maintenance is a central risk. Replicated showers span assets across DFM, DPR, and ENV and unresolved O&M ownership is a common cause of post-construction issues. A maintenance responsibility matrix should be established early in each project and confirmed with the responsible departments before design is finalized.
- Site conditions will constrain which alternatives are feasible at each location. Sites where infiltration is not viable will depend more heavily on sewer connection or onsite reuse alternatives with corresponding cost implications.

Permitting:

- Environmental permitting may take a significant amount of time. In addition, City and state permits (DLNR) will be required for construction.
- Lessons learned from the Kūhiō Beach Showers project, and from each following beach shower improvement project, should be passed on to streamline the permitting project for replications across Oʻahu.

REFERENCES

Fukunaga & Associates (2012). Outdoor Shower Assessment Engineering Report. Prepared for CCH DPR.

ACRONYMS

BWS	Board of Water Supply
CCH	City and County of Honolulu
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DLNR	Department of Land and Natural Resources
DPR	Department of Parks and Recreation
ENV	Department of Environmental Services
GIS	Geographic Information System
N/A	Not Applicable
NPR	Non-Potable Reuse
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
UV	Ultraviolet

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

GREEN INFRASTRUCTURE IMPLEMENTATION PLAN

PROJECT CONCEPT

GENERAL DESCRIPTION	The Green Infrastructure Implementation Plan is an islandwide plan for stormwater management. While green infrastructure (GI) is focused on water quality improvement, additional benefits can include reduced flooding, increased infiltration and groundwater recharge, and heat benefits from increased tree canopy and reduced impervious surfaces, depending on the types of green infrastructure proposed. The Green Infrastructure Implementation Plan will include general design guidelines and identification of suitable locations and projects for implementation.
ID #:	109
Timeframe:	Near-term
Champion Agencies:	DFM
Potential Partnerships:	BWS, DPP, CCSR, DTS, DPR
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A



Figure 1. Examples of GI infrastructure types.
Source: City Stormwater Quality Division, Green Stormwater Infrastructure, https://www.honolulu.gov/swq/green-stormwater-infrastructure/

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Source water resources **Wastewater:** WW collection system and WWPSs **Stormwater:** All SW assets **Roads:** Local roads
Community Assets at Risk:	Beaches, parks, schools, low-lying developed areas, flood-prone neighborhoods

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **100-Year Flood:** Green infrastructure across Oʻahu will reduce runoff volume and the impacts of frequent, smaller storms. Peak-flow reduction during major (e.g., 100-year) storm events is more limited and is achievable primarily through regional-scale facilities specifically sized for that purpose. **Extreme Heat:** Green infrastructure that expands tree canopy and replaces impervious surfaces with vegetated or pervious materials (bioretention, green streets, green roofs) lowers localized surface and air temperatures, mitigating the urban heat island effect in developed areas. **Drought:** By promoting infiltration rather than conveying stormwater directly to outfalls, green infrastructure enhances groundwater recharge, supporting aquifer replenishment and long-term water-supply resilience during drier conditions.

PROJECT COMPONENTS

PLAN/STUDY

The Green Infrastructure Implementation Plan will propose low impact development (LID) and GI projects island-wide for improving surface water quality, reducing flooding, and increasing infiltration and groundwater recharge, while looking to improve tree canopy and reduce urban heat. The Green Infrastructure Implementation Plan will follow the approach of the DFM Stormwater Master Plan, with a focus on water quality, including capturing nuisance ponding and increasing infiltration capacity.

Tasks or chapters may include:

1. Green Infrastructure Definition and Targets. The plan will first define GI, identify GI stormwater management strategies (also called best management practices) included in the plan for use, and define targets for GI including the amount of water treated through GI and load reductions. With the goal of distributing projects around Oʻahu, there should also be goals related to the number of projects or investment in each planning region.
2. Identification of Opportunity Locations for GI. The plan will build on hydrologic modeling from the Stormwater Master Plan combined with soil data, existing impervious surface locations, and flooding maps to prioritize opportunity locations for GI.
3. Project Types and Design Guidelines. The plan will include typical design details and other design guidelines for LID and GI to streamline public GI projects and encourage private landowners and developers implementing LID and GI in their projects. This task may be included in the Onsite Stormwater Management Incentives project, depending on the relative timelines. Existing design guidelines that are still relevant should be referenced in the plan rather than duplicated. The plan will also describe typical project types for green infrastructure implementation including green streets, regional projects, and LID for private development or redevelopment, and outline green infrastructure suitable for each type such as pervious pavement materials, rain gardens/bioretention, bioswales, green roofs, and constructed wetlands.
4. Project Identification, Prioritization, and Mapping. The plan will build on Task 2 which identified GI priority areas and begin to conceptualize GI projects in these areas. GI projects can include new projects and planned CIP projects that could potentially incorporate GI. Projects that can mitigate known water quality and flooding challenges will be prioritized, along with projects that offer multi-benefits or upgrade an already planned construction project by adding GI. Prioritization will also weigh social vulnerability, giving added consideration to GI investment in higher-SOVI communities to advance an equitable distribution of benefits. Mapping will present project locations and can visualize modeling of potential flood and water quality improvements of projects.
5. Plan for Project Implementation. This task will include funding, timing, and a workplan for design and implementation of prioritized GI projects.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ? Protects cultural sites
- ? Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☐ Improves public access to community spaces
- ? Increases public awareness/education
- ? Provides ecosystem restoration
- ? Enhances recreational benefits
- ☒ Other: Reduce urban heat, supports groundwater recharge

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported: N/A

OWH Objectives Supported:

- Practice a shared kuleana for a climate resilient Oʻahu
- Work together to leverage resources and enable climate readiness
- Collectively advocate for and pursue funding to support multi-benefit projects

CRO Strategies Supported: **#9**: Integrate climate resilience into City capital planning, operations, and policies

Relevant Adaptation Strategies:

- Incorporate Low Impact Design/Green Infrastructure Stormwater Management Strategies
- Incorporate Green Roof Design

Expected Timeline:

There is a need for this study now, so it should be prioritized in the near-term.

This is a near-term plan that will interact with other near-term plans and programs:

- OWH Project #30 Stormwater Utility Fee
- OWH Project #39 Onsite Stormwater Management Incentives
- OWH Project #165 Stormwater Master Plan

Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Roadway ROWs contain many utilities, including gravity mains for sewer and stormwater. Redesign of these gravity systems will be necessary and may be costly, particularly if new elevations require pump stations and force mains. • Miami experienced lawsuits from homeowners due to the increased flooding experienced on private property along raised roads. Public support and accessibility may be a challenge for roads that will be raised above the grade of homes or properties.
Additional Considerations:	• Green Infrastructure implementation currently lacks a sustained funding source. Implementation of a Stormwater Utility Fee would be a direct funding stream to incentivize the implementation of green infrastructure, although a myriad of alternative funding sources exists. • Long-term operations and maintenance (O&M) is often the limiting factor for GI programs. The plan should identify O&M responsibility and recurring cost, not just capital funding, since distributed GI assets require ongoing upkeep to sustain performance.

REFERENCES

CCH. (n.d.). Green Stormwater Infrastructure. https://www.honolulu.gov/swq/green-stormwater-infrastructure/

City of El Cerrito. (2019). Green Infrastructure Plan. https://www.elcerrito.gov/DocumentCenter/View/12982/City-of-El-Cerrito-Green-Infrastructure-Plan-2019-09-04-Final-Draft

City of Redwood City. (2019). Green Infrastructure Plan. https://www.redwoodcity.org/home/showpublisheddocument/18796/637020675264700000

City of San José. (2019). Green Stormwater Infrastructure Plan. https://sj-admin.s3-us-west-2.amazonaws.com/2019_0900_CityOfSanJose_StormwaterPlan.pdf

County of San Mateo. (2019). Green Infrastructure Plan. https://www.smcsustainability.org/wp-content/uploads/SMC-GI-PLAN-Final_09-17-19-with-Appendices.pdf

ACRONYMS

BWS	Board of Water Supply
CCH	City and County of Honolulu
CCSR	Office of Climate Change, Sustainability and Resiliency
CIP	Capital Improvement Program
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
GI	Green Infrastructure
LID	Low Impact Development
N/A	Not Applicable
n.d.	No Date
O&M	Operations and Maintenance
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
SW	Stormwater
WW	Wastewater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

ONSITE STORMWATER MANAGEMENT INCENTIVES

PROJECT CONCEPT

GENERAL DESCRIPTION	This project aims to create islandwide incentives for private landowners and developers to implement onsite stormwater management. This will create an incentive program for private property owners to increase onsite stormwater management. The goal of this program is to promote depaving and permeable pavement as well as alternative stormwater management such as rain barrels or rain gardens. This program will include the existing Rain Barrel Incentives run by BWS and build on the Follow the Drop application. Benefits of onsite stormwater management include reduction in flood impacts, infiltration and recharge benefits, and improved water quality.
ID #:	39
Timeframe:	Near-term
Champion Agencies:	DFM, DDC
Potential Partnerships:	DTS, BWS, DPP
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Aquifer recharge, potable distribution demand offset by onsite capture and reuse **Wastewater:** WW collection system and pump stations **Stormwater:** All SW assets **Roads:** Local roads
Community Assets at Risk:	Streams, beaches, schools, homes, and commercial properties.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **100-Year Flood:** Green infrastructure and incentivizing onsite stormwater management across O‘ahu will reduce the runoff and impacts from frequent storms as well as reducing the peak flows from major storm events. **Drought:** Onsite stormwater management promotes infiltration rather than conveyance to outfalls, supporting aquifer recharge. Rain barrel and cistern capture additionally offsets potable demand for irrigation and other non-potable uses, building water-supply resilience during drier conditions.

PROJECT COMPONENTS

PLAN/STUDY

Before an onsite stormwater management incentives program can be put in place, a study will need to occur to determine the cost incentives and the format of the program. BWS currently has a rebate program that could be continued or used to reduce the stormwater utility fee charged by detaining and reusing stormwater onsite.

The study will include implementation guidelines that can be used for design or implementation by landowners. The study will also include guidance for low impact development (LID) for large developers including design and implementation guidelines and requirements for submission to receive credit. The study will also evaluate program structures that broaden participation across income levels and tenure types, including tiered rebate levels, direct-install options, and upfront or point-of-sale incentives in place of after-the-fact reimbursement.

PROGRAM

Create an onsite stormwater management incentives program to encourage depaving, permeable pavement, green roofs, rain barrels, and rain gardens on private property. These incentives should be geared towards both residential and commercial properties, and can be tied into the Stormwater Utility Fee, or separate. BWS has an existing rebate program for rain barrel installation. Similar rebates could be created for permeable pavement or rain garden construction, pending a funding mechanism for those programs. In conjunction with a Stormwater Utility Fee, reductions in the utility fee could be the incentive for onsite stormwater management, in addition to one-time rebates.

In addition to the ongoing rain barrel rebates, incentives could be made for depaving and converting to permeable pavers or drought-tolerant landscaping or building a rain garden. This could also include installing green roofing on commercial properties.

This program can leverage the Follow the Drop incentive by DFM, an app primarily used in East Honolulu, that is being expanded island-wide to determine residential runoff needs and appropriate on-site stormwater management. The Follow the Drop app could be used to validate projects receiving a rebate or fee reduction, as well as give residents necessary information to determine potential stormwater management for their property. Large developers will be required to submit more substantial evidence of LID design and implementation to receive credit for stormwater management. Where incentives take the form of an ongoing fee reduction rather than a one-time rebate, the program will define how continued performance is verified, including whether credits require periodic re-certification and the conditions under which a credit lapses.

INFRASTRUCTURE

N/A

Community Benefits:

- ☐ Protects cultural sites
- ? Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☐ Improves public access to community spaces
- ☒ Increases public awareness/education
- ? Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Work together to leverage resources and enable climate readiness Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#2:** Amplify and create capacity for community-led climate adaptation **#7:** Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Onsite Stormwater Management Incentives • Stormwater Utility Fee • Incorporate Low Impact Design/Green Infrastructure Stormwater Management Strategies • Incorporate Green Roof Design
Expected Timeline:	**There is a need for this study now, so it should be prioritized in the near-term.** This is a near-term project and will likely need to be coordinated/interact with the following other projects: • OWH Project #30 Stormwater Utility Fee • OWH Project #109 Green Infrastructure Implementation Plan • OWH Project #165 Stormwater Master Plan
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$100,000-$1M The incentive program itself represents a recurring annual obligation rather than a one-time cost; program scale will depend on the funding available through the Stormwater Utility Fee. *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Stormwater incentives would be strongly supported by implementation of OWH Project #30 Stormwater Utility Fee. While alternative funding sources could be pursued, the stormwater utility fee would be the most direct, creating both a funding stream and incentive.
- This program and the OWH Project #30 Stormwater Utility Fee are mutually dependent, not sequential: the incentive structure requires the Fee as a funding stream and credit mechanism, while the Fee's credit and fee-reduction provisions depend on this program's design. The two efforts require coordinated development rather than one following the other.
- Rebate and credit structures carry inherent equity limitations. Renters cannot modify property and are excluded from participation, and after the fact rebates require upfront capital that low- and fixed-income owners are least able to front. This concentrates benefits among households least in need of them. Landlord-tenant split incentives further suppress participation on rental properties. Program design should address these barriers directly through tiered rebates, direct-install options, targeted outreach in higher-SoVI communities, or upfront incentive structures.

Additional Considerations:

- Rebates or utility fee reductions will need to be determined based on the amount of impervious surface or rainfall captured by a rain garden or rain barrel. These fee reductions will not go down to zero since there will be a minimum fee that will be charged for the program.
- Verification and persistence of installed BMPs is a known failure mode for onsite credit programs. Follow the Drop supports validation at the point of rebate, but ongoing fee reductions presume the BMP remains functional. The program should define re-certification intervals, lapse conditions, and responsibility for confirming continued performance.

REFERENCES

City and County of Honolulu. (n.d.). Green Stormwater Infrastructure. https://www.honolulu.gov/swq/green-stormwater-infrastructure/

Honolulu Board of Water Supply. (n.d.). Residential Rebates. https://www.boardofwatersupply.com/residentialrebates

ACRONYMS

BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DTS	Department of Transportation Services
LID	Low Impact Development
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
SW	Stormwater
WW	Wastewater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

MANAGED RETREAT LEGAL AND POLICY INVESTIGATION STUDY

PROJECT CONCEPT

GENERAL DESCRIPTION	Conduct a study on the legal and policy considerations that the City must examine to evaluate managed retreat in susceptible areas. Considerations will focus on sandy beaches susceptible to coastal erosion and hardened, developed shorelines that may require a range of solutions. This study should assess the jurisdiction and authority of each CCH agency, legal and financing opportunities specific to the City, and differences between retreat for private landowners versus public utilities and facilities. The study should address feasibility of a notice-suspend-retreat path towards managed retreat, considering the role and implications of utility retreat and suspended service in highly impacted areas. This study will build upon the state-level guidance published by the Office of Planning and Sustainable Development (OPSD) and be pursued through case studies from other jurisdictions as well as hypothetical local scenarios. This study should result in recommendations for specific policies the City could enact to enable managed retreat in instances where it may be required as a pathway to adaptation.
ID #:	33
Timeframe:	Near-term
Champion Agencies:	DPP
Potential Partnerships:	UH, CCSR - Content contributions BWS, ENV, DTS - Utility stakeholders/advisory role DLNR, OPSD, Dept. of the Attorney General, HDOT - State coordination
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** All coastal assets **Wastewater:** All coastal assets **Stormwater:** All coastal assets **Roads:** All coastal roads **Beaches:** All beaches
Community Assets at Risk:	All coastal assets.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: HIGH** **Sea Level Rise (Above Ground):** Permanent solution if moved out of the coastal area susceptible to SLR. **Sea Level Rise (Groundwater):** Permanent solution if moved out of the nearshore area susceptible to shallow groundwater rise. **100-Year Flood:** Permanent solution if moved well out of the 100-year flood zone. **Hurricane:** Permanent solution to storm surge if moved out of the hurricane storm surge area, but all areas of the island may be susceptible to hurricane impacts. **Tsunami:** Permanent solution if moved out of the tsunami evacuation zone. The tsunami evacuation zones are more extensive than other flooding hazards, and a managed retreat program would likely only retreat a portion of the tsunami evacuation zone. **Coastal Erosion:** Permanent solution if moved out of nearshore area susceptible to erosion. Restoring developed nearshore property back to natural shoreline or naturalized shoreline (if in an already hardened area) could reduce and slow erosion.

PROJECT COMPONENTS

PLAN/STUDY

Two types of shoreline conditions should be addressed in this study: sandy beaches and hardened shoreline areas. Sandy beaches are imminently affected by sea level rise and coastal erosion, and are a high priority for retreat due to the public trust to protect the beaches and limited alternative options. Sandy beach areas have additional environmental regulations and considerations such as honu breeding grounds. Developed and hardened areas may have significantly more development present, higher development values, and more present infrastructure to consider. In general, hardened areas would be unlikely to retreat unless infrastructure provision became infeasible. Under such a scenario, interim solutions before full retreat is implemented would need to be considered on a reasonable timescale.

Specific strategies should be explored and that have been identified in previous studies including special improvement districts, transfer of development rights, long-term land use planning, and conservation/rolling easements. These general ideas have been described in previous state-level guidance (see Additional Considerations). Case studies from other jurisdictions may also be explored.

Questions that may be addressed:

1. What is the authority of CCH under the current setup and under SB 2401? What jurisdiction does CCH have in questions of managed retreat and what belongs to the State? How does this picture compare to other jurisdictions?
2. What are the Oʻahu-specific components needed to plan for retreat? Who needs to be engaged, and what should the collaboration look like?
3. Can utility retreat and cost to adapt be a driver out of high-risk areas? Why or why not? Are there recent precedents for this?
4. What would need to be considered to create a repeatable template for trigger-based implementation of retreat, understanding timing, precursors, and ramp up times?
5. How could previous studies be translated into Oʻahu-specific guidance and template policy language? How feasible is implementation? For example, is there a need to create a new Special Management Area (SMA), zone, or organization?

Specific tasks or chapters may include:

1. **Existing Authority Assessment**. Study the existing jurisdiction and authority of CCH to implement retreat or buyouts, including financing considerations. Determine the legal basis for suspended utility service. Discuss passage of SB 2401 and the role of State planning agencies for shoreline adaptation.
2. **Zoning Assessment**. Study the land use zones in potential retreat and receiving areas. What changes in zoning would be required to implement a program of retreat or receiving? Recommend ways that permitting could be utilized to reduce high-risk reconstruction to repeated loss areas, flood zones, or areas with significant SLR impacts.

PROJECT COMPONENTS

3. **Policy Templates**. Recommend sample policies and guidance that could be used if a retreat program in CCH were pursued, including trigger-based actions. For example, templates for how to define thresholds, templates for rolling easement policy, etc. would help inform future next steps.
4. **Tabletop Exercises**. Workshops could be run with stakeholders to walk through tabletop scenarios of managed retreat policies. Some examples could include how new zoning laws would impact property-owners in a repetitive loss scenario, what happens to a property if a storm takes out a seawall, and how phasing of utility pipelines in high-risk eroding coastline would impact existing properties.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ? Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☐ Improves water quality
- ? Improves public access to community spaces
- ☒ Increases public awareness/education
- ? Provides ecosystem restoration
- ? Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Develop a unified roadmap and decision-making process under a One Water approach
CRO Strategies Supported:	**#11**: Reduce flood risk and coastal erosion by directing development to safer and higher ground

PROJECT COMPONENTS

Relevant Adaptation Strategies:	• Relocate or Abandon Facility • Conservation or Open Space Easement to Provide Floodable Space • Purchase of Development Rights
Expected Timeline:	This is a near-term study that will likely need to be coordinated/interact with the following other projects: • OWH Project #19 Raise Main Arterials Further Inland (in ʻEwa) • OWH Project #26 Long-Range Post-Retreat Study (in ʻEwa) • OWH Project #35 Road Raising Strategy • OWH Project #53 Coastal Management Plan for Erosion and Flooding (in Koʻolau Poko) • OWH Project #115 Māpunapuna Area Adaptation Plan
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Preliminary Understanding:

Some starting points based on the current understanding of what is within the county's purview related to managed retreat:

- Enforcement including how to deal with non-conforming structures.
- Building Codes & Public Safety. Explore establishing a trigger-based regulatory system, tagging unsafe structures and encouraging homeowners to take protective action before they become a public danger.
- Infrastructure planning. Abandoning or relocating high-risk infrastructure away from susceptible coastlines.
- Role of OPSD in creating shoreline resilience areas or planning regions. Their Regional Shoreline Management Scoping Study from 2023 identifies a process to delineate shoreline management regions.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Ongoing State-level Work:

- There is a state-level report by the Office of Planning and Sustainable Development (OPSD) Coastal Zone Management Program (CZMP) about managed retreat strategies for Hawaii, specifically about eroding sandy beaches. If the state plan goes into action and CCH is designated as having a Beach Resilience Planning Area (BRPA), then CCH may not need additional policy/legal guidance for retreating eroding sandy beaches.
- SB 2401 designates the State Office of Planning and Sustainable Development (OPSD) in a planning and coordinating role to develop shoreline adaptation pathways plans for regional shoreline mitigation districts. This study will need to address its implications of the role of the cities and counties in adaptation planning.

Additional Considerations:

- Sandy beaches susceptible to coastal erosion are a near-term focus due to their imminent threat to loss from erosion, the direct connection to the public trust, and the high cost relative to anticipated payoffs of alternative resilience strategies. Hardened shorelines are also a concern since there is significant development and risk in those areas, and they have to consider resilience strategies in the near-term, between adapt-in-place and retreat.
- There has been precedence that rezoning would not be considered takings, including disallowing building within a beachfront zone (one example is Leone v. County of Maui).

Technical Questions:

While not a focus of the study questions, these questions can provide additional context.

- In addition to policy and legal questions, technical questions exist about how managed retreat could be implemented. Those include:
- Locations and triggers. How would locations that are suitable for managed retreat be determined, and when to implement? Focusing first on sandy beaches and hardened shorelines with industrial development.
- Receiving land. Where could retreated populations move to? Where could increased density or increased residential zoning create ample housing for retreated populations?
- Cost-benefit of adaptation. When is it cost-prohibitive to adapt-in-place? Does this threshold differ between development and shoreline types? When should protection be a first stage before managed retreat? Cost-benefit should consider post-disaster recovery investment and downtime.
- Timing of utility retreat. Determine the timing and triggers necessary for a managed, notice-suspend-retreat strategy. Propose procedures to give long-lead warning of suspended service to property owners, and transparency in the climate-based triggers associated with that notice and the associated retreat.

Additional Examples:

- Examples of retreat in other locations that can be used as guidance or case studies include Miami, Florida; Christchurch, New Zealand; and Lahaina, Hawai‘i.

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ACRONYMS

BRPA	Beach Resilience Planning Area
BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
CZMP	Hawaiʻi Coastal Zone Management Program
DLNR	Department of Land and Natural Resources
DPP	Department of Planning and Permitting
DTS	Department of Transportation Services
ENV	Department of Environmental Services
GIS	Geographic Information System
HDOT	Hawaiʻi Department of Transportation
HRS	Hawaiʻi Revised Statutes
N/A	Not Applicable
OPSD	Office of Planning and Sustainable Development
OWH	One Water Honolulu
SB	Senate Bill
SLR	Sea Level Rise
SMA	Special Management Area
SoVI	Social Vulnerability Index
UH	University of Hawaiʻi

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

EXPAND NON-POTABLE WATER TO LARGE PARKS AND WATER LOSS CONTROL

PROJECT CONCEPT

GENERAL DESCRIPTION	This project reduces potable water use at large City parks and beach parks through two complementary strategies: 1) converting parks to non-potable water (NPW) where a viable system is accessible, and 2) improving irrigation efficiency at parks that are not. Both advance resource conservation, cost savings, and water-supply and drought resilience. DPR is one of BWS's largest potable water customers, and BWS faces source capacity limitations in south Oʻahu following the shutdown of Hālawa Shaft (which provided 10 mgd of potable water) due to the Red Hill fuel releases. BWS is developing supplemental water supply sources, but permitting delays may take a decade or more. Reducing potable demand for parks and recreational areas frees scarce water supply source capacity for drinking water supply. Moreover, R-1 and NPW rates are approximately half of potable water rates, so conversion and efficiency measures would also yield direct cost savings. Key future BWS infrastructure (such as the ʻEwa Reservoir One [ER-1] and a Mililani Pre-Treatment Facility [PTF] Granular Activated Carbon [GAC] facility) will enable full implementation.
ID #:	169
Timeframe:	Near-term
Champion Agencies:	DPR, DDC, BWS
Potential Partnerships:	N/A
Adaptation Strategy Type:	Infrastructure
Location of Project:	Islandwide, with specific parks as noted.
Oʻahu SoVI Index:	N/A

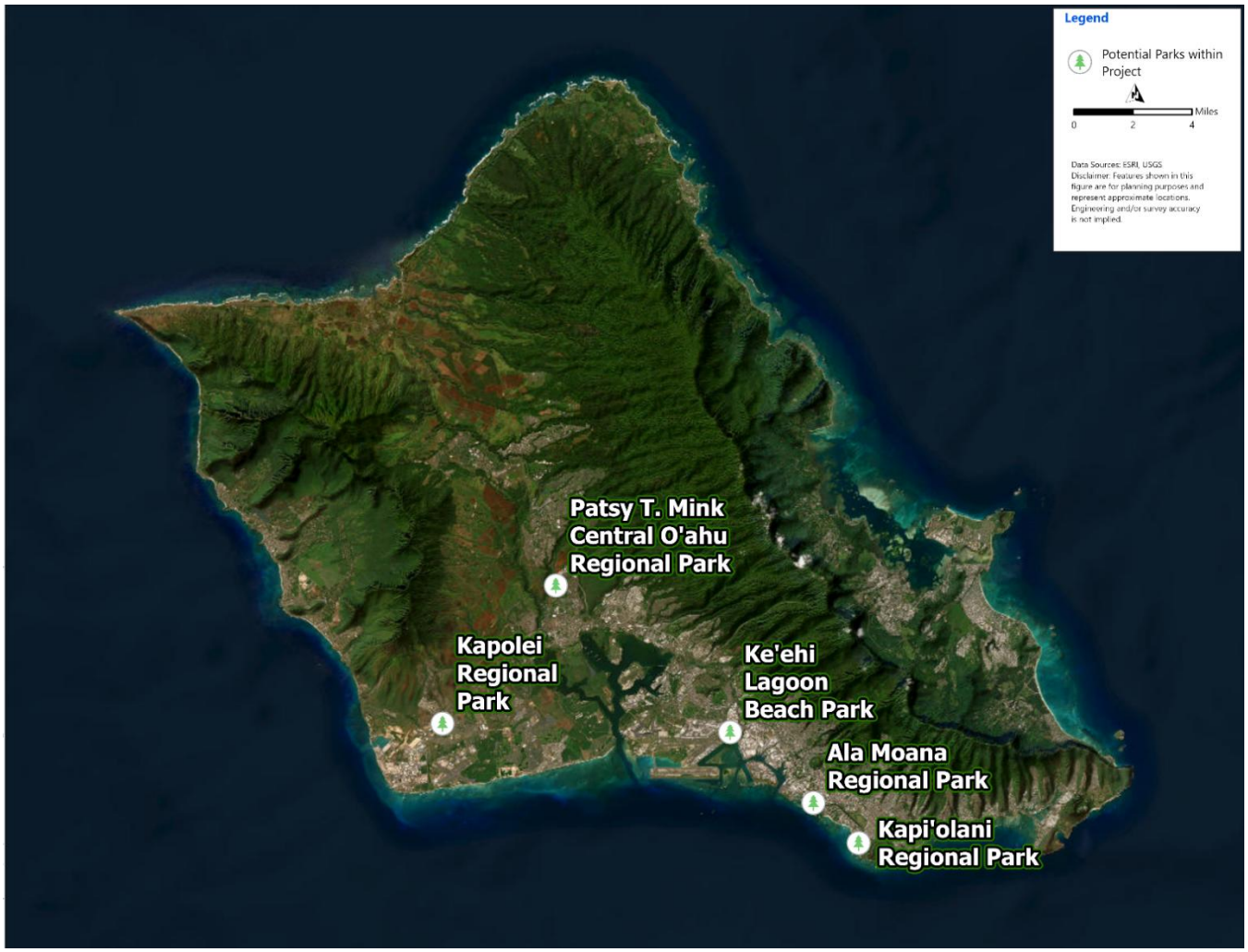


Figure 1. Aerial Map of Oʻahu with Proposed Project Locations



Figure 2. Keʻehi Lagoon Beach Park Proposed NP Service (Courtesy of BWS)

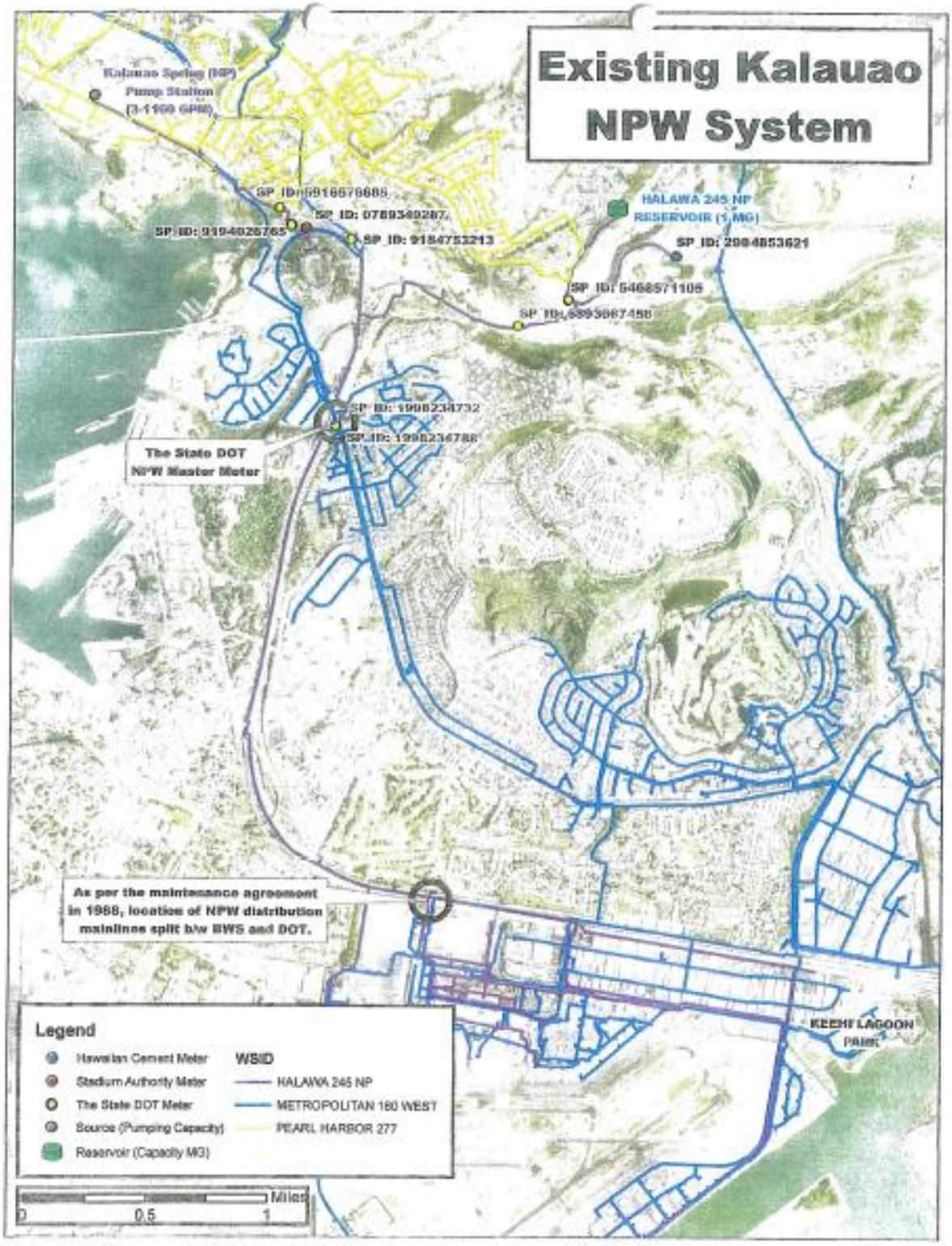


Figure 3. Existing Kalauao NPW System (Courtesy of BWS)

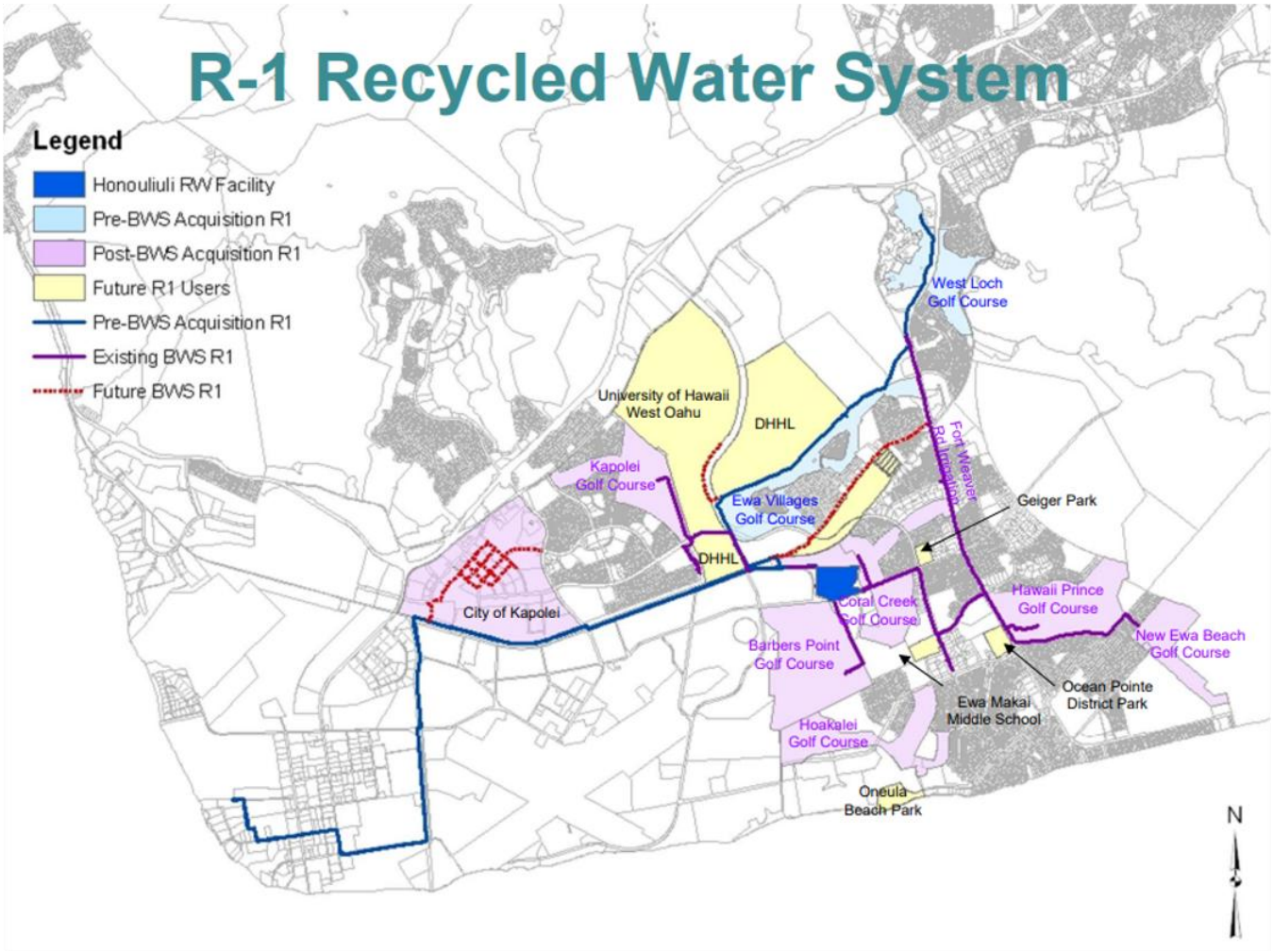


Figure 4. R-1 Recycled Water System. *Source: Recycled Water Use on Oʻahu. (2014). 2nd Annual Joint Government Water Conference. Presented by Barry Usagawa. https://health.hawaii.gov/sdwb/files/2014/09/SessionA-02RecycledWaterUseOahu.pdf*

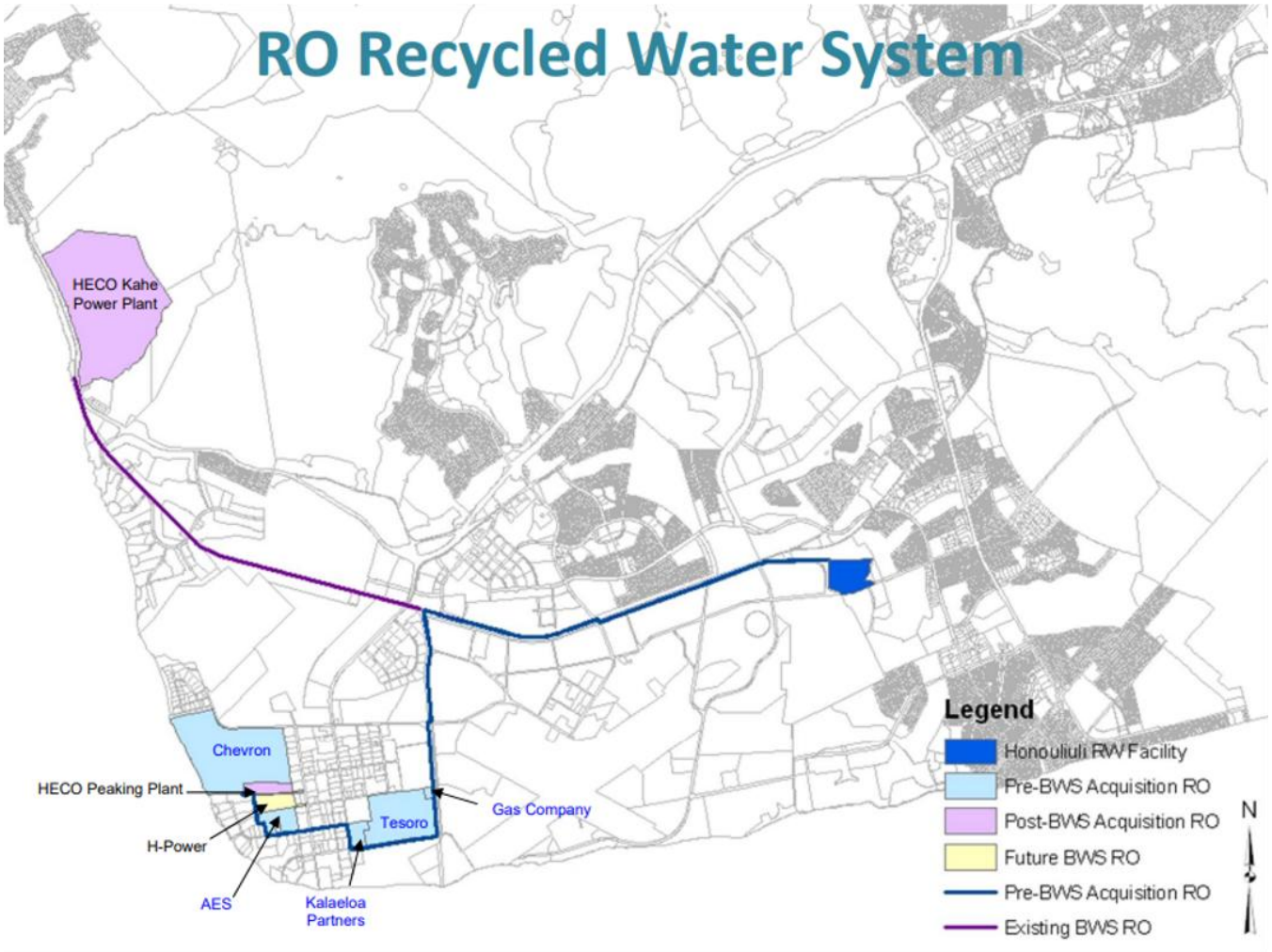


Figure 5. Existing recycled water use in ʻEwa from Honouliuli, with potential users in yellow.
Source: Recycled Water Use on Oʻahu. (2014). 2nd Annual Joint Government Water Conference. Presented by Barry Usagawa. https://health.hawaii.gov/sdwb/files/2014/09/SessionA-02RecycledWaterUseOahu.pdf



Figure 6. Potential Location of a Future GAC Treatment Facility next to an Irrigation Tank at Central Oʻahu Regional Park [CORP] (Google Earth)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Hālawa Shaft (10 mgd, out of service following Red Hill fuel releases); BWS Kalauao Springs non-potable system; BWS Honouliuli recycled water system; potable distribution and irrigation systems serving large City parks. **Wastewater:** N/A **Stormwater:** N/A **Roads:** N/A
Community Assets at Risk:	Large City regional parks and beach parks: Keʻehi Lagoon Beach, Kapolei Regional, Patsy T. Mink Central Oʻahu Regional, Ala Moana Regional, Kapiʻolani Regional, whose recreational value and landscape condition depend on continued irrigation.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-LOW** **Drought:** The primary goal of non-potable reuse for park irrigation is to reduce potable water demands and supply needs, reducing strain on the potable water system and protecting the aesthetic and recreational value of parks with an alternative drought-proof water supply source for irrigation. **Extreme Heat:** Increased heat increases water demand, and filling this demand with non-potable water reduces strain on the potable water supply.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

N/A

INFRASTRUCTURE

This project has two key components:

- Converting large parks to non-potable water where a viable system is accessible

PROJECT COMPONENTS

- Improving irrigation efficiency at parks that are not able to be connected to an NPR system in a cost-effective manner.

Existing conditions:

- The BWS Kalauao Springs NPW system, constructed in the 1990s and extending from Pearlridge to Lagoon Drive, is underutilized despite fronting Keʻehi Lagoon Beach Park (72 acres). The BWS Honouliuli recycled water system, acquired in the early 2000s and since expanded throughout the ʻEwa District, is likewise underutilized. An R-1 meter exists for Kapolei Regional Park (73 acres), but the park is irrigated with potable water until BWS completes the E. Kapolei 215' 3 MG R-1 Reservoir that will provide gravity flow. The R-1 system currently operates on rotating scheduled pumping, usually at night to minimize direct public contact. Central Oʻahu Regional Park [CORP] (269 acres) is currently irrigated with untreated water from BWS Waipiʻo Hts II pump station that contains trace TCP pesticide concentrations too high for drinking but adequate for irrigation and DPR pays NPW rates. Potential R-1 water from Mililani PTF is desired so BWS can realize the full pump capacity for drinking once a granular activated carbon (GAC) treatment facility is installed; DPR is amenable to siting a GAC facility in the park next to their irrigation tank. By contrast, Ala Moana Beach Park (100 acres) and Kapiʻolani Park (300 acres) are not adjacent to any viable non-potable water system.

Proposed actions - conversion components:

- Convert Keʻehi Lagoon Beach Park, Keʻehi Lagoon Memorial Park (State-owned, but same water system as beach park), Kapolei Regional Park, CORP, and other large parks to NPW where an existing or planned NPW system is accessible, coordinating with BWS on the East Kapolei Reservoir and the Mililani PTF GAC facility as enabling infrastructure.

Proposed actions - efficiency components:

At Ala Moana Beach Park and Kapiʻolani Park, conduct leak surveys and repair/replace aging irrigation systems to reduce water loss. BWS Water Sensible Rebate program can develop custom rebates for these improvements based on potable water savings and the BWS Leak Detection Team can offer irrigation-metered water use and leak detection expertise.

Design and Construction:

Keʻehi Lagoon Beach Park:

- Conduct a cross-connection survey to separate any inadvertent interconnections of the irrigation system with the potable systems. Install signage and when irrigation pipes are replaced, install purple pipe or label tape along the entire length of the piping.
- Install a new NPW lateral and meter connection at the Keʻehi Lagoon Beach Park entrance and submeter the Keʻehi Lagoon Memorial Park (State-owned disabled veterans memorial park) and adjust water billing. The Kalauao Spring pipeline on Lagoon Drive fronts the park entrance. Confirm that the RP backflow preventer is operating, and replace as needed. Since the meter is larger than 2 inches, BWS cannot install. DDC should administrate the design and construction of the NPW connection.

PROJECT COMPONENTS

Kapolei Regional Park:

- BWS will open the R-1 lateral valve and reinstall a R-1 meter if it has been removed. DPR needs to reconnect the irrigation system point of connection from the potable meter on Manawai Street to the adjacent R-1 meter before BWS will open the R-1 valve to prevent cross connections. Then BWS will remove the potable irrigation meter. The park was built by a developer and initially irrigated with a brackish non-potable system operated by Campbell Estate. The park was converted to potable in the early 2000's because the brackish well water was getting too salty. BWS subsequently took over the Campbell Kapolei City irrigation system and connected it to the new R-1 system. The brackish groundwater wells located at the State Judiciary Building remain but are not operated.

Patsy T. Mink Central Oʻahu Regional Park:

- CORP is currently irrigated with untreated water from BWS Waipiʻo Hts II pump station on Waipiʻo Uka Street and Kamehameha Hwy that contains trace TCP pesticide concentrations. DPR is amenable to siting a GAC facility for the Waipiʻo Hts II water in the park next to their irrigation tank. The untreated water pipeline from the wells will continue to provide untreated potable water for CORP irrigation. If ENV upgrades Mililani PTF to produce R-1 quality water, a cross country pipeline can be extended across Kipapa Gulch to CORP irrigation tanks under gravity. BWS paid for a new 12-inch pipeline segment across Roosevelt Bridge when DOT renovated the bridge.

Ala Moana Regional Park and Kapiʻolani Regional Park:

- BWS's large master meters contain data loggers that can measure flow rates and set intervals to determine if flows are occurring after the parks have closed. A range of potential leak losses can be determined from the loggers. DPR should install submeters at all major irrigation circuits to determine if water losses are occurring when the irrigation systems are off. Due to frequent vandalism at parks, high tech water loss equipment is not cost effective, so manual water loss surveys may be needed. Leak correlators can be used to locate leaks along with visible wet spots if soils are not very porous. Correlators work well on metallic pipes but have less accuracy on PVC pipes. If select circuits continue to have high water loss as determined by submeter readings, the irrigation circuit may need to be replaced. This can be done in phases. DPR should consider creating a leak detection and repair crew as the cost effectiveness of the staffing and equipment investment could pay for itself as water rates increase and water conservation may defer costly water supply infrastructure projects.
- Consider Asterra satellite leak detection survey that can detect chlorinated water ponding next to distribution systems. BWS uses this system to pinpoint possible points of interest for further ground surveys to locate leaks.

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☐ Improves water quality **?** Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration **?** Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination • Incorporate Shoreline/ Stream Setbacks • Water Conservation and Leak Detection Improvements • Water Loss Control • Source Water Protection • Distribution System Improvements
Expected Timeline:	There is a need for the conversions and water loss reductions now because it is affecting current budgets and the ability to fund more O&M and park improvements. This near-term project will likely need to be coordinated/interact with the following other projects: • OWH Project #4 Honouliuli R-1 Distribution System Expansion

PROJECT COMPONENTS

- OWH Project #67 State Agriculture Water System Connection to Future R-1
- OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study
- OWH Project #90 Stormwater Retention, Recharge, and Reuse in Mauka Lands
- OWH Project #101 Iwilei Area Adaptation Plan
- OWH Project #106 Reuse Strategy for Redevelopment Areas
- OWH Project #115 Māpunapuna Area Adaptation Plan
- OWH Project #122 Adapt Waikīkī Phase 2
- OWH Project #104 Kapālama Canal Linear Park
- OWH Project #155 Ala Wai Golf Course Non-Potable Irrigation Study
- OWH Project #167 Central Oʻahu Water Recycling Facilities, Mililani
- OWH Project #162 NASED Regulatory Requirements for Reuse
- OWH Project #168 Reuse and Potable Water Services for Whitmore Agriculture

Triggers:

Climate Hazard: N/A

Funding: N/A

Regulatory: N/A

Planning Level Cost Estimate:

$10-$100M

Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Short term budget limitations for improvements, with increasingly higher O&M budgets over the long term if no action

Additional Considerations:

Additional Benefits:

- It is assumed that additional park improvements will be prioritized to coincide and benefit from ongoing construction, such as multi-use modal path installation and other recreational benefits.
- Signage and outreach will occur for public awareness around the project areas.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Examples and Guidance:

- Hālawa District Park was converted from potable irrigation to Kalauao Spring NPW in early 2020's

Technical Considerations:

- No EA needed for conversions.
- Cross-connection surveys are essential; recycled-water use must also comply with DOH R-1 use-area restrictions and signage requirements.

REFERENCES

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ACRONYMS

BWS	Board of Water Supply
CORP	Central Oʻahu Regional Park
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DOH	Department of Health
DOT	Department of Transportation
DPR	Department of Parks and Recreation
EA	Environmental Assessment
ENV	Department of Environmental Services
ER-1	ʻEwa Reservoir One
ET	Evapotranspiration
GAC	Granular Activated Carbon
Hts	Heights
MG	Million Gallons
mgd	Million Gallons per Day
N/A	Not Applicable
NASED	New Aloha Stadium Entertainment District
NPR	Non-Potable Reuse
NPW	Non-Potable Water
O&M	Operations and Maintenance
OWH	One Water Honolulu
PVC	Polyvinyl Chloride
R-1	Recycled Water Meeting R-1 Standards
RP	Reduced Pressure
SoVI	Social Vulnerability Index
TCP	1,2,3-Trichloropropane
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

COUNTRY TOWN RESILIENT SIDEWALK & PATH IMPROVEMENTS FOR UNIMPROVED ROADWAYS

PROJECT CONCEPT

GENERAL DESCRIPTION	This near-term project advances a multi-site Complete Streets and water integration program focused on improving pedestrian access and roadway conditions across multiple communities on Oʻahu, including Kamehameha Highway (Haleʻiwa), Kailua roadway corridors, Waiʻanae roadway corridors, Waipahu Street corridor, Wahiawā roadway corridors, Kalihi roadway corridors, and low-lying/local roadway networks within the McCully neighborhood. A complete list of streets is included under infrastructure assets at risk. The program targets communities where sidewalks and safe pedestrian pathways are limited or do not currently exist along with high prevalence of limited or constrained drainage infrastructure, requiring the construction of new sidewalks, shared use paths, and associated roadway improvements. These improvements are integrated with stormwater management considerations since many corridors are within watersheds of concern for both water quality, flooding, and poor drainage. A key component of the program is the integration of permeable pavement and green infrastructure strategies into roadway and walkway improvements. Opportunities for these elements are focused in areas with unimproved roads with no or inadequate stormwater infrastructure, with the goal of reducing impervious surface coverage and improving infiltration to ultimately reduce flooding. The program also includes material pilot applications, including permeable pavement installations, to evaluate performance for those who use bikes and other mobility devices. These pilot efforts are intended to inform scalable implementation of Complete Streets and water integrated design approaches across similar corridors.
ID #:	172
Timeframe:	Near-term

PROJECT CONCEPT

Champion Agencies:	DTS
Potential Partnerships:	DDC, BWS, DPP, DFM, ENV
Adaptation Strategy Type:	Infrastructure
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Water lines **Wastewater:** Sewer mains, sewer laterals, and two submersible sewer pumps on the UH Campus **Stormwater:** Catch basins and stormwater drain lines **Roads:** Kamehameha Highway corridor (Haleʻiwa), Kailua roadway corridors (Kailua Road, Kūʻulei Road, Kalaheo Avenue, and Wanaʻao Road), Waiʻanae roadway corridors (Plantation Road, Mill Street, McArthur Street, and Lualualei Homestead Road), Waipahu Street corridor, Wahiawā roadway corridors (California Avenue and Glen Avenue/Uuku Street), Kalihi roadway corridors (Puʻuhale Road, Palama Street, and Kanoa Street), and the McCully neighborhood roadway network (Algaroba, Waiola, Citron, Malanai, Nanea, Fern, Lokahi, Kuikahi, Hauʻoli, Pumehana, Lime, and Punahou Streets).
Community Assets at Risk:	**Schools:** Schools along Kamehameha Highway in Haleʻiwa, Kailua roadway corridors, Waiʻanae roadway corridors, Waipahu Street corridor, Wahiawā roadway corridors, Kalihi roadway corridors, and low-lying/local roadway networks within the McCully neighborhood that support recreation, community activities, and pedestrian connectivity. **Recreational and Cultural Facilities:** Community centers, cultural facilities, and recreational destinations along Kamehameha Highway in Haleʻiwa, Kailua roadway corridors, Waiʻanae roadway corridors, Waipahu Street corridor, Wahiawā roadway corridors, Kalihi roadway corridors, and low-lying/local roadway networks within the McCully neighborhood.

Parks:

Parks, open spaces, and community gathering areas along Kamehameha Highway in Haleʻiwa, Kailua roadway corridors, Waiʻanae roadway corridors, Waipahu Street corridor, Wahiawā roadway corridors, Kalihi roadway corridors, and low-lying/local roadway networks within the McCully neighborhood that support recreation, community activities, and pedestrian connectivity.

Neighborhoods:

Residential areas along Kamehameha Highway in Haleʻiwa, Kailua roadway corridors, Waiʻanae roadway corridors, Waipahu Street corridor, Wahiawā roadway corridors, Kalihi roadway corridors, and low-lying/local roadway networks within the McCully neighborhood that support recreation, community activities, and pedestrian connectivity.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:

Climate Resilience: MEDIUM

100-Year Storm: Impacts include localized flooding due to limited drainage infrastructure and high impervious surface coverage and ponding and overtopping of roadways and intersections, particularly in low lying areas such as McCully and Date Street, resulting in reduced access to adjacent neighborhoods and community assets. Complete streets would reduce impervious surfaces and runoff, increase stormwater infiltration and detention, and reduce impacts from rainfall events.

Extreme Heat: Heat accumulation within wide paved roadway sections and excess pavement areas contributes to elevated surface temperatures in dense urban areas. Thermal stress on pedestrian and bicycle infrastructure, including sidewalks and bike lanes, reduces usability and comfort in areas with limited shade or vegetative cover. Urban heat effects will be reduced by increased shade structures, tree cover, and green space.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

N/A

INFRASTRUCTURE

Multi-Site Complete Streets Implementation

- Advance roadway and walkway improvements across multiple communities lacking adequate pedestrian infrastructure
- Implement sidewalks, shared use paths, and bicycle facilities to improve access and safety

Stormwater and Water Integration

- Incorporate stormwater management strategies within the corridor to address flooding and water quality concerns
- Integrate drainage elements within constrained right of way conditions across varied corridor types

Permeable Pavement and Material Pilots

- Evaluate excess pavement and hatched areas for potential reduction or conversion to permeable materials to decrease impervious cover
- Assess feasibility of permeable materials within bicycle lanes and other roadway elements to improve infiltration and reduce runoff
- Implement material pilots to test performance and scalability across different site conditions

Depaving and Impervious Surface Reduction

- Identify excess pavement and hatched areas for potential removal or conversion to permeable surfaces
- Reduce runoff volumes and improve infiltration through targeted redesign of underutilized paved areas

Cool Pavement and Future Material Strategies

- Assess opportunities for cool pavement materials in future resurfacing and parking lot projects
- Support long term reduction in surface temperatures and improved thermal comfort within urban corridors

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☐ Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	• Practice a shared kuleana for a climate resilient Oʻahu • Enhance coordination and recognize interconnections to develop and implement projects and strategies
CRO Strategies Supported:	**#6:** Improve watershed health to mitigate wildfire risk and manage flooding **#9:** Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	• UHI Reduction with Enhanced Green Spaces • Mauka stormwater treatment, retention, and infiltration
Expected Timeline:	There is a need for this project now, so it should be prioritized in the near-term.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A

PROJECT COMPONENTS

Planning Level Cost Estimate:	$10M-100M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Coordinating and prioritizing multi-site implementation across diverse communities with varying roadway conditions and infrastructure constraints • Balancing pedestrian safety improvements with integration of permeable materials and stormwater strategies • Retrofitting drainage solutions into corridors with limited existing infrastructure and high impervious surface coverage • Ensuring improvements do not exacerbate existing flooding conditions in areas such as McCully and Date Street
Additional Considerations:	• Limited space within existing right of way to incorporate drainage features, permeable surfaces, and pedestrian infrastructure • Need to integrate stormwater strategies with roadway, bicycle, and pedestrian design elements across varied corridor types • Managing runoff in areas with excess pavement and limited infiltration capacity • Ensuring materials and infrastructure perform under both extreme rainfall and heat conditions • Cost and impact to underground historic resources

REFERENCES

None

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DTS	Department of Transportation Services
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
UH	University of Hawaiʻi
UHI	Urban Heat Island

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

ROAD RAISING STRATEGY

PROJECT CONCEPT

GENERAL DESCRIPTION	There are many coastal City streets and roads on Oʻahu that may be impacted by flooding and coastal erosion due to sea level rise (SLR). This study aims to address potential adaptation strategies such as road raising, relocation, or retreat, when and how to start lifting or otherwise adapting streets, including how to identify triggers for planning and design, how to prioritize and sequence which roads to raise, and how to address impacts to infrastructure in the City street ROW, particularly gravity systems. This study will consider alternatives to road raising and how to determine when alternative adaptations should be used. This study should provide design considerations for roadway elevations, considering regional differences across Oʻahu. Recommendations should be developed in coordination with land use planning efforts, including applicable Development Plans and Special Area Plans, recognizing that roadway adaptation decisions and surrounding land use changes are independent. Transportation considerations should be outlined, such as how to identify critical roadways or emergency corridors. A strategy may be developed with HDOT for coordination with State roadways.
ID #:	35
Timeframe:	Near-term
Champion Agencies:	DDC, DTS, DFM
Potential Partnerships:	BWS, ENV, CCSR, DPP TRB, HDOT
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:

Water: Coastal water pipelines in City ROW

Wastewater: Coastal sewer lines in City ROW

Stormwater: Roadway drainage infrastructure

Roads: Coastal roadways

Community Assets at Risk:

Beach parks, coastal access roads/pathways to beach parks, community spaces, residential, commercial, and government facilities within flood plain.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:

Climate Resilience: MEDIUM-HIGH

Sea Level Rise (Above Ground): Raising roads above SLR inundation is a long-term solution, depending on the raised height of the roadway and depth of SLR. Adaptation would be a permanent solution if the roadway is moved out of the coastal area susceptible to SLR. The goal will be to raise critical roadways above projected SLR inundation over the selected planning horizon. Alternatively, where appropriate, roads and adjacent areas may be able to be protected with shoreline hardening solutions, such as floodwalls/berms/dikes, that benefit areas subject to SLR inundation beyond the road as long as rising groundwater is not present or can be mitigated.

Sea Level Rise (Groundwater): Raising roadways subsurface above groundwater is a long-term solution, depending on the pace and magnitude of sea level rise and groundwater rise. Adaptation would be a permanent solution if roadways are moved out of the nearshore area susceptible to shallow groundwater rise. The goal will be to raise highway subsurface above the high groundwater table. Alternatively, targeted groundwater pumping to reduce groundwater levels may be a solution that could benefit structures along and surrounding the roadways at risk of groundwater inundation.

100-Year Flood: Raising or relocating roadways subject to inundation during a 100-year flood event would provide some benefit related to temporary flooding, but this hazard would not be the trigger to raise roadways due to the inherent occurrence frequency.

Coastal Erosion: Elevating roadways is not a solution for coastal erosion. Coastal erosion may be a primary trigger to adapt a roadway, likely leading to realignment or shoreline hardening as potential adaptations. Adaptation should be a permanent solution if coastal erosion is the primary trigger to adapt a roadway. The goal will be to move the roadway out of the eroding area and to reduce or slow coastal erosion. Coastal erosion could still affect roadways with raised elevation, and without additional regional adaptation to reduce erosion, raising roadways alone would not be sufficient.

PROJECT COMPONENTS

PLAN/STUDY

The plan for future road adaptations under SLR must address the complexity of an interconnected system with differential and changing exposure to flooding and erosion hazards caused by SLR. Major concerns of SLR impacting roadways include three failure mechanisms: 1) road base/sub-base failure due to a high groundwater table, 2) serviceability failure due to standing water overtopping the roadway, and 3) roadway collapse due to coastal erosion.

Elevating roadways may be a solution to flooding hazards while alternative adaptation strategies will be necessary to address coastal erosion. General study for island-wide guidance, including the development of SLR thresholds, design guidelines, and future road planning policies, will be combined with case study application to West Waikīkī. Timelines should be defined to trigger road raising and understand when more comprehensive adaptation strategies may be necessary.

Questions for the study to address:

1. What are typical road elevation strategies that can be applied? What are typical sections of raised roadways, including impacts to gravity pipelines, other buried utilities, adjacent property, sidewalks, and needs for stormwater and/or wastewater pumping?
2. What is the suitability of road raising? How can we determine what locations or situations are suitable for different adaptation strategies (e.g., when to raise vs relocate vs harden vs protect with berms/dikes)?
3. How will these strategies fit into broader community adaptation (e.g., managed retreat, coastal flood protection)? How will raising roads positively or negatively impact surrounding areas? What are alternative adaptation options for roadways that are impacted by coastal erosion or are otherwise not suitable for elevating?
4. What will be the most effective method of collaboration between the state (HDOT), City, and other entities with infrastructure in the ROW subject to SLR/groundwater inundation?
5. How can we apply this guidance to a West Waikīkī case study? Which roads should be prioritized in West Waikīkī? How high does the elevation need to be for West Waikīkī?
6. What land use changes are needed to support each adaptation strategy, and which decisions must be deferred until land use direction is set?

Specific tasks or chapters may include island-wide guidance:

1. **Assess Roadway Susceptibility to SLR**. Include detailed elevation information about the roadway surface and subbase elevation to determine the timing of impacts from overland and groundwater flooding. This assessment could occur island-wide, or within identified hotspots, building on the OWH analysis. When will overland flooding impact the road surface, and when will groundwater rise impact the base/sub-base of the roadway? When will coastal erosion affect the ground supporting the roadway? When and where will a combination of these risks occur? This assessment will inform the prioritization of different areas or stretches of roadway with the highest risk of damage or inundation from SLR. Additionally, roads should be classified by their criticality, particularly if they are access routes, major connectors, or bus routes.

2. **Road Raising Design Guidelines**. Example guidelines for raising roads may include drainage standards and/or typical cross-sections. Study how raised roadways will impact adjacent properties, sidewalks, and connecting roads that are not raised. This analysis will include sample grading studies, looking at how raising one segment will affect adjacent areas ('shedding'), and a drainage plan for sidewalks. Consider impacts to gravity pipelines and other buried infrastructure and provide example design concepts, including pump stations, relocating, or regrading, as necessary. Consider the costs and logistics of impacts to other infrastructure, particularly wastewater and stormwater gravity pipelines, as well as power or communications infrastructure and buildings along/adjacent to the flooded roadways.
3. **Alternative Adaptations**. Consider situations where elevating roadways alone will not be sufficient. Review and consolidate possible adaptation strategies. These strategies may include relocating roads to higher/mauka areas, abandonment, and/or extensive coastal flood protection (e.g., floodwalls/berms/dikes makai of roadways including associated groundwater pumping or dewatering). Determine the characteristics that make an area suitable for each adaptation strategy. Some potential characteristics that could be considered are density of roadways, land use zone, width of land makai of roadway, scale or length of roadway at risk for flooding, and mauka land available for relocation or alternative protection strategies. In addition, coastal erosion hazard may dictate the need for additional hardening measures, as a raised roadway may be above the floodplain but still susceptible to erosion. The potential adaptation strategies should include example implementation guidelines.

In addition, additional tasks will focus on specific application to the West Waikīkī case study:

1. **Embed Road Raising into Broader Adaptation Pathways**. Study how planning for road adaptation intersects with ongoing planning efforts in Waikīkī. These other planning efforts include Adapt Waikīkī 2050, large-scale coastal flood protection efforts, and TOD planning and implementation. Some of these efforts will require increased collaboration with other ongoing adaptations, some may negate the need for road adaptation, and others may enable different types of adaptation. For example, a seawall or levee may negate the need for raising individual roadways.
2. **Assessment of Flooding, Drainage, Topography, and Roadway Exposure**. Utilize existing data and modeling, or incorporate modeling of flooding including the detailed topography and drainage to understand the roadway exposure to flood and SLR in West Waikīkī. The detailed assessment should provide spatial mapping of the existing and future projected depth to groundwater and depth of standing water above ground to inform the triggers and adaptations. Impacts to roadways, infrastructure systems, and adjacent properties should be considered.
3. **Assessment of Future Conditions considering Gravity Systems and Elevated Roadways**. Model the drainage under future conditions assuming the elevated roadways. Study any potential negative impacts on other infrastructure or properties, and any flooding that could be caused or exacerbated by elevating the streets. Understand the impacts to gravity stormwater and wastewater conveyance systems under the roadways, and the functioning of the broader wastewater and stormwater systems, including the potential need for pump stations or additional drainage capacity and infrastructure. This detailed assessment should identify locations where elevating roadways is, or is not, feasible or the preferred solution.
4. **Triggers for Road Raising or Relocation**. Determine road raising triggers. Roads may be categorized into local, major, critical access, and emergency use. Identify SLR levels, inundation frequency, and/or erosion triggers that signify when adaptation planning should begin, and when the road raising may no

longer be sufficient adaptation. In addition, phasing between adapting State roads and City roads should be considered.

5. **Collaboration Structure**. Define the roles of responsible organizations. It will be imperative that there is collaboration with the multiple transportation agencies, as the roadways are an interconnected system that cannot be considered or adapted in isolation. This step will include defining the roles of collaboration and understanding how communication and phasing of interconnected projects can be done across agencies. It is also imperative that wastewater and stormwater infrastructure is central to road raising or relocation feasibility considerations, as those gravity systems may experience impacts, or require additional lift stations, that extend beyond the particular roadways undergoing adaptation. Land use planning coordination is a prerequisite to committing to any specific street adaptation, as decisions to raise, relocate, or abandon a street depend on future land use intended for the surrounding area. Sequencing with other department planning cycles, like DPP, should be defined at the study initiation.

Outcomes of the study may be:

1. Identified target flood elevation triggers for raising roadways, along with a list of priority critical roadways that will require adaptation, including a decision tree (similar to figures shown above),
2. Standard details showing typical sections for raised roads and drainage for lower sidewalks and adjacent properties,
3. Guidance for design within transition zones between adapted and original roadways (similar to figures shown above),
4. Details on feasible adaptation strategies and appropriate roadways for each, including drainage for SW and WW infrastructure.
5. A detailed plan of which streets to raise in West Waikīkī, recommended elevations, and identified triggers for design to begin.

The decision tree will be used to determine the trigger that applies to individual roadways. Sea level rise amounts and roadway elevation will determine the need for adaptation. Additional conditions including groundwater inundation, coastal erosion, feasibility of changes to the affected gravity pipelines, and broader regional adaptations to sea level rise will determine if elevating the roadway is feasible or if alternative adaptations need to be pursued. Similar to the Miami Road Elevation Strategy, the outcomes will include a road elevation policy for local, major, critical access, and emergency roads, along with 3 methods of elevation design criteria: (1) level of service, (2) road base elevations, and (3) private property harmonization.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ? Increases community flood protection ☐ Improves water quality ☒ Improves public access to community spaces ? Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies
CRO Strategies Supported:	**#11**: Reduce flood risk and coastal erosion by directing development to safer and higher ground
Relevant Adaptation Strategies:	• Relocate or Abandon Facility • Elevate Access Road and Associated Utilities • Incorporate Groundwater Seepage Barrier • Public Infrastructure Services Adaptation Phasing Study for Permanent SLR Flooding • Stabilize Roadbeds and Protect Roadbed Integrity • Resilient Roadway Design Guidelines • Pilot Study on the Use of an Adaptive Design Process (for Highways) • Adapting Infrastructure for SLR

PROJECT COMPONENTS

EXAMPLES

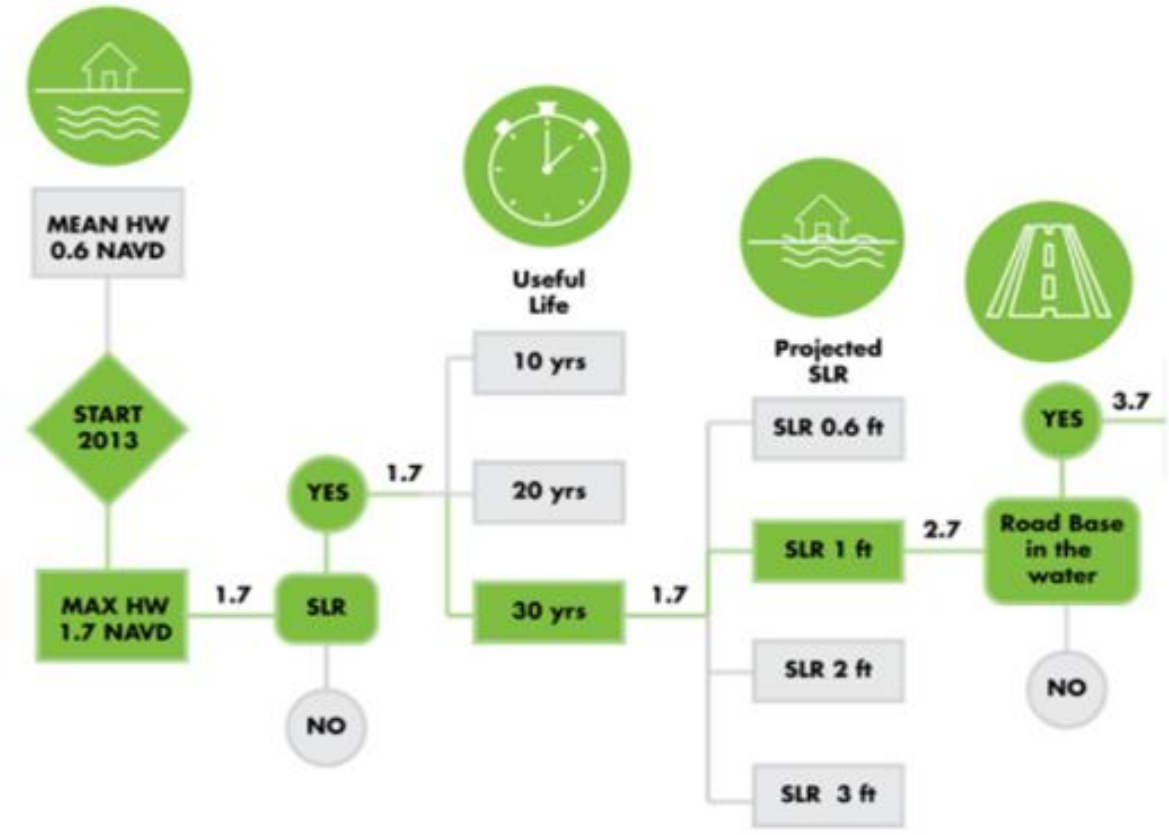


Figure 1. Example Road Elevation Decision Tree: City of Miami Beach 2013 Road Elevation Policy Decision Tree

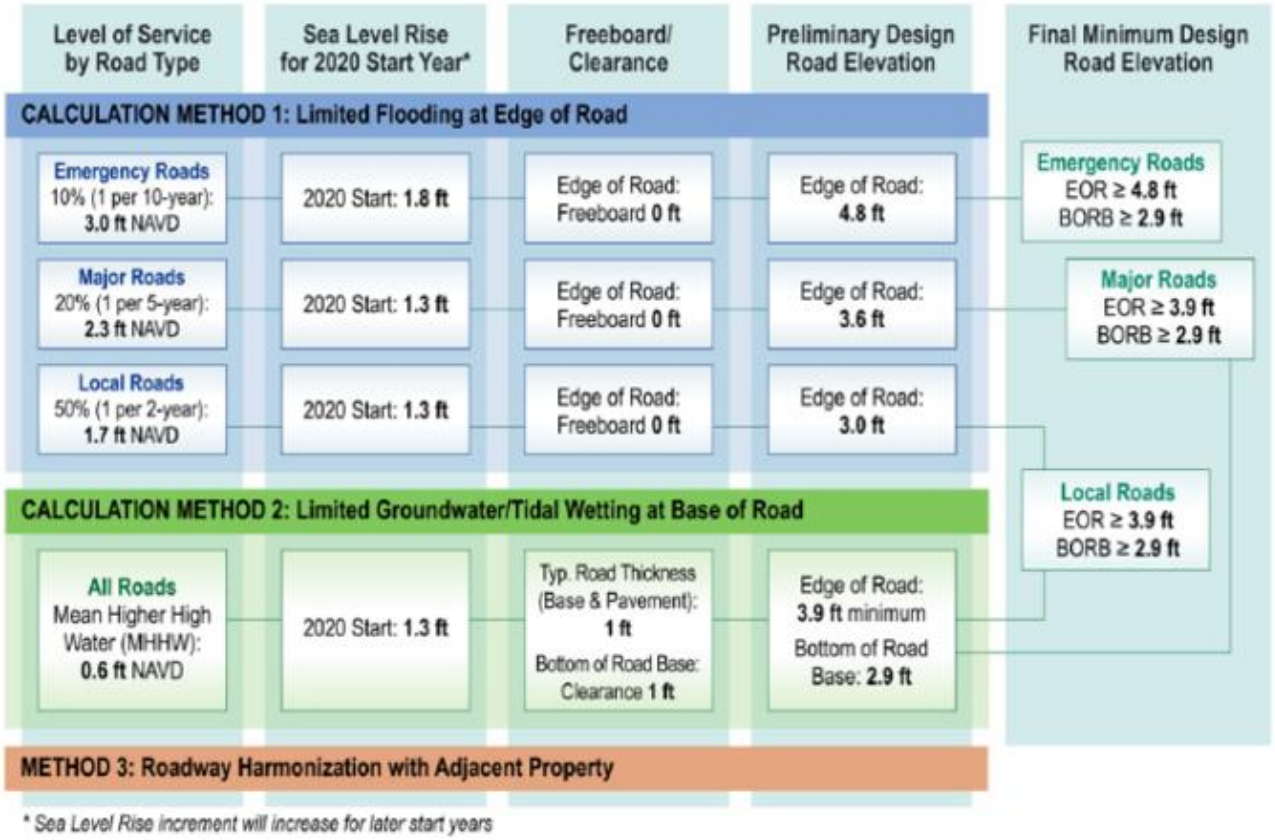


Figure 2. Example Road Design Elevation Policy Summary Chart

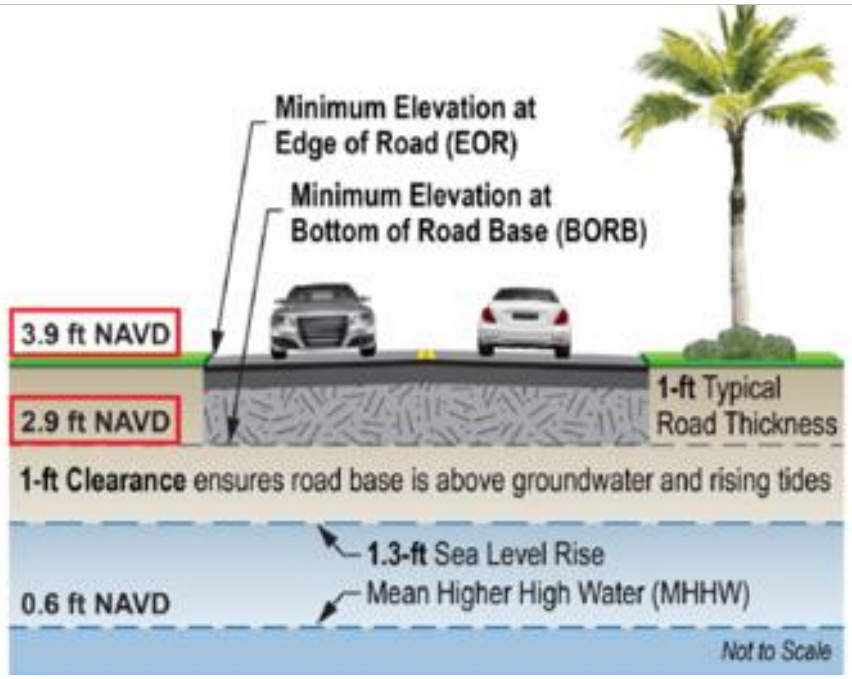


Figure 3. Example Profile Schematic for Road Design Elevation

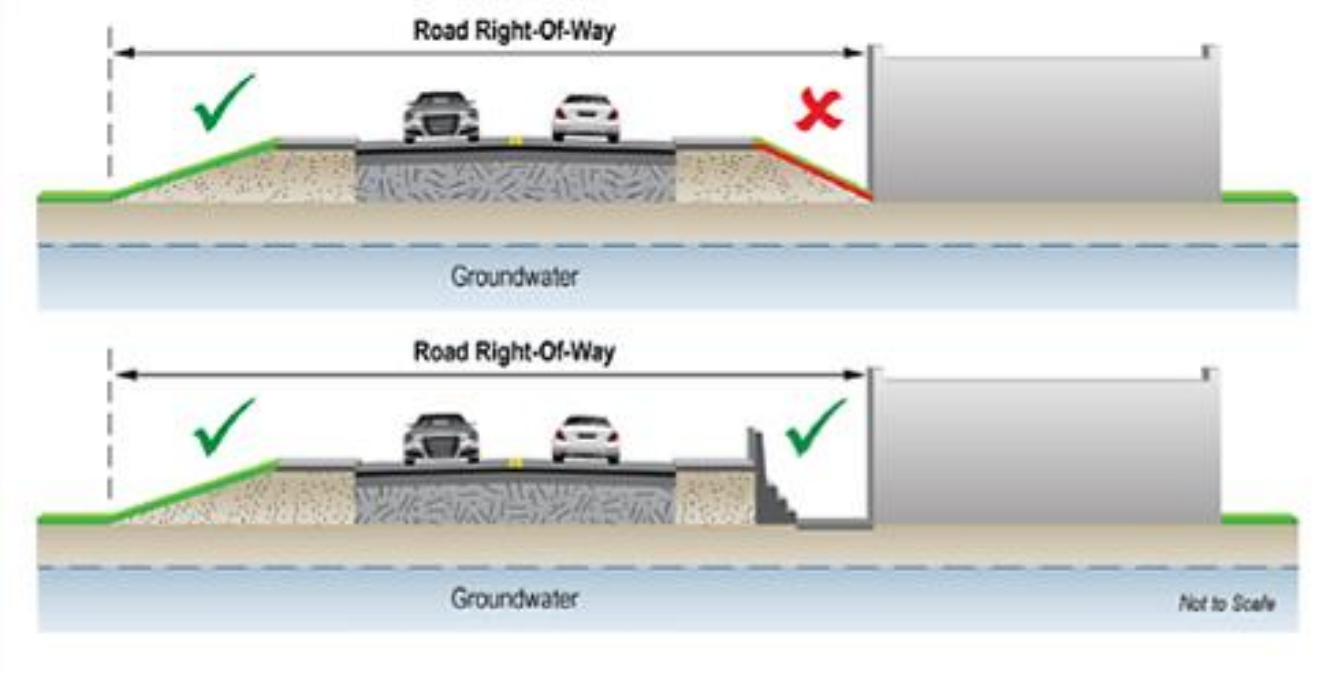


Figure 4. Example Profile Schematic for Elevated Road Design Connection to Adjacent Commercial Property

Figures from the Miami Beach Integrated Water Management Road Elevation Strategy and Recommended Sea Level Rise/Tidal Flood Adaptation Projects (Jacobs, 2020) to illustrate potential project outcomes of the Road Raising Strategy.

Expected Timeline:	**There is a need for this study now, so it should be prioritized in the near-term.** This study can be informed by the OWH Project #33 Managed Retreat Legal and Policy Investigation Study or they can be completed in parallel. There will be some overlap in road adaptation and managed retreat strategies, but many road adaptation strategies can be defined independent of retreat. In cases where a roadway must be relocated and there is additional eminent domain or other pathways to land acquisition, the plan for raising roadways can be informed by the managed retreat study. This study can also be informed by the Adaptation Pathways Pilot Project looking at Road Raising for Ala Wai Boulevard. This is a near-term study that will inform many future plans and projects and will likely need to be coordinated/interact with other projects: • OWH Project #19 Raise Main Arterials Further Inland • OWH Project #26 Long-Range Post-Retreat Study • OWH Project #33 Managed Retreat Legal and Policy Investigation Study • OWH Project #60 Resilience Corridor and Pedestrian Accessibility Study • OWH Project #105 Resilience Corridors and Road Raising • OWH Project #101 Iwilei Area Adaptation Plan • OWH Project #103 Iwilei Drainage Improvements • OWH Project #110 Māpunapuna Flood Improvements • OWH Project #115 Māpunapuna Area Adaptation Plan • OWH Project #122 Adapt Waikīkī Phase 2
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Roadway ROWs contain many utilities, including gravity mains for sewer and stormwater. Redesign of these gravity systems will be necessary and may be costly, particularly if new elevations require pump stations and force mains.
- Miami experienced lawsuits from homeowners due to the increased flooding experienced on private property along raised roads. Public support and accessibility may be a challenge for roads that will be raised above the grade of homes or properties.

Additional Considerations:

Additional Components:

- Potential to propose resilient street design guidelines, particularly for new roadway construction and having design elevations that account for SLR, shallow groundwater rise, and coastal erosion.
- Explore tools such as improvement districts, cost-sharing mechanisms, and incentives or rebates for affected private property interfaces. Adaptation will likely require easements and cause impacts to private properties.

Examples and Guidance:

- Based on the case study of Honoapiʻilani Highway on Maui, it is possible that the state (HDOT) will prefer highway realignment over raising the roadway. This choice may be more resilient long-term, as moving mauka reduces the exposure to multiple hazards and eliminates concern over groundwater rise and erosion, which could still impact raised roadways.
- This plan should build on the HDOT state-level guidance. HDOT State Guidance has assessed the vulnerable stretches of state highway with regard to multiple climate hazards. They have also compiled state, federal, and local guidance regarding climate change in Hawaiʻi. This guidance does not specify adaptation strategies such as raising or relocating roadways and associated access roads and/or adjacent properties.
- This plan will also be consistent with DDC's Climate Change Design Guidelines, which outline potential adaptation strategies to address sea level rise and coastal flooding. Based on project cost, criticality, and exposure, various levels of vulnerability assessment are required, and adaptation strategies should be considered for every project. Road raising is one of the listed adaptation strategies within the Guidelines.

Technical Considerations:

- Feasibility of shallow groundwater mitigation actions on a large scale (e.g., stretch of coastline): Is groundwater pumping feasible or cost prohibitive as a long-term solution?

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- A regional coastal protection measure for inundation may eliminate the piecemeal approach of adapting individual assets and stretches of roadway. Large-scale coastal flood protection infrastructure projects will need to inform the necessary road adaptations.

REFERENCES

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ACRONYMS

BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
City	City and County of Honolulu
CRO	Climate Ready Oʻahu
DDC	Department of Design And Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPP TRB	Department of Planning and Permitting Traffic Review Branch
DTS	Department of Transportation Services
ENV	Department of Environmental Services
FEMA	Federal Emergency Management Agency
HDOT	Hawaiʻi Department of Transportation
N/A	Not Applicable
OWH	One Water Honolulu
ROW	Right-of-Way
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
TOD	Transit-Oriented Development
WW	Wastewater
yrs	Years

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

WAIMĀNALO EFFLUENT R-1 REUSE FEASIBILITY STUDY

PROJECT CONCEPT

GENERAL DESCRIPTION

The current Waimānalo Wastewater Treatment Plant (WWTP) produces an average of about 0.75 mgd of treated wastewater effluent. The Waimānalo WWTP currently does not produce recycled (also known as reuse) water. The Waimānalo WWTP currently uses injection wells for effluent disposal. However, the existing disposal method may be ruled by the State of Hawai'i Department of Health (DOH) as functionally equivalent to an unallowable point source discharge, rendering it an infeasible disposal option. To address this concern, the Department of Environmental Services (ENV) is considering modifications to the treatment capabilities at the Waimānalo WWTP which would allow at least some portion of the effluent to be reused elsewhere instead of being disposed of onsite. Expanding water reuse will help increase water supply resilience for the Waimānalo area and reduce the use of injection wells for wastewater effluent disposal.

Reuse water is classified into R-1, R-2, or R-3 quality based on the level of treatment done before use. This project will focus on treating the Waimānalo WWTP effluent to R-1 quality, which is the highest quality of the three categories. To produce R-1 water, the effluent must go through oxidation, filtration, and disinfection steps that reduce turbidity and pathogens to the extent that the water can be used for agricultural and/or recreational landscape irrigation. Should there be a sufficient user base for the recycled water, the production of R-1 water at the Waimānalo WWTP would reduce the need for injection well disposal and decrease demand for potable water supplied from the Honolulu Board of Water Supply (BWS). Additionally, this would support preservation of the streams and other water sources, which are valued natural resource in the area. The State currently provides water to farmers from the Maunawili Ditch, whose source is high-level water tunnels, springs, and streams in Maunawili and Waimānalo Valley. This project will allow irrigation demand to be met at least partially with R-1 water rather than water diverted from the sources that supply the Maunawili Ditch.

Waimānalo consists of primarily residential and agricultural water users. The area has a golf course and a large number of Agricultural Lands of Importance to the State of Hawai'i (ALISH), which may be good candidates

PROJECT CONCEPT

for utilizing recycled water and improving water resilience. The construction of R-1 recycled water pipelines within roadways may also offer an opportunity for utilities to perform inspections and/or upgrades of buried infrastructure at the same time. In addition to infrastructure improvements, this project will help to spread awareness of recycled water as an irrigation source and help inform the community of the challenges that both BWS and ENV face when trying to maintain potable water and wastewater services with a changing climate.

Currently, the ongoing ENV Kahuku, Paʻalaʻa Kai, and Waimānalo Facility Plans (KPKW) project produced a KPKW Waimānalo Effluent Reuse Feasibility 30% Report (BC, 2025) that serves as a feasibility study to inform the infrastructure improvements required for this project. Although not complete and subject to change, this 30% report identified potential WWTP upgrades required to produce R-1 water and a number of potential R-1 users. At the Waimānalo WWTP, a new disinfection system using UV or chlorine would be required and other ancillary improvements at the WWTP or offsite may be required, including a process to reduce effluent sodium, a backup disposal system, a 431,000 gallon R-1 storage tank, and equipment for each user to pressurize their own systems (BC, 2025). In addition to infrastructure improvements required to produce R-1 water, the 30% report identified ten potential R-1 users who collectively own over 1,000 acres of cropland that use on average over 200 kilogallons of potable water per day. The location of these parcels is provided in the figure below. Four of the ten potential users expressed interest in using R-1 water for irrigation. A new distribution pipeline system to provide those four users R-1 water will be an estimated 16,200 linear feet using the potential alignment shown below (BC, 2025).

This project encompasses the completion of the KPKW Waimānalo Effluent Reuse Feasibility assessment in the near term and the design, construction, and implementation of the assessment's proposed strategies and infrastructure improvements in the long term.

ID #:	75
Timeframe:	Near-term
Champion Agencies:	ENV

PROJECT CONCEPT

Potential Partnerships:	CCH: BWS, DPR, DTS State: HDOT, DOH, DAB, DHHL, University of Hawaiʻi Others: Private landowners, agricultural businesses Any entity that owns/manages a large plot of land suitable for R-1 irrigation may be involved as a user/stakeholder and must commit in some capacity to being a user in order for this project to be feasible. The list of City and State agencies listed is not exhaustive, but these groups have been identified as owners of parcels that may be suitable R-1 users.
Adaptation Strategy Type:	Plan/Study (and Infrastructure mid-term)
Location of Project:	Waimānalo, Koolau Poko
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Waimānalo Beach, Waimānalo near Olomana Golf Course
Congressional District:	2
Council District:	III
Legislative District:	House District 51
Neighborhood Board:	Waimānalo Subdistricts 7, 8, 10
Oʻahu SoVI Index:	High



Figure 1. Satellite view of Waimānalo

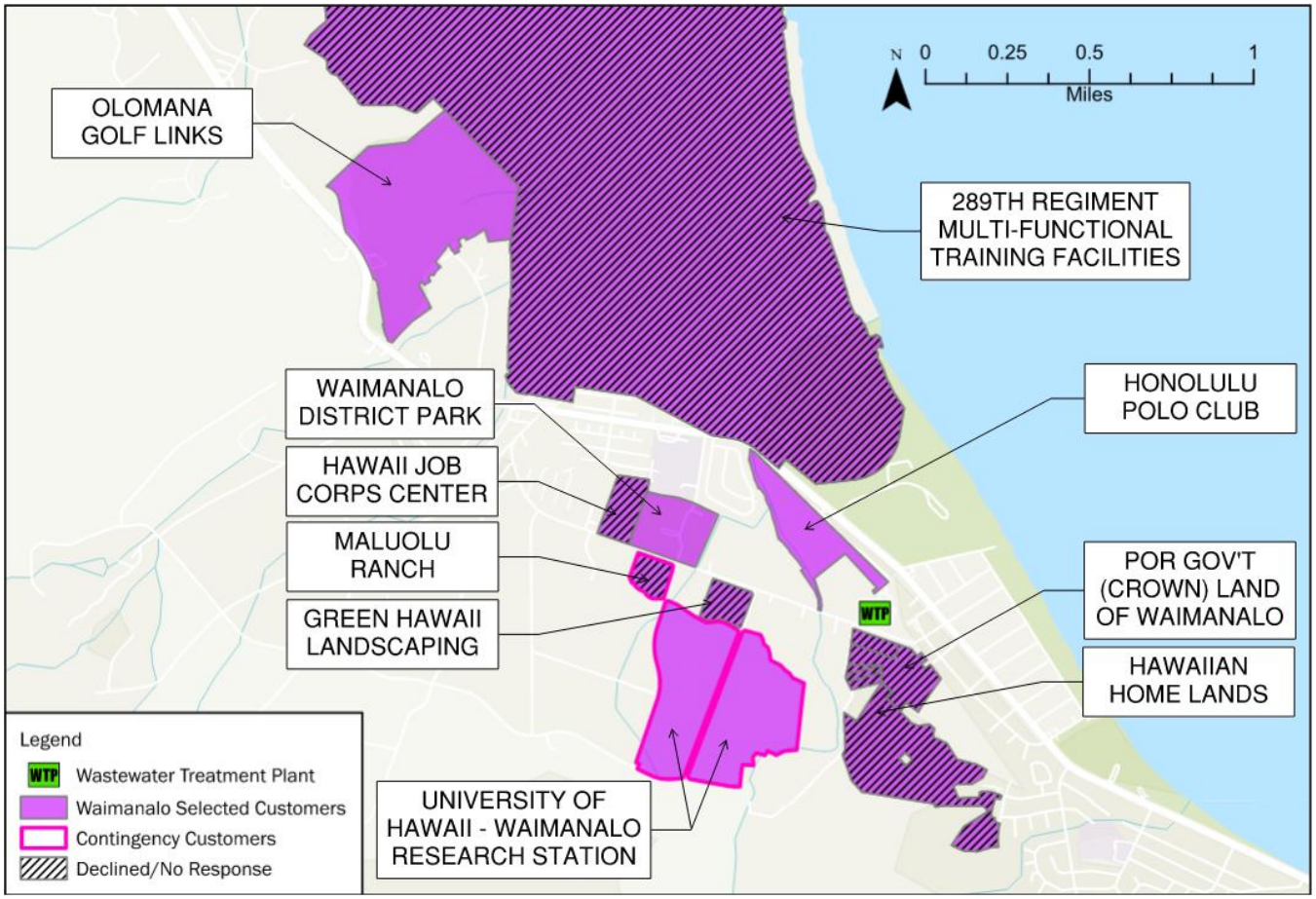


Figure 2. Map of potential end users identified. (Source: KPKW Waimānalo Effluent Reuse Feasibility 30% Report (BC, 2025))

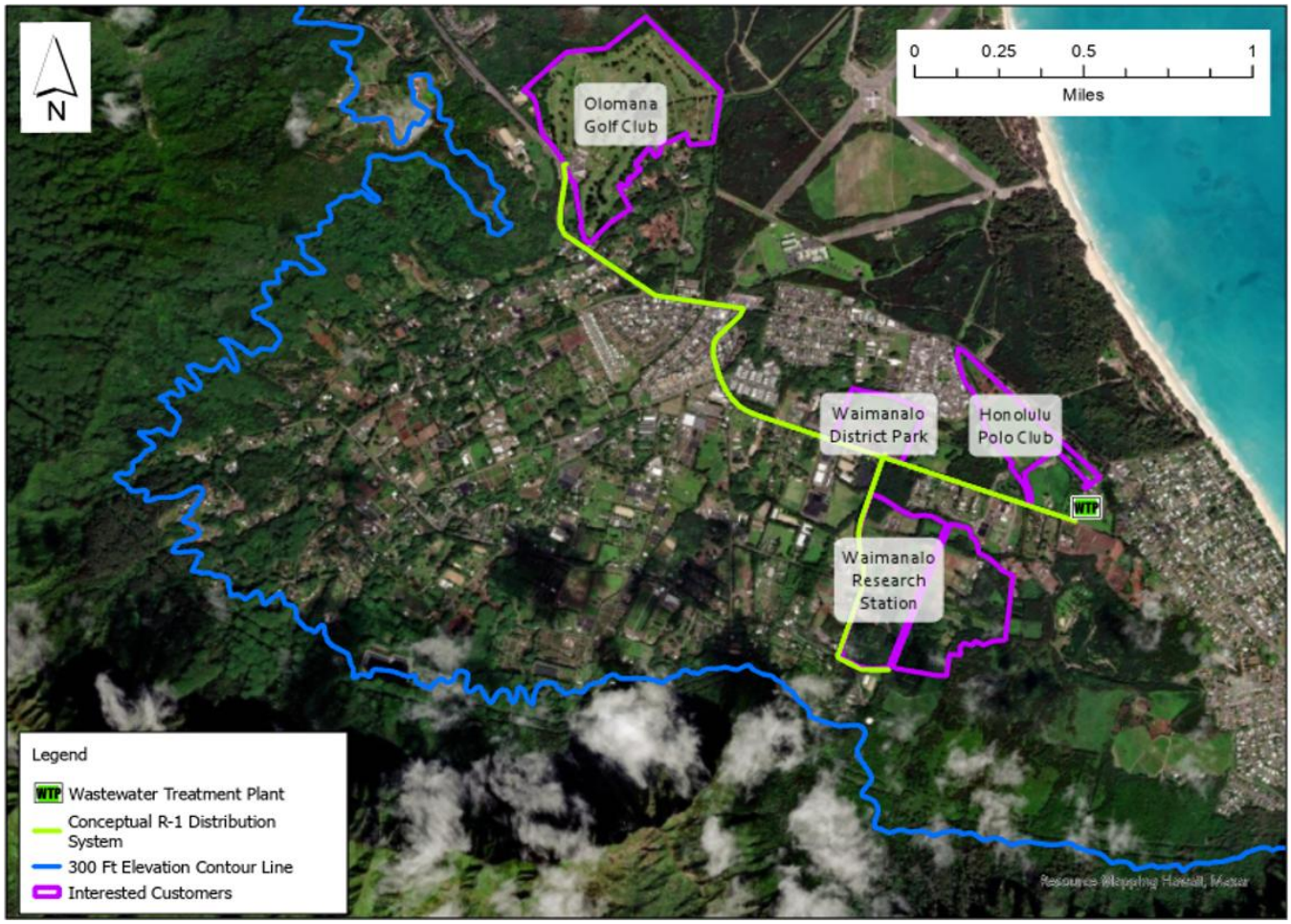


Figure 3. Potential distribution alignment for four interested R-1 users. (Source: KPKW Waimānalo Effluent Reuse Feasibility 30% Report (BC, 2025))

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Sources, distribution system (piped and ditch systems) **Wastewater:** Treatment plant, pump station, pipelines are not necessarily at risk from drought, but are heavily impacted by this project **Stormwater:** Streams, channels **Roads:** Kalaniana‘ole Highway, Ahiki Street are not necessarily at risk from drought, but are impacted by long-term infrastructure improvements
Community Assets at Risk:	Waimānalo Fire Station 27, Waimānalo Health Clinic, Waimānalo Elementary and Intermediate Public School, Blanche Pope Elementary School, Hūnānāniho Beach Park, Waimānalo Beach Park, Waimānalo District Park, Kaiona Beach Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Drought:** The Waimānalo area has a low risk from drought. However, water supply is a concern for this area and the lack of sufficient BWS sources requires imported water to serve Waimānalo customers. R-1 reuse and distribution will reduce the potable water needs for irrigation. **Extreme Heat:** Increased heat increases water demand, which places a strain on limited water resources. Non-potable water use will reduce the demand on the potable water system.

PROJECT COMPONENTS

PLAN/STUDY

There is the KPKW Waimānalo Effluent Reuse Feasibility R-1 reuse feasibility assessment as part of current ENV Kahuku, Pa‘ala‘a Kai, and Waimānalo Facility Plans project, and this assessment will be completed in the near-term to inform infrastructure improvements in the long term.

PROGRAM

N/A

INFRASTRUCTURE

In the mid-term, there is anticipated to be construction of R-1 recycled water infrastructure to produce and distribute R-1 irrigation water to users in the Waimānalo and potentially Kailua areas as part of a separate project. This infrastructure would allow ENV to reduce the use of injection wells for effluent disposal and reduce the potable water demand on BWS sources that serve agricultural users. There is the opportunity to collaborate with the State by connecting R-1 system to State Waimānalo Irrigation System (UH CTAHR and DOA), which is discussed in OWH Project #67 State Waimānalo Irrigation System Connection to Future R-1 System.

Community Benefits:

- ? Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- ☐ Improves water quality
- ☐ Improves public access to community spaces
- ☒ Increases public awareness/education
- ? Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:

Respect and support Native Hawaiian culture and traditional practices reliant on healthy land and water resources

Improve water supply resilience for local community use

Improve water quality and flood mitigation

PROJECT COMPONENTS

OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse • Stream restoration
Expected Timeline:	Near-term: Completion of KPKW Waimānalo Effluent Reuse Feasibility assessment, DOH deadline that mandates reduced usage of injection wells. Mid-term: Establish agreements for a sufficient number of R-1 users. Then planning, design, construction of R-1 treatment and distribution infrastructure.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• DOH is a driver for ENV to consider reuse. It is not guaranteed that DOH will renew injection well permits in future due to potential environmental and human health impacts of injection well use. • R-1 water is not a perfect substitute for potable water. Recycled water adds nutrients to the soil when used for irrigation. The pricing of R-1 water may not be competitive with potable water options.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Per the KPKW Waimānalo Effluent Reuse Feasibility 30% Report (BC, 2025), potential users who were interviewed cited costs as a significant factor when considering a switch to R-1. Costs of R-1 water would have to be competitive with BWS and Waimānalo Irrigation System rates to make it financially viable to switch. At this time, there are concerns that the R-1 water would be too costly.

Additional Considerations:

- The Waimānalo area relies on imported potable water. Water supply issues arose in the past when Maunawili Ditch was damaged.
- Reuse would help to replace a portion of the water that currently is diverted from Maunawili Stream, improving streamflow and preservation of the stream.
- There is potential for R-1 usage in the Kailua-Kāneʻohe wastewater basin if pipeline from Waimānalo WWTP is constructed. It may be necessary if there is an insufficient user base in the Waimānalo area.
- Existing infrastructure is threatened by sea level rise, and the City would need to be strategic about upgrading systems that have an elevated risk of climate hazard impacts.
- It is unclear if ENV, BWS, or another entity would own or maintain the R-1 system. BWS and ENV have begun collaboration on reuse projects and infrastructure on the Leeward side.
- Upgrades to the Waimānalo WWTP will be necessary to bring R-1 water to DOH quality requirements. This project factors in the WWTP upgrade as well as the new distribution system. As of now, the KPKW Waimānalo Effluent Reuse Feasibility 30% Report (BC, 2025) is still in development and the proposed upgrades and distribution system alignment are preliminary and subject to change.

REFERENCES

Brown and Caldwell. (2025). KPKW Waimānalo Effluent Reuse Feasibility 30% Report for ENV.

One Water Honolulu. (January 2026). Project Development Workshops.

ACRONYMS

ALISH	Agricultural Lands of Importance to the State of Hawai‘i
BWS	Board of Water Supply
CCH	City and County of Honolulu
CRO	Climate Ready O‘ahu
DHHL	Department of Hawaiian Home Lands
DAB	Department of Agriculture and Biosecurity
DOH	Department of Health
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
ENV	Department of Environmental Services
HDOT	Hawai‘i Department of Transportation
KPKW	Kahuku, Pa‘ala‘a Kai, and Waimānalo Facility Plans
MBR	Membrane Bioreactor
mgd	Million Gallons per Day
N/A	Not Applicable
NPW	Non-Potable Water
OWH	One Water Honolulu
R-1	Recycled Water Meeting R-1 Standards
R-2	Recycled Water Meeting R-2 Standards
R-3	Recycled Water Meeting R-3 Standards
SoVI	Social Vulnerability Index
UH	University of Hawai‘i
UH CTAHR	University of Hawai‘i College of Tropical Agriculture and Human Resources
UV	Ultraviolet
WRF	Water Recycling Facility
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

NUʻUANU RESERVOIR HYDRO MANAGED AQUIFER RECHARGE

PROJECT CONCEPT

GENERAL DESCRIPTION	The Nuʻuanu Reservoir Hydroelectric and Managed Aquifer Recharge Facility aims to divert impounded surface water from Nuʻuanu Reservoir #4 through pre-treatment and a hydroelectric power generation facility to injection wells for increased groundwater recharge. The focuses of this project are sustainable water management and renewable energy generation. Source water for the project is drawn from the existing reservoir impoundment, so the project does not divert flows from the municipal stormwater collection system. As described by the project proponent: "The Project proposes diversion of surface water runoff into an existing reservoir in the Nuʻuanu Valley to increase recharge of the groundwater supply for drinking water while also generating renewable hydroelectric energy. This project will help enhance the island's irreplaceable groundwater resource, meet statewide water sustainability and renewable energy goals, while improving dam safety and flood control at the Nuʻuanu reservoirs." (PBR HAWAIʻI, 2023). Two main alternatives have been proposed, differing in energy generation capacity and pipeline length. Both alternatives include pre-treatment, power generation, and injection wells. Currently, the project is undergoing Preliminary Design and Environmental Assessment. The next steps for the project are Design, Permitting, and Construction.
ID #:	163
Timeframe:	Near-term
Champion Agencies:	BWS
Potential Partnerships:	HECO, DOH, DLNR CWRM, DFM
Adaptation Strategy Type:	Infrastructure

PROJECT CONCEPT

Location of Project:	Nuʻuanu, PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Included based on discussion with OWH Panel
Congressional District:	1
Council District:	VI
Legislative District:	House District 27
Neighborhood Board:	Nuʻuanu-Punchbowl
Oʻahu SoVI Index:	Medium

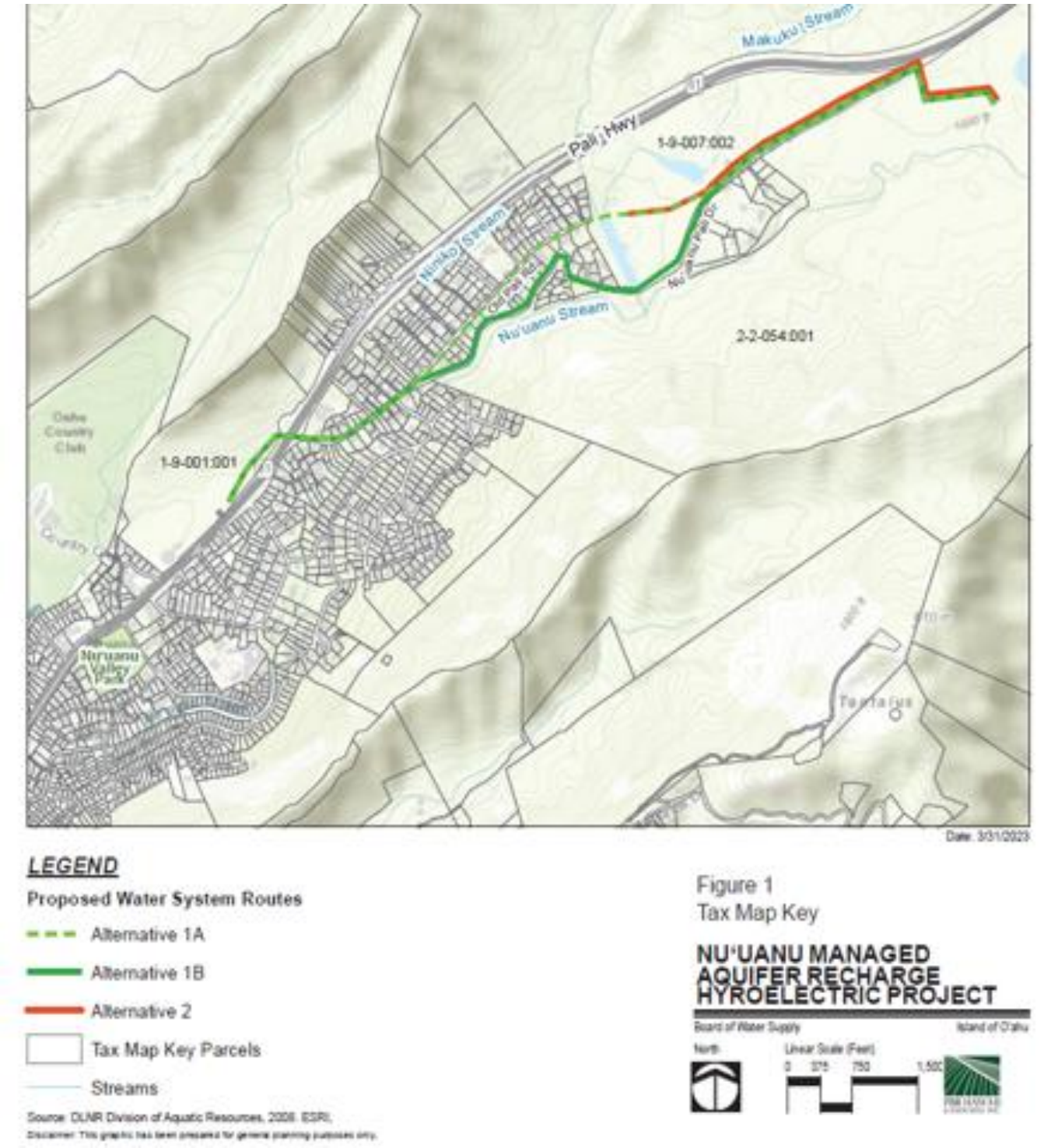


Figure 1. TMK map for Nuʻuanu Managed Aquifer Recharge Hydroelectric Project

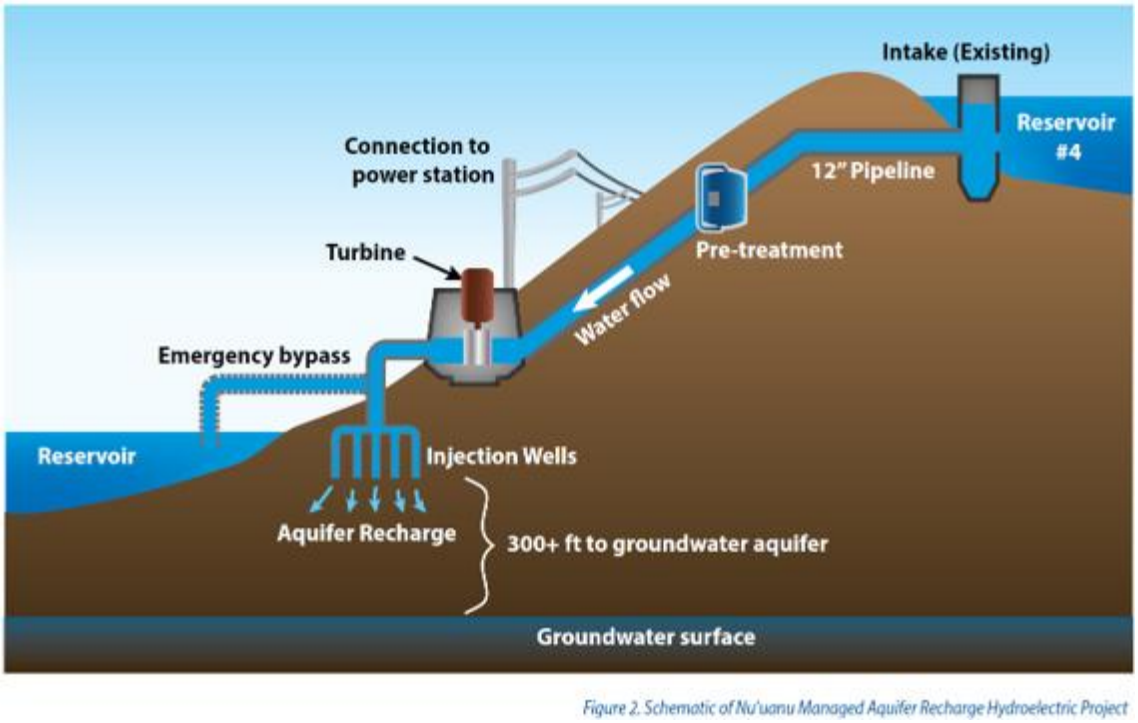


Figure 2. Schematic of Nuʻuanu Managed Aquifer Recharge Hydroelectric Project

Figures from PBR HAWAIʻI & Associates (2023) Pre-Assessment Consultation for a HRS Chapter 343 Environmental Assessment – Nuʻuanu Managed Aquifer Recharge Hydroelectric Project, Island of Oʻahu, Hawaiʻi

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nuʻuanu Stream **Roads:** Nimitz Hwy/Nuʻuanu Stream Bridge (E.B./W.B.), N King St/Nuʻuanu Stream Bridge, N Hotel St/Nuʻuanu Stream Bridge
Community Assets at Risk:	Honolulu Community College, Aʻala Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW** **Drought:** PUC has a low risk to drought; however, there are known water resources challenges in the area. The Nuʻuanu Reservoir hydro and injection well project will provide increased groundwater recharge. **100-year storm:** Another benefit of the Nuʻuanu Reservoir project is to manage reservoir levels and improve dam safety, reducing risk of flooding from extreme rainfall events.

PROJECT COMPONENTS

PLAN/STUDY

This project is ongoing and currently in the feasibility and environmental assessment (EA) phase. Design alternatives have been proposed (see Figures from PBR HAWAIʻI & Associates, 2023). Detailed design and permitting will be necessary in the upcoming phase of the project. Tasks in the upcoming phases may include:

1. **Final Engineering Design:** Finalize drawings and specifications, complete any necessary geotechnical investigations, and prepare a detailed cost estimate. The final design will also include project phasing, and construction plans.
2. **Permitting:** Obtain the permits from necessary agencies, including DOH and DLNR. Additional potential permits are listed in the Additional Considerations below.

PROGRAM

N/A

INFRASTRUCTURE

The infrastructure will include a new facility for hydro power and injection wells. Pretreatment is necessary for the surface water diverted from the reservoir prior to power generation and injection. Components listed below are common to both proposed alternatives; pipeline length and generation capacity vary by alternative.

- Diversion from Nuʻuanu Reservoir No. 4
- 12-inch pipeline in the City ROW
- Pre-treatment including bar screens
- Treatment facility
- Hydropower facility
- Class V, subclass C injection wells for aquifer recharge
- Improvements to dam safety and flood control at the Nu'uanu reservoirs

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices **?** Increases community flood protection **?** Improves water quality ☐ Improves public access to community spaces ☐ Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Reduce pressure on water resources to support local water supply reliability
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Stormwater Capture and Use • Mauka Stormwater Treatment, Retention, and Infiltration • Incorporate Alternative/Backup Power Sources
Expected Timeline:	This ongoing project is undergoing feasibility and environmental assessment, and will be followed by design and construction. Completion of the HRS Chapter 343 Environmental Assessment, and issuance of the DOH underground injection control permit and DLNR CWRM permit, are required before the project can advance to final design and construction. This project will likely need to be coordinated/interact with the following other projects: • OWH Project #101 Iwilei Area Adaptation Plan • OWH Project #103 Iwilei Drainage Improvements

PROJECT COMPONENTS

Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	>$10M for planning, design, construction *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Additional Considerations:

- Permits will be necessary from DOH (underground injection control permit), DLNR Commission on Water Resources Management (CWRM permit - benefit for sustainable yield of the aquifer), and approval from the State Historic Preservation Division.
- Since the project diverts impounded surface water, CWRM review will address stream diversion and instream flow standards in addition to aquifer recharge benefits.
- Even with the proposed alternatives, the project must verify that the hydrogeologic characteristics of each site are suitable for recharge injection.

REFERENCES

PBR HAWAIʻI & Associates, Inc. (2023). Pre-Assessment Consultation for a HRS Chapter 343 Environmental Assessment – Nuʻuanu Managed Aquifer Recharge Hydroelectric Project, Island of Oʻahu, Hawaiʻi. Final Draft. Prepared for the City and County of Honolulu Board of Water Supply.

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
CWRM	Commission on Water Resource Management
DFM	Department of Facility Maintenance
DLNR	Department of Land and Natural Resources
DOH	Department of Health
E.B.	Eastbound
EA	Environmental Assessment
ENV	Department of Environmental Services
HECO	Hawaiian Electric Company
HRS	Hawaiʻi Revised Statutes
N/A	Not Applicable
OWH	One Water Honolulu
PBR HAWAIʻI	PBR HAWAIʻI & Associates, Inc.
PUC	Primary Urban Center
ROW	Right-of-Way
SoVI	Social Vulnerability Index
SW	Stormwater
TMK	Tax Map Key
W.B.	Westbound
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

ALA WAI GOLF COURSE NON-POTABLE IRRIGATION STUDY

PROJECT CONCEPT

GENERAL DESCRIPTION

The Ala Wai Golf Course, operated by the Department of Enterprise Services (DES), currently relies on potable water for irrigation. This study will evaluate the feasibility of developing a non-potable water supply for irrigating the golf course. Following the study, the conceptual design will be advanced through final design, permitting, and construction.

The study will assess the following alternatives for supplying non-potable irrigation water:

1. Stream diversion at Mānoa-Pālolo drainage canal between Kapiʻolani Blvd and King Street,
2. Stream diversion at Mānoa-Pālolo drainage canal at Kaimuki High School,
3. Potential R-1 recycled water concepts, and
4. Stormwater Capture and Storage.

Each alternative will be evaluated based on supply availability, water quality, infrastructure requirements, constructability, and operational considerations.

In addition, the study will assess opportunities to incorporate broader golf course improvements aligned with the Ala Wai Watershed Program, including:

1. Flushing and sediment detention basins to improve water quality in the Ala Wai Canal, and
2. Adaptation measures to address future sea level rise (SLR), such as levees or berms.

ID #:	155
Timeframe:	Near-term
Champion Agencies:	BWS, DDC

PROJECT CONCEPT

Potential Partnerships:	DFM, DES, DLNR, USGS
Adaptation Strategy Type:	Plan/Study
Location of Project:	Waikīkī, PUC
Area Classification:	Major Hubs & Economic Centers
Hotspot:	Waikīkī
Congressional District:	1
Council District:	IV
Legislative District:	House District 20
Neighborhood Board:	Diamond Head-Kapahulu-St Louis Heights
Oʻahu SoVI Index:	Low



Figure 1. Aerial Map of Ala Wai Golf Course

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Very high risk pipelines **Wastewater:** 8-in sewer main **Stormwater:** Ala Wai Canal, 12-in/18-in/30-in/48-in SW conduits **Roads:** Ala Wai Blvd, Ala Wai GC Culvert/Ala Wai GC Drain Bridge
Community Assets at Risk:	The Ala Wai Golf Course is at risk of flooding under the 100-year storm and high tide flooding under future sea level rise conditions. The golf course currently uses minimal irrigation to conserve potable water, reducing the functionality of the course for recreation. Keeping the golf course in operation will preserve open space in the highly developed PUC region.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Drought:** The Ala Wai Golf Course currently uses potable water for irrigation. Providing a non-potable water supply for the golf course will help conserve potable water in the BWS Metro Low Water System, which is vulnerable to water shortages during peak summer months. Using non-potable water for golf course irrigation will reduce demand on the BWS Metro Low Water System, conserve groundwater resources, and improve overall drought resilience. **Extreme Heat:** Increased heat increases water demands. Replacing potable water use with non-potable sources for irrigation reduces the demand on the potable water system and increases water supply. **100 Year Storm:** The Ala Wai Golf Course is a critical publicly owned open space in the Ala Wai Watershed that can be adapted for multi-benefit uses to mitigate flooding under extreme rain events. The Ala Wai Canal is an impaired water body due to pollution from urban runoff. Current water quality conditions are harmful to aquatic life and limit recreational uses. Implementing a stream diversion for irrigation, along with the flushing and detention basin concept, presents an opportunity to improve water quality in the Ala Wai Canal.

PROJECT COMPONENTS

PLAN/STUDY

Establish Evaluation Criteria

- Define operational requirements for the non-potable supply system, including seasonal demand and water quality needs.
- Identify alignment with ongoing efforts within the OWH Projects #123 Ala Wai Watershed Integrated Stormwater Management and #122 Adapt Waikīkī Phase 2.
- Establish goals to support future multi-benefit use of the golf course.

Ala Wai Golf Course Site Analysis

- Evaluate the capacity of existing irrigation ponds and determine the need for additional storage.
- Assess available constructable space for non-potable water conveyance, distribution, and flushing/detention infrastructure, including areas needed for future SLR adaptation.
- Identify infrastructure adaptations required to mitigate climate risks to the non-potable water system.

Non-Potable Water Alternatives Analysis

- Quantify available water supply, permitting requirements, conveyance infrastructure needs, and raw water quality for each alternative.
- Evaluate water supply reliability and quality under future climate conditions, including potential salinity increases due to SLR.
- Develop resilient concepts for stream diversions and pumping stations that are adaptable to future flood and SLR conditions.
- Develop treatment system concepts where raw water quality does not meet landscape irrigation requirements.
- Prepare planning-level cost estimates, define operational requirements, and identify key constraints and constructability considerations for each alternative.

Integration of Flushing and Detention System

- Evaluate the feasibility of integrating a flushing and detention system into the non-potable water supply system to benefit water quality in the Ala Wai Canal.
- Perform hydrologic and hydraulic modeling to define operational requirements for the flushing and detention system under a range of conditions, including low flow, typical, flood, and future scenarios.
- Develop planning-level cost estimates for the additional cost of including a flushing and detention system.

Implementation Pathway Development

- Evaluate and compare alternatives based on the established criteria. Perform life cycle cost analysis and recommend a preferred alternative.

PROJECT COMPONENTS

- Advance the selected alternative into final design, environmental review, permitting, and construction.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ☐ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- **?** Improves water quality
- ☐ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☐ Provides ecosystem restoration
- **?** Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:

Protect coastal and nearshore ecosystems

Increase water supply

OWH Objectives Supported:

Work together to leverage resources and enable climate readiness

Enhance coordination and recognize interconnections to develop and implement projects and strategies

CRO Strategies Supported:

#7: Strengthen fresh water security by improving water conservation and reuse

Relevant Adaptation Strategies:

- Alternative Water Supplies
- Water Conservation and Demand Reduction
- Climate Resilient Infrastructure Design

PROJECT COMPONENTS

Expected Timeline:	**Near Term (0 - 5 years):** Complete the Ala Wai Golf Course Non-potable Irrigation Study. Project should begin after OWH Project #123 Ala Wai Watershed Integrated Stormwater Management and OWH Project #122 Adapt Waikīkī Phase 2 for alignment on other future potential uses for the Ala Wai Golf Course. **Near to Mid-Term:** Perform Environmental Assessment, design, permit, and construct the selected non-potable water supply system concept.
Triggers:	**Climate Hazard:** N/A **Funding:** Funding availability will be the trigger for the next phase **Regulatory:** N/A
Planning Level Cost Estimate:	$500,000 - $1,000,000 *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Assumptions	• Assumptions for available stream flows, demands, water quality, and design criteria will be developed through the study.
Potential Challenges:	• Under future SLR conditions, the Ala Wai Golf Course is vulnerable to emergent groundwater, groundwater inundation, and high-tide flooding, which require adaptation measures to maintain recreational use. • The non-potable water system may require Stream Diversion Works and Surface Water Use permits. • There may be constructability constraints for stream diversion infrastructure, including access, space limitations, and site conditions.
Additional Considerations:	• Tidal influence and emergent groundwater under future SLR conditions may affect stream diversion locations and increase salinity beyond irrigation water quality thresholds, potentially requiring additional treatment. • Proposed stream diversion and pump station locations may be vulnerable to flooding under future SLR conditions. • Coordination with the USGS to relocate the Mānoa-Pālolo stream gauge may be required.

REFERENCES

N/A

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DES	Department of Enterprise Services
DFM	Department of Facility Maintenance
DLNR	Department of Land and Natural Resources
GC	Golf Course
N/A	Not Applicable
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
USGS	United States Geological Survey

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

NASED REGULATORY REQUIREMENTS FOR REUSE

PROJECT CONCEPT

GENERAL DESCRIPTION

The New Aloha Stadium Entertainment District (NASED), TMK: 9-9-003:061 & 071 site, is about 98 acres within the Hālawa Area Transit-Oriented Development (TOD) boundary. NASED will include delivery of a new 30,000 seat multi-purpose stadium and an integrated, mixed-use, live-work-play-thrive district anchored by the new Aloha Stadium. Development of the surrounding district is expected to occur over 20+ years in phases and include residential market and housing options, hotels, office, retail, commercial, and entertainment uses and will generate annual revenue to the state to help offset the cost of the new Aloha Stadium.

Water and wastewater infrastructure capacity is limited and may not be able to accommodate the entire development. Both dry weather and wet weather sewer capacity are constrained in this area, and development at the stadium site is currently limited to the previously permitted Aloha Stadium Sewer capacity until downstream system improvements are complete. Under current DOH reuse guidelines, an onsite R-1 reuse system requires a backup discharge option. The downstream sewer system will therefore need capacity for the full development even if reuse is implemented, meaning reuse reduces potable water demand and peak wet weather flows but does not substitute for the downstream conveyance improvements.

Regulatory requirements can be efficiently coordinated through the pre-application master plan coordinating mechanism One Water Private Development Guidelines for Climate Adaptation to achieve climate resilience through a reduction of potable water use through non-potable water use and high efficiency fixtures, and a reduction of peak wastewater generation during wet weather events. Coordinated custom incentives programs can offer Water Sensible rebates for water and wastewater, Green Infrastructure (GI) impervious surfaces incentives, and waivers of impact fees for qualifying affordable housing, which can offset capital costs of dual water systems, on-site gray water reuse, wet weather sewer storage, low impact GI features & stormwater BMPs, etc. This project will result in a master plan that includes recommended regulatory permitting requirements.

PROJECT CONCEPT

ID #:	162
Timeframe:	Near-term
Champion Agencies:	BWS, ENV
Potential Partnerships:	DPP, DFM, DAGS, private developers
Adaptation Strategy Type:	Plan/Study
Location of Project:	Hālawa, PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Included based on discussion with OWH Panel
Congressional District:	1
Council District:	VII
Legislative District:	House District 32
Neighborhood Board:	ʻAiea Subdistrict 1
Oʻahu SoVI Index:	High

Figure 1 – Preferred Conceptual Design, Option B

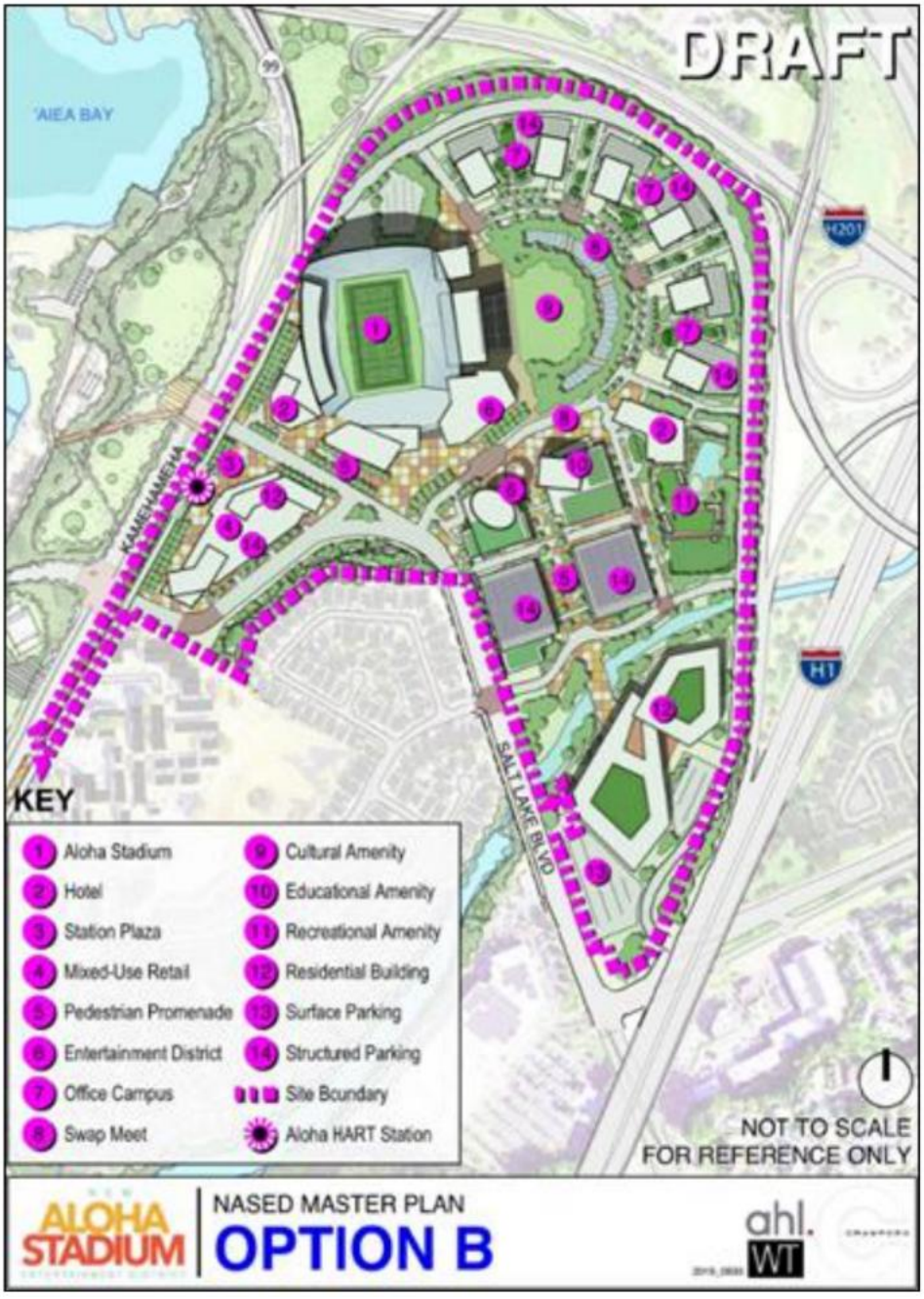


Figure 1. Image from Utility Projections Memorandum for New Aloha Stadium Entertainment District, Hālawa, Oʻahu, Hawaiʻi by Coffman Engineers (2024)

Table 1 – Projected Development Types and Uses

Land Use	Units	Stadium	Phase 1	Phase 2	Phase 3	Phase 4	Total
Stadium - Main	Seats	30,000	--	--	--	--	**30,000**
Stadium - Administrative	People	50	--	--	--	--	**50**
Ground-Floor Retail	Sq. Ft.	--	83,776	59,323	69,261	68,891	**281,251**
Lifestyle / Entertainment Retail	Sq. Ft.	--	125,000	25,000	--	--	**150,000**
Office	Sq. Ft.	--	60,000	--	60,000	--	**120,000**
Rental Residential	Units	--	300	300	600	300	**1,500**
Conventional Condo	Units	--	600	300	300	400	**1,600**
Premium Condo	Units	--	150	175	--	200	**525**
Affordable Residential	Units	--	340	115	370	85	**910**
Hotel	Keys	--	250	250	300	--	**800**
Civic Uses	Sq. Ft.	--	--	200,000	--	--	**200,000**

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COFFMAN ENGINEERS

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Figure 2. Image from Utility Projections Memorandum for New Aloha Stadium Entertainment District, Hālawa, Oʻahu, Hawaiʻi by Coffman Engineers (2024)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Hālawa Shaft, Hālawa Wells, and ʻAiea Wells (shut down due to potential contamination from Red Hill fuel releases); Kalauao Spring non-potable source; Waimalu aquifer replacement well sites (Waiau, Newtown, Kaonohi, ʻAiea) **Wastewater:** Hālawa WWPS and force main; Pearl City WWPS and associated force mains; Waipahu WWPS; Pearl City and Waimalu trunk sewers and tributary branch sewers; wastewater transmission pipelines from Hālawa to ʻAiea to Waipahu WWPS **Stormwater:** Stormwater pipelines, Hālawa Stream **Roads:** New public rights-of-way planned within the district; potential Complete Streets features
Community Assets at Risk:	New Aloha Stadium Entertainment District (Stadium, residential, hotels), ʻAiea Elementary School, ʻAiea Intermediate School, Pearl Harbor National Memorial

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Extreme Heat:** Water demands increase during summer heat as a result of increased evapotranspiration and cooling water demand; putting more pressure on already limited water supplies. Increased recycled water use will reduce the strain on potable water systems. **Drought:** High summer demand, coupled with drought conditions, could create a water shortage condition for Metro Honolulu. Recycled water use will reduce the risk of water shortages, especially during summer if R-1 water is used to offset peak irrigation demands in summer/hot/dry periods.

PROJECT COMPONENTS

PLAN/STUDY

This project will consist of a Master Plan for the NASED redevelopment area that includes new and ongoing infrastructure improvement projects and recommends regulatory permitting requirements for new developments to incorporate onsite reuse. The study should consider constraints on water supply, the legal basis for onsite reuse requirements, case study examples from peer agencies, water reuse efficiency guidelines, and identification of potential non-potable uses within anticipated building types. The study should also address DOH backup discharge requirements for onsite reuse systems and their implications for downstream sewer capacity sizing.

Example regulations include:

- Kalauao Spring non-potable water is under-utilized and is required for toilet flushing for the New Aloha Stadium
- DFM Low Impact Design Guidelines for Stormwater Quality BMPs and green infrastructure
- Water Use Efficiency guidelines and/or recommendations

The Master Plan will include new and ongoing CIP projects including those listed below.

Wastewater Transmission Pipelines Improvements, Hālawa to ʻAiea to Waipahu Wastewater Pump Station that directly support NASED.

Wet weather storage at the stadium could mitigate the transmission capacity limitation to allow more NASED development.

- Benefits: Additional sewer line capacity will allow full development of NASED, but could take more than a decade to implement.
- Constraints: Extended time frame.
- Major Permitting: Stream crossing, archaeological have the longest lead time.
- Financing: ENV, Bonds, Fees

Hālawa Wastewater Pump Station Force Main System Improvements, ENV Project #2012046

Relocate existing sewer force main from Aloha Stadium parking lot, and/or force main system redundancy improvements, and Hālawa pump station upgrades for compatibility, capacity for future flows, system reliability, and spill contingency plan improvements, over multiple phases.

- Justification: Addresses requirements in the 2010 Consent Decree for force main spill contingency plan updates, and follow-up actions to implement the recommended CIP improvements. Project will address future capacity needs.
- 6-year ENV CIP Project, pg. 256 FY 2027 BFS CIP
- Total Cost: $50M (Design and Inspection Cost: $1.5 + $2.5 = $4M, Construction Cost: $25M)

PROJECT COMPONENTS

Pearl City Trunk Sewers - Rehabilitation/Replacement, ENV Project #2020046

Address hydraulic and structural deficiencies between Pearl City and Waimalu, including tributary branch sewers. Scope determined by planning, CCTV inspection, condition assessment, measurement of sewer inverts, and conveying the future peak wet weather design flow.

- Justification: Sewer improvements are needed to accommodate future growth, including TOD and projected wet weather flows, and to address the results of condition assessment work.
- ENV CIP Project, pg. 305 FY 2027 BFS CIP

Total Cost: $56M (Design and Inspection Cost: $3 + $3 = $6M, Construction Cost: $50M)

Pearl City/Waipahu Trunk Sewer, ENV Project #2018057

Proposed new gravity sewer line from Pearl City WWPS toward Waipahu WWPS, constructed with trenchless methods such as micro-tunneling. Alternative configurations and routes for the new sewer will need to be evaluated. This project will need to be coordinated with a new or reconstructed Waipahu WWPS, to accommodate a new deeper sewer. This project would eliminate need for Pearl City WWPS and associated force mains.

- Justification: Long-term improvement to accommodate future growth of the TOD and projected wet weather flows, provide ease of maintenance and operations, and eliminate the existing Pearl City WWPS.
- Total Cost: $160.5M (Design + Inspection Cost: $2 + $4.5 = $6.5M, Construction Cost: $160M)
- Pg. 305 FY 2027 BFS CIP

Waipahu WWPS Force Main (New), ENV Project #2012053

New force main serving Waipahu WWPS. Coordination required with the Pearl City/Waipahu Trunk Sewer Project

- Costs pending

Waipahu WWPS No. 2 (New), ENV Project #2018056

New Waipahu wastewater pump station. Required to accommodate the deeper gravity sewer proposed under the Pearl City/Waipahu Trunk Sewer project.

- Costs pending

New Replacement Wells in Waimalu Aquifer

Waiau 550', Newtown 550', Kaonohi 850', ʻAiea 497'. Approximate source yield is 2 mgd per well, for a combined yield of 8 mgd. Estimated completion: 2035-2040.

- Benefits: Provides replacement source water supply capacity to compensate for the shutdown of Hālawa Shaft, Hālawa Wells, and ʻAiea Wells due to potential contamination from the Red Hill fuel releases.
- Constraints: Funding and long lead timing for completion
- Major Long Lead Permitting: EA, CWRM Water Use Permits, archaeological

PROJECT COMPONENTS

- Financing: BWS rates, bonds, grants
- Design Cost: 10% of construction cost
- Construction Cost: Placeholder Cost ~$10/mgd

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ☐ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- ☒ Improves water quality
- ☐ Improves public access to community spaces
- **?** Increases public awareness/education
- ☐ Provides ecosystem restoration
- **?** Enhances recreational benefits
- ☒ Other: Support affordable housing, economic sustainability, and entertainment activities

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse

PROJECT COMPONENTS

Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination • Onsite Stormwater Management Incentives • Implement Low Impact Development (LID)/Green Infrastructure Stormwater Management Strategies • Water Conservation and Leak Detection Improvements
Expected Timeline:	This is a near-term project due to planned redevelopment and anticipated water supply needs. This project will likely need to be coordinated/interact with the following other projects: • Hālawa TOD • OWH Project #4 Honouliuli R-1 Distribution System Expansion • OWH Project #30 Stormwater Utility Fee • OWH Project #39 Onsite Stormwater Management Incentives • OWH Project #106 Reuse Strategy for Redevelopment Areas • OWH Project #109 Green Infrastructure Implementation Plan • OWH Project #164 Potable Reuse Pilot Honolulu • OWH Project #165 Stormwater Master Plan • Waipahu WWPS Force Main (ENV Project #2012053) • Waipahu WWPS No. 2 (ENV Project #2018056)
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	>$100M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Assumptions:

The total effluent of Honouliuli is 25 mgd, of which 9 mgd must go to the outfall to keep the valve flap open, leaving up to 16 mgd that could be treated to R-1 standards. Existing R-1 ADD has been approximately 7 mgd. During wet weather flows, R-1 water can be returned to the plant effluent stream to dilute contaminant concentrations before discharge, supporting compliance with current and anticipated discharge requirements including dieldrin. Available effluent may increase with regional growth and development.

Potential Challenges:

- Water and wastewater infrastructure capacity is inadequate to accommodate full buildout until new wells and sewer transmission projects are completed. The extended time frame for project completion exceeds ten years.
- Development at the stadium site is limited to the previously permitted Aloha Stadium sewer capacity until downstream system improvements are complete. Recorded flow data indicate wet weather SSOs downstream of Aloha Stadium at the current system's capacity, which constrains the pace and sequence of district phasing.
- Because current DOH reuse guidelines require a backup discharge option for onsite reuse systems, downstream sewer capacity must be sized for the full development regardless of whether reuse is implemented. Reuse therefore reduces demand and peak flows but cannot offset the need for downstream conveyance improvements.
- Regulatory requirements will need to be established for onsite gray water reuse for toilet flushing and for wet weather storage, including the legal basis for imposing them on private development.
- Financing will depend on a combination of State and private developer investment, and funding mechanisms have not yet been identified.

REFERENCES

City and County of Honolulu, Board of Water Supply. (n.d.). Map Near Aloha Stadium.

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State of Hawaiʻi Department of Accounting and General Services. (2022). Final Environmental Impact Statement for the New Aloha Stadium Entertainment District, Volume 1. https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-09-23-OA-FEIS-New-Aloha-Stadium-Entertainment-District-Vol-1.pdf

ACRONYMS

BFS	Department of Budget and Fiscal Services
BMP	Best Management Practice
BWS	Board of Water Supply
CCH	City and County of Honolulu
CCTV	Closed-Circuit Television
CIP	Capital Improvement Program
CRO	Climate Ready Oʻahu
CWRM	Commission on Water Resource Management
DAGS	Department of Accounting and General Services
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
EA	Environmental Assessment
ENV	Department of Environmental Services
FEIS	Final Environmental Impact Statement
FY	Fiscal Year
GI	Green Infrastructure
H-1	Interstate H-1
I/I	Infiltration and Inflow
LID	Low Impact Development
mgd	Million Gallons per Day
N/A	Not Applicable
NASED	New Aloha Stadium Entertainment District
OWH	One Water Honolulu
PUC	Primary Urban Center
R-1	Recycled Water Meeting R-1 Standards
SOVI	Social Vulnerability Index
SW	Stormwater
TMK	Tax Map Key
TOD	Transit-Oriented Development
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

ADAPT WAIKĪKĪ PHASE 2

PROJECT CONCEPT

GENERAL DESCRIPTION

Adapt Waikīkī 2050 (AW2050) Phase 1 established the foundation for climate resilience planning in the Waikīkī Special District (WSD) through climate hazard vulnerability assessments, stakeholder engagement, and the development of adaptation strategies to address sea level rise and compound flooding. The study identified vulnerable assets, evaluated future climate risks, and developed policy, infrastructure, and planning recommendations to improve resilience through 2050 and beyond. Building on these findings, Phase 2 will continue the development of priority AW2050 strategies and pilot sea level rise (SLR) and compound flood adaptation concepts in West Waikīkī. Phase 2 will focus on AW2050 actions related to Strategy 2: Mitigate Widespread Stormwater Flooding from Rainfall-Driven Compound Flood Events; Strategy 3: Extend the Useful life of subsurface Infrastructure Exposed to Permanent and Widespread Shallow Groundwater; and Strategy 4: Develop and Pilot Adapt-In-Place and Managed Retreat Strategies to address permanent SLR-driven flooding.

Key goals and outcomes of the Adapt Waikīkī Phase 2 will be:

1. Design Flood Elevations (DFEs) recommendation report for determining SLR-adjusted DFEs for roads and structures to include evaluation of projected risks, place-based features, regulatory environment, and precedent cases. The report will further identify a reasonable range of options for establishing SLR-adjusted DFEs and identify storm water management measures that could modify the DFEs,
2. Create an Adaptation Approaches and Implementation Processes for Transition Zones report. This report will include applying the DFE methodology to three representative road types in the West Waikīkī area and outline implementation processes that identify public and private sector considerations for “transition zone” differences in finished grade and implications for surrounding properties. Consideration will be given to differences when the action is driven by a private landowner (structure-driven) or if the action is initiated by the City (infrastructure-driven),

PROJECT CONCEPT

3. Create a Design for Climate stand-alone supplement to the Waikīkī Special District Design Guidelines based upon findings and recommendations in Phases 1 and 2,
4. To the extent possible, align with the OWH Project #123 Ala Wai Watershed Integrated Stormwater Management to establish a plan to elevate canal flood walls to mitigate future high tide and compound flooding from overtopping Ala Wai Canal,
5. To the extent possible, align with actions to maintain recreational use and create green spaces to mitigate extreme heat and intermittent storm flooding, and
6. Align with agencies developing the OWH Project #35 Road Raising Strategy that will be developing in parallel.

ID #:	122
Timeframe:	Near-term
Champion Agencies:	DPP
Potential Partnerships:	ENV, BWS, DFM, CCSR, DPR
Adaptation Strategy Type:	Plan/Study
Location of Project:	Waikīkī, PUC
Area Classification:	Major Hubs & Economic Centers
Hotspot:	Waikīkī
Congressional District:	1
Council District:	IV, V
Legislative District:	House District 24, 25

PROJECT CONCEPT

Neighborhood Board:	Waikīkī Subdistricts 1, 2, 3, Ala Moana/Kakaʻako Subdistrict 3
Oʻahu SoVI Index:	Medium



Figure 1. Aerial Map of Waikīkī



Figure 2. Map of Waikīkī Special District Assets



Figure 3. Map of Flood Depth from 4 ft of SLR (Groundwater) in Waikīkī Special District

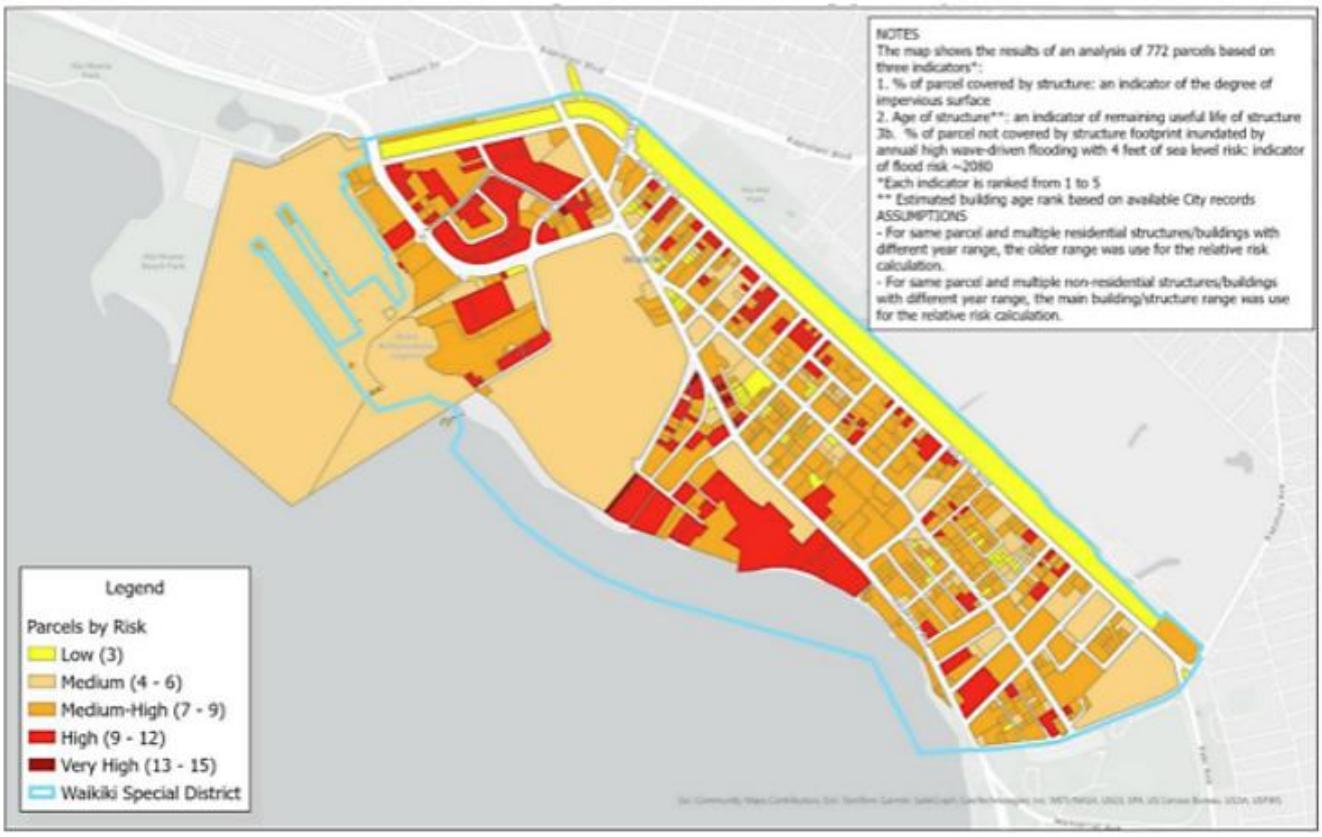


Figure 4. Map of Flooding Risk from 4 ft of SLR for Waikīkī Special District Parcels

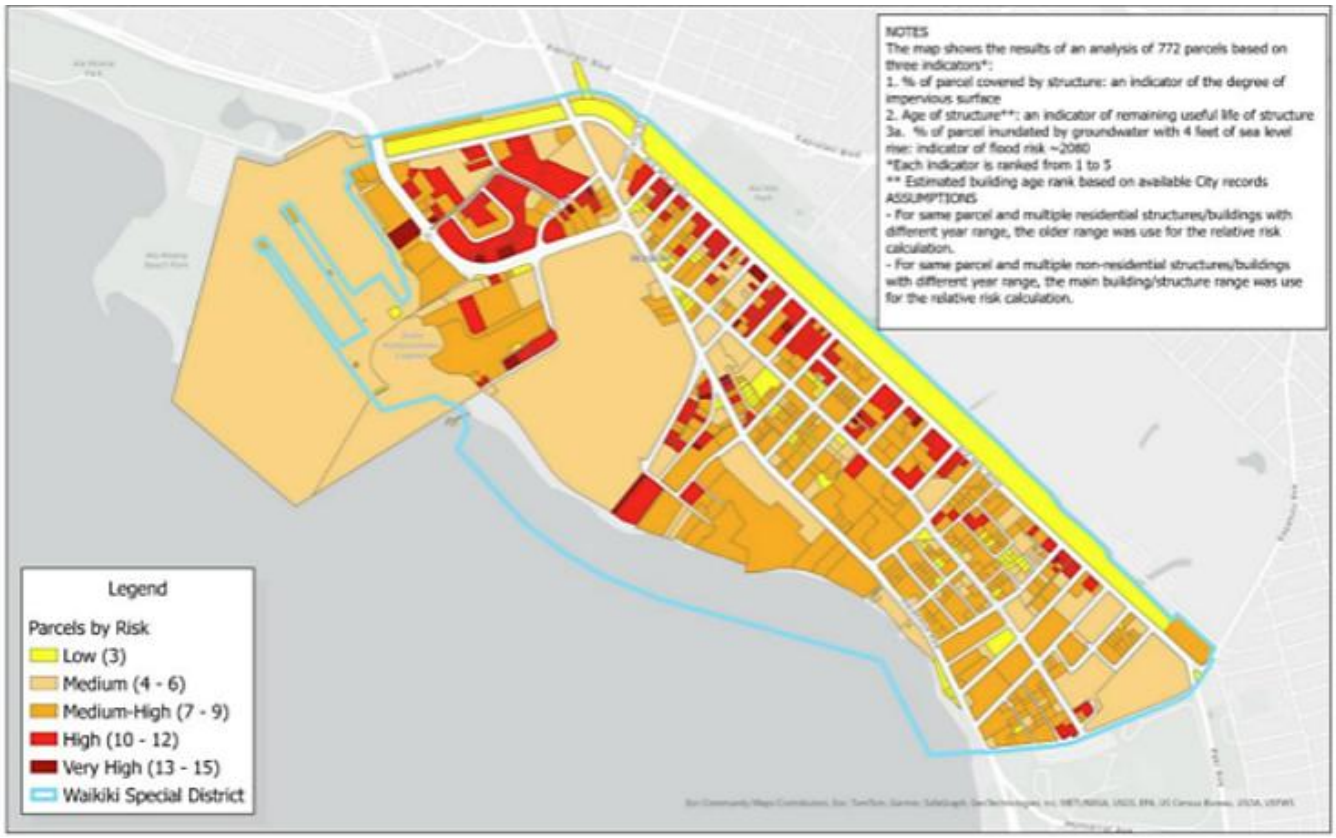


Figure 5. Map of Groundwater Inundation Risk from 4 ft of SLR for Waikīkī Special District Parcels

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Very high risk/high risk pipelines **Wastewater:** 8-in/10-in/12-in/15-in/16-in/20-in/27-in sewer main **Stormwater:** Ala Wai Canal, 12-in/18-in/24-in/30-in/36-in/28-in/60-in/66-in SW conduits **Roads:** Ala Wai Blvd, Ala Wai GC Culvert, Ala Wai GC Drain bridge, Seaside Ave, Kānekapōlei St, Kahanamoku St, Kālia Rd These are a sample of the wider range of infrastructural assets that are at risk within the broader Waikīkī Area.
Community Assets at Risk:	Ala Wai Golf Course, Ala Wai Canal (and impacts to beaches), Kahanamoku Beach, Fort DeRussy, Duke Kahanamoku man-made Lagoon, Ala Wai Boat Harbor, Straub Waikīkī Hospital Clinic These are a sample of the wider range of community assets that are at risk within the broader Waikīkī Area.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** Waikīkī has low risk to drought and wildfire, though these hazards will also be included in Adapt Waikīkī Phase 2, mostly as co-benefits. **Sea Level Rise (Above Ground):** The project develops a methodology to establish a sea level rise-adjusted Design Flood Elevation (DFE) for WSD and evaluates potential roadway elevation strategies to reduce impacts from future coastal inundation and high tide flooding. Recommendations for pilot adaptation measures and creation of updated WSD design guidance will help improve the resilience of roads, buildings, and public spaces exposed to increasing surface flooding. **Sea Level Rise (Groundwater):** The project will further characterize the impacts of emergent and shallow groundwater on roads, utilities, buildings, and other infrastructure to identify vulnerabilities under future sea level rise conditions. The project will develop and/or build upon recommendations for floodproofing, infrastructure adaptations, and design standards to improve performance and reduce damage associated with groundwater intrusion and chronic saturation identified in Phase 1. **Coastal Erosion:** Waikīkī has projections of coastal erosion impacts at 1 foot of SLR. Adapt Waikīkī Phase 2 will consider and address coastal erosion impacts. **100-Year Storm:** The project improves understanding of rainfall-driven and compound flooding through the drainage and roadway study. The study will inform drainage

improvements, roadway elevation recommendations, and adaptation strategies to reduce economic disruption and transportation impacts during major storm events.

Extreme Heat: Strategies adopted through all project phases will aim to maintain and increase parks, recreational areas, and green spaces that reduce urban extreme heat impacts. Adapt Waikīkī Phase 3 will identify opportunities to incorporate shade, vegetation, and other heat-mitigation measures that provide co-benefits for public health, recreation, and resilience.

Hurricane: Waikīkī may have complete inundation up to 3 feet under a Category 1 Hurricane. Hurricane resilience will be included in Adapt Waikīkī Phase 2.

Tsunami: Waikīkī is within the tsunami evacuation zone. Tsunami resilience will be included in Adapt Waikīkī Phase 2.

PROJECT COMPONENTS

PLAN/STUDY

Drainage and Roadway Study

Conduct a focused assessment of priority road segments under future flood conditions and extrapolate findings to develop planning-level recommendations for stormwater drainage improvements and roadway elevation to mitigate SLR-driven flooding.

Stakeholder Outreach

Develop education and outreach products to notify private developers and the public about the Sea Level Rise Advisory Overlay. Engage stakeholders in the development of a SLR-adjusted DFE and WSD design guidelines update. Continue working with stakeholders and partners in the Ala Wai Watershed to plan for long-term adaptation planning in the Ala Wai Watershed which may include increasing canal flood wall elevations.

Establish a method for SLR-adjusted DFEs

Determine the appropriate calculation for a new SLR-adjusted DFE based on the expected useful life of the asset and develop options for DFEs that consider stormwater management for the WSD.

Waikīkī Special District Design Guidelines Update

Create a stand-alone supplement to the Waikīkī Special District Design Guidelines to incorporate climate resilience. Consider the accommodation of raised roads and infrastructure and address emergent and shallow groundwater, such as elevating buildings, repurposing occupied at-grade spaces, and wet floodproofing. The guidelines will establish a Sea Level Rise Advisory Overlay representing the cumulative extent of flooding under future SLR conditions (2 ft, 4 ft, and 6 ft of SLR). The guidelines will supplement will include multiple heat mitigation strategies, considering trade-offs between vegetated open space and shade structures for all retrofits, redevelopment, and rights-of-way.

Pilot Adaptation Strategies in West Waikīkī

Align with the Road Raising Strategy project to propose conceptual designs to raise roads in West Waikīkī, the are facing the highest climate impacts of WSD. Additionally, propose conceptual designs for stormwater drainage

PROJECT COMPONENTS

adaptations, such as new stormwater pump stations to prevent drainage backflow. Perform a cost-benefit analysis of the road elevation strategy to compare alternatives of adapting in place, protecting assets, or relocating or realigning subsurface assets within the WSD.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ☒ Protects cultural sites
- ☒ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:

Reduce economic disruptions for residents, workers and businesses from groundwater and overland flooding

Enhance public safety and maintain access to essential services from groundwater and overland flooding

OWH Objectives Supported:

Enhance coordination and recognize interconnections to develop and implement projects and strategies

Develop a unified roadmap and decision-making process under a One Water approach

Work together to leverage resources and enable climate readiness

CRO Strategies Supported:

#9: Integrate climate resilience into city capital planning, operations and policies

PROJECT COMPONENTS

	#10: Make buildings, homes and infrastructure more climate resilient **#12**: Keep our communities cool as temperatures rise during heat waves
Relevant Adaptation Strategies:	• Area Adaptation Plan • Study Most Effective Responses to Rising Groundwater • Refine Flood Risk Mapping to Account for Climate Change and/or Increase Resolution • Elevate Access Road and Associated Utilities • Drainage System Plan

PROJECT COMPONENTS

EXAMPLES

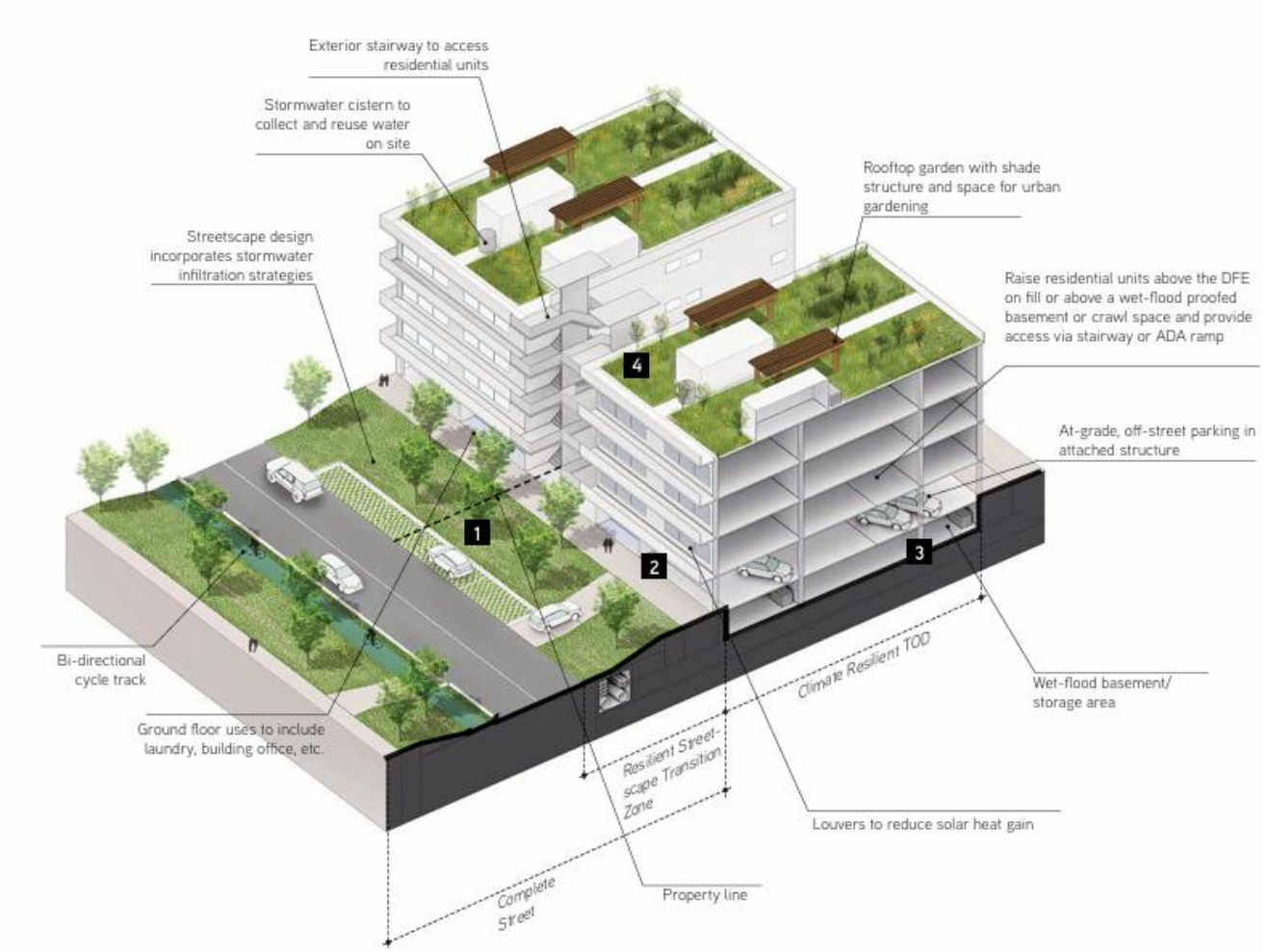


Figure 6. Example Implementation of Resilience Corridors, Transition Zones and SLR-DFE (Source: Source: https://www.honolulu.gov/tod/wp-content/uploads/sites/73/2025/02/Climate_Adaptation_Principles.pdf)

PROJECT COMPONENTS

Expected Timeline:	Near-Team Alignment With Other Proposed and Ongoing Projects: • OWH Project #35 Road Raising Strategy • OWH Project #123 Ala Wai Watershed Integrated Stormwater Management Adapt Waikīkī Phase 2 will begin in the next 0-2 years. The Road Raising Strategy will run in parallel with the beginning of Adapt Waikīkī Phase 2. Following the completion of the Road Raising Strategy, outcomes should inform the WSD Design Guidelines Update and the Pilot in West Waikīkī. Feedback on the cost-benefit analysis framework for the pilot in West Waikīkī and lessons learned from the conceptual design can inform approaches to Road Raising in other areas on Oʻahu.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$100k-$1M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Property owners may benefit unevenly from proposed improvements. A defensible approach is required to weigh the cost-benefit of adapting in place vs. strategic retreat. • Major adaptation measures may be cost-prohibitive, and the broader community in Oʻahu may not accept prioritizing investment in Waikīkī over other needed projects. • A phased adaptation approach over time is most favorable to maintaining Waikīkī as a desirable resort location. Radical changes or drastic disruptions will likely not be accepted.
Additional Considerations:	• Political will and stakeholder buy-in from the private development community will be required to continue implementing adaptation strategies in Waikīkī.

REFERENCES

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ACRONYMS

AW2050	Adapt Waikīkī 2050
BWS	Board of Water Supply
CCH	City and County of Honolulu
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready O‘ahu
DFE	Design Flood Elevation
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
ENV	Department of Environmental Services
GC	Golf Course
N/A	Not Applicable
n.d.	No Date
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SOEST	School of Ocean and Earth Science and Technology
SoVI	Social Vulnerability Index
TOD	Transit-Oriented Development
UH	University of Hawai‘i
WSD	Waikīkī Special District

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

IWILEI AREA ADAPTATION PLAN

PROJECT CONCEPT

GENERAL DESCRIPTION

"Area Adaption Plans (AAP) are a new class of Special Area Plan to address the specific challenges of adapting city land use practices, infrastructure, and building guidelines to the changing conditions of the global climate. These changes include climate change induced flooding, sea level rise, rising groundwater, and increased heat. AAPs will provide location-based guidance for multiple hazards on a near-term timeline, while advancing the conversation and necessary research for long-term adaptation. The AAPs will be closely coordinated with City climate policies including those of the Office of Climate Change, Sustainability and Resiliency, and the One Water Panel of agencies' planning for resilient infrastructure. The AAPs may be updated over time." (DPP Area Adaptation Plan Webpage).

Iwilei poses a unique opportunity for community-scale resilience planning. Ongoing redevelopment, centering on transit-oriented development (TOD) projects around rail, bus, and pedestrian networks, including several major redevelopment projects led by public agencies, are currently in motion. The Iwilei neighborhood is envisioned to feature some future changes to the street grid that support various forms of mobility and activate the streets to create a safe and pedestrian-oriented environment. The sum of this new redevelopment provides an opportunity that can serve as a model for resilience-by-design in large-scale urban redevelopment, considering multiple natural hazards and climate impacts. Through a proactive focus on preparation for future climate conditions, the City can work to mitigate near-term impacts and maintain flexibility in planning for longer-term impacts due to sea level rise.

The TOD plans anticipate redevelopment of Iwilei over the next 40+ years converting largely commercial and public land to include housing and mixed-use development. The Infrastructure Improvement Master Plan for the Iwilei Area (2023) identified many required improvements to support the anticipated increase in density and development. Improvements are identified across hard infrastructure systems including sewer, water, stormwater, roads, and electrical. The City is prioritizing the development of the Kūwili Station TOD in coordination with State and private developers. The Iwilei AAP will piece together and supplement the many ongoing Iwilei Master Plan efforts by providing a district-scale perspective. The effort will support goals identified in the Primary Urban Center Development Plan (PUC DP) and guidance in Climate Ready Oʻahu. The

PROJECT CONCEPT

Iwilei AAP will outline goals and challenges and provide a path for collaboration between agencies, stakeholders, and the community to support the neighborhood changes that TOD will bring. Sea level rise projections show that low lying areas of Iwilei will face significant challenges to infrastructure maintenance within 50 years without further adaptation efforts.

ID #:	101
Timeframe:	Near-term
Champion Agencies:	DPP, DFM (drainage study), CCSR (adaptation pathways)
Potential Partnerships:	BWS, ENV, DDC, DPR, HECO, DHLM
Adaptation Strategy Type:	Plan/Study
Location of Project:	Iwilei, PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Iwilei
Congressional District:	1
Council District:	VI
Legislative District:	House District 28
Neighborhood Board:	Kalihi-Pālama
Oʻahu SoVI Index:	Very High



Figure 1. Iwilei Study Area.

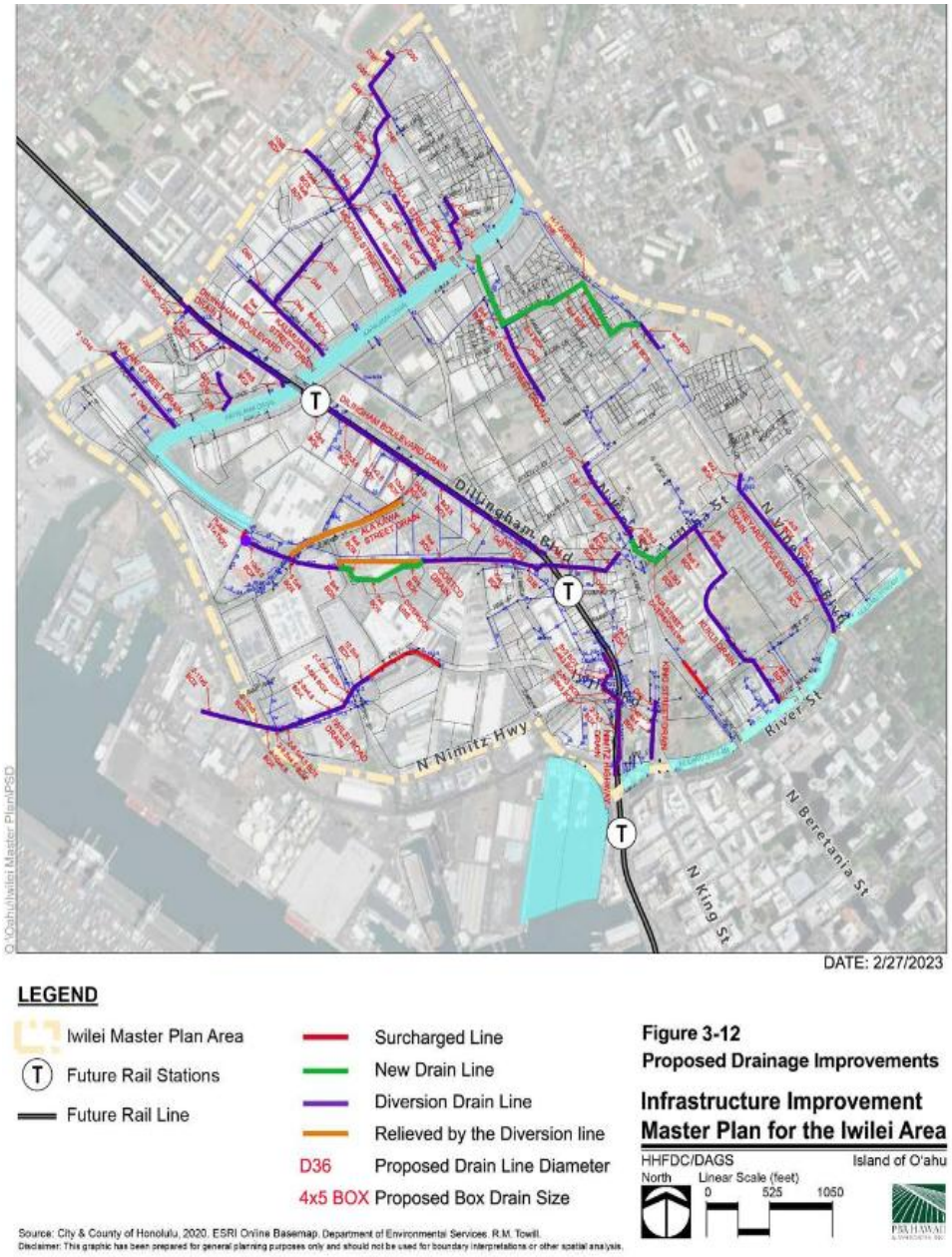


Figure 2. Infrastructure Improvement Master Plan for the Iwilei Area (2023)

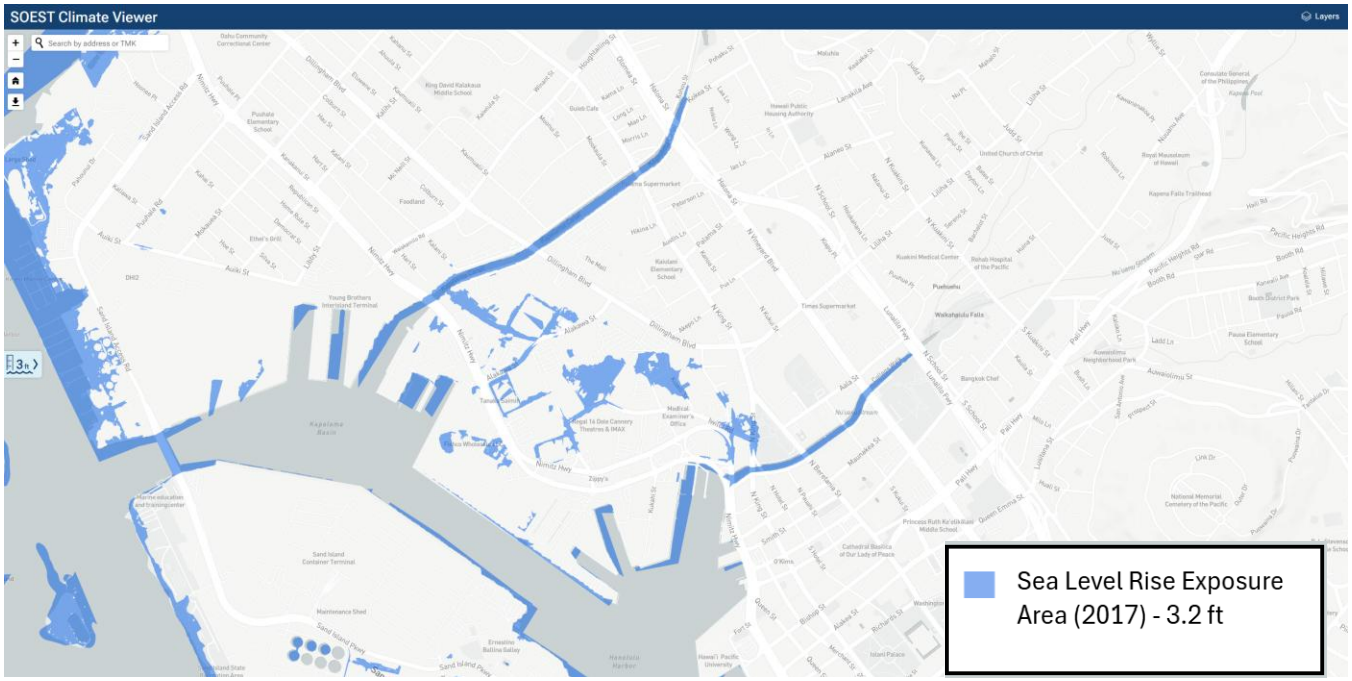


Figure 3. SLR exposure area for the project factsheet location. Source: University of Hawai'i, SOEST Climate Viewer.

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nu'uanu Stream **Roads:** Ala Moana Blvd, Nimitz Hwy, Nimitz Hwy/Slip Cover Hon Harbor Bridge, Nimitz Hwy/Slip Cover Honolulu Harbor Bridge #1, Nimitz Hwy/Nu'uanu Stream Bridge (E.B./W.B.), N King St/Nu'uanu Stream bridge, N Hotel St/Nu'uanu Stream Bridge, N King St/Kahili Stream Bridge
Community Assets at Risk:	Honolulu Harbor, Aloha Tower, A'ala Park, Nearby Waterfront Fire Station 45, nearby Chinatown Substation Police Station

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** This Area Adaptation Plan will focus on all hazards that impact Iwilei, particularly those exacerbated by climate change. While Iwilei has a low physical exposure to drought conditions and wildfire and coastal erosion are not mapped in the area, those hazards may also be included in the AAP, particularly through multi-benefit solutions. **Sea Level Rise (Above Ground):** Iwilei is impacted by high wave-driven flooding, drainage backflow, and passive flooding at 5 feet of SLR. This plan will address sea level rise impacts through development guidelines and collaborative planning. **Sea Level Rise (Groundwater):** Iwilei is impacted by groundwater inundation at 4 feet of SLR. This plan will address shallow groundwater rise impacts. **Hurricane:** Iwilei has projected complete inundation up to 3 feet in a Category 1 hurricane. This plan will address strategies for hurricane resilience. **100-Year Storm:** Iwilei experiences partial inundation under the 100-year storm. This plan will address strategies for flood resilience. **Tsunami:** Iwilei is within the extreme tsunami evacuation zone. This plan will address tsunami resilience strategies. **Extreme Heat:** Iwilei has a high afternoon extreme heat index, above 90°F. This plan will address urban heat and extreme heat mitigation strategies.

PROJECT COMPONENTS

PLAN/STUDY

There has already been extensive study in the Iwilei redevelopment area, and this Plan will build on that completed and ongoing work to fill remaining gaps and create a platform for a more unified adaptation strategy for the region. The PUC DP set out specific goals that should be supported in the Iwilei AAP, including tools and adaptation guidance for SLR, integrated and green solutions for stormwater management, and treatment of riparian zones for perennial streams.

Overarching adaptation strategies can be adopted from the One Water Honolulu Plan strategy list as appropriate. Finally, recommended actions will include policies, studies, and infrastructure projects that can be implemented in the near-term and over time.

Specific tasks or chapters in the AAP may include the following:

1. **Existing Conditions and Data Review.** This review will include an overview of existing and future drainage conditions in the context of planned redevelopment. The review will combine and summarize climate risk data from existing studies. Where available and feasible, model outcomes will be validated with existing conditions. The data review should build on the Infrastructure Improvement Master Plan for the Iwilei Area (2023), which identifies infrastructure needs for the redevelopment area based on increased capacity needs, housing growth, and the need for infrastructure to support coming development. This plan has proposed many improvements to the infrastructure and drainage that maybe considered, built upon, and carried forward in the context of climate change and hazard analysis.
2. **All-Hazards Decade-by-Decade Analysis.** This detailed hazard exposure analysis will utilize the existing data from the One Water Honolulu Plan, the Iwilei Master Plan, and other existing works. Climate data will be incorporated to provide decade-by-decade projections of hazard extent within Iwilei, combined with existing and planned development to understand current and future exposed assets or properties. This step will be followed by outreach to communicate the findings to public and private developers and to inform ongoing projects before formal requirements or guidelines are published.
3. **Drainage Study and Master Planning.** DFM will lead an Iwilei Drainage Study and a Drainage Master Plan. The Iwilei Regional Drainage Master Plan will propose elevations and drainage infrastructure based on the 'living with water' redevelopment concept. The drainage study will produce maps that consider the topography and show where water is expected in current and future conditions. Discrete, accurate mapping of future conditions of sea level rise and new flood insurance rate maps (FIRMs) are necessary to inform planners and design engineers. This may include phasing larger drainage infrastructure and stormwater pump stations in the lower elevations of west, central and makai Iwilei to accept the storm water runoff from adjacent parcels. Stormwater pumps can then pump flood waters to Kapālama Canal and Honolulu Harbor. The drainage master plan will include stormwater elevations and pipeline sizes. This master planning should build on the ongoing TOD planning, incorporating projected development changes. Drainage master planning will include consideration of private land.
4. **Project and Policy Prioritization.** This stage will include brainstorming, prioritizing, and identifying opportunities for multi-benefit projects, tied back to the goals of Climate Ready Oʻahu, the PUC DP, and the applicable TOD plans. The stage will identify the community priorities, both related to climate risk and other priority multi-benefits, and recommend adaptation strategies broadly and for specific project areas. This phase will include coordination among projects within the public and private sectors and will

PROJECT COMPONENTS

prioritize them based on a combination of the necessary timing to meet ongoing project phases, and the anticipated climate impacts decade-by-decade analysis. Priority Projects may be connected to overarching or existing adaptation plans including road raising and large-scale flood protection.

5. **Adaptation Pathway Identification.** CCSR will lead the development of adaptation pathways for specific areas and infrastructure, and/or projects will be defined that include triggers and decision-points based on climate impacts such as sea level rise. This stage will build on the project and policies identified, and will include sea level rise triggers for major regional adaptations including policies, regional shoreline adaptation, and road raising.
6. **Outreach and Engagement.** Community engagement includes community members and/or community focus groups, technical experts, stakeholders, the One Water Panel, technical consultants, and academic researchers. Engagement should identify and confirm existing concerns, identify community priorities, and provide feedback on proposed projects and policies. This task should identify overarching adaptation strategies that may be applied in multiple projects or areas. Outreach should span all planning phases.

The AAP outcomes include:

1. **All-Hazards Exposure.** The outcome of the all-hazards decade-by-decade analysis will be an early deliverable that can inform developers while formal guidelines and future City projects are in progress. The all-hazards exposure information will be combined with outreach to inform public and private development in Iwilei.
2. **Development Guidelines** Specific guidelines to new developments within Iwilei regarding climate preparedness, onsite stormwater management, site grading or elevation, and water conservation. These guidelines should include a design flood elevation that includes sea level rise considerations. These guidelines may also recommend living spaces above the ground floor and onsite stormwater management to reduce localized flooding. The guidelines may also include a new sea level rise exposure area for Iwilei (SLRXA-I), similar to the maps created for Adapt Waikīkī 2050. These guidelines should also include heat mitigation and guidelines to incorporate heat resilience based on localized modeling of the urban heat island effect, if available.
3. **Projects and Policies List.** Specific adaptation actions with alternatives for each risk/solution, for each of the next three decades (2030-2040, 2040-2050, and 2050-2060). There may also be high-level long-term pathways that can be considered and selected as later studies. Tasks will be categorized in Research & Monitoring, Policy & Regulation, Financing, Planning and Engineering Feasibility Studies, Public Outreach, Design and Construction. These projects will include prioritized One Water Honolulu projects (Kapālama Canal Linear Park, Iwilei Regional Flood System, and Resilient Corridors).
4. **Adaptation Pathways.** The adaptation pathways will include timing of projects and policies related to climate triggers, likely based on sea level rise. The pathways will include triggers for planning efforts, infrastructure projects, road raising, and large-scale shoreline resilience projects. Multiple pathways will be considered, including decision-points. These pathways will consider future infrastructure and land uses for decision-making.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ? Protects cultural sites
- ☒ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve walkability and multi-modal transport options Increase water supply and improve water quality Improve drainage and reduce flooding
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Develop a unified roadmap and decision-making process under a One Water approach
CRO Strategies Supported:	**#9**: Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies	• Area Adaptation Plan • Drainage System Plan • Infiltration and Inflow Study

Expected Timeline:	Alignment with Proposed and Ongoing Projects: • Kalihi, Kūwili, and Downtown TOD • Iwilei Master Plan This project will likely need to be coordinated/interact with the following other projects: • OWH Project #35 Road Raising Strategy • OWH Project #102 Pilot Floodable Spaces • OWH Project #103 Iwilei Drainage Improvements • OWH Project #104 Kapālama Canal Linear Park • OWH Project #105 Resilience Corridors and Road Raising • OWH Project #106 Reuse Strategy for Redevelopment Areas • OWH Project #115 Māpunapuna Area Adaptation Plan • Future projects proposed by the AAP
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Iwilei has many ongoing development projects that may be difficult to coordinate at this stage. The timeline of implementation will be more constrained by ongoing development, which will likely have an end-of-century lifespan, rather than impacts from sea level rise, which are anticipated around 4-5 feet of SLR.
Additional Considerations:	• Affordable housing will need to be prioritized, such that housing is not especially vulnerable to sea level rise and climate impacts and imposed guidelines are not cost-prohibitive to affordable housing development. This plan should support Kūwili and other affordable housing developments.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

	• Adapt Waikīkī is based around the Waikīkī Special District. It should be considered whether a similar designation is beneficial or necessary for Iwilei to impose particular sea level rise zoning requirements. • Adapt Waikīkī set a path forward for area adaptation planning in Honolulu. Replication of Adapt Waikīkī must be flexible to support differing conditions and contexts across the island. A particular consideration for Iwilei is the imminent need for planning due to ongoing redevelopment. Due to the rapid pace, the planning effort should focus on getting climate hazard data out to developers and updating guidelines quickly so that they will be put in place before many of the developments break ground.
Technical Considerations	• Iwilei has a significant amount of artificial fill soil, so resilience to subsidence, geohazards, and soil densification techniques should be considered in the adaptation plan. • Numerous petroleum releases occurred over the years and site redevelopment activities often encounter contamination. Previous subsurface investigations have found gasoline, diesel fuel, fuel oils, lubricating oils, lead, and arsenic. As sea level rises from ground water inundation, contaminants will be transported to the surface and into area drains which could reach Honolulu Harbor. The limits of fuel contamination in the Iwilei area must be investigated, mapped and remediated.

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ACRONYMS

AAP	Area Adaptation Plan
BWS	Board of Water Supply
CCH	City and County of Honolulu
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DHHL	Department of Hawaiian Home Lands
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
E.B.	Eastbound
ENV	Department of Environmental Services
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HCDA	Hawaiʻi Community Development Authority
HECO	Hawaiian Electric Company
Hwy	Highway
N/A	Not Applicable
OWH	One Water Honolulu
PacIOOS	Pacific Islands Ocean Observing System
PUC	Primary Urban Center
PUC DP	Primary Urban Center Development Plan
SLR	Sea Level Rise
SLRXA-I	Sea Level Rise Exposure Area - Iwilei
SoVI	Social Vulnerability Index
SW	Stormwater
TOD	Transit-Oriented Development
W.B.	Westbound
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

MĀPUNAPUNA AREA ADAPTATION PLAN

PROJECT CONCEPT

GENERAL DESCRIPTION	"Area Adaption Plans (AAP) are a new class of Special Area Plan to address the specific challenges of adapting city land use practices, infrastructure, and building guidelines to the changing conditions of the global climate. These changes include climate change induced flooding, sea level rise, rising groundwater, and increased heat. AAPs will provide location-based guidance for multiple hazards on a near-term timeline, while advancing the conversation and necessary research for long-term adaptation. The AAPs will be closely coordinated with City climate policies including those of the Office of Climate Change, Sustainability and Resiliency, and the One Water Panel of agencies' planning for resilient infrastructure. The AAPs may be updated over time." (DPP Area Adaptation Plan Webpage). Māpunapuna is primarily an industrial and commercial area with unique challenges and opportunities. The Project should build upon the FEMA Māpunapuna Area Drainage Study and Action Plan (2024) to designate adaptation pathways for Māpunapuna that extend the usability as long as possible while preparing for long-term land-use change and managed retreat. The AAP will include a detailed climate risk profile of Māpunapuna, including present and future projected hazards. The AAP will propose adaptation pathways that include large-scale adaptation and managed retreat.
ID #:	115
Timeframe:	Near-term
Champion Agencies:	DPP, DFM (drainage study), CCSR (adaptation pathways)
Potential Partnerships:	BWS, ENV, DDC, DPR, DTS, and potential State/Federal Agencies
Adaptation Strategy Type:	Plan/Study
Location of Project:	Māpunapuna, PUC

PROJECT CONCEPT

Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Māpunapuna
Congressional District:	1
Council District:	VII
Legislative District:	House District 30, 31
Neighborhood Board:	Āliamanu/Salt Lake/Foster Village/Airport
Oʻahu SoVI Index:	Medium

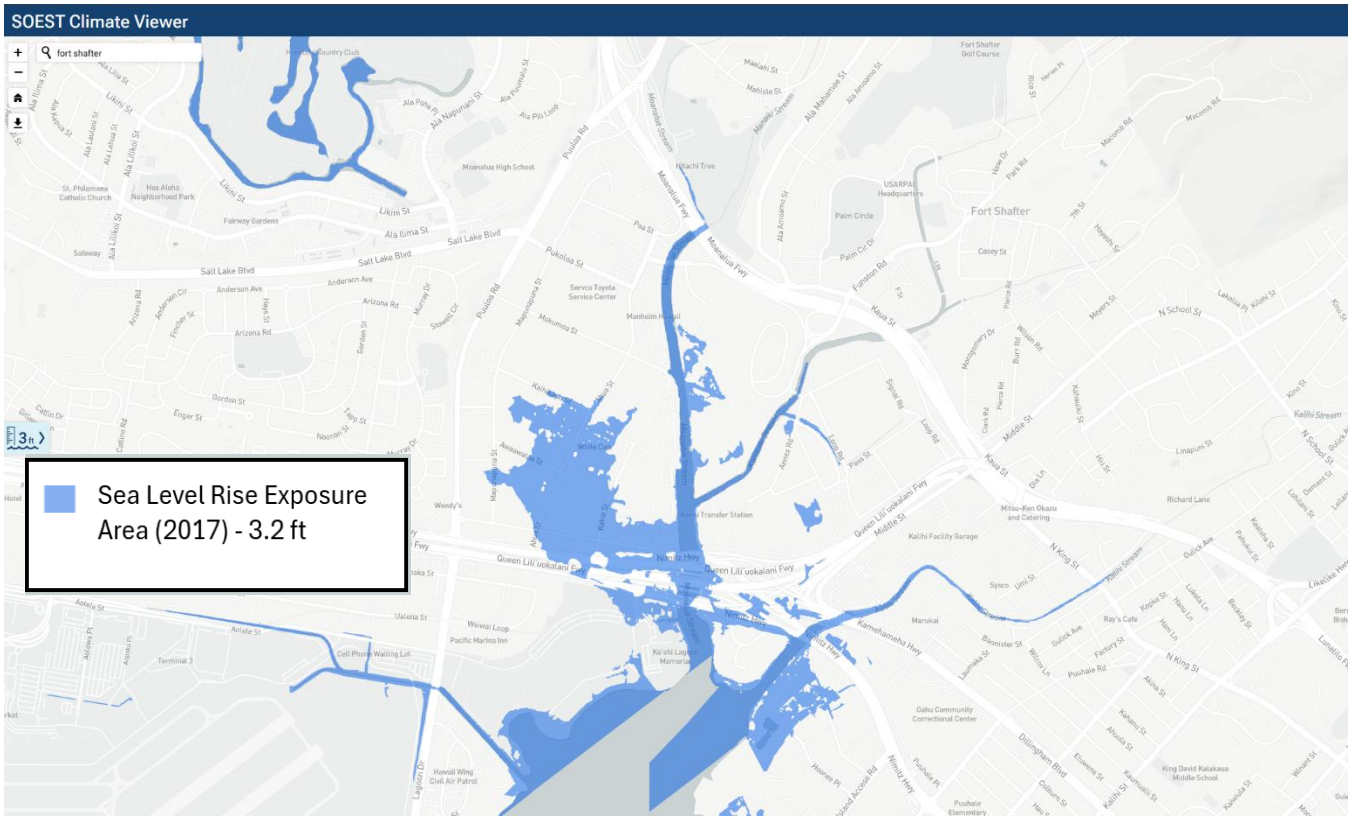


Figure 1. SLR Exposure Area for Project Factsheet Area (Source: University of Hawaiʻi. SOEST Climate Viewer)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Very high risk/high risk pipelines **Wastewater:** Kamehameha Highway WWPS, 24-in/30-in/42-in force main, 10-in/12-in/20-in/24-in/30-in/36-in/48-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in/42-in/48-in/54-in SW conduits, Moanalua Stream **Roads:** Moanalua Rd, N Nimitz Hwy, Makai Frontage Rd/Moanalua Stream Bridge, Nimitz Hwy/Moanalua Stream Bridge (E.B/W.B.), Puʻuloa Ramp/Moanalua Stream Bridge, Funston Rd/Kahauiki Stream Bridge, Walker Dr/Kahauiki Stream Bridge, Funston Loop/Kahauiki Stream Bridge
Community Assets at Risk:	Keʻehi Lagoon, HDOT Base Yards, Keʻehi Lagoon Beach Park, Moanalua Gardens, Moanalua Public Middle and Elementary Schools

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** In general, the area adaptation plan will consider all hazards that are relevant to the area, considering multi-benefit solutions and improving our understanding of the impacts to the area. Māpunapuna has low risk to drought and wildfire, though those hazards could also be included. **Sea Level Rise (Above Ground):** Māpunapuna is impacted by high wave-driven flooding at 2 feet SLR, drainage backflow at 3 feet SLR, and passive flooding at 4 feet of SLR. The AAP will include SLR impacts. **Sea Level Rise (Groundwater):** Māpunapuna is already experiencing impacts from rising groundwater. Analysis shows the area will be impacted by groundwater inundation at 1 foot of SLR. The AAP will include shallow groundwater rise. **Coastal Erosion:** Māpunapuna will be impacted by coastal erosion at 2 feet of SLR. The AAP will include coastal erosion. **100-Year Storm:** Māpunapuna is already experiencing flooding due to storm events. Analysis shows the area will experience complete inundation under the 100-year storm. Māpunapuna is susceptible to storm drain backflow. The AAP will include 100-year storm and rainfall-induced flooding impacts. **Hurricane:** Māpunapuna has projected complete inundation up to 3 feet in a Category 1 hurricane. This AAP will address hurricane resilience. **Tsunami:** Māpunapuna is within the extreme tsunami evacuation zone. The AAP will include tsunami resilience.

Extreme Heat: Māpunapuna has a high afternoon extreme heat index, above 90 degrees Fahrenheit. The AAP will consider risk reduction for extreme heat.

PROJECT COMPONENTS

PLAN/STUDY

Māpunapuna is already at significant risk of acute flooding events, which will be exacerbated by SLR. Māpunapuna is a potential case study for managed retreat opportunities and has opportunity for significant land use and development changes in the long-term. Māpunapuna will experience impacts under near-term SLR (beginning at 1 foot SLR), requiring significant adaptation in the mid-term (by 3 feet SLR). Keʻehi Lagoon Beach Park is also within Māpunapuna and should be considered in the plan for ways to improve, protect, and utilize the park space to achieve area goals. Māpunapuna also contains Hawaiian Homeland properties, so there may be additional opportunities for protecting or restoring cultural resources and using traditional Hawaiian practices, particularly in those areas. Overarching adaptation strategies can be adopted from the One Water Honolulu Plan strategy list as appropriate. Additionally, potential adaptation projects have been identified in the FEMA Māpunapuna Area Drainage Study and Action Plan (2024) that may be considered separately as foundations for potential adaptation projects.

Specific tasks or chapters in the AAP may include the following:

1. **All-Hazards and Data Review and Analysis.** This review will include existing and future drainage conditions in the context of planned redevelopment. The review will combine and summarize climate risk data from existing studies. This detailed hazard exposure analysis will utilize the existing data from the One Water Honolulu Plan, the FEMA Māpunapuna Area Drainage Study and Action Plan, and other existing works. Climate data will be incorporated to provide decade-by-decade projections of hazard extent within Māpunapuna to understand current and future exposed assets or properties. This step will be followed by outreach to communicate the findings to stakeholders to widen awareness of climate impacts.
2. **Identify and Establish Necessary Institutions for Authority and Funding.** This task will identify the necessary institutions that will have the authority to implement projects, policies, funding, guidelines, and requirements. These institutions could include a redevelopment authority or special improvement district. This area will be a TOD special district, which could be used as the boundary for requests, using an overlay. It is necessary that the institution will be able to generate funding to finance and manage the planning, design, and construction projects. The City and State should consider establishing an Improvement District, a community facility district, or creating or amending an existing redevelopment authority like the Hawai'i Community Development Authority (HCDA), with the authority, resources, and responsibility to take a regional approach to establish rules and manage the planning, financing, design and construction of major sea level rise adaptation and redevelopment projects in Māpunapuna. It should be considered that a redevelopment authority would remove the planning authority from DPP. Developing proportionate cost share agreements is an important precursor to enable actionable outcomes.
3. **Adaptation Pathway Identification.** Adaptation pathways for specific areas, infrastructure, and/or projects will be defined that include triggers and decision-points based on climate impacts such as sea level rise. The first step in this stage is defining potential pathways, which should include FEMA Alternative 5 flood protection, road raising, and managed retreat. The pathways will include sea level rise

PROJECT COMPONENTS

triggers for major regional adaptations, including the timing and when a pathway is no longer considered feasible. The retreat pathway(s) should include proposed land uses for post-retreat scenarios including stormwater detention that can be used for the surrounding areas, public parks, and open space.

4. **Outreach and Engagement.** The community engagement includes community members, technical experts, stakeholders, the One Water Panel, technical consultants, and academic researchers. Engagement should include the stakeholders early in identifying and understanding the potential adaptation pathways. Outreach should span all planning phases.

The AAP outcomes include:

1. **All-Hazards Exposure.** The outcome of the decade-by-decade analysis will be an early deliverable that can inform the regional adaptation and pathways analysis and will be paired with outreach.
2. **Special District and/or Redevelopment Authority.** Creating this district or authority establishes the authority needed for adaptation pathways to be pursued, and importantly the ability to raise funds. The funding structure will enable financing of projects or receipt of land in the case of retreat.
3. **Adaptation Pathways.** The adaptation pathways will include timing of projects and policies related to climate triggers, likely based on sea level rise. The pathways will include triggers for planning efforts, road raising, large-scale shoreline resilience projects, and managed retreat. Multiple pathways will be considered, including decision-points. A cost-benefit will be considered for large-scale adaptation and flood protection considering a retreat alternative. Sea level rise triggers will be established considering a level that should trigger retreat, a level to implement phased adaptations, and a rate of sea level rise that would deem road raising and other temporary adaptations ineffectual.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ☐ Protects cultural sites
- ☒ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

PROJECT COMPONENTS

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Maintain safe and reliable community access by increasing the resilience of drainage systems and roads to flooding Mitigate impacts of urban heat Improve stream and nearshore water quality and ecosystem health
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Develop a unified roadmap and decision-making process under a One Water approach
CRO Strategies Supported:	**#9**: Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	• Area Adaptation Plan • Drainage System Plan • Infiltration and Inflow Study
Expected Timeline:	Timing of SLR impacts: Māpunapuna is projected to have impacts beginning at 1 foot of SLR. Additional flood mechanisms have impacts under higher SLR, and all impacts increase with SLR. This project will likely need to be coordinated/interact with the following other projects: • FEMA Māpunapuna Area Drainage Study and Action Plan (2024) • OWH Project #33 Managed Retreat Legal and Policy Investigation Study • OWH Project #35 Road Raising Strategy • OWH Project #101 Iwilei Area Adaptation Plan • OWH Project #102 Pilot Floodable Spaces • OWH Project #105 Resilience Corridors and Road Raising • OWH Project #106 Reuse Strategy for Redevelopment Areas • OWH Project #110 Māpunapuna Flood Improvements • Longer-term retreat from the Māpunapuna area

PROJECT COMPONENTS

Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Managed retreat is rarely a favorable outcome for adaptation, and will require significant planning, stakeholder engagement, buy-in, and advance notice. Engaging the community in this planning early will enable conversations and decision-making to include near-term goals as well as potential alternatives to retreat and ways to support the community long-term.
Additional Considerations:	• Adapt Waikīkī is organized around the existing Waikīkī Special District, which provides an established boundary and regulatory framework for that plan. Whether a comparable special district designation would benefit Māpunapuna or other AAP areas should be evaluated as part of this plan. • The FEMA Māpunapuna Area Drainage Study and Action Plan (2024) made recommendations, and the Alternative 5 has been recommended to move forward. This should be a central consideration in the Māpunapuna AAP, and the AAP should be sure to build on the FEMA report and not be duplicative.
Technical Considerations:	• Māpunapuna has settled up to 5 feet in some areas in the last 85 years due to compression of the clay soil. Future settlement and soil properties are important to consider for future projects and development. • The groundwater in Māpunapuna has been found to be tidally influenced and is anticipated to be directly impacted by sea level rise. Rise in the shallow groundwater table must be considered, particularly for any infiltration or subsurface projects.

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ACRONYMS

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CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
E.B.	Eastbound
ENV	Department of Environmental Services
FEMA	Federal Emergency Management Agency
HCDA	Hawaiʻi Community Development Authority
HDOT	State of Hawaiʻi Department of Transportation
N/A	Not Applicable
OWH	One Water Honolulu
PacIOOS	Pacific Islands Ocean Observing System
PUC	Primary Urban Center
SLR	Sea Level Rise
SOEST	School of Ocean and Earth Science and Technology
SoVI	Social Vulnerability Index
SW	Stormwater
TOD	Transit-Oriented Development
W.B.	Westbound
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

ALA WAI WATERSHED INTEGRATED STORMWATER MANAGEMENT

PROJECT CONCEPT

GENERAL DESCRIPTION

The Ala Wai Watershed is comprised of approximately 12,033 acres; the watershed includes the sub-watersheds of Makiki, Mānoa and Pālolo streams, and extends from the top of the Koʻolau Mountains to the near-shore waters of Waikīkī and Māmala Bay. The Ala Wai Watershed was selected as a priority watershed because of the historical and cultural importance of this watershed and its contemporary importance as a center of educational, economic, and community activities. With a population of approximately 200,000 people, this watershed is home to 40% of the people of the Primary Urban Center. In addition, Waikīkī has a visitor population of approximately 50,000 to 100,000 people depending on the season.

The Ala Wai Canal is a 2-mile long man-made waterway that was constructed during the period 1920-1924 to provide land in Waikīkī for the construction of homes, hotels, and retail establishments. Waikīkī was originally a wetland and estuary landscape that was converted by native Hawaiians into a productive area with many taro fields and fishponds. The Canal was originally dredged to a depth of -10.0 to -25.0 feet MSL, but sediment transported into the canal by the tributary streams decrease this depth substantially and the canal requires periodic dredging. Water quality within the Ala Wai Canal is degraded due to pollutant inputs from the three tributary streams and storm drain systems that discharge from both the Mōʻiliʻili (mauka) and Waikīkī (makai) sides.

From community engagement, the following values and objectives were identified:

1. Restore Hawaiian cultural water and land practices, where practicable,
2. The native Hawaiian concepts of conservation and natural resources management that are embodied in the Hawaiian concepts of ola i ka wai and mālama ʻāina should be the guiding principles,
3. The most durable and equitable solutions involve the community,
4. Watershed processes are interconnected, with conditions in upstream areas influencing downstream resources and surface water interactions affecting groundwater systems,

PROJECT CONCEPT

5. Value and manage stormwater as a resource rather than a hazard. Stormwater should be held and used on-site as much as possible,
6. Stormwater should be managed through distributed interventions implemented throughout the watershed,
7. Recognize that space is not a limiting factor to scaling up green infrastructure and incentives should be provided,
8. Promote community understanding that stormwater management is everyone's kuleana. Long-term implementation will require sustained stakeholder support and continued community engagement,
9. Through the One Water collaboration framework, agencies and stakeholders can work effectively to improve public health, economic well-being, and the environment, and
10. Community participation and behavior change are important factors in achieving long-term watershed resilience goals.

ID #:	123
Timeframe:	Near-term
Champion Agencies:	DFM, BWS
Potential Partnerships:	CCSR, DPP, DDC, DTS, DPR, Ala Wai Watershed Collaboration, Kumuola Foundation, Waikīkī Business Association
Adaptation Strategy Type:	Program
Location of Project:	Waikīkī, PUC
Area Classification:	Major Hubs & Economic Centers
Hotspot:	Waikīkī
Congressional District:	1
Council District:	IV, V, VI

PROJECT CONCEPT

Legislative District:	House Districts 20, 21, 22, 23, 24, 25, 26, 27
Neighborhood Board:	Diamond Head/Kapahulu/St Louis Heights Subdistricts 1 and 2, Nuʻuanu Subdistricts 1, 2, and 3, Waikīkī Subdistricts 1, 2, and 3, McCully/Moʻiliʻili, Ala Moana/Kakaʻako Subdistrict 3, Pālolo Subdistricts 1, 2, and 3, Mānoa Subdistrict 1, Kaimuki Subdistricts 1, 2, 3, and 4
Oʻahu SoVI Index:	Low



USACE rendering of the "One Percent Annual Chance Exceedance Flood" for Waikīkī and Mōiliʻiliʻi. There is a one percent chance that a flood of this magnitude could occur in any given year.

Figure 1. One-percent chance of flood for Waikīkī and Moʻiliʻili

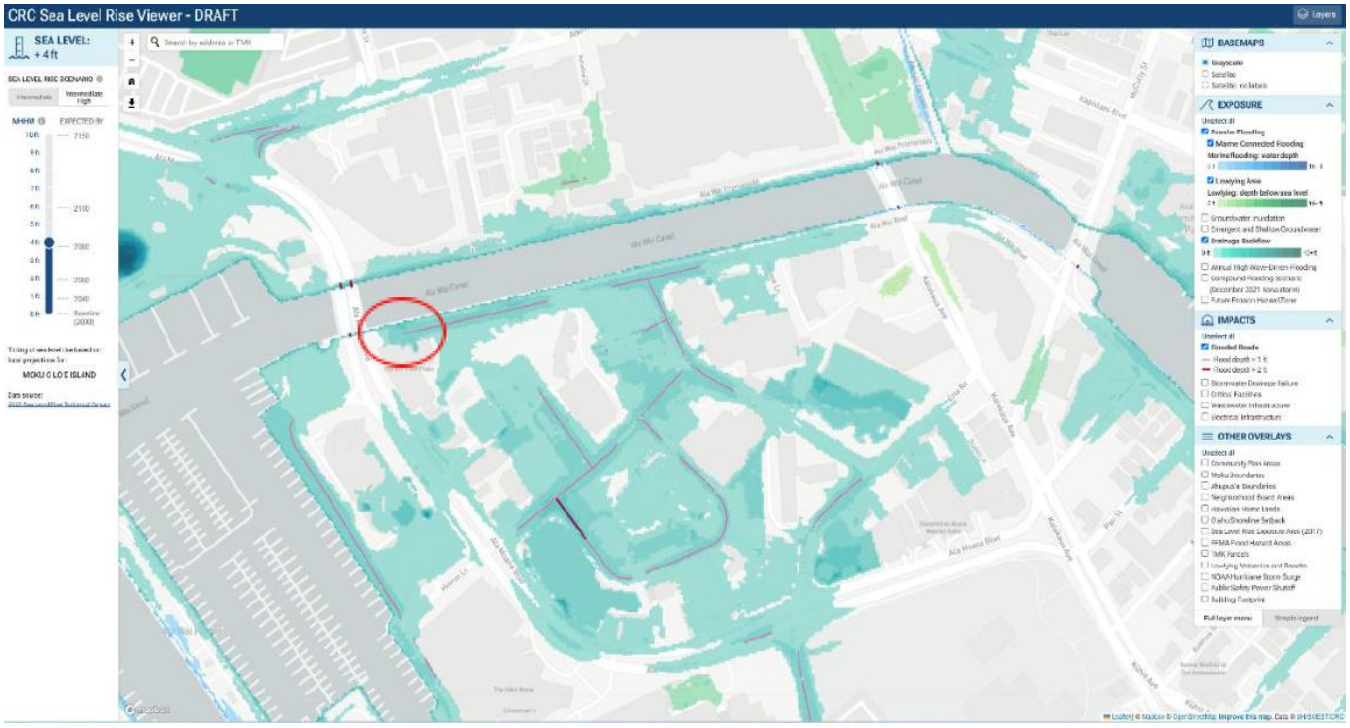
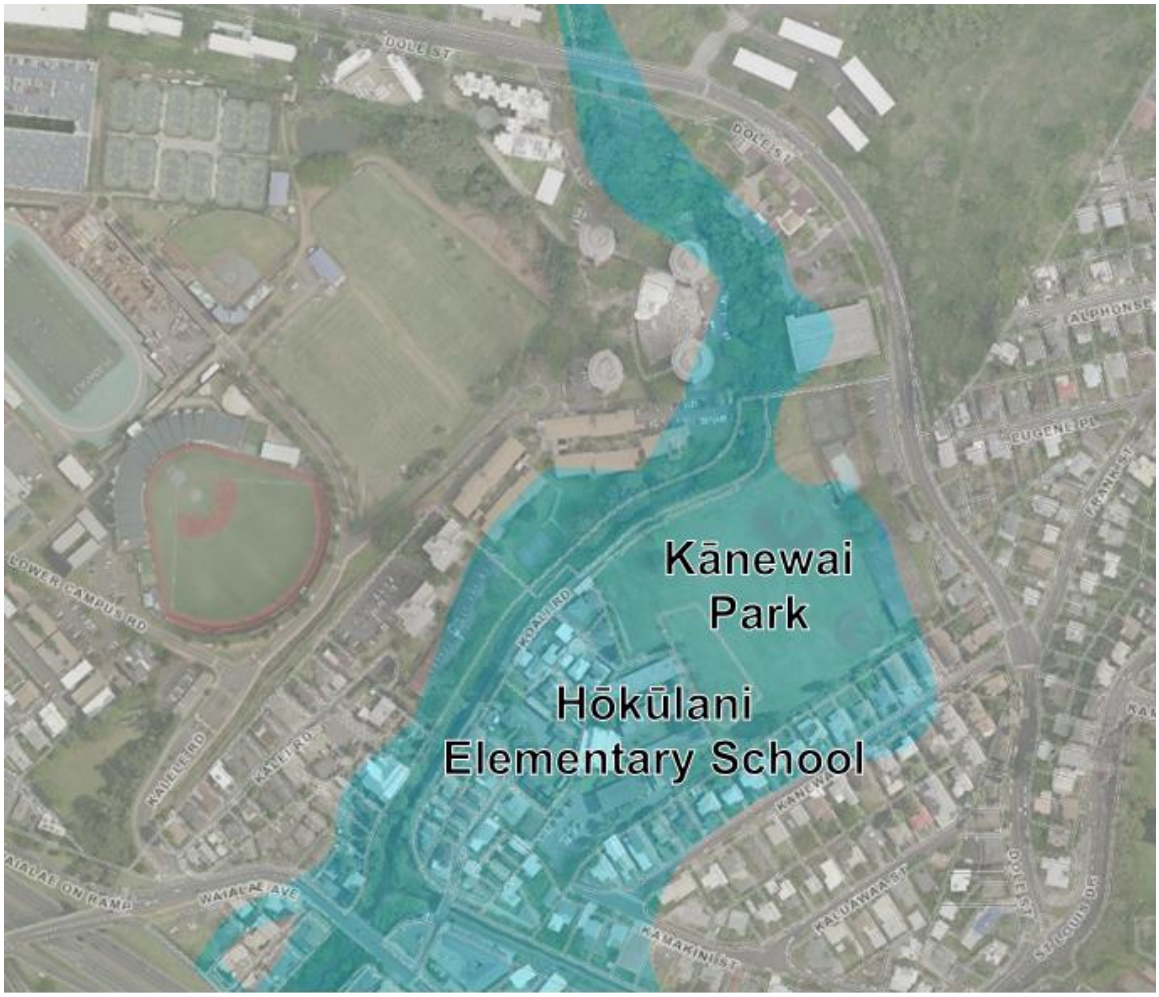


Figure 2. West Waikīkī with possible stormwater pump station at end of Ala Wai Blvd and canal flood wall between Ala Moana Blvd and Kalākaua Ave.



Flood Zone AE (100-year flood zone or high risk flood area).

Figure 3. Flood Zone AE (100-year flood zone or high-risk flood area) includes a school and park, amongst other buildings.

PROJECT CONCEPT

Infrastructure Assets at Risk:

Water: Very high risk/high risk pipelines

Wastewater: 10-in/20-in/27-inch sewer main

Stormwater: Ala Wai Canal, 18-in/24-in/48-in/60-in/66-in SW conduits

Roads: Ala Wai Blvd, Seaside Ave, Kānekapōlei St

Community Assets at Risk:

Beaches and Parks:

At 1 foot of SLR, some beaches begin to experience flooding and coastal erosion. At 3-4 feet of SLR, beaches and parks are increasingly vulnerable to coastal inundation, annual high wave-driven flooding, and emergent groundwater. These hazards can result in chronic flooding, saturated soils, drainage backflow, loss of usable recreational space, and damage to landscaping, amenities, and other park infrastructure.

Schools, Hospitals and Access Roads:

Schools and hospitals within Iwilei, Waikīkī, and the broader PUC area are vulnerable to flooding from extreme rainfall and sea level rise, which can restrict access and disrupt services. These facilities would benefit from enhanced stormwater management, including improved drainage, subsurface capture, and integration with nearby floodable spaces to reduce localized flooding while maintaining safe access.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:

Climate Resilience: MEDIUM

Sea Level Rise (Above Ground): Waikīkī, Makiki, Ala Moana Beach Park, Kapiʻolani Park, Ala Wai Community Park, Ala Wai Neighborhood Park, and the Ala Wai Golf Course are vulnerable to coastal inundation, annual high wave-driven flooding, and drainage backflow associated with sea level rise. Stormwater structures, notably those along Ala Wai Blvd in West Waikīkī, will begin to fail with 1 foot of SLR. Ala Wai Canal, Mānoa Stream and two ocean inlets on either side of Iwilei are impacted by sea level rise. At 3 feet of SLR, the streams experience overtopping and begin to impact local infrastructure. Watershed-scale stormwater management, green infrastructure, and drainage improvements can help reduce localized flooding, improve drainage system performance, and increase resilience to compound flooding.

Sea Level Rise (Groundwater): Waikīkī and lower Makiki are vulnerable to shallow and emergent groundwater resulting from sea level rise and the area's porous geology. Rising groundwater can reduce drainage effectiveness, contribute to chronic flooding, and increase stress on underground infrastructure. Under 1 foot of SLR, several areas will experience emergent and shallow groundwater which can corrode pipelines and cause

increased infiltration into the stormwater and wastewater collection systems. Flooding and corrosion will create challenges for main break repairs in low-lying regions. Stormwater capture, retention, infiltration, and reuse strategies can help manage runoff closer to its source, reducing pressure on drainage systems and supporting long-term adaptation to groundwater inundation.

100-Year Flood: The Ala Wai Watershed is vulnerable to flooding during extreme rainfall events, particularly along the Makiki, Mānoa, and Pālolo stream corridors where runoff can exceed drainage capacity. During extreme rainfall events, constrained drainage systems may become overwhelmed, resulting in localized flooding, drainage backflow, and reduced system performance throughout Waikīkī. Distributed green infrastructure, detention and retention opportunities, floodable spaces, and other watershed-scale stormwater management measures can reduce runoff volumes, slow peak flows, improve water quality, and lessen flood impacts throughout the watershed.

Coastal Erosion: Waikīkī Beach and low-lying coastal parks are vulnerable to shoreline erosion and the loss of recreational and coastal resources. While this project does not directly address erosion, watershed management actions that improve water quality, reduce pollutant loading, and enhance coastal ecosystem health can support broader coastal resilience and shoreline management efforts.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

The Ala Wai Watershed Integrated Stormwater Management project requires several critical components to reduce flood risk and enhance water quality to restore the lands and waters of this watershed to a reasonable level of health and equilibrium.

Community Education and Involvement

- Promote water conservation, resource stewardship, and community awareness through educational programs and outreach initiatives.
- Continue educational programs, especially in schools to build a resource conservation ethic.
- Connect conservation mindfulness to the actions people take.
- Continue DFM's Everyday Clean Water Hero, Mauka to Makai Environmental Expo, Adopt-A-Stream and Storm Drain Marking programs to involve and educate the public to not dump waste into storm drains in order to protect water quality, public health, safety, property and the nearshore environment.
- Expand BWS water conservation programs to achieve long-term water sustainability, reduce costs and conserve potable water for drinking.
- Expand conservation rebate programs for rain barrels, clothes washers and weather-based irrigation controllers and enforce uniform plumbing codes to require more efficient plumbing fixtures such as toilets, shower heads, faucets, etc.
- Reuse rainwater on-site.

Management of Mauka Forests and Conservation Districts

- Implement forest management practices, including invasive species removal and ungulate control, to improve watershed function, reduce erosion and sediment transport, slow runoff, and enhance aquifer recharge.

Green Infrastructure for Urban Spaces

- The Urban Kīpuka Analysis will evaluate opportunities to use public spaces for stormwater management through a combination of engineered green, blue, and gray infrastructure, integrating hardscape, water features, and vegetated areas into multi-benefit recreational spaces that detain runoff, reduce pressure on the stormwater system, and enhance the resilience of the urban landscape during and after storm events.
- Expand opportunities for green infrastructure within residential, commercial, and public properties throughout the watershed, and provide incentives to offset initial capital costs.
- Promote on-site reuse to capture and retain rain water, recharge the aquifer and reduce potable water used for irrigation.

PROJECT COMPONENTS

- DFM's low impact development standards requiring green infrastructure should apply to all new and re-developed properties.
- DFM's proposed Stormwater Utility and Fee will incentivize property owners to reduce impervious surfaces.
- Stream bank vegetative restoration will reduce erosion of stream banks and ecosystem restoration will improve habitat for native aquatic species, protect and expand riparian zones, enhance populations of native plant species, and improve water quality.
- Phase out cesspools and connect to the City's sanitary sewer system to eliminate discharges to streams.
- Restore Hawaiian cultural water and land practices, where practicable through loʻi kalo restoration along streams, including: UH Hawaiian Studies Center, Ka Papa Loʻi ʻO Kānewai in Mānoa Stream, BWS Hālau Wai Mānoa Loʻi Restoration in mauka Manoa Stream, Hālau Ku Mana Loʻi ʻo Moleka in Makiki Stream and Ke Kula Kaiapuni ʻo Ānuenue in Pālolo Stream.

Gray Flood Mitigation Infrastructure

- Detention basins on public lands to reduce peak stormwater flows and thus mitigate existing undersized drainage systems in the urban spaces from being overwhelmed in a major storm. The community is against the acquisition of private lands and siting heavily used public parks for detention basins. However, some publicly owned facilities, such as the Ala Wai Golf course, may lend themselves to berming and multi-purpose stormwater detention and recreational uses.
- Diversion structures could help to bypass flows in existing streams and canals with insufficient capacity to reduce backwater conditions and prevent overtopping.
- Multi-purpose flood walls around the Ala Wai Canal can protect Waikīkī from flooding. These improvements can be designed to accommodate pedestrian access and recreational use, improving aesthetics.

Sea Level Rise Adaptation

- Install storm drain outlet backflow preventers to allow runoff to discharge while preventing high-tide waters from entering the drainage system. Because the porous limestone geology underlying Waikīkī allows groundwater-driven flooding, flood walls alone may be insufficient to address long-term sea level rise impacts. However, strategically placed walls and berms can help reduce overtopping of the Ala Wai Canal and associated flooding during high tides and future sea level rise conditions.
- Additional adaptation measures may include elevating flood-prone streets and private properties, as well as implementing seawater pump stations in areas where elevation-based solutions are not feasible.
- Repurposing the Beachwalk sewer pump station for stormwater management could also help convey saltwater and stormwater to the eastern end of the Ala Wai Canal, improving circulation and supporting water quality improvements.

INFRASTRUCTURE

N/A

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☒ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality **?** Improves public access to community spaces **?** Increases public awareness/education ☒ Provides ecosystem restoration **?** Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Reduce economic disruption for residents, workers and businesses from groundwater and overland flooding Enhance public safety and maintain access to essential services from groundwater and overland flooding Improve drainage/reduce flooding Improve water quality and ecosystem health
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#2**: Amplify and create capacity for community-led climate adaptation. **#6**: Improve watershed health to mitigate wildfire risk and manage flooding. **#7**: Strengthen fresh water security by improving water conservation and reuse.
Relevant Adaptation Strategies:	• Stormwater Capture and Use • Implement Low Impact Design (LID) Green Infrastructure Stormwater Management Strategies • Onsite Stormwater Management Incentives

PROJECT COMPONENTS

- Incorporate Non-Structural Hazard Mitigation Measures
- Increase or Preserve Site Tree Canopy Coverage, Natural Planted Areas or Wetlands
- Study to Incorporate Native Hawaiian Practices for Resilient Design

PROJECT COMPONENTS

EXAMPLES

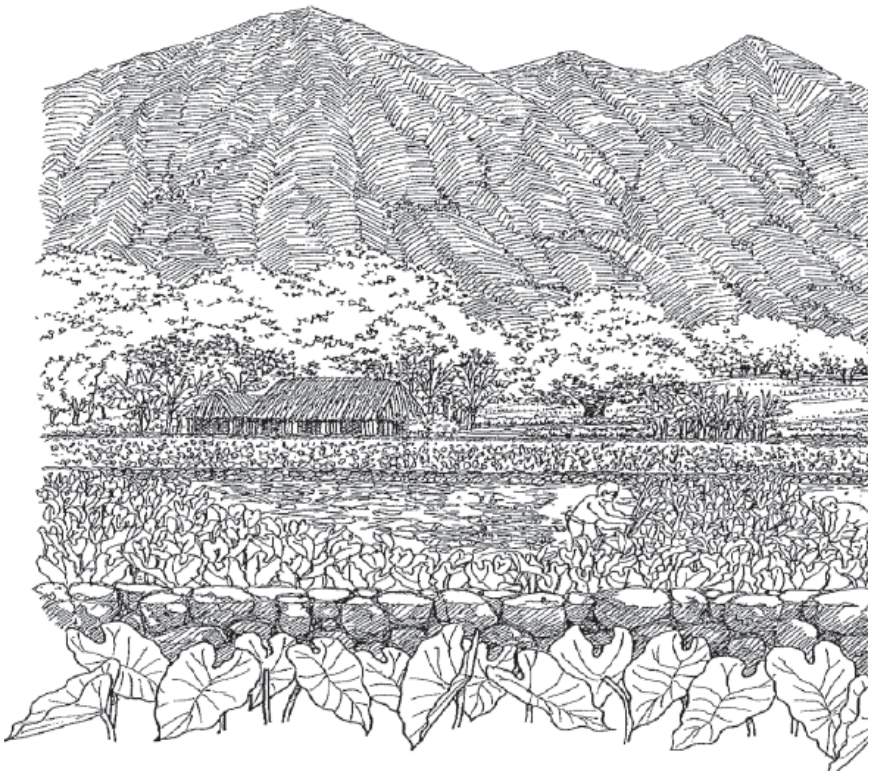


Figure 4. BWS Hālau Wai Manoa Loi Restoration

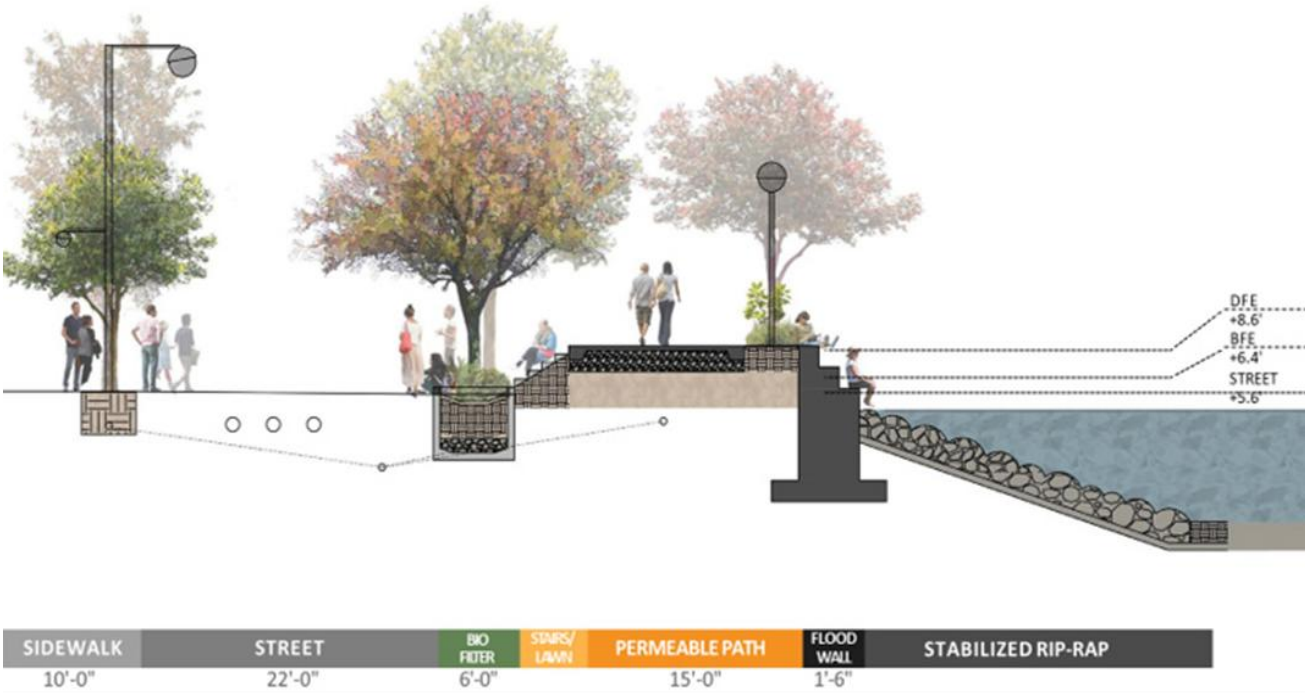


Figure 5. Multi-purpose flood wall example from the Kapālama Canal Catalytic Project

[1] - Source: Unknown

[2] - Source: *https://www.honolulu.gov/tod/projects/planning-initiatives/kapalama-canal/*

PROJECT COMPONENTS

Expected Timeline:	Near-Term Alignment with Other Proposed and Ongoing Projects: • OWH Project #39 Onsite Stormwater Management Incentives • OWH Project #102 Pilot Floodable Spaces • OWH Project #105 Resilience Corridors and Road Raising • OWH Project #109 Green Infrastructure Implementation Plan • OWH Project #165 Stormwater Master Plan • OWH Project #166 Projects from the Integrated Plan
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1M-$10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Creation of the Stormwater Fee to fund drainage improvements, green infrastructure, and impervious surfaces incentives. • No space for expansion of stream channels to address more intense storms. • Opposition to an Ala Wai Canal flood wall, detention basins in parks. • Poor water quality of Ala Wai Canal.
Additional Considerations:	• Beach replenishment, groin expansion to save Waikīkī beach. • Engage community to build understanding of floodable spaces. • Geologic conditions increase the risk for groundwater impacts. • Four loʻi kalo restoration sites already exist as leading examples for opportunities.

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ACRONYMS

BWS	Board of Water Supply
CCH	City and County of Honolulu
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
LID	Low Impact Development
MSL	Mean Sea Level
N/A	Not Applicable
n.d.	No Date
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
USACE	United States Army Corps of Engineers

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

UNIVERSITY AVENUE URBAN COMPLETE STREETS AND GREEN INFRASTRUCTURE

PROJECT CONCEPT

GENERAL DESCRIPTION	This near-term project advances a federally funded traffic safety and roadway rehabilitation effort along University Avenue, led by the City and progressing into design under DDC. The corridor extends from Hīhīwai Street to Maile Way and is currently in the preliminary engineering stage, with improvements focused on enhancing pedestrian and bicycle safety while supporting drainage considerations. The corridor is located within a watershed which has both water quality and flooding challenges, which informs the integration of stormwater management strategies into the roadway design. Opportunities for green and blue infrastructure are being explored, including the use of permeable materials, targeted drainage elements, and selective reduction of excess pavement and hatched areas to manage runoff and avoid worsening existing flood conditions. The project builds on an existing Complete Streets framework that includes reconstructed sidewalks, curb and gutter improvements, upgraded crosswalks, and dedicated bicycle facilities such as protected and marked bike lanes integrated within the roadway section. These improvements aim to expand access for pedestrians and cyclists while creating space within the right of way for distributed stormwater features and flexible material strategies. Considerations include addressing existing flooding conditions in areas such as the McCully corridor and limiting additional runoff in locations with limited drainage infrastructure. The design approach emphasizes the use of permeable surfaces and context sensitive drainage solutions within constrained urban conditions, particularly in bicycle lanes and underutilized paved areas.
ID #:	170
Timeframe:	Near-term
Champion Agencies:	DTS, DDC, DFM
Potential Partnerships:	N/A

PROJECT CONCEPT

Adaptation Strategy Type:	Infrastructure
Location of Project:	Various locations, PUC. Potential replication islandwide
Area Classification:	Critical Hubs & Economic Centers
Hotspot:	Included based on discussion with OWH Panel
Congressional District:	1
Council District:	V
Legislative District:	House District 23, 24
Neighborhood Board:	McCully/Moʻiliʻili
Oʻahu SoVI Index:	Medium

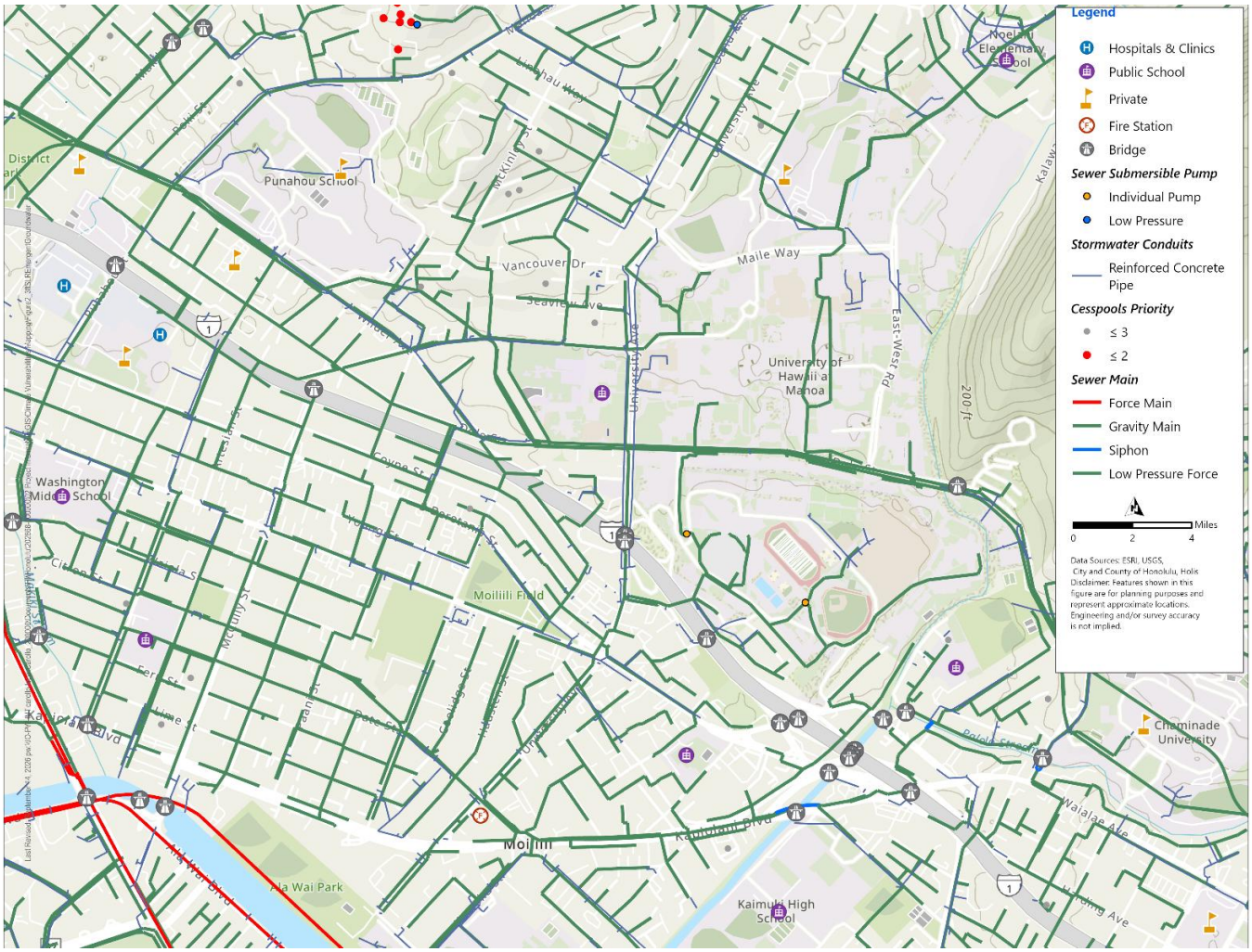


Figure 1. Map of Assets in Project Area

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Water lines **Wastewater:** Sewer mains, sewer laterals and 2 submersible sewer pumps on the UH Campus **Stormwater:** Catch basins and stormwater drain lines **Roads:** University Avenue corridor (Hīhīwai Street to Maile Way), McCully corridor, Date Street corridor Low lying roadway segments and adjacent areas in the McCully and Date Street corridors
Community Assets at Risk:	**Schools:** UH Mānoa campus facilities along University Avenue, including the Campus Center and nearby academic buildings Campus areas near Dole Street and East-West Road **Recreational and Cultural Facilities:** Clarence T.C. Ching Athletics Complex Les Murakami Stadium Japanese Cultural Center of Hawai‘i **Parks:** Green spaces within Mānoa Valley and areas adjacent to Mānoa Stream Community-scale recreation areas and landscaped open spaces within and around the UH Mānoa campus **Neighborhoods:** Residential neighborhoods in Mānoa Valley and along Metcalf Street, Wilder Avenue, and surrounding streets Residential areas near the McCully and Date Street corridors

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **100-Year Storm:** Increased roadway and localized flooding due to limited drainage infrastructure and high impervious surface coverage along the corridor; ponding and overtopping of roadways and intersections, particularly in low lying areas such as McCully and Date Street, resulting in reduced access to adjacent neighborhoods and

	community assets. Complete streets would reduce impervious surfaces and runoff, increase stormwater infiltration and detention, and reduce impacts from rainfall events. **Extreme Heat:** Heat accumulation within wide paved roadway sections and excess pavement areas contributing to elevated surface temperatures along University Avenue; thermal stress on pedestrian and bicycle infrastructure, including sidewalks and bike lanes, reducing usability and comfort in areas with limited shade or vegetative cover. Urban heat effects will be reduced by increasing shade structures, tree cover, and green space, and reduced asphalt and other impervious cover.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

N/A

INFRASTRUCTURE

Roadway and Safety Improvements

- Rehabilitate the University Avenue corridor from Hīhīwai Street to Maile Way through pavement reconstruction, curb and gutter replacement, sidewalk reconstruction, and reconfiguration of the roadway cross section.
- Implement Complete Streets elements including protected and buffered bicycle lanes, shared lane markings, upgraded crosswalks (including raised crosswalks), median refuge islands, and traffic control signage to improve multimodal safety and accessibility.

Stormwater and Drainage Integration

- Reconstruct curb and gutter systems and maintain roadway grade at the crown while modifying curb alignments and roadway geometry to influence runoff pathways within the corridor.
- Incorporate drainage clearance adjacent to raised crosswalks and curb extensions to maintain flow conveyance along the curb line and prevent localized ponding at intersections.
- Coordinate median islands, curb extensions, and bus boarding areas with roadway drainage patterns to avoid creating new barriers to surface flow and to support controlled runoff routing within the right-of-way.
- Target low-lying segments and intersections in the McCully and Date Street corridors for grading and drainage coordination to reduce recurring ponding and improve surface runoff conveyance.

Permeable Surfaces and Depaving Opportunities

- Evaluate excess pavement, striped, and hatched areas for removal or conversion to reduce impervious cover and improve runoff management.
- Assess and incorporate permeable or alternative surface materials within bicycle lanes, pedestrian areas, and underutilized paved zones, where feasible, to increase infiltration and reduce stormwater runoff.

Pedestrian and Bicycle Infrastructure Expansion

- Construct and reconstruct sidewalks, shared-use paths, and curb ramps along the corridor, including widened pedestrian facilities and new shared-use path segments (e.g., along Dole Street and adjacent key intersections) to improve accessibility.
- Incorporate protected bicycle lanes, bike boxes, and enhanced crossing treatments that are coordinated with roadway geometry and drainage considerations to support safe multimodal travel.

PROJECT COMPONENTS

Flood Risk Reduction and Corridor Adaptation

- Address recurring flooding in areas such as the McCully and Date Street corridors through integrated roadway grading, drainage coordination, and runoff management measures embedded within the corridor design.
- Advance corridor-scale design strategies that reduce runoff generation, improve conveyance, and avoid exacerbating existing flooding conditions while maintaining roadway function.

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☒ Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Flood protection and reduced flooding in residential areas Long-term protection of watershed and ecosystem health Invest in resilient infrastructure to withstand extreme weather conditions and natural disasters
OWH Objectives Supported:	Practice shared kuleana, enhance coordination, work together, collectively advocate
CRO Strategies Supported:	**#6**: Improve watershed health to mitigate wildfire risk and manage flooding **#9**: Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	• UHI Reduction with Enhanced Green Spaces • Mauka stormwater treatment, retention, and infiltration

PROJECT COMPONENTS

Expected Timeline:	There is a need for this project now, so it should be prioritized in the near-term.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$1-10M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Coordinating roadway rehabilitation and drainage integration within a constrained urban right of way along University Avenue
- Balancing traffic safety improvements with reduction of impervious surfaces might occupy limited right-of-way space and constrain opportunities to remove pavement or incorporate permeable materials.
- Retrofitting stormwater management strategies into an existing corridor with limited drainage infrastructure
- Balancing flood risk reduction with cultural, ecological, and community priorities

Additional Considerations:

- Limited space to incorporate drainage features, permeable surfaces, and green infrastructure within existing roadway geometry
- Need to integrate stormwater strategies with existing roadway, pedestrian, and bicycle infrastructure elements
- Managing runoff within areas of high impervious cover, including excess pavement and hatched zones
- Ensuring new sidewalks, bike lanes, and crossings are designed to function under both flooding conditions and extreme heat exposure

REFERENCES

None

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
PUC	Primary Urban Center
SoVI	Social Vulnerability Index
UH	University of Hawaiʻi
UHI	Urban Heat Island

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

CENTRAL OʻAHU WATER RECYCLING FACILITIES, MILILANI

PROJECT CONCEPT

GENERAL DESCRIPTION

There is an opportunity to evaluate the feasibility of repurposing the existing Mililani Pre-Treatment Facility and upgrading it to produce R-1 quality recycled water. Currently, the headworks is in operation to provide preliminary grinding and grit removal before the wastewater is sent to Honouliuli WWTP. A feasibility study would evaluate the upgrades needed at the existing facility to produce this level of recycled water. It would also evaluate nearby opportunities where R-1 water could be used.

As an example, recycled water produced at the Mililani Reclamation Facility could be used for irrigation of nearby parks such as the Central Oʻahu Regional Park (CORP). Under current DOH Reuse Guidelines, R-1 quality water has few restrictions on the application of recycled water for irrigation purposes and allows for spray irrigation of parks with appropriate signage. CORP would be a viable option for reuse, and using gravity fed recycled water from an upstream Mililani scalping facility would be able to meet most or all of its existing non-potable irrigation water demand through the use of recycled water, and thereby eliminate the current use of potable water from a nearby BWS well for park irrigation purposes.

Another incentive (i.e., driver) and benefit for locating a small scale, decentralized reclamation facility in Central Oʻahu is the mitigation of projected climate change impacts on future ground water supplies. Certain scenarios, which project reduced rainfall and ground water recharge, could result in a lower ground water sustainable yield ultimately reducing the availability of potable water supply to meet future demand in Central Oʻahu, including the ability to augment potable water supply in other districts. The potential impacts of climate change and periods of prolonged drought conditions give rise to the need for and importance of alternative water supplies to meet future demands.

In combination with aggressive implementation of water conservation measures, wastewater reclamation can be viewed as a “no-regrets” action that would help preserve potable water supplies for the highest and best use. Recycled water is a safe, reliable, and consistent (drought-proof) source of non-potable water supply that can be beneficially developed to help meet projected water demands in Central Oʻahu.

PROJECT CONCEPT

ID #:	167
Timeframe:	Near-term
Champion Agencies:	BWS, ENV
Potential Partnerships:	DPR
Adaptation Strategy Type:	Plan/Study
Location of Project:	Central Oʻahu
Area Classification:	Recharge and Runoff Management Opportunities
Hotspot:	Included based on discussion with OWH Panel
Congressional District:	1
Council District:	VIII
Legislative District:	House District 37
Neighborhood Board:	Mililani-Waipiʻo-Melemanu
Oʻahu SoVI Index:	Medium



Figure 1. Satellite View of Central O‘ahu



Figure 2. Satellite View of the Mililani PTF

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Very high risk/high risk pipelines, nearby critical wells **Wastewater:** Mililani Pre-Treatment Facility, Mililani WWPS, Honouliuli WWTP, sewer lines are not necessarily at risk from drought but may be impacted by this project **Stormwater:** Drainage infrastructure is not necessarily at risk from drought, but streams and associated infrastructure may be impacted by this project (could include Kipapa Stream, Waikele Stream, Waipahu Stream, Waiawa Stream) **Roads:** Roads are not necessarily at risk from drought but may be impacted by long-term recycled water infrastructure improvements
Community Assets at Risk:	Mililani District Park, Central O'ahu Regional Park, Waipio Neighborhood Park, Waikele Country Club, Straub Benioff Medical Center, Mililani schools (Mililani High School, Mililani Uka Elementary School, etc.), Mililani Memorial Park and Mortuary

Note: Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Drought:** Concern for long-term aquifer recharge and potable water supply for this area. R-1 reuse and distribution will reduce the potable water needs for irrigation and leave more potable water available for drinking water and maintaining streamflow. **Extreme Heat:** Increased heat will increase water demand. By replacing potable water with R-1 where possible, demand on the potable water system can be reduced.

PROJECT COMPONENTS

PLAN/STUDY

The project must begin with a planning phase to determine the feasibility of converting the former Mililani WWTP into a facility that can produce non-potable water. The site is currently being used as a preliminary treatment facility (PTF) for wastewater flows from Mililani, and it could be developed and repurposed to house a new reuse treatment facility, which could produce R-1 quality recycled water for beneficial reuse. The conceptual Mililani Reclamation Facility could be designed as a scalping facility, which is a type of decentralized wastewater treatment facility that takes and treats as much water as needed to match existing demand and produces a high quality non-potable water supply.

The study would need to determine how much wastewater could be scalped from flows being sent to Honouliuli WWTP without impact to the suspension of solids and downstream flows. More information is needed to determine how much can be scalped without causing solids to settle out in the pipeline or other potential concerns regarding the siphon located downstream of the Mililani PTF.

PROJECT COMPONENTS

The study would also assess other non-potable water supply constraints relative to the service area location, available storage and conveyance infrastructure, and perform a life-cycle cost-benefit analysis to determine the financial feasibility of the project. The study would also determine where the non-potable water could be used, including nearby areas such as Central O‘ahu Regional Park.

PROGRAM

N/A

INFRASTRUCTURE

The infrastructure components would be determined through the feasibility and a preliminary basis of design. The infrastructure needed could include a membrane bioreactor (MBR), UV disinfection, and conveyance infrastructure to transport non-potable water to its point of use.

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☐ Improves water quality ☒ Improves public access to community spaces ☐ Increases public awareness/education ☐ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Reduce pressure on the Pearl Harbor Aquifer to support regional water supply reliability
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient O'ahu
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse

PROJECT COMPONENTS

Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination
Expected Timeline:	The first phase of this project would be a study to determine the feasibility of converting the former Mililani WWTP into a R-1 decentralized treatment facility.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	$100,000-$1M *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• It is unclear if ENV, BWS, or another entity would own or maintain the R-1 system. BWS and ENV have begun collaboration on reuse projects and infrastructure on the Leeward side. • R-1 water is not a perfect substitute for potable water as it adds nutrients to soil when used for irrigation. Pricing of R-1 water may not be competitive with potable water options. • ENV will need to have the long-term budget and personnel to operate and maintain the expanded facility.
Additional Considerations:	• The population in this area continues to grow from the development of the Koa Ridge community alone. Only a portion of the community is currently constructed, so the actual water demand for this part of Central Oʻahu will continue to rise as the community expands. Planning/projecting for an elevated potable water demand in the future should be considered early on when weighing the feasibility and urgency of projects like this that will help improve drought resiliency and allow for a larger portion of irrigation demand in this area to be met with non-potable water.

REFERENCES

CCH Department of Design and Construction. (2000). Mililani Wastewater Reclamation Facility Feasibility Study.

Honolulu Board of Water Supply. (n.d.). Draft Central Oʻahu Watershed Management Plan.

ACRONYMS

BWS	Board of Water Supply
CCH	City and County of Honolulu
CORP	Central Oʻahu Regional Park
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPR	Department of Parks and Recreation
ENV	Department of Environmental Services
in	Inches
MBR	Membrane Bioreactor
N/A	Not Applicable
n.d.	No Date
OWH	One Water Honolulu
PTF	Pre-Treatment Facility
PUC	Primary Urban Center
R-1	R-1 Recycled Water
SoVI	Social Vulnerability Index
SW	Stormwater
UV	Ultraviolet
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

REUSE AND POTABLE WATER SERVICES FOR WHITMORE AGRICULTURE

PROJECT CONCEPT

GENERAL DESCRIPTION	The Whitmore area consists of former pineapple plantation lands transitioning to diversified agriculture with Whitmore and Poamoho residential subdivisions and Dole Helemano ORI Plantation commercial uses along Kamehameha Hwy. Water and wastewater services are limited in this area. Agriculture workforce housing and commercial developments are not possible without City water and wastewater services. Wahiawā WWTP has been upgraded to produce R-1 quality water, but DOH requires the WWTP to identify a primary disposal location in order to obtain R-1 certification. The current discharge of effluent into Wahiawā Reservoir is under an existing Consent Decree. New pipelines from Wahiawā WWTP across Wahiawā Reservoir to ADC's earthen reservoirs could provide storage for R-1 effluent and wet weather flows for drought proof irrigation water, and this would allow for DOH to provide R-1 certification. BWS provides domestic water to Poamoho and Dole Helemano ORI Plantation via two master meters along Whitmore Avenue, but long private cross-country pipelines are subject to leaks, breaks, and water loss. A BWS potable pipeline with fire hydrants from Whitmore along Kamehameha Hwy to Dole Helemano ORI Plantation will provide needed fire protection and peak demand transmission capacity. An agricultural processing facility and produce commercial market is envisioned along Whitmore Ave at the former Dole base yard. City water and wastewater services are needed to support a thriving diversified agricultural economy for food security resilient to drought and wildfire from climate change.
ID #:	168
Timeframe:	Near-term
Champion Agencies:	BWS, ENV

PROJECT CONCEPT

Potential Partnerships:	ADC, Castle & Cooke, Dole, Poamoho Community Association
Adaptation Strategy Type:	Infrastructure
Location of Project:	Whitmore Helemano, Central Oʻahu
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Included based on discussion with OWH Panel
Congressional District:	2
Council District:	II
Legislative District:	House District 46
Neighborhood Board:	Wahiawā
Oʻahu SoVI Index:	High



Figure 1. Whitmore to ORI Helemano Plantation Approximately 2 Miles from Whitmore Ave

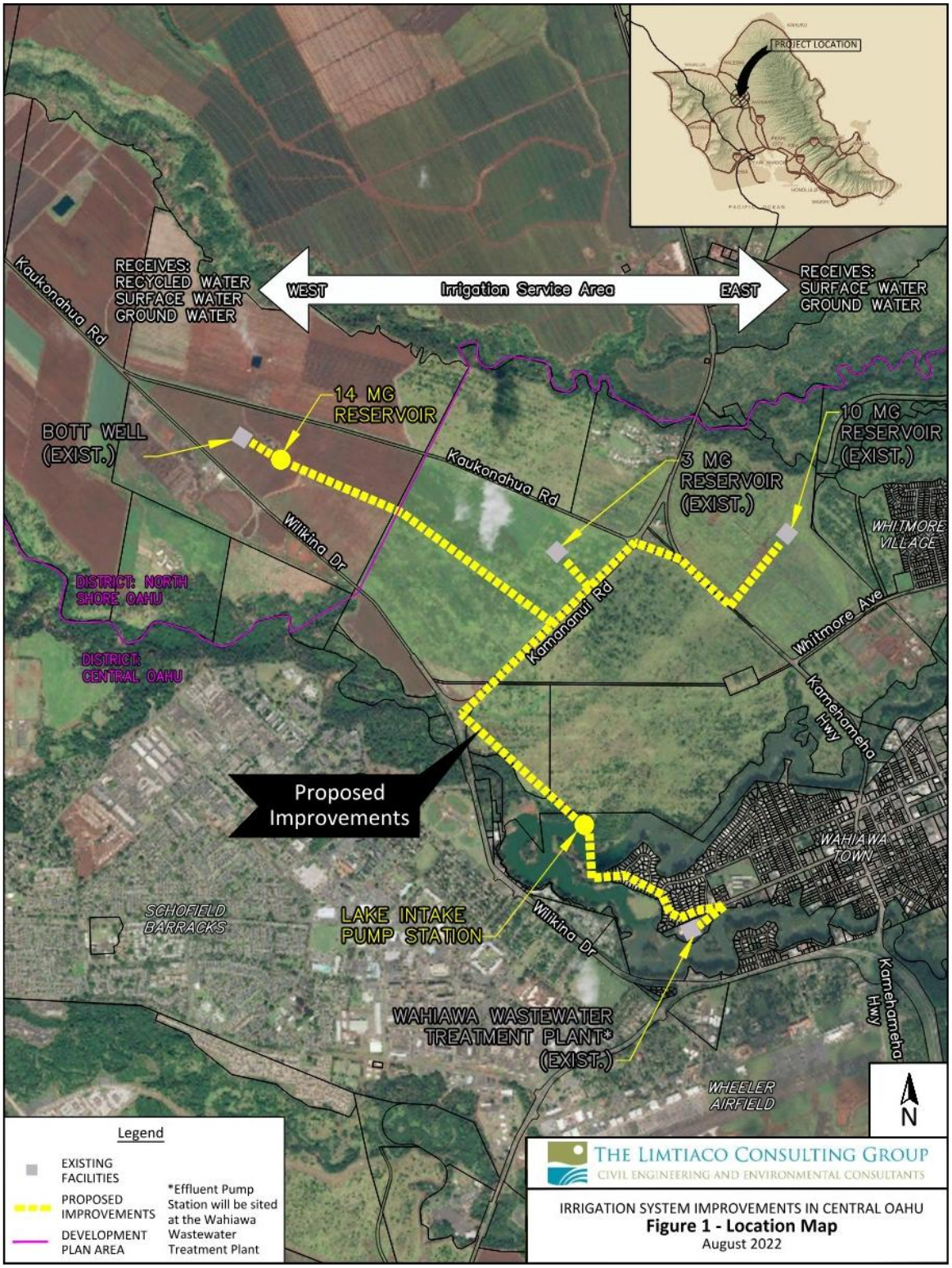


Figure 2. Map of Site Vicinity

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Water lines between Whitmore Ave and Wahiawā WWTP **Wastewater:** Sewer lines between Whitmore Ave and Wahiawā WWTP **Stormwater:** Swales in City and State ROW **Roads:** Whitmore Ave (City), Kamehameha Hwy (State)
Community Assets at Risk:	Whitmore and Poamoho Communities, Dole Helemano Plantation ORI

Note: Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Drought:** Lack of water infrastructure in existing agricultural lands, loss of agricultural crop investments. Proposed R-1 water will increase non-potable water availability for irrigation. **Extreme Heat**: Increased heat increases water demands. Implementation of R-1 water for irrigation and other non-potable water uses will reduce the demand on potable water. **Wildfire:** Lack of fire hydrants, open fallow grass lands subject to wildfire, residential conflagration threats. Proposed potable pipeline will supply fire hydrants in the Whitmore area.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

N/A

INFRASTRUCTURE

R-1 Pipeline to Whitmore:

Average day flow = 2 mgd. Pipeline length: Approximately 1.5 miles

Will need a pump station, emergency generator, and wet weather storage. Can develop ground storage or utilize ADC's earthen reservoirs.

Benefits: R-1 irrigation for diversified agriculture beneficial use. R-1 primary disposal solution. Remove current discharge of tertiary effluent into Wahiawā Reservoir reducing nutrient loading. Risk reduction of future changes to Consent Decree.

Constraints: R-1 certification subject to identification of off spec and wet weather discharge. Can provide wet weather flow option if interconnected to Schofield WWTP pipeline, or construct wet weather storage in Whitmore.

Major Permitting: Army Corps 401/404 permit for pipeline crossing Wahiawā Reservoir, DOH WWTP R-1 Certification, EA, Easements

Financing: ENV, Bonds, Fees, Recycled water grants

Design: TBD

Construction: TBD

Potable 12-Inch Pipeline from Whitmore Ave to Dole ORI Helemano Plantation:

Pipeline length: Approximately 2 miles

There will be a bridge crossing and new fire hydrants and meters. This will be an extension of the BWS Wahiawā 1180ʻ water system and will provide water service to the Kūkaniloko birthstones cultural site.

Benefits: Provide fire protection and peak demand transmission capacity

Constraints: Funding:

Major Permitting: Environmental Assessment, Easements, Kamehameha Hwy Poamoho Stream Bridge Crossing, Additional CWRM permitted use may be needed depending on average day demand requirements

Financing: Proportionate share agreements with BWS, Dole, Castle & Cooke, Poamoho and ADC, State Legislative appropriation/grant, FDA Grant

Design: 10% of construction cost, $2 million

PROJECT COMPONENTS

Construction: $160 per diameter inch / linear foot (2026 bid tabs) for 2 miles, Approximately $20 million (less if installed in unpaved road shoulder)

Community Benefits:	? Protects cultural sites ? Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ? Improves water quality ? Improves public access to community spaces ☐ Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse **#8**: Facilitate a climate resilient local food system
Relevant Adaptation Strategies:	• Support diversified agriculture and economic sustainability • Food security • Beneficial use of recycled water • Improve water quality • Drought mitigation with alternative water supply • Wildfire mitigation - Fire protection • Public health and safety • Water conservation reducing water loss in aging water infrastructure

PROJECT COMPONENTS

Expected Timeline:	This is a near-term based on project need
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A
Planning Level Cost Estimate:	>$100M for full implementation including planning, design, and construction. *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Regulatory requirements for R-1 certification, wet weather storage, off-spec disposal • Financing • Proportionate share agreements

REFERENCES

Agribusiness Development Corporation. (n.d.). Central Oʻahu Agriculture and Food Hub Project. https://dbedt.hawaii.gov/adc/central-oahu-agriculture-and-food-hub-project/

BWS. (2024). Whitmore, Poamoho, and Dole Plantation Presentation.

BWS. (n.d.). Central Oʻahu Non-Potable Water Master Plan Phase 2.

Hawaiʻi Commission on Water Resource Management. (2014). Central Oʻahu Non-Potable Water Master Plan. https://files.hawaii.gov/dlnr/cwrm/planning/conwmp2014.pdf

Hawaiʻi Department of Agriculture and Agribusiness Development Corporation. (2021). Draft Environmental Assessment: Irrigation System Improvements for Central Oʻahu, Wahiawā, and Waialua Districts. https://files.hawaii.gov/dbedt/erp/Doc_Library/2021-06-23-OA-DEA-Irrigation-System-Improvements-for-Central-Oahu,-Wahiawa,-and,-Waialua-Districts.pdf

Office of Senator Donovan M. Dela Cruz. (n.d.). Whitmore Project Presentation.

The Limtiaco Consulting Group. (2021). Figure 4: State Land Use Districts.

ACRONYMS

ADC	Agribusiness Development Corporation
BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
CWRM	Commission on Water Resource Management
DBEDT	Department of Business, Economic Development and Tourism
DOH	Department of Health
ENV	Department of Environmental Services
FDA	Food and Drug Administration
mgd	Million Gallons per Day
N/A	Not Applicable
OWH	One Water Honolulu
R-1	R-1 Quality Recycled Water
SoVI	Social Vulnerability Index
TMK	Tax Map Key
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

POTABLE REUSE PILOT AT HONOULIULI

PROJECT CONCEPT

GENERAL DESCRIPTION

Hawai‘i faces challenges with its drinking water supply from increased development to climate change. Transit-oriented development (TOD) and affordable housing growth are tempered by climate change impacts. These impacts include decreased rainfall and aquifer levels, more frequent and intense droughts, groundwater contamination, water loss from aging infrastructure, and variable surface water supplies and quality. Water resources managers in Hawai‘i are also focused on protecting the aquatic environment by reducing wastewater discharges to the ocean and improving the quality of the water that is discharged. Environmental protection is essential to maintain a healthy ecosystem and biodiversity, as well as for cultural purposes.

Joint solutions that protect the environment and address drinking water supply issues are being evaluated. The development of a safe and reliable alternative water supply is needed to diversify Hawai‘i’s potable water resources. BWS and Veolia Water successfully constructed and operate the Honouliuli Water Recycling Facility (WRF), that receives secondary effluent from the ENV Honouliuli WWTP. The WRF has a capacity of 12 mgd of R-1 water for irrigation and 2 mgd of demineralized reverse osmosis (RO) water for power plant boiler feed and the Par Pacific refinery. The treatment processes of R-1 and RO water are shown in Figure 1, below. Although non-potable reuse is a valuable component of a diverse water supply portfolio, the national trend is advancing reuse to produce potable water, called potable reuse, or Purified Recycled Water (PRW). Potable reuse has been installed at a greater capacity in the U.S. than ocean desalination. There is an ongoing Pure Water Hawai‘i effort that has a stakeholder process that includes a series of workshops and surveys with regulators, agencies, and experts in Hawai‘i to clearly define perceptions and challenges to PRW implementation.

Developing PRW programs require many years to plan, design, permit, and construct (7 to 15+ years). Pure Water Hawai‘i, in parallel with stakeholder engagement, is developing Guidelines for the treatment and monitoring systems tailored to Hawai‘i. These Guidelines allow for flexibility in the selection of technologies to be tailored to the challenges of a particular project, not prescriptive one size fits all requirements that are seen in some other locations. The development of the Guidelines, supported by the broader Hawai‘i engineering community, then allows for PRW

PROJECT CONCEPT

demonstration work which further supports and leads to formal regulations development for DOH.

BWS proposes to contribute to the Pure Water Hawai'i effort by developing a PRW pilot utilizing the Honouliuli MF/RO effluent as feed water. The piloting work is expected to focus on both RO and non-RO based technologies to provide flexibility to the future guidelines and regulations development process. Reverse Osmosis Based Advanced Treatment (RBAT) and Carbon Based Advanced Treatment (CBAT) have both repeatedly demonstrated high quality product water suitable for indirect potable reuse (IPR) or DPR. In states that allow flexibility to select a treatment train (e.g., Colorado), the decision to use RBAT is driven by the need to remove salt. CBAT is more cost effective than RBAT and provides greater water recovery than RBAT. Again, either treatment train can meet stringent water quality requirements.

The RBAT train could be completed by adding UV AOP and free chlorine (and potentially GAC) downstream of the full-scale Honouliuli MF/RO. Should salts be low enough, CBAT could take WWTP effluent or MF effluent and then add on the CBAT treatment train. The PRW pilot utilizing fully characterized Honouliuli WWTP secondary effluent could lay the foundation for a future PRW production facility at the Honouliuli WRF. The pilot project can also leverage the One Water financing opportunities to supplement BWS funding. Advanced treatment of wastewater for potable uses is a strong, climate resilient, multi-benefit One Water project.

ID #:	164
Timeframe:	Near-term
Champion Agencies:	BWS, ENV, DOH
Potential Partnerships:	EPA, NWRI, UH WRRC ASCE, ACECH, HWEA, AWWA – professional organizations
Adaptation Strategy Type:	Infrastructure
Location of Project:	'Ewa

PROJECT CONCEPT

Area Classification:	Mid-Density Communities
Hotspot:	ʻEwa
Congressional District:	1
Council District:	I
Legislative District:	House District 41
Neighborhood Board:	ʻEwa
Oʻahu SoVI Index:	Medium

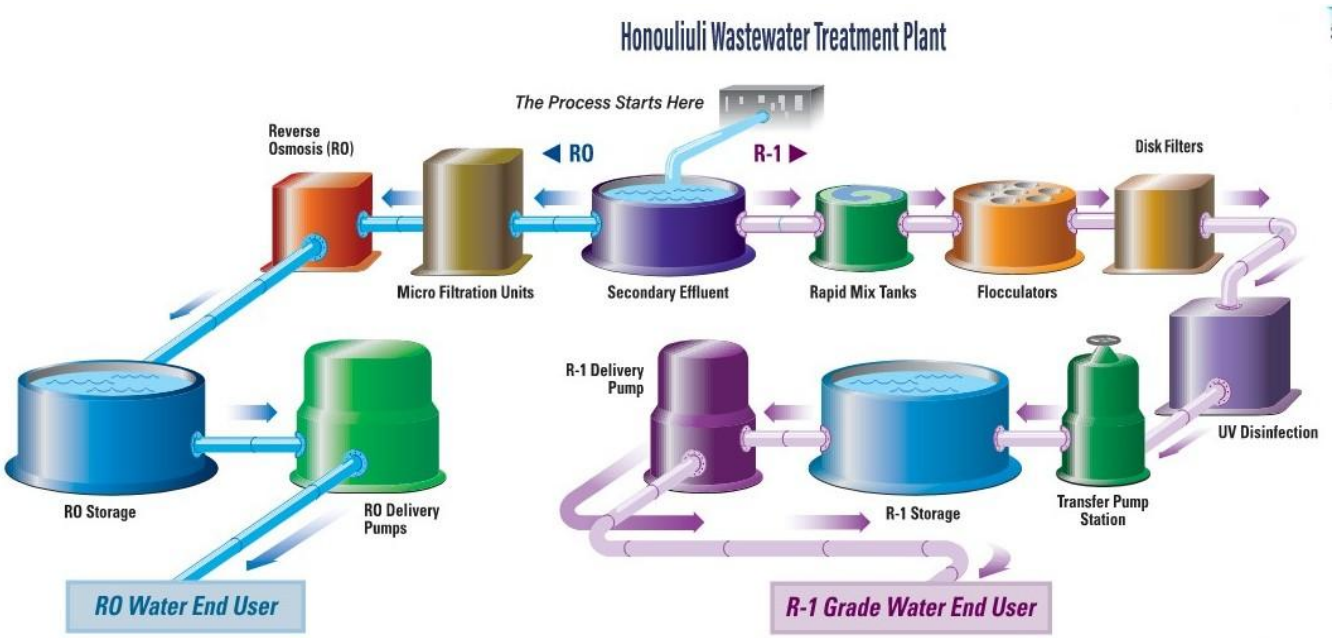


Figure 1. Honouliuli WRF Processes. Source: BWS Recycled Water Program (2021). Using Water Wisely.

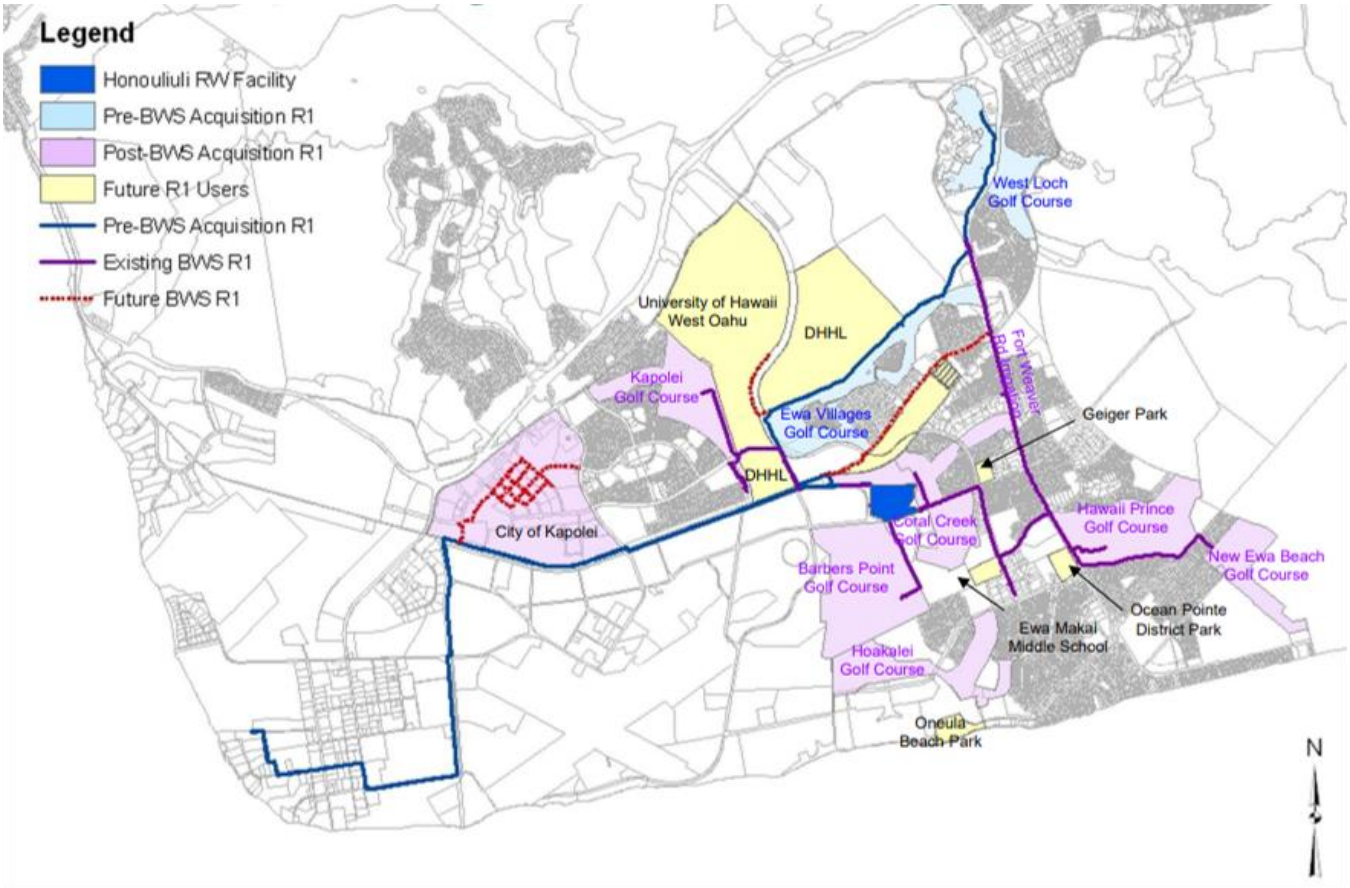


Figure 2. Existing R-1 recycled water distribution system in ʻEwa

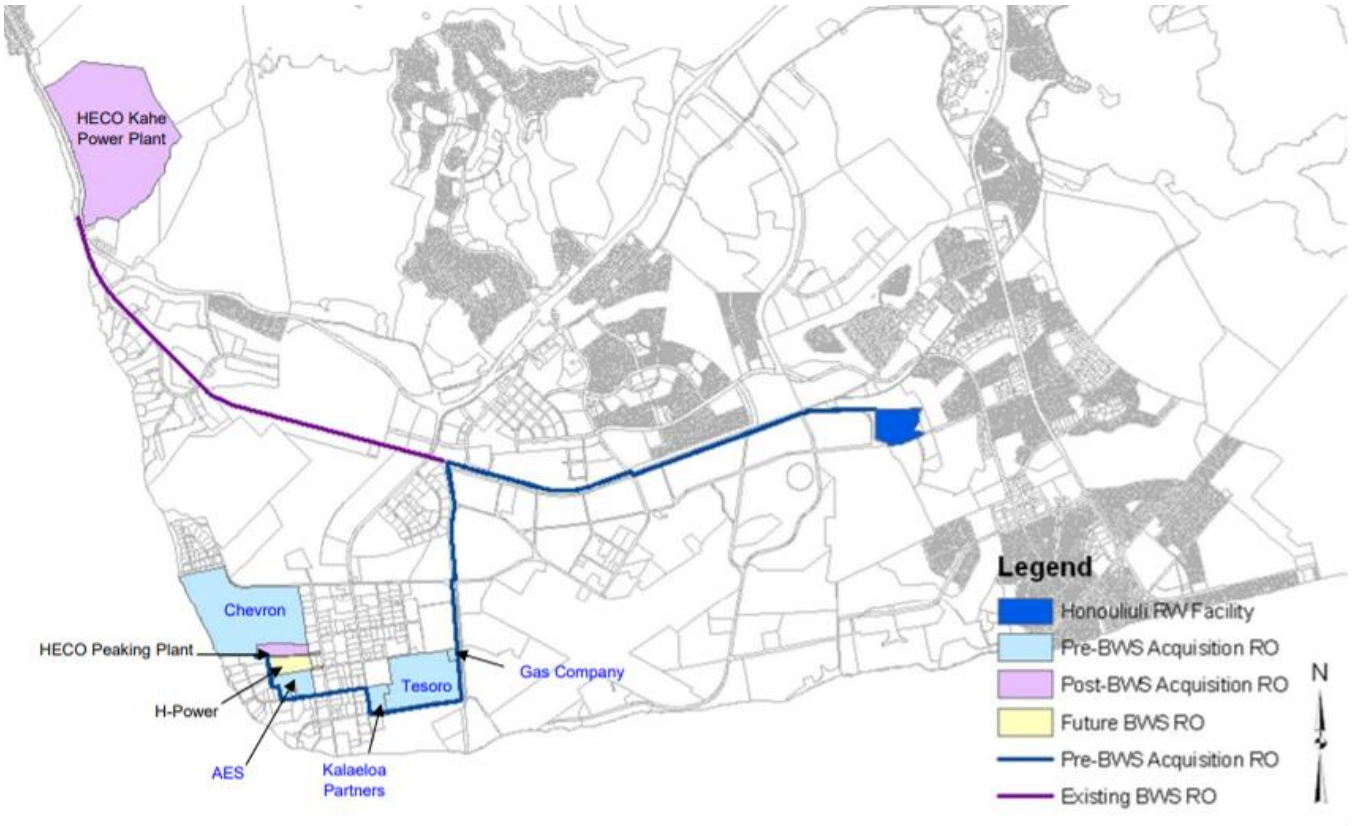


Figure 3. Existing RO recycled water distribution systems in ʻEwa.

Note: the RO system distributes R-1 water that has received additional advanced treatment by reverse osmosis.
Source: Recycled Water Use on Oʻahu. (2014). 2nd Annual Joint Government Water Conference. Presented by Barry Usagawa. https://health.hawaii.gov/sdwb/files/2014/09/SessionA-02RecycledWaterUseOahu.pdf

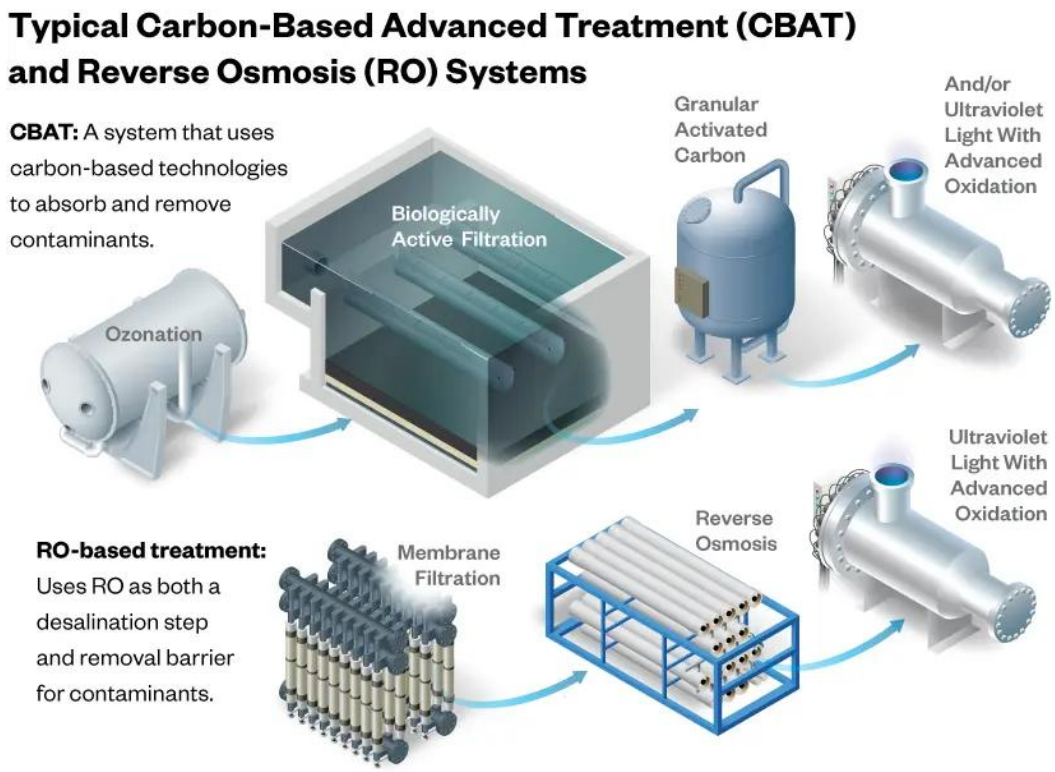


Figure 4. Example Carbon Based Advanced Treatment (CBAT) and Reverse Osmosis Based Advanced Treatment (RBAT). Both treatment trains begin with WWTP effluent as the feed source.

Source: Hazen and Sawyer. Potable Reuse Is Coming to Your Region. Are You Ready? Horizons. https://www.hazenandsawyer.com/horizons/potable-reuse-is-coming-to-your-region

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High-risk pipelines **Wastewater:** Honouliuli WWTP and WRF, Honouliuli WWTP Influent WWPS, 8-in/24-in sewer main, 18-in/30-in sewer force main **Stormwater:** Stormwater channel parallel to Saratoga Ave, Stormwater channel from Olai St to beachfront, Stormwater channel in Barbers Point Beach park to beachfront, 12-in/18-in/24-in/30-in/42-in/48-in Stormwater conduit **Roads:** Geiger Road, Saratoga Ave, Kalaeloa Blvd, Geiger Road Bridge
Community Assets at Risk:	Pearl Harbor National Wildlife Refuge, Barbers Point Beach Park, Kalaeloa airport/military base

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Drought:** ʻEwa has medium risk to drought, and the broader area has groundwater concerns due to the Red Hill fuel release. Potable reuse decreases the dependence on groundwater. **Extreme Heat:** Potable water demand increases during extreme heat events. Increasing the potable water source can decrease the impact of these stresses.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

N/A

INFRASTRUCTURE

Objective: Develop the Pure Water Hawai‘i implementation Guidelines and Stakeholder Engagement for a regulatory framework that allows DOH to promulgate potable reuse rules. Evaluate, design, operate and maintain a PRW pilot at the Honouliuli WRF inclusive of comprehensive treatment technology, systems performance monitoring, water quality characterization and testing, and documentation to support the regulatory framework and the development of potable reuse rules.

Regulatory and Stakeholder Coordination: Engage permitting authorities, EPA, DOH SDWB, technical and operational stakeholders and analyze current regulatory environment for potable reuse in Hawai‘i and other western states. Obtain regulatory and stakeholder concurrence of all significant phases of the pilot and regulatory framework, prior to proceeding with the next phase.

Water Quality Evaluation: Review existing wastewater, recycled water, and drinking water quality data. This step should include an assessment of industrial dischargers within the sewer collection system and the development of an Enhanced Source Control Program (ESCP), which extends well beyond the EPA-mandated Pretreatment Program and is standard practice for potable reuse.

Financing: Identify and obtain grant financing to offset capital appropriations.

Procure, Construct, Operate and Maintain the Pilot Plant: Define pilot operations, maintenance, chemicals and power use, pilot duration, regular reporting, etc. Conduct comprehensive water quality analyses including but not limited to safe drinking water standards, SVOCs, UCMR, TIC, radionuclides, etc. Include all lab reports.

Workforce Development: Use the pilot as a training platform for the local water and wastewater workforce. Advanced treatment for potable reuse requires operator skills that are not yet widely held in Hawai‘i, and a full-scale facility would depend on a trained operations staff. Coordinate with HWEA, AWWA, and local training programs so that pilot operations build hands-on experience in membrane treatment, advanced oxidation, and the monitoring and response protocols specific to potable reuse.

Reporting: Prepare draft pilot testing report for regulatory review and comments. Incorporate all comments into a final report. Obtain regulatory concurrence/acceptance of pilot findings and integrate with the Pure Water Hawai‘i regulatory framework. There will be development and report-outs from meetings, presentations, and collateral materials, as needed.

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☒ Improves water quality ☐ Improves public access to community spaces ? Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☒ Other: Locally controlled and more sustainable water supply

Note:

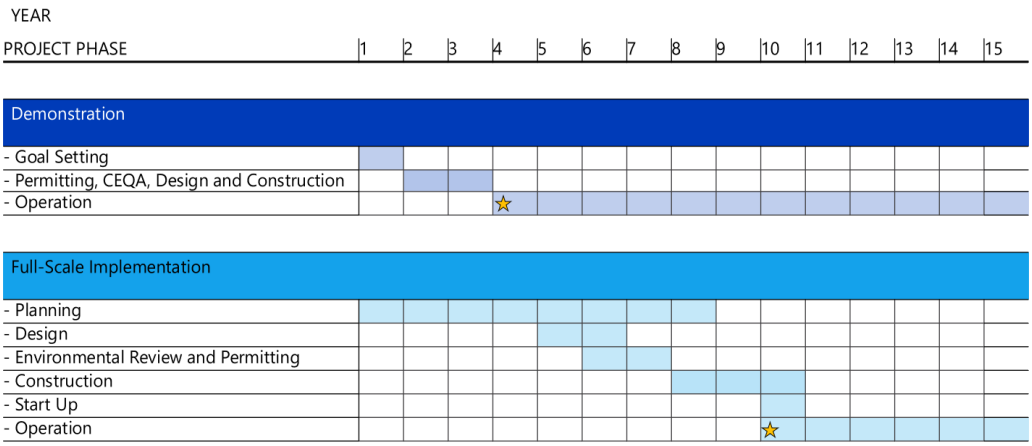
An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	N/A
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination

PROJECT COMPONENTS

Expected Timeline:



Pure Water Hawai'i is the first step in developing flexible guidance. This pilot work is a critical follow-on step that demonstrates treatment and performance based on the guidance.

This implementation phase will follow an ongoing demonstration phase. The Gantt chart above is from the Pure Water Hawai'i Brief 20250501. This project will likely need to be coordinated with the following other projects:

- OWH Project #106 Reuse Strategy for Redevelopment Areas
- OWH Project #162 NASED Regulatory Requirements for Reuse

Triggers:

Climate Hazard: N/A

Funding: N/A

Regulatory: N/A

Planning Level Cost Estimate:

$1M-$10M

Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Regulatory uncertainty is the central challenge. Hawai‘i does not yet have potable reuse rules, and the pilot is intended to generate the demonstrated performance data that supports their development.
- Public acceptance is a well-documented barrier to potable reuse, particularly direct potable reuse. Sustained public education and engagement will be needed alongside the technical work.
- Capital and operating costs for advanced treatment are significant, and grant financing will be needed to offset capital appropriations.
- Adequate space must be available at the Honouliuli WRF to site pilot equipment, feed water connections, and disposal connections.
- Operator expertise in advanced treatment is limited locally and will need to be developed alongside technology.

Additional Considerations:

Stakeholder Engagement:

- The current stakeholder list includes the drinking water and wastewater agencies for all four counties, regulators from the Hawai‘i Department of Health, Department of Land and Natural Resources and the Public Utilities Commission (TBD). and privately owned utilities that oversee drinking water and wastewater facilities across the state.
- An initial survey was conducted with most of these stakeholders in August 2025 to identify their existing knowledge of purified recycled water; perceptions of PRW in Hawai‘i from a regulatory, political, social and cultural viewpoint; and the impacts of PRW development on future water supply reliability and sustainability. A second stakeholder survey is expected to be conducted in September 2026.

Additional Components:

- Integrate the pilot findings in support of the Pure Water Hawai‘i regulatory framework

Examples and Guidance:

- Western states with established potable reuse regulatory frameworks, including Colorado and California

Technical Considerations:

- Water quality characterizations and finished water quality targets, treatment train design, and post-treatment compatibility with the existing distribution system.

REFERENCES

Hawai‘i Department of Health. (n.d.). Recycled Water Program. Wastewater Branch. https://health.hawaii.gov/wastewater/home/reuse/

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ACRONYMS

ACECH	American Council of Engineering Companies of Hawai‘i
ASCE	American Society of Civil Engineers
AWWA	American Water Works Association
BWS	Board of Water Supply
CBAT	Carbon-Based Advanced Treatment
CRO	Climate Ready O‘ahu
DOH	Department of Health
DPR	Direct Potable Reuse
ENV	Department of Environmental Services
EPA	Environmental Protection Agency
ESCP	Enhanced Source Control Program
GAC	Granular Activated Carbon
HWEA	Hawai‘i Water Environment Association
IPR	Indirect Potable Reuse
MF/RO	Microfiltration/Reverse Osmosis
N/A	Not Applicable
NWRI	National Water Research Institute
OWH	One Water Honolulu
PRW	Purified Recycled Water
Pure Water HI	Pure Water Hawai‘i
R-1	R-1 Quality Water
RBAT	Reverse Osmosis-Based Advanced Treatment
RO	Reverse Osmosis

SDWB	Safe Drinking Water Branch
SoVI	Social Vulnerability Index
SVOCs	Semi-Volatile Organic Compounds
SW	Stormwater
TIC	Tentatively Identified Compound
TOD	Transit Oriented Development
UCMR	Unregulated Contaminant Monitoring Rule
UIC	Underground Injection Control
UV	Ultraviolet
WRF	Water Recycling Facility
WRRC	Water Resources Research Center
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

DEVELOP COOPERATIVE FIRESHED PARTNERSHIPS

PROJECT CONCEPT

GENERAL DESCRIPTION	For this near-term project, BWS is engaging UH Ecosystem and Landcare Program (UHELP) to assist public and private landholders in identifying areas of wildfire concern and planning cross-boundary fire risk reduction projects that address water, access, and vegetation management needs in the Mākaha and Waiʻanae watersheds. The objective is to develop cooperative Fireshed Partnerships as networks of large landowners (e.g., >100 acres) with contiguous wildfire mitigation actions and implementation plans mapped across lands where high wildfire risk intersects with homes in the wildland urban interface, major access routes, infrastructure, and other valued resources.
ID #:	129
Timeframe:	Near-term
Champion Agencies:	BWS
Potential Partnerships:	DEM, HFD, DFM, ENV, DDC, CCSR, DPR
Adaptation Strategy Type:	Plan/Study
Location of Project:	Waiʻanae
Area Classification:	County Towns and Rural Coastline
Hotspot:	2
Congressional District:	I
Council District:	129

PROJECT CONCEPT

Legislative District:	House District 45
Neighborhood Board:	Waiʻanae Coast Subdistrict 1
Oʻahu SoVI Index:	Very High

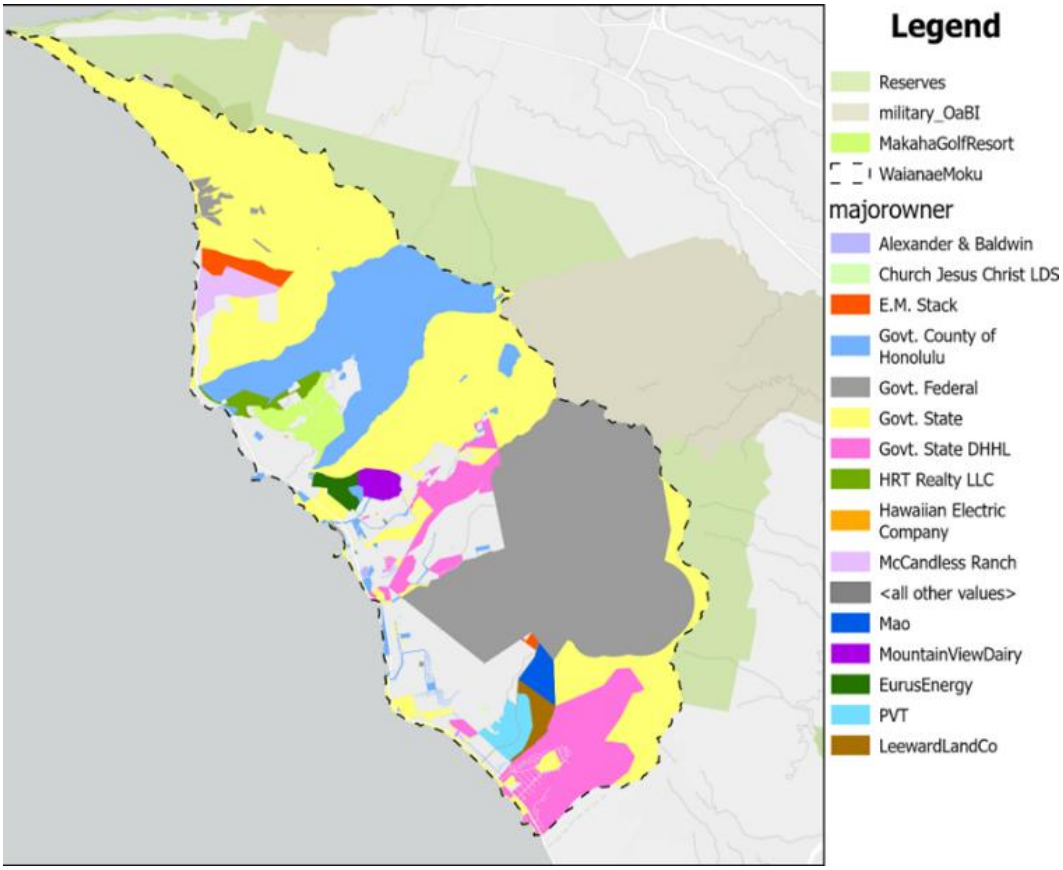


Figure 1. Large landowners in the Waiʻanae moku

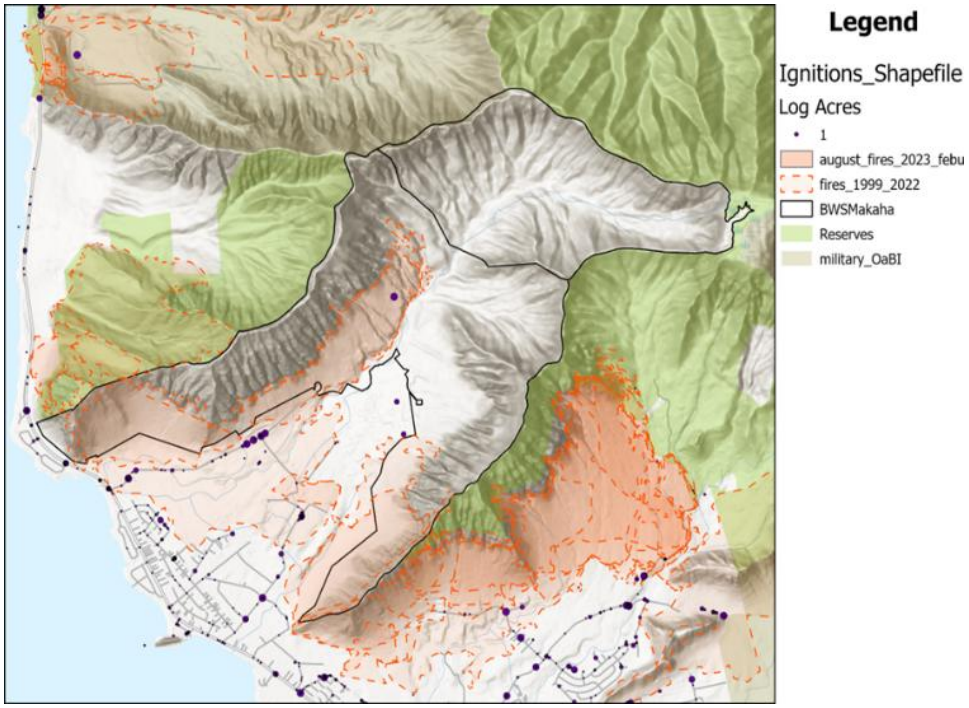


Figure 2. Previous ignition areas in Waiʻanae

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Mauka pump stations, reservoirs, pipelines **Wastewater:** WWTP, pump stations **Stormwater:** N/A **Electric Power Lines:** In valleys and across the Waiʻanae Mountains **Roads:** Valley roadways
Community Assets at Risk:	Residential areas, community spaces (parks, schools), farms, commercial areas

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Wildfire:** Adaptation will create contiguous fire breaks at the urban - wildland interface, establish vegetative fire breaks and geographic choke points and identify defensive lines along roadways with fire hydrants where HFD can set-up firefighting equipment supported by helicopter water drops. BWS established helicopter dip tank sites adjacent to BWS reservoirs and hydrants. **Drought**: Emergency Response Plans provide procedures for portable emergency generators assigned to strategic BWS pump stations if and when HECO initiates their Public Safety Power Shut-off plan to prevent sparking in leeward areas when humidity and wind speed reaches threshold levels.

PROJECT COMPONENTS

PLAN/STUDY

UHELP will develop a Fireshed Plan for Waiʻanae Kai and Mākaha Valley for the purposes of:

1. Mapping available fire-related suppression resources, hazardous fuels, vulnerable assets, resource needs, and the costs and suitability of risk mitigation strategies,
2. Identifying and planning multi-partner fuels management projects, including grazing, fuel breaks and reforestation/green strips, to reduce risk and educate local leadership and other communities,
3. Identifying resource sharing opportunities for long-term, spatially contiguous fuels mitigation projects within the greater Waiʻanae Kai and Mākaha Valley, and
4. Provide maps, project descriptions, and other materials to support public outreach and advocacy efforts.

To achieve these objectives, UHELP will use custom hazardous fuels and fire risk maps to assess exposure to natural and cultural resources and analyze gaps in current mitigation actions to identify suitable strategies for contiguous risk reduction around valued assets. UHELP will develop operational, cross-boundary plans that provide management actions, costs, and resource sharing opportunities among neighboring landowners to address water, vegetation management, and emergency access needs.

The plan will achieve the following:

1. Identify areas of significant fire risk and exposure to communities and watershed resources.
2. Map the locations and describe the risk reductions of existing fire mitigation and land care actions within the project area including BWS and adjacent large owners (next page)
3. Propose and design future fire mitigation projects for Waiʻanae Kai and Mākaha Valley that are prioritized with BWS and emergency responders
4. Provide maps, data, and project descriptions to communicate fire mitigation needs and determine mitigation preferences and priorities with homeowners and related associations within the valley

The Fire Planning scope will produce an actionable plan for the purposes of wildfire risk reduction and implementation by BWS and participating partners. Its larger purpose is to identify stakeholders for collaboration across fire risk mitigation and response opportunities. These include adjacent public and private landowners, participating Firewise communities, and emergency fire responders. At a high level, the scope will include the following:

1. The preparation and completion of a Fireshed Plan
2. Consultation and review among adjacent land partners and emergency responders for prioritization and preferred treatment methods of fire fuels, and
3. Creation and dissemination of GIS data generated under this project.

More specifically, the plan will include the following components:

1. Landcare Specialist, Wildfire Planner, GIS Analyst, and Land cover and Fire Modeler will undertake partnership facilitation/development to review existing plans and projects that relate to fire management

PROJECT COMPONENTS

and develop vulnerability maps and conduct site assessments of existing resources, hazards, and vulnerabilities.

2. Engage with federal, state, and private landowners/managers through one-on-one meetings to identify and collaboratively map priority areas and project sites, timelines, and material needs for new fuels reduction actions. Develop project parameters and associated one-time and recurring maintenance needs. Develop project specifications such as pulse grazing (for fuels reduction), infrastructure (water, fuel break and green break improvements) and associated cost estimates.
3. Coordinate the public interface among key members of County and State emergency responders, in conjunction with BWS. The meetings will determine how fire risk reduction actions benefit critical infrastructure in the context of various potential response scenarios. Prepare a prioritized list of fuels mitigation and infrastructure improvement projects for inclusion in the final Fireshed Plan.
4. Compile and present the final Fireshed Plan in addition to site specific maps and resource needs, and partner commitments.

PROGRAM

N/A

INFRASTRUCTURE

N/A

Community Benefits:

- ☒ Protects cultural sites
- ☒ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- ☐ Improves water quality
- ☐ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☐ Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☒ Other: water conservation awareness

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported: Respect Native Hawaiian rights and traditional practices reliant on healthy land and water resources.

PROJECT COMPONENTS

	Ensure access for emergency services along Mākaha roads
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#2**: Amplify and create capacity for community-led climate adaptation **#6**: Improve watershed health to mitigate wildfire risk and manage flooding **#9**: Integrate climate resilience into City capital planning, operations, and policies **#10**: Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies	• Watershed and forest management best practices • Vegetative firebreaks • Update Wildfire Prevention, Mitigation and Emergency Response Plans • Coordination with First Responders, HFD, DEM, HIEMA • Educate communities and establish community fire wise programs for residential • Install fire hydrants in water system distribution gap areas • Emergency Generators Deployment Plan for BWS pump stations • Maintain gravity tunnel systems that operate without power • Coordinate with HECO on the PSPS plan implementation • Install check valves on water meters in wildfire vulnerable areas to prevent backflow of contaminants into the water system • Shut off meters if homes are destroyed by wildfire when safe to do so, to prevent water loss to maintain reservoir levels
Expected Timeline:	This project includes a study and programmatic component that may lead to infrastructure projects. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the mid-term timeframe.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A

PROJECT COMPONENTS

Planning Level Cost Estimate:	$100,000-$1,000,000 *Cost estimates are high-level estimates for planning purposes only. More refined cost estimates should be developed during project scoping to inform total project budgets before implementation*

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Coordinating implementation among multiple large landowners with differing priorities and long-term maintenance commitments for fuels reduction and firebreaks. • Sustaining long-term maintenance of fuel treatments (e.g., grazing, green strips, firebreaks), which may require recurring funding, labor, and clear ownership. • Balancing wildfire risk reduction with watershed protection, erosion control, and cultural resource preservation, particularly in sensitive mauka and valley environments. • Aligning community expectations, landowner participation, and agency priorities, particularly in WUI areas with mixed public/private ownership and varying levels of wildfire preparedness.
Additional Components:	• Potential to propose resilient fire resistant building code design guidelines. • Integrate evacuation route planning and redundancy improvements • Evaluate opportunities to co-locate wildfire mitigation with watershed restoration • Incorporate community education and Firewise program expansion to support local participation in risk reduction actions
Additional Considerations:	• Water sampling procedures to ensure safe drinking water after fire events. • Water supply and access for firefighting, including hydrant availability, storage capacity, and potential improvements to system reliability. • Lessons learned from Lahaina Wildfire

REFERENCES

BWS. (2026). UHELP Fireshed Scope of Work.

Hawai‘i Wildfire Management Organization. (2018). Concerns and Priorities Overview: Western O‘ahu Community Wildfire Protection Plan. https://www.hwmo.org/s/2018_4_18_CWPP-Concerns-and-Priorities-Overview_Western-Oahu_FINAL_HWMO.pdf

Hawai‘i Wildfire Management Organization. (2024). Western O‘ahu Community Wildfire Protection Plan. https://www.hwmo.org/s/FINAL-HNL-Western-Oahu_CWPP_Dec2024_R1-SKH_SIGNED-compressed.pdf

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ACRONYMS

BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready O‘ahu
CWPP	Community Wildfire Protection Plan
DDC	Department of Design and Construction
DEM	Department of Emergency Management
DFM	Department of Facility Maintenance
DPR	Department of Parks and Recreation
ENV	Department of Environmental Services
GIS	Geographic Information System
HECO	Hawaiian Electric Company
HFD	Honolulu Fire Department
HIEMA	Hawai‘i Emergency Management Agency
N/A	Not Applicable
OWH	One Water Honolulu
PSPS	Public Safety Power Shutoff
SoVI	Social Vulnerability Index
UH	University of Hawai‘i
UHELP	University of Hawai‘i Ecosystem and Landcare Program
WUI	Wildland-Urban Interface

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

PROJECTS FROM THE INTEGRATED PLAN

PROJECT CONCEPT	
GENERAL DESCRIPTION	The U.S. Environmental Protection Agency (USEPA) defines integrated planning as a process that identifies efficiencies from separate wastewater and stormwater programs to best prioritize capital investments and achieve our human health and water quality objectives. This approach can also lead to more sustainable and comprehensive solutions, such as green infrastructure, improving water quality, and providing multiple benefits that enhance community vitality. In 2025, ENV launched the Integrated Plan to address joint water quality issues with DFM and work towards developing more streamlined permitting between each agency's water quality requirements. This factsheet is a placeholder for a mid-term project that is identified from the Integrated Planning effort.
ID #:	166
Timeframe:	Mid-term
Champion Agencies:	ENV, DFM
Potential Partnerships:	TBD
Adaptation Strategy Type:	Plan/Study
Location of Project:	Islandwide
Oʻahu SoVI Index:	N/A

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** TBD **Wastewater:** TBD **Stormwater:** TBD **Roads:** TBD
Community Assets at Risk:	TBD

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: TBD** **100-year storm:** Projects coming from the Integrated Plan effort will likely prioritize rainfall and stormwater flooding issues associated with the 100-year storm and other events. Other climate resilience benefits are to be determined from the outcome of the Integrated Plan.

PROJECT COMPONENTS

PLAN/STUDY

N/A

PROGRAM

N/A

INFRASTRUCTURE

This information is to be determined.

Potential projects include dieldrin treatment at Kailua WWTP, Dieldrin Capture in TMDL Watershed, Trash Reduction in Waiʻanae Watershed, TMDL compliance for Kawa Stream, Kapaʻa Stream, Kapaʻa Closed Sanitary Landfill, or Kāneʻohe Stream, Upgrading Sand Island WWTP to Secondary Treatment, or High Priority Cesspool Conversion.

Community Benefits:

- ☐ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- **?** Improves water quality
- ☐ Improves public access to community spaces
- ☐ Increases public awareness/education
- **?** Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported: N/A

OWH Objectives Supported:

- Practice a shared kuleana for a climate resilient Oʻahu
- Work together to leverage resources and enable climate readiness
- Collectively advocate for and pursue funding to support multi-benefit projects

PROJECT COMPONENTS

CRO Strategies Supported:	**#9**: Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	TBD
Expected Timeline:	The near-term project will come from the ongoing Integrated Plan effort by ENV and DFM.
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	TBD
Additional Considerations:	TBD

REFERENCES

CCH. (2026). Applying the Integrated Planning Framework to Improve Water Quality on Oʻahu. Presented at the Pacific Water Conference, February 12, 2026.

CCH. (2025). One Water Honolulu 2025 Annual Report.

ENV. (2026). City and County of Honolulu Integrated Plan, City Council Energy, Environment & Sustainability Committee Meeting. Presented by Roger Babcock, March 31, 2026.

ENV. (2025). Integrated Planning Feasibility Study. Prepared by CDM Smith.

ACRONYMS

CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
TBD	To Be Determined
TMDL	Total Maximum Daily Load
US EPA	United States Environmental Protection Agency
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

STORMWATER RETENTION, RECHARGE, AND REUSE IN MAUKA LANDS

PROJECT CONCEPT

GENERAL DESCRIPTION	This project would develop a planning and partnership effort to identify opportunities for stormwater capture, infiltration, groundwater recharge, and multi-benefit flood mitigation on mauka and former agricultural lands in the North Shore region. The project would focus on stream systems draining toward Haleʻiwa and Waialua, where flood-prone waterways, modified drainage patterns, and sediment transport contribute to downstream flooding and water quality concerns. The initial planning phase would evaluate feasible project locations, land ownership and access constraints, implementation roles, funding pathways, and long-term maintenance needs. Because many potential project areas are located on non-City or mixed-ownership lands, implementation would rely on coordination with agricultural stakeholders, large landowners, and regional partners. Potential future improvements may include check dams or grade-control structures, stormwater retention and infiltration features, stream and drainageway restoration, loʻi or wetland restoration, agricultural water management improvements, and other nature-based or hybrid strategies that slow runoff, support recharge, improve watershed function, and advance shared North Shore resilience goals.
ID #:	90
Timeframe:	Mid-term
Champion Agencies:	DFM
Potential Partnerships:	BWS, DPR, DDC
Adaptation Strategy Type:	Infrastructure
Location of Project:	Haleʻiwa, North Shore

PROJECT CONCEPT

Area Classification:	Country Towns and Rural Coastline
Hotspot:	Haleʻiwa
Congressional District:	2
Council District:	II
Legislative District:	House District 47
Neighborhood Board:	North Shore Subdistricts 3, 4
Oʻahu SoVI Index:	High



Figure 1. Project Region with Key Streams and Reservoirs

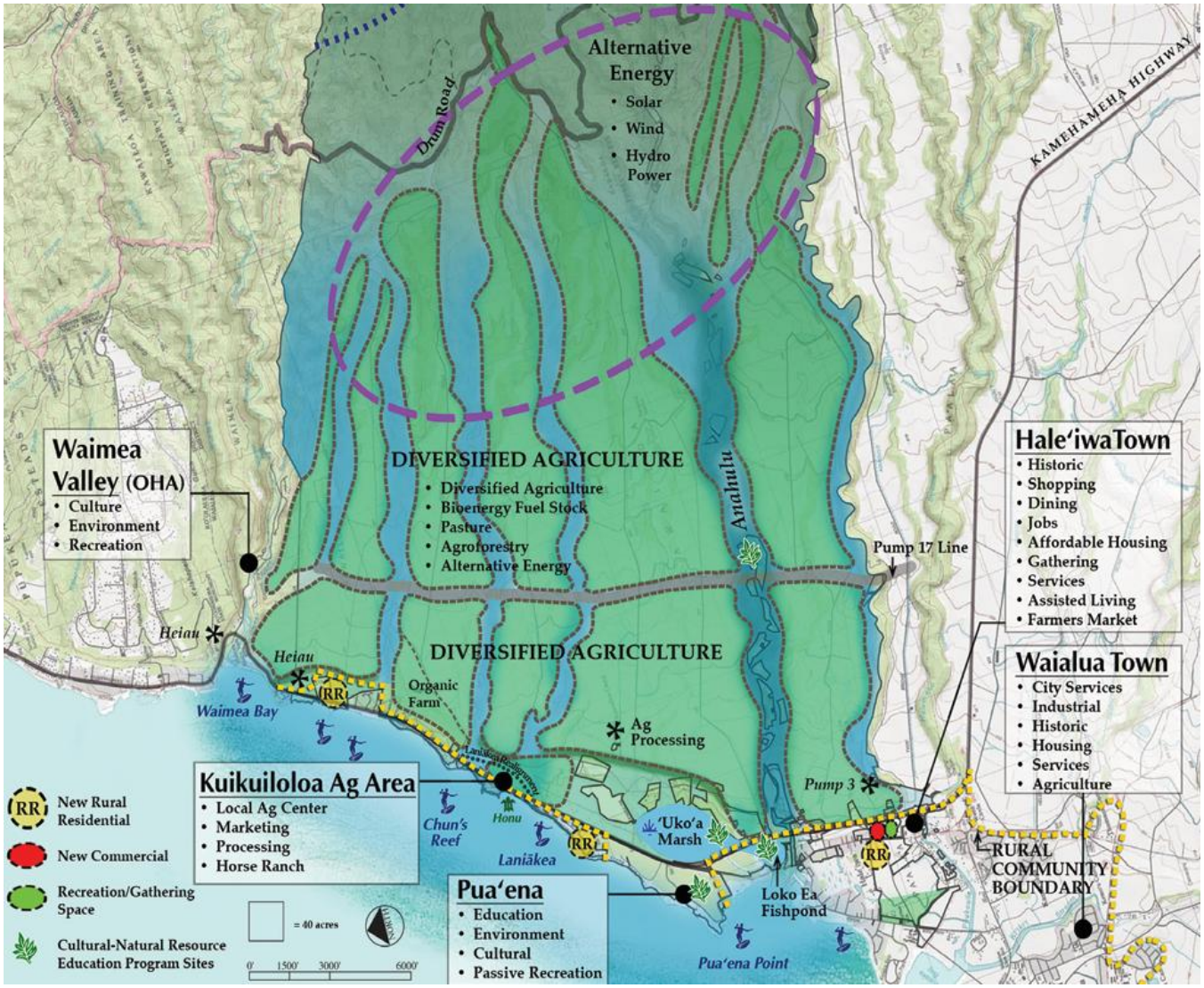


Figure 2. Planned, multi-benefit projects (Source: Kamehameha Schools' North Shore Plan (2007))

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk water mains, wells, pump stations **Wastewater:** Lack of sewer infrastructure; High cesspool density **Stormwater:** Anahulu River, Paukauila Stream, Kiʻikiʻi Stream, Loko Ea stream, 24-in SW conduits **Roads:** Hale'iwa Rd, Kamehameha Hwy, Anahulu stream/Kam Hwy Bridge, Loko Ea stream/Kam Hwy bridge, Ukoa Pond/Kam Hwy bridge, DFM Road Maintenance Base Yard, Joseph P. Leong Hwy
Community Assets at Risk:	Haleʻiwa Boat Harbor, Haleʻiwa Ali'i Beach Park, Haleʻiwa Beach Park, Loko Ea Fishpond, Ukoa Pond

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **100-Year Flood & Hurricane:** Complete inundation under 100-year storm conditions and partial inundation up to 3 feet under Category 2 hurricane conditions. Stormwater capture, infiltration, and stream management projects can reduce peak runoff, slow stormwater flows, reduce sediment transport, and improve watershed resilience during major storm events. Watershed-scale approaches may also provide flood mitigation benefits to downstream communities in Haleʻiwa and Waialua. **Drought:** Stormwater infiltration and groundwater recharge projects can help improve long-term water availability and support critical water supplies, including the Waialua well system.

PROJECT COMPONENTS

PLAN/STUDY

The planning phase of this project will include a watershed-scale planning and feasibility study to identify opportunities for stormwater capture, infiltration, groundwater recharge, and multi-benefit flood mitigation on mauka and former agricultural lands in the North Shore region.

The study will focus on stream systems draining toward Haleʻiwa and Waialua, where flood-prone waterways and modified mauka drainage patterns contribute to downstream flooding, sediment transport, and water quality concerns.

The planning effort will evaluate feasible project locations, land ownership and access constraints, potential partnerships, implementation roles, funding pathways, and operations and maintenance needs. It should build on existing North Shore planning efforts, including planning by Kamehameha Schools, whose prior planning emphasizes sustainable land management, natural and cultural resource stewardship, agricultural preservation, ecosystem enhancement, education, and community resilience.

Site screening will follow a defined sequence: available land area; ownership and access; geotechnical conditions, including soil infiltration capacity, subsurface characterizations, and slope stability; site slopes, and distance from a viable diversion source. For each candidate parcel, the study will compare site elevation against the invert of the contributing channel to determine whether gravity diversion is achievable or whether pumping would be required.

Potential concepts to evaluate may include check dams, diversion structures, detention or retention features, infiltration and recharge improvements, stream or drainageway restoration, loʻi or wetland restoration opportunities, agricultural water management improvements, and other nature-based or hybrid stormwater management strategies.

The study will identify the permitting pathway for each concept type early, as permitting, particularly for stream diversion, may govern feasibility.

The study should also evaluate whether the OWH Project #30 Stormwater Utility Fee could create future incentives or stormwater credits for private or institutional landowners that provide land or easements for stormwater capture and recharge improvements.

PROGRAM

The project should include a partner coordination and outreach program led by DFM to identify feasible implementation pathways with agricultural stakeholders, large landowners, and relevant City and State agencies. Kamehameha Schools may be a particularly valuable potential partner because its existing North Shore planning framework already advances many of the same goals as One Water Honolulu, including watershed stewardship, agricultural resilience, ecosystem restoration, and sustainable land management.

Stormwater capture, diversion, and grade-control structures carry significant public consequences: a structural failure is a flood hazard to downstream Hale'iwa and Waialua, and an improperly timed diversion is an unauthorized taking of water supply. These facilities should therefore be publicly owned, designed, constructed, and maintained, with the City retaining responsibility for engineering standards, operation, and long-term O&M.

PROJECT COMPONENTS

The partnership model with large landowners should instead be built on land access in exchange for surface amenity. Landowners provide easements or land dedications; the City delivers a facility whose surface enhances the property and serves the community, a retention basin that doubles as a ball field, a recharge area configured as a nature park or educational site, or a restored loʻi or wetland that advances a landowner's stewardship and education goals. This structure aligns directly with Kamehameha Schools' stated North Shore priorities and gives landowners a benefit worth granting access for.

Where landowner activity is appropriate, it is limited to non-structural, low-consequence stewardship, routine drainageway clearing, debris management, and erosion control on their own land, coordinated with but distinct from City-owned facilities.

INFRASTRUCTURE

Infrastructure improvements would be identified through the planning and feasibility phase. Potential future improvements may include distributed stormwater capture and retention features, check dams or grade-control structures, diversion structures, infiltration and recharge basins, stream or drainageway restoration, loʻi or wetland restoration features, agricultural water system improvements, and other nature-based or hybrid stormwater management projects. Facilities should be designed to incorporate compatible surface uses where feasible, consistent with the partnership model described above.

Future infrastructure should advance only after priority locations, land ownership, access, maintenance responsibility, partner roles, permitting feasibility, and funding pathways are confirmed.

Community Benefits:	☒ Protects cultural sites ☒ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ? Improves public access to community spaces ? Increases public awareness/education ☒ Provides ecosystem restoration ? Enhances recreational benefits ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Mitigate damage to infrastructure, community assets, and property impacted by sea level rise, coastal erosion, and flooding

PROJECT COMPONENTS

	Improve groundwater, waterway, and coastal water quality impacted by contamination from cesspools, agriculture, and industry
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Work together to leverage resources and enable climate readiness Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#5:** Strengthen climate resilience of beach and wetland ecosystems through preservation and restoration **#7**: Strengthen fresh water security by improving water conservation and reuse **#11**: Reduce flood risk and coastal erosion by directing development to safer and higher ground
Relevant Adaptation Strategies:	• Stormwater Capture and Use • Mauka stormwater treatment, retention, and infiltration • Modify Site Drainage, Storage, and Infiltration • Drainage System Plan • Maintenance plan for Rivers and Streams • Debris Management Plans and Systems • Stream Restoration • Riparian and Wetland Buffers • Restoration of loʻi kalo
Expected Timeline:	The first phase of this project will be a planning study and identification of partnerships. This project will likely need to be coordinated/interact with the following other projects: • OWH Project #30 Stormwater Utility Fee • OWH Project #92 Haleʻiwa Area Adaptation Plan • OWH Project #165 Stormwater Master Plan
Triggers:	**Climate Hazard:** Heavy Rain, Drought **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Implementation will require coordination among landowners, agricultural stakeholders, and public agencies, with clear roles for project implementation and long-term maintenance.
- Land ownership, access, liability, and funding constraints may limit the feasibility of some stormwater capture and recharge opportunities.
- Permitting will be a primary feasibility constraint, particularly for any diversion component. Diverting stream flow implicates the State Water Code and requires CWRM authorization, including a stream diversion works permit and consistency with adopted or interim instream flow standards. On streams supporting loko iʻa (Loko Ea, Ukoa) and loʻi kalo, instream flow requirements and appurtenant and traditional and customary water rights are significant and potentially contested considerations. Additional approvals may include DLNR stream channel alteration and Conservation District use permits, CWA Section 404/401 (USACE/DOH), SMA, and CZM consistency. The permitting pathway should be established during the feasibility study rather than after siting.
- Public ownership of capture and diversion facilities means the City assumes long-term O&M responsibility and liability for structures on land it does not own. Easement terms, access rights, inspection authority, and O&M funding must be resolved before construction, and O&M cost should be carried in the funding strategy, not deferred.
- Geotechnical conditions may disqualify otherwise promising sites. Infiltration capacity, subsurface conditions, and slope stability on mauka and former agricultural lands are not well characterized at planning level and could materially change siting and cost.

Additional Considerations:

- Existing North Shore planning efforts may provide opportunities to advance shared watershed management, agricultural resilience, and ecosystem restoration goals.
- Adoption of the Stormwater Utility Fee could create future funding opportunities or incentives for private landowners to provide land or easements for stormwater capture and recharge improvements.
- Former agricultural lands may carry legacy soil contamination from historical pesticide and herbicide use. Where projects promote infiltration, a Phase I/II environmental assessment may be warranted to confirm that recharge will not mobilize contaminants toward well systems.

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City and County of Honolulu Department of Planning and Permitting. (September, 2025). North Shore Sustainable Communities Plan. https://www4.honolulu.gov/docushare/dsweb/Get/Document-355118/NSSCP%20PRD%202025.pdf

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Lokoea Organization. (2007). Kamehameha Schools Mission and Strategic Plan. https://www.lokoea.org/uploads/1/1/3/4/113439871/mission_strategic_plan.pdf

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready O‘ahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPR	Department of Parks and Recreation
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
SW	Stormwater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

HALEʻIWA AREA ADAPTATION PLAN

PROJECT CONCEPT

GENERAL DESCRIPTION	"Area Adaption Plans (AAP) are a new class of Special Area Plan to address the specific challenges of adapting city land use practices, infrastructure, and building guidelines to the changing conditions of the global climate. These changes include climate change induced flooding, sea level rise, rising groundwater, and increased heat. AAPs will provide location-based guidance for multiple hazards on a near-term timeline, while advancing the conversation and necessary research for long-term adaptation. The AAPs will be closely coordinated with City climate policies including those of the Office of Climate Change, Sustainability and Resiliency, and the One Water Panel of agencies' planning for resilient infrastructure. The AAPs may be updated over time." (DPP Area Adaptation Plan Webpage). Following the model of Adapt Waikīkī, the Haleʻiwa Area Adaptation Plan (AAP) will propose near-term (to 2050) projects for resilience to climate hazards and sea level rise. The AAP will provide location-based guidance for multiple hazards on a near-term timeline, while advancing the conversation and necessary research for long-term adaptation. The AAP will include policies, public projects, and development guidelines. The AAP will include a detailed climate risk profile of Haleʻiwa, including present and future projected hazards. The AAP will propose adaptation actions regarding land use, water resources, infrastructure, housing, economics, parks & rec, and social services. The AAP will follow the general format of proposing strategies, themes, and actions. Haleʻiwa is on the North Shore of O'ahu, a rural coastal town that has experienced significant flooding from riverine and rainfall events, while also having high exposure to sea level rise and coastal flood hazard.
ID #:	92
Timeframe:	Mid-term
Champion Agencies:	DPP, CCSR (adaptation pathways)
Potential Partnerships:	BWS, ENV, DFM, DPR, DTS

PROJECT CONCEPT

Adaptation Strategy Type:	Plan/Study
Location of Project:	Haleʻiwa, North Shore
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Haleʻiwa
Congressional District:	2
Council District:	II
Legislative District:	House District 47
Neighborhood Board:	North Shore Subdistrict 3
Oʻahu SoVI Index:	High

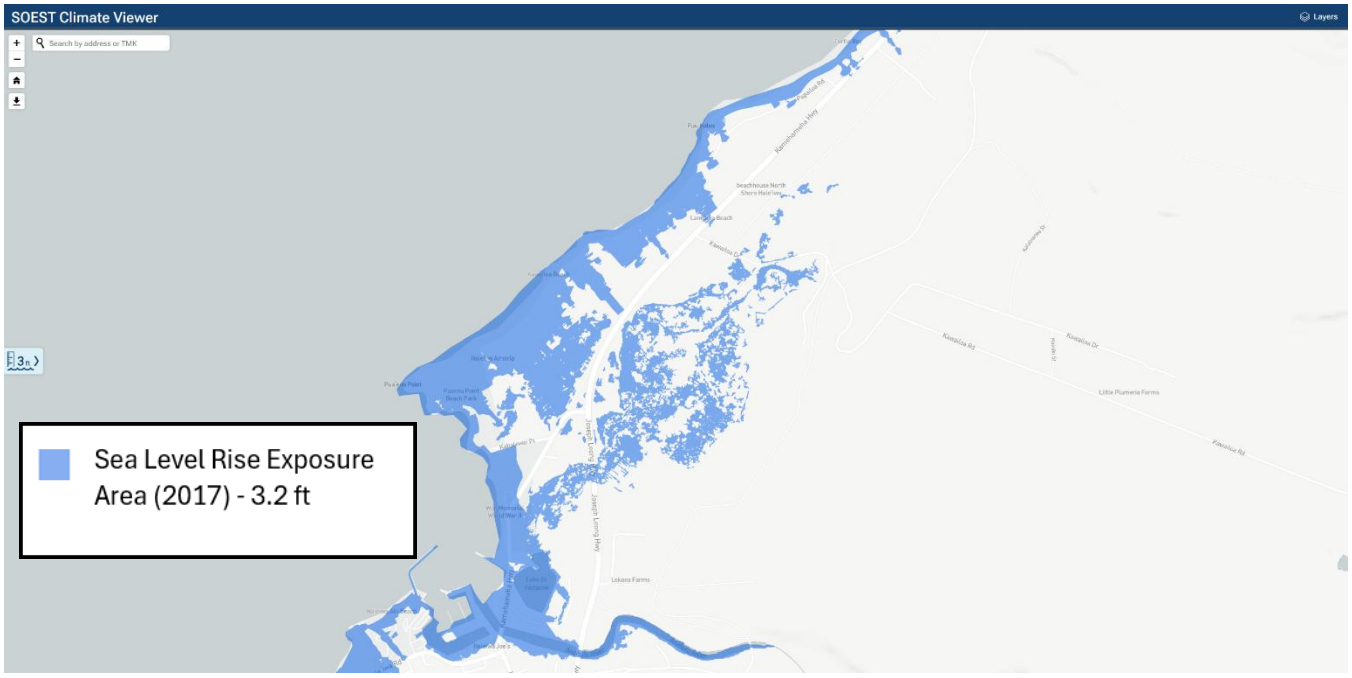


Figure 1. SLR Exposure Area at 3.2 ft in Haleʻiwa. (Source: University of Hawaiʻi. SOEST Climate Viewer)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk water mains **Wastewater:** Lack of sewer infrastructure **Stormwater:** Flood barriers and containment, Anahulu River, Paukauila Stream, Kiʻikiʻi Stream, Loko Ea stream, 24-in SW conduits **Roads:** Haleʻiwa Rd, Kamehameha Hwy, Anahulu stream/Kam Hwy Bridge, Loko Ea stream/Kam Hwy bridge, Ukoa Pond/Kam Hwy bridge, DFM Road Maintenance Base Yard, Joseph P. Leong Hwy
Community Assets at Risk:	Haleʻiwa Boat Harbor, Haleʻiwa Aliʻi Beach Park, Haleʻiwa Beach Park, Loko Ea Fishpond, Ukoa Pond

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** In general, the AAP will consider all hazards that are relevant to Haleʻiwa, considering multi-benefit solutions and improving our understanding of downstream impacts. Haleʻiwa has low risk to drought, however that could be included in the AAP as well. **Sea Level Rise - Overland Flooding:** Experiences 80% probability of passive flooding at 6 feet SLR and annual high wave-driven flooding at 1 foot SLR. There is a lack of data for drainage backflow. The AAP should plan to fill this data gap. **Coastal Erosion:** Impacts begin at 1 foot SLR. The AAP will address coastal erosion. **Sea Level Rise - Groundwater:** There is a lack of data for groundwater inundation. The AAP should plan to fill this data gap. **100-Year Storm:** Complete inundation under the 100-year storm. The AAP will include the 100-year storm. **Tsunami:** Haleʻiwa is within the tsunami evacuation zone. The AAP will consider tsunami risk. **Extreme Heat:** Haleʻiwa has a high afternoon extreme heat index above 90 degrees Fahrenheit. The AAP will include extreme heat. **Wildfire:** Haleʻiwa is within the high wildfire risk zone. The AAP will consider wildfire risk. **Hurricane:** Partial inundation up to 3 feet under Category 2 conditions. The AAP will include hurricane impacts.

PROJECT COMPONENTS

PLAN/STUDY

The AAP should propose a list of projects including infrastructure, studies, programs, and policies that will be completed in each of the next three decades. This list will include short-term, early-win projects, as well as a phase for adaptation pathways and long-range community planning for end-of-century conditions. These projects will address the major climate hazards identified for Haleʻiwa and have multi-benefits to the community. Overarching adaptation strategies can be adopted from the One Water Honolulu Plan guidance. Themes will be identified, including public priorities and desired outcomes. According to the North Shore Sustainable Communities Plan, climate change should be considered in all planning decisions. Adaptation will be necessary for Haleʻiwa and needs to be considered in concert with the goals of maintaining the historical country town atmosphere. This AAP should address how climate change adaptation can work within the community goals, as well as when protecting the community may come with unavoidable changes.

Specific concerns for Haleʻiwa include:

- Being in the dam evacuation zones (ʻŌpaeʻula 01 and Kemoʻo 5 Reservoirs)
- High priority cesspools and lack of sewer infrastructure
- Flood-prone Anahulu stream
- Coastal Erosion
- Haleʻiwa is a Special Design District, requiring that any developments or infrastructure projects align with the historical vision of the town.

Specific tasks or chapters in the AAP may include the following:

1. **Existing Conditions and Data Review.** This review will include existing and future drainage conditions in the context of planned redevelopment. The review will combine and summarize climate risk data from existing studies. As available, validation will incorporate existing conditions and ground truth the existing model outcomes. This review will consider recent Kona Low flooding.
2. **All-Hazards Decade-by-Decade Analysis.** This detailed hazard exposure analysis will utilize the existing data from the One Water Honolulu Plan, North Shore Resilience Working Group, and other existing works. Climate data will be incorporated to provide decade-by-decade projections of hazard extent within Haleʻiwa. This step will be followed by outreach to communicate the findings to the public.
3. **Haleʻiwa Drainage Study.** Use best available existing mapping and/or modeling of flooding pathways in Haleʻiwa including rainfall/riverine and coastal/ storm surge mechanisms. Inform outreach to private stream owners on flooding that could be reduced with improved maintenance.
4. **Project and Policy Prioritization.** This stage will include brainstorming, prioritizing, and identifying opportunities for multi-benefit projects, tied back to the goals of Climate Ready Oʻahu. Identify the community priorities, both related to climate risk and other priority multi-benefits. Apply adaptation strategies to applicable project areas. This phase will include coordination among projects within the public and private sectors and will prioritize them based on the necessary timing and the anticipated climate impacts. Projects will be connected to overarching adaptation plans including road raising and

PROJECT COMPONENTS

large-scale flood protection. This stage may include the development of adaptation pathways, led by CCSR.

5. **Outreach and Engagement.** The community engagement includes community members, technical experts, stakeholders, the One Water Panel, technical consultants, and academic researchers. Engagement should identify and confirm existing concerns, establish community priorities, and identify priority projects and policies. Identify overarching adaptation strategies that may be applied in multiple projects or areas. Outreach should span all planning phases. Outreach should include information and enforcement on stream maintenance for privately owned streams to reduce flood risk in Haleʻiwa.

The AAP outcomes include:

1. **All-Hazards Exposure.** The outcome of the all-hazards decade-by-decade analysis will be an early deliverable that can inform developers while formal guidelines and future City projects are in progress. The all-hazards exposure information will be combined with outreach to inform public and private projects in Haleʻiwa.
2. **Climate Resilient Guidelines.** Updates to the Haleʻiwa Special District guidelines should include climate resilience. Specific identified improvements will be included as guidelines for future developments or projects.
3. **Haleʻiwa Drainage Study.** Use best available existing mapping and/or modeling of flooding pathways in Haleʻiwa including rainfall/riverine and coastal/storm surge mechanisms. Inform outreach to private stream owners on flooding that could be reduced with improved maintenance.
1. 4. **Projects and Policies List.** Identify specific adaptation actions with alternatives for each risk/solution, for each of the next three decades (2030-2040, 2040-2050, and 2050-2060). There may also be high-level long-term pathways that can be considered and selected as later studies. Tasks will be categorized in Research & Monitoring, Policy & Regulation, Financing, Planning and Engineering Feasibility Studies, Public Outreach, Design and Construction. These projects will include the long-term North Shore One Water project (Mauka Stormwater Capture & Use).

PROGRAM

N/A

INFRASTRUCTURE

N/A

PROJECT COMPONENTS

Community Benefits:	☒ Protects cultural sites ☒ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☒ Improves public access to community spaces ☒ Increases public awareness/education ☒ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve community resilience to wildfire Mitigate damage to infrastructure, community assets, and property impacted by sea level rise, coastal erosion, and flooding Improve groundwater, waterway, and coastal water quality impacted by contamination from cesspools, agriculture, and industry
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Amplify the voices of Oʻahu's people through meaningful stakeholder engagement Develop a unified roadmap and decision-making process under a One Water approach
CRO Strategies Supported:	**#9**: Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	• Area Adaptation Plan • Drainage System Plan • Infiltration and Inflow Study
Expected Timeline:	This is a mid-term study since there are areas with ongoing development that will require AAPs to be developed in the near-term. This AAP will recommend adaptation projects for the long-term.

PROJECT COMPONENTS

	This project will likely need to be coordinated/interact with the following other projects: • OWH Project #35 Road Raising Strategy • OWH Project #90 Stormwater Retention, Recharge, and Reuse in Mauka Lands • OWH Project #109 Green Infrastructure Implementation Plan • OWH Project #165 Stormwater Master Plan
Triggers:	**Climate Hazard:** N/A **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Haleʻiwa has many competing goals: expand public access and protect the shoreline from flood and erosion, keep low-density development and contain development to preserve rural farmland, and preventing development within flood-prone areas while many rural residential zones are along the shoreline.
Additional Considerations:	• Haleʻiwa is a designated Special Design District. This may require special design or permitting considerations. • There are many endangered species and protected wildlife in Haleʻiwa. It will be important to understand the impacts on timing of projects/ construction, as well as the many permits that will be necessary (special district, historical areas, conservation, etc.) • This AAP effort should build on and not duplicate existing efforts. One such effort is the North Shore Resilience Working Group, which focuses on coastal erosion and beach loss issues along the region, working on a beach and dune erosion management plan and guidelines for emergency coastal erosion management. They are also planning on a state-wide managed retreat program, with North Shore as a pilot area.
Technical Considerations:	• Recent flooding events will inform public perception of risk, as they are the most present and visible impacts now. It is important that the AAP be informed by risk analysis and consider all forms of climate hazard impacts while responding to the community needs and concerns.

REFERENCES

City and County of Honolulu Department of Planning and Permitting. (September, 2025). North Shore Sustainable Communities Plan. https://www4.honolulu.gov/docushare/dsweb/Get/Document-355118/NSSCP%20PRD%202025.pdf

City and County of Honolulu. (n.d.). Honolulu Complete Streets, North Shore. https://www.honolulu.gov/completestreets/north-shore/

Surfrider Foundation Oʻahu. (n.d.). North Shore Coastal Resilience Working Group. https://oahu.surfrider.org/northshoreworkinggroup

University of Hawaiʻi. (n.d.). SOEST Climate Viewer. https://www.soest.hawaii.edu/crc/slr-viewer/

ACRONYMS

AAP	Area Adaptation Plan
BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

BEACH PARK EROSION AND FLOOD RESILIENCE

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes coastal erosion and extreme heat mitigation measures at shoreline parks in the Koʻolau Loa moku. The study will identify and prioritize sites that could most benefit from these measures within the moku. Priority city-managed sites that may experience severe erosion in the future could include Punaluʻu Beach Park and Kaʻaʻawa Beach Park. Additional sites may be identified through work currently in progress by HDR.
ID #:	64
Timeframe:	Mid-term
Champion Agencies:	DPR/CCSR
Potential Partnerships:	DDC
Adaptation Strategy Type:	Plan/Study
Location of Project:	Koʻolau Loa
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Kaʻaʻawa/Kahana
Congressional District:	2
Council District:	III
Legislative District:	49

PROJECT CONCEPT

Neighborhood Board:	Koʻolau Loa Neighborhood Board
Oʻahu SoVI Index:	High



Figure 1. All Hazards Map of Project Area.

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High-risk water mains, wells **Wastewater:** High priority cesspools **Stormwater:** 12-in., 18-in., and 24-in. stormwater conduits **Roads:** Kamehameha Hwy, Lau Place
Community Assets at Risk:	Ahupuaʻa ʻO Kahana State Park, Hauʻula Beach Park, Kalaeʻōʻio Beach Park, Swanzy Beach Park, Makaua Beach Park, Kaʻaʻawa Beach Park, Kaʻaʻawa Public Elementary School, Kaʻaʻawa Fire Station 21, Punaluʻu Beach Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **Sea Level Rise (Overland and Emergent Groundwater Flooding):** Impacts begin at approximately 1 foot of SLR and include groundwater inundation, while annual high wave flooding and coastal erosion are anticipated at approximately 2 feet of SLR. Rising sea levels may increase flood exposure along the Kaʻaʻawa and Kahana coastline, with drainage backflow occurring at 6 feet of SLR. Coastal flooding and erosion may affect community assets and transportation infrastructure in the area. Near-term impacts are anticipated. **Hurricane:** Complete inundation is anticipated in some areas under a Category 1 hurricane event. Flooding during major storm events may affect community assets and transportation access within the Kaʻaʻawa/Kahana area and could disrupt access to critical facilities and services. **100-Year Storm:** Complete inundation is anticipated during a 100-year storm event. Flooding may affect low-lying portions of the Kaʻaʻawa/Kahana area and disrupt transportation access and community assets. Mid-term impacts are anticipated. **Extreme Heat:** Some areas are exposed to high afternoon temperatures and extreme heat conditions. Elevated temperatures may affect vulnerable populations and outdoor users of community facilities. Mid-term impacts are anticipated. This project will address extreme heat by providing shade and passive cooling in parks.

PROJECT COMPONENTS

PLAN/STUDY

1. Site Identification and Vulnerability Assessment

Review shoreline parks throughout the Koʻolau Loa moku and identify sites vulnerable to coastal erosion, sea level rise, flooding, and extreme heat.

Compile existing studies, mapping, and climate hazard information, including work currently being completed by HDR.

Assess potential impacts to park facilities, recreational areas, natural resources, cultural resources, and public access.

Prioritize parks based on anticipated exposure, consequence of impact, and community importance.

2. Alternatives Analysis

Evaluate potential coastal erosion mitigation measures, such as nature-based shoreline stabilization, dune restoration, native vegetation planting, strategic retreat, and park reconfiguration.

Evaluate extreme heat mitigation strategies, including shade tree planting, heat-resilient landscaping, cooling structures, and other passive cooling measures.

Assess opportunities to incorporate Native Hawaiian practices and natural infrastructure approaches.

Compare alternatives based on effectiveness, feasibility, environmental considerations, permitting requirements, lifecycle costs, and community benefits.

3. Prioritization and Implementation Planning

Develop criteria to rank and prioritize candidate shoreline parks for future adaptation investments.

Identify preferred adaptation strategies for high-priority sites, including city-managed sites such as Punaluʻu Beach Park, Hauʻula Beach Park, and other priority locations identified through ongoing studies.

Develop conceptual implementation recommendations, planning-level cost ranges, and potential funding opportunities.

Create a phased implementation roadmap identifying near-, mid-, and long-term actions.

PROGRAM

N/A

INFRASTRUCTURE

N/A

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☐ Improves water quality ☒ Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Safeguard Native Hawaiian cultural practices; ensure traditions are respected and preserved Environmentally friendly solutions such as low-impact development and natural buffers to address flooding Improve resilience of critical infrastructure to withstand natural disasters and emergencies. Kamehameha Highway is the only way to and from many communities.
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Work together to leverage resources and enable climate readiness.
CRO Strategies Supported:	**#2**: Amplify and create capacity for community-led climate adaptation **#5**: Strengthen climate resilience of beach and wetland ecosystems through preservation and restoration **#11**: Reduce flood risk and coastal erosion by directing development to safer and higher ground
Relevant Adaptation Strategies:	• Reef Facilitation • Breakwater/Revetments

PROJECT COMPONENTS

- Restore Beach, Dune Systems, and Coastal Floodplain
- Build a Living Levee
- Riparian and Wetland Buffers
- Bank Grading/Planting
- Incorporate Heat and Drought Resilient Vegetation
- Incorporate Native Vegetation
- Incorporate Salt and Flood Resilient Vegetation
- Increase or Preserve Site Tree Canopy Coverage, Natural Planted Areas, or Wetlands
- Implement Cool Alternatives to Traditional Pavements for Roads and Sidewalks; Incorporate Heat Resilient Materials
- Incorporate Shade and Cooling Structures
- Heat Management Plan
- Study to Incorporate Native Hawaiian Practices for Resilient Design

Expected Timeline:	This project includes a study component that may lead to infrastructure projects. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the long-term timeframe.
Triggers:	**Climate Hazard:** SLR, Heavy Rain, Extreme Heat **Funding:** Implementation of improvements identified in the study may be advanced when sufficient funding becomes available. **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Coastal erosion rates and future sea level rise impacts may vary by site, creating uncertainty in prioritization and design. Balancing shoreline protection, public access, cultural resources, and environmental stewardship may also present challenges.
Additional Considerations:	• Future improvements should consider sensitive coastal habitats, Native Hawaiian cultural resources, permitting requirements, and exposure to multiple hazards, including coastal erosion, flooding, hurricanes, tsunamis, and extreme heat.

REFERENCES

None

ACRONYMS

CRO	Climate Ready O'ahu
DFM	Department of Facility Maintenance
DPR	Department of Park and Recreation
LID	Low Impact Development
N/A	Not Applicable
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
TMDL	Total Maximum Daily Load

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

MCBH R-1 RECYCLED WATER UPGRADE

PROJECT CONCEPT

GENERAL DESCRIPTION

This project will consist of a study and associated coordination efforts to support the development of the Marine Corps Base Hawai‘i (MCBH) recycled water system that will reduce the base's demand for potable water from Honolulu Board of Water Supply (BWS) and other potable sources. MCBH is currently working on upgrading their wastewater treatment plant (WWTP) to produce R-1 recycled water separately from this project that can be used for irrigation and will eliminate up to 1 million gallon per day of treated effluent that is currently disposed of via an ocean outfall. There will also be an opportunity for the Department of Environmental Services (ENV) to support this effort by helping to treat some of the flows from MCBH and utilize the recycled water as well. The focus of this plan/study is to determine the impact of the MCBH's upgrade on BWS and ENV operations in the area and determine the potential benefits for the City and the surrounding community.

BWS has encouraged the MCBH in the past to consider the R-1 upgrade because it will allow the MCBH Klipper Golf Course and other green spaces to be irrigated with recycled water rather than potable water. Currently, BWS provides potable water to MCBH that must be pumped over a long distance from potable sources. The reduction in potable water demand would allow BWS to reduce the water supply and energy burden for serving MCBH and in turn allow for less diversion from streams. That will allow for improved streamflow and preservation of the surface water resources within and mauka of the Kāne‘ohe area.

At the same time, this plan will consider the feasibility of diverting some of the MCBH's wastewater flows to the nearby ENV Kailua Regional WWTP (KRWWTP) if needed to support the MCBH WWTP's treatment capacity and R-1 production. Expanding water reuse in general, whether the City or other entities are producing the reused water, will help increase water supply resilience for the Kāne‘ohe area. In addition to the potential water supply resiliency improvements, this project will help to spread awareness of recycled water as an irrigation source and help inform the community (civilians and military personnel) of the challenges that both BWS and ENV face when trying to maintain potable water and wastewater services with a changing climate.

ID #:	61
Timeframe:	Mid-term
Champion Agencies:	BWS
Potential Partnerships:	ENV, MCBH/Department of Defense
Adaptation Strategy Type:	Plan/Study
Location of Project:	Kāneʻohe, Ko'olau Poko
Area Classification:	Country Towns and Rural Coastline
Hotspot:	ʻAikahi/Kalāheo
Congressional District:	2
Council District:	III
Legislative District:	House District 50
Neighborhood Board:	Mōkapu, Kailua Subdistrict 4
Oʻahu SoVI Index:	Medium



Figure 1. Satellite view of MCBH

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Wells, distribution system **Wastewater:** KRWWTP, Kāneʻohe Bay WWPS, sewer lines are not necessarily at risk from drought but may be impacted by this project **Stormwater:** Drainage infrastructure is not necessarily at risk from drought, but streams and associated infrastructure may be impacted by this project **Roads:** Roads are not necessarily at risk from drought, but may be impacted by infrastructure improvements motivated by this project (This list includes key assets in the ʻAikahi/Kalāheo hotspot area immediately south of MCBH. However, assets throughout Kāneʻohe will also be impacted by drought and water supply issues that this project aims to address, so the true list of assets at risk is significant and will not be included here for brevity)
Community Assets at Risk:	ʻAikahi Fire Station 19, ʻAikahi Public Elementary School, ʻAikahi Park Shopping Center, Kalāheo Public Highschool, Kainalu Public Elementary School, Kāneʻohe Bay, Kailua Bay, ʻAikahi Community Park (This list includes key assets in the ʻAikahi/Kalāheo hotspot area immediately south of MCBH. However, assets throughout Kāneʻohe will also be impacted by drought and water supply issues that this project aims to address, so the true list of assets at risk is significant and will not be included here for brevity)

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Drought:** Concern for longer-term aquifer recharge and potable water supply for this area. R-1 reuse and distribution will reduce the potable water needs for irrigation and leave more potable water available for drinking water and maintaining streamflow. **Extreme Heat:** Increased heat increases water demand. Increased non-potable water supply and use can decrease demand on the limited potable water supply.

PROJECT COMPONENTS

PLAN/STUDY

This plan/study will identify the impacts of the MCBH WWTP R-1 upgrade on City infrastructure. The anticipated reduction in MCBH potable water demand and change to the wastewater/recycled water treatment system will impact or provide opportunities for beneficial impacts to BWS and ENV operations in the Kāneʻohe area. Components of the study may include for example options for how BWS can use the water that will no longer be used for irrigation in MCBH, or opportunities for ENV to support the wastewater demands of MCBH and expand reuse in other areas outside the base as well. The study should also identify the collaboration and stakeholder engagement needs for the collaboration between City and MCBH. The City will need to be well-informed and coordinated with the MCBH R-1 upgrade, as the implementation of that external project will significantly impact this project.

PROGRAM

N/A

INFRASTRUCTURE

This plan may produce recommendations for improvements to water or wastewater infrastructure, but implementation of those improvements will require an infrastructure project that follows this one.

Community Benefits:

- ? Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- ☐ Improves water quality
- ☐ Improves public access to community spaces
- ? Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:

Protect water quality and natural resources in streams, ponds, and coastal areas

Improve water supply resilience for local community use

PROJECT COMPONENTS

OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse
Expected Timeline:	This project will be triggered by the external MCBH R-1 upgrade project. However, coordination and engagement with the City and MCBH has already taken place and needs to continue throughout the completion of the upgrade. The City will need to know the timing of the upgrade and how MCBH will operate the system. This will determine the reduction in BWS potable water and if there will be any involvement of ENV with treating MCBH wastewater flows.
Triggers:	**Climate Hazard:** Drought **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• R-1 water is not a perfect substitute for potable water. Adds nutrients to soil when used for irrigation. Pricing of R-1 water may not be competitive with potable water options. • Existing infrastructure is threatened by sea level rise. Want to avoid upgrading City and MCBH systems with elevated risk of climate hazard impacts. The Draft Environmental Assessment submitted by MCBH identifies the need to upgrade the WWTP with increased resilience to tsunamis at minimum.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Additional Considerations:	• Significant coordination with the DOD/MCBH will be required. A collaborative and sustained relationship between the City and MCBH will inform what parts of the study can be feasibly implemented and realized. If communication with MCBH is difficult, it will likely be difficult to produce a study with feasible options. Additionally, if the City needs to implement any operational or infrastructure changes, those actions must be aligned with the actions and timeline of the MCBH's improvements.

REFERENCES

MCBH. (2025). Draft Environmental Assessment for Water Reclamation Facility Upgrade. https://files.Hawai'i.gov/dbedt/erp/Other_TEN_Publications/2025-04-08-OA-NEPA-DEA-MCBH-Water-Reclamation-Facility-Upgrade.pdf

One Water Honolulu. (January, 2026). Project Development Workshops.

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready O'ahu
DOD	Department of Defense
ENV	Department of Environmental Services
KRWWTP	Kailua Regional Wastewater Treatment Plant
MCBH	Marine Corps Base Hawai'i
N/A	Not Applicable
OWH	One Water Honolulu
R-1	Recycled Water Meeting R-1 Standards
SoVI	Social Vulnerability Index
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

WAIMĀNALO ROADS DRAINAGE STUDY AND IMPROVEMENTS

PROJECT CONCEPT

GENERAL DESCRIPTION

This project includes a preliminary drainage study to identify and characterize drainage issues in the area and then the implementation of potential infrastructure improvements to address drainage needs. The study will support the development of stormwater infrastructure solutions to increase drainage capacity and reduce flooding impacts on local roads, especially during heavy rain or extreme storm events like hurricanes or tsunamis. In the past, large storms have impacted this area, causing prolonged periods of flooding within properties and roadways.

The infrastructure improvement recommendations may include new or upgraded storm drains, catch basins, and related drainage facilities, with final infrastructure components to be determined based on study findings and tailored to this specific area.

Through past and ongoing Kalanianaʻole Highway improvement projects, the areas along the highway in the northern part of Waimānalo were improved to add or renovate sidewalks, median, and drainage structures. The Hawaiʻi Department of Transportation (HDOT) is continuing highway improvements through the southern portion of Waimānalo and Waimānalo Beach, where currently drainage and pedestrian safety is a concern (relative to the recently improved areas in Waimānalo). There is an opportunity in this project to coordinate roadway drainage improvements with this existing/future HDOT project where the highway and the adjacent corridor is already planning to be under construction. Coordination will allow the improvements of both projects to take place along similar timelines, which will ultimately result in a safer highway for pedestrians with better drainage, especially important during heavy rainfall or tsunami events, with likely reduced disruption to vehicle traffic for construction.

ID #:	68
Timeframe:	Mid-term
Champion Agencies:	DFM

PROJECT CONCEPT

Potential Partnerships:	DTS, BWS, ENV, HDOT
Adaptation Strategy Type:	Infrastructure
Location of Project:	Waimānalo, Ko'olau Poko
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Waimānalo Beach
Congressional District:	2
Council District:	III
Legislative District:	House District 51
Neighborhood Board:	Waimānalo Subdistricts 1-11
Oʻahu SoVI Index:	High

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** BWS pipelines and facilities in low-lying areas **Wastewater:** Waimānalo WWTP and Influent Pump Station, Kahawai Stream WWPS, pipelines **Stormwater:** Waimānalo Stream and Channel, Kahawai Stream, drainage pipelines **Roads:** Kalanianaʻole Hwy and other local roads
Community Assets at Risk:	Waimānalo Fire Station 27, Waimānalo Health Clinic, Waimānalo Elementary and Intermediate Public School, Blanche Pope Elementary School, Hūnānāniho, Waimānalo Beach Park, Waimānalo District Park, Kaiona Beach Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Heavy Rain, Hurricane:** Heavy rainfall (up to and including a 100-year storm) and flooding from these extreme events may exceed the capacity of existing drainage facilities, leading to roadway flooding, reduced access along Kalanianaʻole Highway and local roads, and impacts to nearby community assets. Flooding and debris may overwhelm existing drainage systems and disrupt normal drainage patterns. Drainage capacity increases will address flooding from these extreme events. **Tsunami:** Coastal inundation from tsunami may exceed the capacity of existing drainage facilities, leading to roadway flooding, reduced access along Kalanianaʻole Highway and local roads, and impacts to nearby community assets. Flooding and debris may overwhelm existing drainage systems and disrupt normal drainage patterns. Tsunami impact will be addressed by improvements to the drainage system to have increased capacity to handle coastal inundation.

PROJECT COMPONENTS

PLAN/STUDY

The preliminary study portion of this project will evaluate the existing drainage conditions and infrastructure in Waimānalo, particularly along major roadways like Kalanianaʻole Highway near Waimānalo Beach where recent HDOT improvements have not yet been constructed. Major components of the study could include, but are not limited to, a drainage assessment, stormwater infrastructure evaluation, identification and prioritization of local road drainage improvements, including storm drains, catch basins, drainage outlets, detention/retention features, and related facilities, planning-level cost, phasing, and implementation recommendations. These components can be divided into assessment and improvement categories as follows:

1. Existing Conditions and Drainage Assessment
    - Evaluate existing stormwater drainage conditions along Kalanianaʻole Highway and local roads.
    - Identify drainage deficiencies, capacity constraints, and locations vulnerable to flooding.
    - Assess existing stormwater infrastructure, including storm drains, catch basins, and related drainage facilities.
2. Stormwater Improvement Alternatives
    - Identify and evaluate potential improvements to address stormwater drainage needs and increase drainage capacity along local roads.
    - Develop conceptual alternatives for new or upgraded storm drains, catch basins, and other related stormwater infrastructure.
    - Compare potential improvement options and their ability to reduce flooding impacts.

PROGRAM

N/A

INFRASTRUCTURE

The infrastructure construction portion of this project that will follow the completion of the study will implement the some or all of the recommended improvements based on funding availability, feasibility, etc. This portion will require a planning phase and then an implementation/construction phase. These phases may include but are not limited to the following tasks:

1. Infrastructure Improvement Planning
    - Prioritize recommended stormwater infrastructure improvements.
    - Develop planning-level implementation recommendations to support future project development and construction.
    - Advance selected improvements into design and permitting.
    - Establish project phasing and implementation priorities.

PROJECT COMPONENTS

2. Infrastructure Improvements Implementation

- Implement selected drainage improvements identified through the study.
- Construct new or upgraded storm drains, catch basins, drainage outlets, detention/retention features, and related facilities, as appropriate.
- Long-term monitoring or progress checks to see if drainage capacity and flooding impacts are reduced by the improvements.

Community Benefits:	? Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ? Improves public access to community spaces ? Increases public awareness/education ? Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve water quality and flood mitigation
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies Work together to leverage resources and enable climate readiness Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#10**: Make buildings, homes, and infrastructure more climate resilient

PROJECT COMPONENTS

Relevant Adaptation Strategies	• Stormwater Capture and Use • Modify Site Drainage, Storage, and Infiltration • Mauka stormwater treatment, retention, and infiltration • Drainage System Plan • Upsize Stormwater Drainage Capacity or Sanitary Sewer Capacity • Stormwater Utility Fee
Expected Timeline:	This project may be informed by the near-term OWH Project #165 Stormwater Master Plan and funded by the near-term OWH Project #30 Stormwater Utility Fee. The implementation of one or both of these projects is not necessary for this project to start, but the feasibility and justification for implementing the identified improvements may be strengthened by the implementation of those projects as precursors. The project includes both a study and infrastructure component. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the mid-term timeframe.
Triggers:	**Climate Hazard:** N/A **Funding:** Yes **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges & Additional Considerations:	• There is a lack of existing DFM stormwater infrastructure particularly in the Waimānalo Beach area, in the lots between Waimānalo Beach Park and Hūnānāniho. There is also limited infrastructure near or along Kalaniana‘ole Highway in this area. This elevates the likelihood that the study will find existing drainage concerns and consequently will recommend that more new infrastructure be built. • DFM is aware of the lack of drainage infrastructure. Funding will be needed to implement the potentially extensive extent of new infrastructure required to achieve adequate drainage during storm events. The successful implementation of the stormwater utility fee may provide the funding required.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Currently, roadside ditches and shoulders provide drainage. Agricultural lots run perpendicular to the ditches, and dirt swales from those lots drain into the ditches. This can lead to excessive runoff and transport of soil from the agricultural land into the ditches. Within this project or a separate project, the addition of vegetation and/or gravel to the swales will reduce soil runoff and excess soil accumulating in the ditches.
- Past storm events have caused flooding issues within properties and the roadways in Waimānalo. Larger events such as a hurricane, tsunami, or a 100-year storm would likely cause even more pronounced flooding and property damage. The community may desire the improvements recommended in this study for improved safety and for reassurance that the City and State are attentive to the local flooding concerns and taking action to address them.
- Coordination with HDOT will be required. Ideally, coordination will allow for construction of both HDOT improvements and improvements from this project to occur simultaneously or in-tandem, but at minimum, coordination will be needed to make improvements along the highway or any other State roads in the area.

REFERENCES

One Water Honolulu. (January 2026). Project Development Workshops.

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
ENV	Department of Environmental Services
HDOT	Hawaiʻi Department of Transportation
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

KAHAWAI STREAM RESTORATION STRATEGY

PROJECT CONCEPT

GENERAL DESCRIPTION

Areas along the stream/channels in the Kahawai Watershed are at risk to recurrent flooding and emergent groundwater, driven by intense rainfall, shallow groundwater tables, and constraints on stream flow through developed areas. This study will evaluate opportunities for stream restoration and nature-based flood mitigation along the stream to reduce flood risk, manage emerging groundwater, and protect nearby infrastructure and community assets.

The study will identify highest-risk stream reaches and nearby low-lying areas, assess interactions between surface water, groundwater, and existing infrastructure, and develop a prioritized set of nature-based and hybrid mitigation strategies that can be advanced into future design and implementation phases.

The study will focus on:

- Streams flowing through the Kahawai Watershed, including modified and natural reaches through residential and open space areas
- Associated drainage channels and low-lying floodplain areas connected to the stream
- Areas experiencing emergent groundwater during wet periods, contributing to persistent surface flooding

Note that there are inconsistent and conflicting naming conventions for the streams that flow through the Waimānalo area. For the purposes of this project, the watershed and stream of focus is the one labeled Kahawai Stream in the Kahawai Watershed as shown in the map below provided by the Department of Health. Other sources may call this stream by a different name (i.e., Inoaʻole Stream or Inaʻole Stream). This stream was selected for this project because it is impacted by several climate hazards and flows through/near a significant portion of the Waimānalo community and multiple important assets (i.e., the Waimānalo WWTP, Waimānalo District Park, Hūnānāniho Beach Park, etc.). With the threat of natural and manmade hazards that limit drainage and contribute to flooding from streams, improvements that can reduce the risk of current and future

PROJECT CONCEPT

	flooding events will be critical for protecting this community into the future with a changing climate.
ID #:	70
Timeframe:	Mid-term
Champion Agencies:	DFM
Potential Partnerships:	DTS, State agencies (i.e., DLNR, DHHL), Federal agencies (i.e., DOD)
Adaptation Strategy Type:	Plan/Study
Location of Project:	Waimānalo, Koʻolau Poko
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Waimānalo Beach, Waimānalo near Olomana Golf Course
Congressional District:	2
Council District:	III
Legislative District:	House District 51
Neighborhood Board:	Waimānalo Subdistrict 7, 10
Oʻahu SoVI Index:	High



Figure 1. Satellite view of Waimānalo

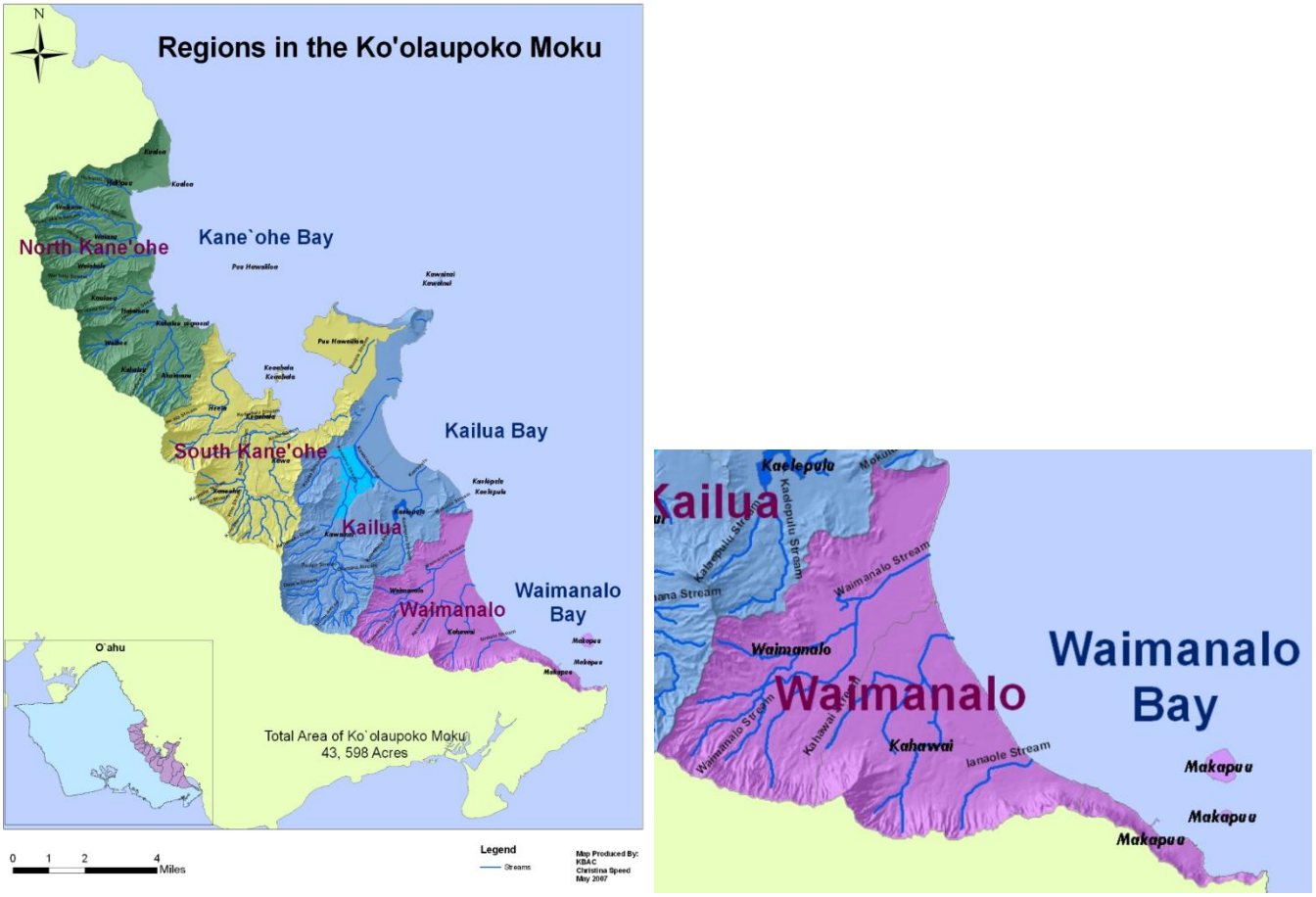


Figure 2. Maps of Koʻolau Poko Streams (Department of Health, 2013). The watershed of focus is the one marked Kahawai and the stream labeled Kahawai Stream.

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** BWS pipelines and facilities in low-lying areas **Wastewater:** Waimānalo WWTP and Influent Pump Station, Kahawai Stream WWPS, pipelines **Stormwater:** Stream/channel and drainage conveyances with limited capacity during extreme rainfall. Culverts and crossings vulnerable to blockage and backwater effects **Roads:** Local roads adjacent to the stream that experience inundation or reduced access during storms (i.e., Hīhīmanu Street)
Community Assets at Risk:	Waimānalo Fire Station 27, Waimānalo Health Clinic, Waimānalo Elementary and Intermediate School, Blanche Pope Elementary School, Hūnānāniho Beach Park, Waimānalo Beach Park, Waimānalo District Park, Kaiona Beach Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Hurricane:** Intense rainfall and debris accumulation increases flood depths and duration. Stream restoration and improvements will slow the flow of rainfall, reducing flood damage. **100-Year Flood:** Flooding can cause overtopping of streambanks and inundation of adjacent neighborhoods and backwater effects where stream capacity is exceeded. Stream restoration and maintenance will reduce flood risk by creating higher capacity within the streambed, slowing water and increasing infiltration, and increasing water uptake in increased vegetated areas. **Sea Level Rise:** Reduced downstream drainage during high tides, compounding effects with groundwater rise in coastal portions of the watershed, frequent or constant inundation near streambanks, especially during high tides or rain events. While this study will not address SLR, it will consider impacts from sea level rise and shallow groundwater rise when projecting future infiltration and stream flows. **Drought:** The Waimānalo area has a low risk from drought. Stream restoration and maintenance can slow the flow of rainfall and increase groundwater recharge, reducing impacts of droughts.

PROJECT COMPONENTS

PLAN/STUDY

This study will further identify flooding and emergent groundwater risk areas within the watershed and identify current risk factors for past and current known flooding issues. Then, potential flood mitigation and stream restoration opportunities will be identified and prioritized. Finally, a pathway roadmap will be developed to identify the next steps to implement improvements and align with other improvement initiatives within the watershed. Main components of the study include:

Flooding and Groundwater Risk Assessment

- Identify locations along the stream with the highest flood frequency, depth, and duration
- Assess areas impacted by emergent groundwater and surface–groundwater interactions

Infrastructure Analysis

- Evaluate how existing roads, stormwater systems, and utilities influence stream behavior and flood pathways

Stream Restoration and Mitigation Screening

- Identify nature-based and hybrid mitigation measures

Floodplain reconnection

- Streambank restoration and stabilization
- Stormwater detention and infiltration
- Enhancement of riparian and wetland areas

Prioritization Framework

- Rank mitigation opportunities based on flood risk reduction, feasibility, community benefit, and environmental co-benefits

Implementation Roadmap/Pathway Development

- Outline next steps for design, permitting, partnerships, and funding
- Identify opportunities to align with other watershed or infrastructure initiatives

PROGRAM

N/A

INFRASTRUCTURE

This study will likely produce recommendations for improvements to stormwater drainage and/or roadways, but implementation of those improvements will require an infrastructure project that follows this one.

Community Benefits:	☒ Protects cultural sites **?** Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☐ Improves public access to community spaces **?** Increases public awareness/education ☒ Provides ecosystem restoration **?** Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Flood protection for residential neighborhoods Investment in resilient, nature-based infrastructure Long-term watershed and community resilience
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#6**: Improve watershed health to mitigate wildfire risk and manage flooding
Relevant Adaptation Strategies	• Stream restoration • Drainage system plan • Maintenance plan for rivers and streams
Expected Timeline:	This project will produce a stream restoration and flood mitigation study in the mid-term that will identify potential improvements that will be prioritized and mapped out for implementation. Alignment with other roadway, drainage, or watershed projects may shift the project implementation timeline. Identifying high-priority mitigation areas, grant funding opportunities, or increased impacts from SLR hazards, including emergent groundwater, may increase the priority in the CIP for earlier project implementation

Triggers:	**Climate Hazard:** SLR **Funding:** Availability of capital or grant funding for improvements or increased maintenance activities **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	Limited space for flood mitigation in developed areas. City's focus is within the streambanks and enforcement of private properties to maintain the stream segments adjacent to their property. The Department of Planning and Permitting would have more leverage if development regulations for private properties adjacent to the stream need to be enforced. Coordination across land ownership and agency jurisdictions. This project and components can be applied to other streams, however State and Federally owned land and assets in Waimānalo can impact the level of City involvement and inherent responsibility for stream maintenance and improvement activities. Coordination with State and/or Federal stakeholders may be required to implement some of the recommended actions from this study. Stream-related permitting and other regulatory requirements may be major challenge, requiring coordination and approval of the Commission on Water Resource Management, among others. Funding for future implementation beyond the study phase will be necessary.
Additional Considerations:	Managing combined surface water and groundwater flooding, especially during storm events and with climate change over time Integrating nature-based solutions with existing drainage infrastructure Permitting requirements for work in and around streams. Collaboration with other entities like private landowners and Federal agencies

REFERENCES

Department of Health. (2013). Regions in the Koʻolaupoko Moku. https://www.google.com/search?q=Waimānalo+stream&rlz=1C1GCEA_enUS1222US1223&oq=Waimānalo+stream&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIICAEQABgWGB4yDQgCEAAYhgMYgAQYigUyCggDEAAYgAQYogQyBwgEEAAY7wUyCggFEAAYgAQYogTSAQgzMDMyajBqN6gCALACAA&sourceid=chrome&source=chrome.ob&ie=UTF-8&safe=active&ssui=on

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United States Army Corps of Engineers. (2023). Waimānalo Community Flood Hazard Study. https://www.poh.usace.army.mil/Portals/10/20230131_Waimānalo_Report_with_Appx.pdf?ver=lOm2lFORUTladtqFXsGPGA%3d%3d

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DHHL	Department of Hawaiian Homelands
DLNR	Department of Land and Natural Resources
DOA	Hawaiʻi Department of Agriculture
DOD	Department of Defense
DTS	Department of Transportation Services
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

STORMWATER RETENTION ALONG KAMOʻOALIʻI STREAM

PROJECT CONCEPT

GENERAL DESCRIPTION	The Stormwater Retention along Kamoʻaliʻi Stream is a proposed infrastructure project that will evaluate, design, and construct a detention basin to capture and temporarily store stormwater runoff within the Kāneʻohe watershed. The detention basin will provide temporary storage during storm events, slowing stormwater discharge and reducing peak flows that can contribute to downstream flooding, erosion, and sediment transport. In addition to improving flood mitigation, the project may support water quality benefits by allowing sediment and pollutants to settle before runoff is released. Through collaboration between the Board of Water Supply (BWS), Department of Facility Maintenance (DFM), and Department of Design and Construction (DDC), the project will strengthen long-term watershed management and increase the resilience of Kāneʻohe's infrastructure and coastal resources to future climate impacts. This project provides additional stormwater retention capacity within the Kamoʻaliʻi Stream watershed that is not included in the ongoing HDOT drainage improvements at the Halekou Interchange (between the H-3 and Kamehameha Highway) and remains relevant independent of that effort.
ID #:	59
Timeframe:	Mid-term
Champion Agencies:	DFM, BWS, DDC
Potential Partnerships:	ENV, DES
Adaptation Strategy Type:	Infrastructure (Plan/Study Phase at the Beginning)
Location of Project:	Stormwater Retention along Kamoʻaliʻi Stream
Area Classification:	Country Towns and Rural Coastline

PROJECT CONCEPT

Hotspot:	Kāneʻohe
Congressional District:	2
Council District:	III
Legislative District:	House District 49
Neighborhood Board:	Kāneʻohe Subdistrict 10
Oʻahu SoVI Index:	High

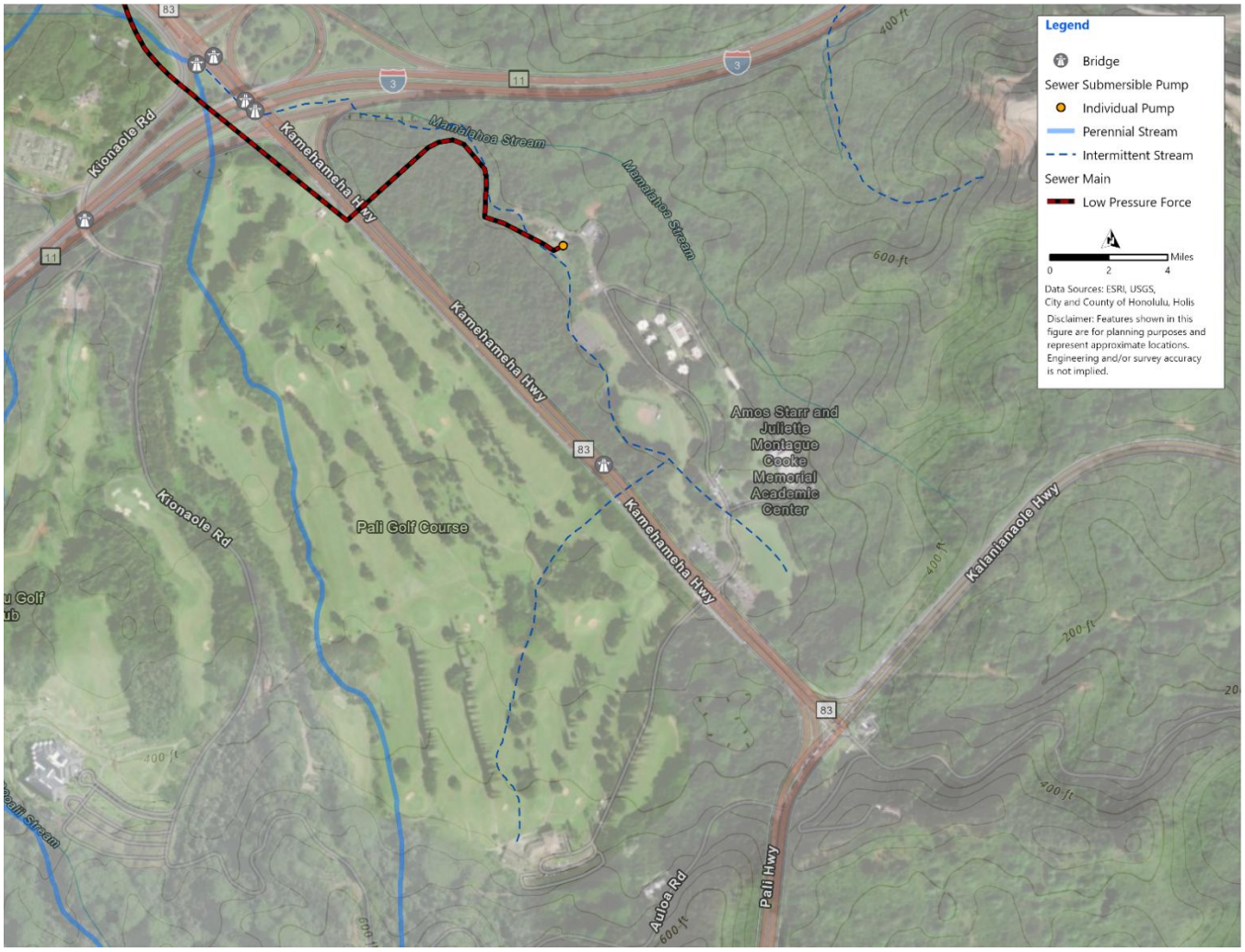


Figure 1. Infrastructure at Pali Golf Course

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk water lines **Wastewater:** Sewer mains **Stormwater:** Intermittent and perennial streams **Roads:** Pali Highway, Kamehameha Highway, H-3
Community Assets at Risk:	Atherton Soccer Field, Likeke Falls Trailhead, Old Pali Road Hike, Koʻolau Ballrooms and Conference Center, Pali Golf Course

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **100-Year Flood:** Extreme rainfall associated with a 100-year flood event may generate runoff volumes that exceed the detention basin's storage capacity. While the project is intended to reduce peak flows and downstream flooding, severe flood events may still result in overtopping, erosion, or localized flooding within and around the Pali Golf Course drainage area. **Hurricane:** Intense rainfall during hurricanes can produce large volumes of stormwater runoff over a short period, increasing demands on the detention basin and associated drainage infrastructure. The project is intended to help manage these flows however, extreme storm conditions may reduce storage effectiveness and increase sediment and debris accumulation requiring post-storm maintenance. **Drought:** Extended drought conditions may reduce stormwater inflows and result in prolonged dry periods within the detention basin. Drier soil conditions and reduced vegetation health may affect basin performance and maintenance requirements when heavy rainfall events return following extended dry periods. Stormwater detention slows runoff and increases infiltration into the soil for groundwater recharge. Increased stormwater retention can reduce drought impacts on groundwater locally.

PROJECT COMPONENTS

PLAN/STUDY

Building off the Stormwater Master Plan Results, identify opportunities within the Kāneʻohe watershed for stormwater detention to reduce flooding and improve water quality. Model potential solutions and engage the community to select an appropriate location for the infrastructure phase.

PROGRAM

N/A

INFRASTRUCTURE

1. Stormwater Detention Basin Planning and Design

Evaluate stormwater runoff volumes, drainage patterns, and flood-prone areas within the Pali Golf Course watershed.

Identify suitable locations, storage requirements, and design criteria for a stormwater detention basin.

Develop planning-level recommendations to improve flood mitigation and stormwater management capacity.

2. Stormwater Detention Basin Construction

Construct a detention basin/pond to capture and temporarily store stormwater runoff during heavy rainfall events.

Install associated conveyance, inlet, outlet, and overflow infrastructure to manage stormwater flows safely.

Reduce peak runoff rates, downstream flooding, and erosion impacts within the Kāneʻohe watershed.

3. Stormwater System Resilience Enhancements

Incorporate erosion and sediment control measures to maintain long-term basin performance.

Improve the resilience of local drainage infrastructure to extreme rainfall and storm events.

Support watershed management objectives by enhancing stormwater retention and reducing flood risks to surrounding communities and infrastructure.

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☒ Improves public access to community spaces ☐ Increases public awareness/education ☒ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Protect water quality and natural resources in streams, ponds, and coastal areas
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu
CRO Strategies Supported:	**#6**: Improve watershed health to mitigate wildfire risk and manage flooding **#9**: Integrate climate resilience into City capital planning, operations, and policies **#10**: Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies:	• Modify Site Drainage, Storage, and Infiltration • Implement Low Impact Design (LID)/Green Infrastructure Stormwater Management Strategies • Upsize Stormwater Drainage Capacity or Sanitary Sewer Capacity • Stormwater System Resilience
Expected Timeline:	The project should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the mid-term timeframe. Implementation may be advanced if flooding becomes more frequent or severe within the Pali Golf Course drainage area, or if downstream communities, infrastructure, or roadways experience recurring flood impacts. Increased runoff

PROJECT COMPONENTS

	associated with changing precipitation patterns and observed drainage deficiencies may also trigger implementation.
Triggers:	**Climate Hazard:** Heavy Rain **Funding:** Implementation of drainage improvements may be advanced when sufficient funding becomes available. **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Extreme rainfall events associated with 100-year storms and hurricanes may generate runoff volumes that exceed the detention basin's design capacity, reducing flood mitigation effectiveness during major storm events. Sediment accumulation, debris blockage of inlet and outlet structures, and ongoing maintenance requirements may also affect long-term system performance.
Additional Considerations:	• Future improvements should consider available land within Pali Golf Course, potential impacts to existing recreational uses, permitting requirements, and ongoing maintenance responsibilities. Design should also account for changing precipitation patterns, downstream drainage conditions, and potential water quality considerations associated with stormwater retention and discharge. • Future improvements should also consider watershed drainage patterns, runoff volumes, and the detention basin's ability to manage increasing precipitation intensity associated with climate change. Design should evaluate basin storage capacity, conveyance infrastructure, sediment management needs, and opportunities to increase infiltration while maintaining long-term operational performance.

REFERENCES

None

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DES	Department of Enterprise Services
DFM	Department of Facility Maintenance
ENV	Department of Environmental Services
LID	Low Impact Design
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

COASTAL MANAGEMENT PLAN FOR EROSION AND FLOODING

PROJECT CONCEPT

GENERAL DESCRIPTION	This project will develop a comprehensive Coastal Management Plan for Kāneʻohe to address chronic coastal erosion, flooding, and shoreline access challenges affecting beach park areas and surrounding coastal resources. The study will assess existing shoreline conditions, identify areas most vulnerable to erosion and flooding, and evaluate the factors contributing to long-term coastal change, including wave action, storm impacts, and sea level rise. The effort will also examine how these hazards affect recreational areas, public access, community assets, and natural coastal resources throughout the Kāneʻohe coastline. As part of the planning process, the project will evaluate and compare a range of shoreline management and resilience strategies to address identified vulnerabilities. Potential measures include beach nourishment to restore and maintain shoreline width, levee improvements in high-risk areas to reduce flood exposure, and accessibility enhancements to improve public access to the shoreline. Through coordination among DPP, BWS, DFM, ENV, and DPR, the Coastal Management Plan will establish priorities, identify implementation opportunities, and provide a long-term framework for reducing coastal erosion and flood risks while maintaining community access to Kāneʻohe's coastal resources.
ID #:	53
Timeframe:	Mid-Term
Champion Agencies:	TBD
Potential Partnerships:	BWS, DFM, ENV, DPR, DPP
Adaptation Strategy Type:	Plan/Study
Location of Project:	Kāneʻohe

PROJECT CONCEPT

Area Classification:	Country Towns and Rural Coastline
Hotspot:	Ko'olau Poko
Congressional District:	2
Council District:	III
Legislative District:	48, 49
Neighborhood Board:	Kāneʻohe Subdistricts 5, 6, 14
Oʻahu SoVI Index:	Low

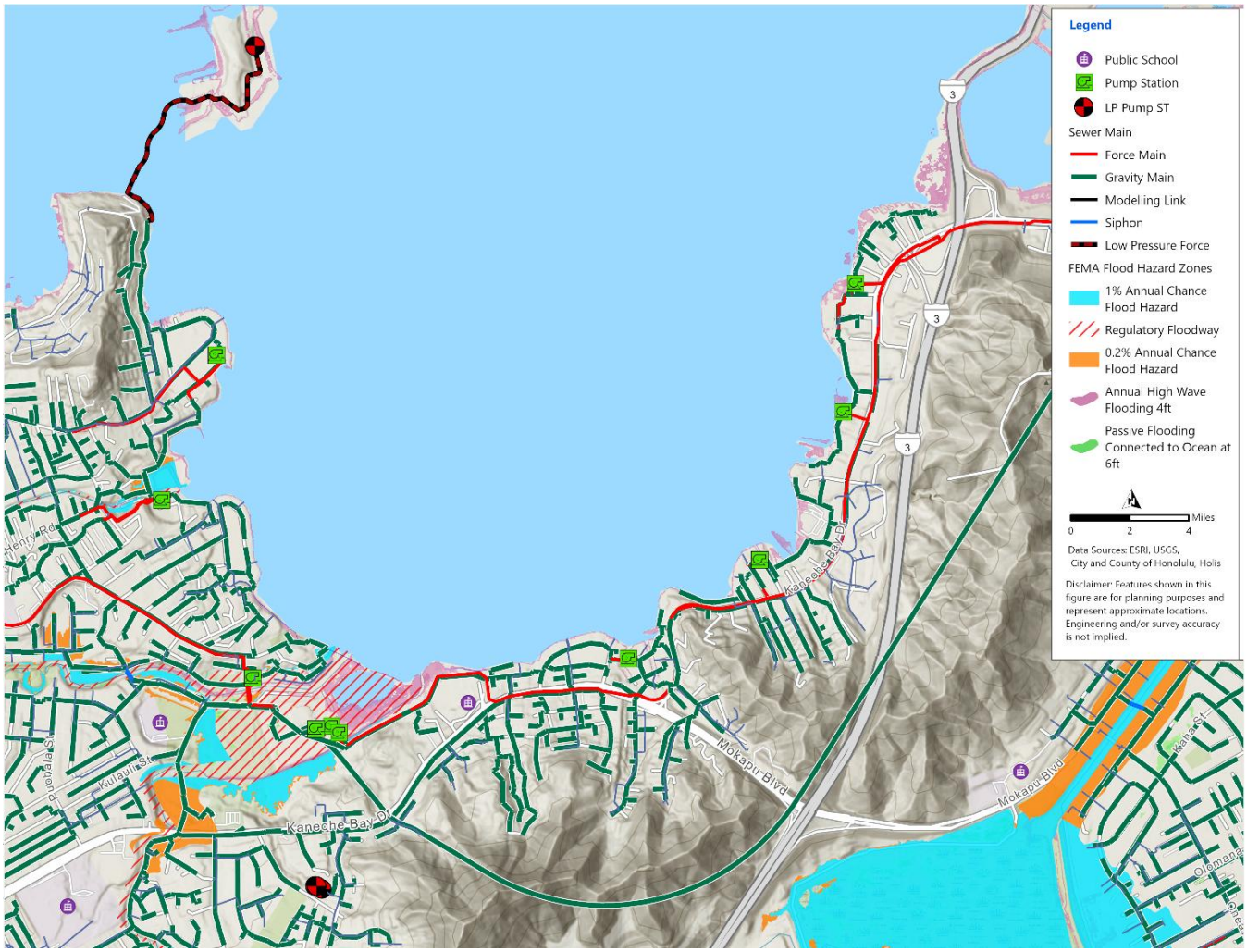


Figure 1. Kāneʻohe Area Map

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Water mains **Wastewater:** Pump stations, sewer mains, Kāneʻohe Influent Tunnel Facility **Stormwater:** Stormwater drain lines, Kāneʻohe Stream, Keaʻahala Stream, Kawa Stream **Roads:** Kāneʻohe Bay Drive, Kamehameha Highway, Lilipuna Rd
Community Assets at Risk:	Heʻeia Kea State Boat Harbor, Heʻeia State Park shoreline, Nāonealaʻa a Kāneʻohe (formerly Kāneʻohe Beach Park) shoreline areas, Waikane shoreline recreation areas, Kualoa Regional Park shoreline, Kahaluʻu Regional Park (mauka area), Laenani Neighborhood Park, Waiāhole Beach Park, Bayview Golf Park, Pūʻōhala Elementary School

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **100 Year Flood:** Flooding can increase sediment transport and pollutant runoff into Kāneʻohe Bay, affecting water quality and coastal resources. This plan will include consideration of vulnerability from riverine or rainfall flooding. **Hurricane:** Hurricanes can cause significant coastal inundation, including damage to shorelines and debris deposition. This plan will consider flood and erosion caused by hurricanes. **Tsunami:** Tsunami inundation can cause significant coastal flooding, shoreline damage, and debris deposition along the Kāneʻohe coastline. Impacts may affect beach park facilities, public access corridors, and coastal ecosystems. This plan will include tsunami waves within coastal flooding mechanisms. **Sea Level Rise (Overland Flooding):** Sea level rise is projected to increase passive coastal flooding and wave-driven inundation in Kāneʻohe, particularly in low-lying shoreline areas. More frequent flooding may reduce beach usability, affect public access, and increase stress on coastal infrastructure and community assets. This plan will focus on coastal flooding and sea level rise impacts. **Sea Level Rise (Emergent Groundwater):** Rising sea levels are expected to elevate groundwater levels, resulting in emergent groundwater and groundwater inundation in vulnerable areas. Elevated groundwater can contribute to chronic flooding, reduce drainage effectiveness, and impact coastal infrastructure and natural systems. This plan will consider flooding from shallow groundwater rise.

Coastal Erosion: Coastal erosion threatens the long-term stability of Kāneʻohe's shoreline by narrowing beaches and increasing the vulnerability of coastal resources to flooding and wave impacts. Continued shoreline retreat may limit public access, reduce recreational opportunities, and degrade coastal habitats, highlighting the need for shoreline management strategies such as beach nourishment and other resilience measures. This plan will address impacts to coastal areas from coastal erosion.

PROJECT COMPONENTS

PLAN/STUDY

1. Coastal Hazard and Vulnerability Assessment

Assess existing shoreline conditions and identify areas vulnerable to coastal erosion, flooding, and shoreline access limitations.

Evaluate potential impacts from sea level rise, 100-year flood events, hurricanes, tsunami inundation, and wave-driven flooding.

Identify public access areas, recreational assets, natural resources, and coastal areas that may be affected by future shoreline change.

2. Coastal Management Alternatives Analysis

Evaluate potential shoreline management strategies, including beach nourishment, levee improvements in high-risk areas, and nature-based adaptation measures.

Assess opportunities to improve shoreline resilience while maintaining public access and recreational use of beach park areas.

Compare alternatives based on effectiveness, feasibility, environmental considerations, and long-term adaptability to future coastal hazards.

3. Coastal Management Plan Development

Develop a coordinated coastal management framework to address erosion, flooding, and shoreline access challenges.

Establish priorities for future implementation projects and identify potential partnership opportunities among City agencies.

Develop planning-level recommendations and implementation pathways to support long-term shoreline resilience.

PROGRAM

N/A

INFRASTRUCTURE

1. Implementation Planning

Prioritize shoreline management and flood mitigation projects identified through the Coastal Management Plan.

Develop planning-level recommendations for future beach nourishment, levee improvements, and shoreline access enhancements.

Identify implementation priorities, phasing needs, and potential funding opportunities.

2. Beach Park Erosion and Flood Resilience Improvements

Implement shoreline stabilization and beach nourishment measures to address coastal erosion.

Construct or improve levees in high-risk areas to reduce coastal flooding impacts.

Implement accessibility improvements to maintain and enhance public access to shoreline and recreational areas.

Improve the long-term resilience of beach park facilities, coastal resources, and community assets vulnerable to erosion and flooding.

Community Benefits:	☒ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☐ Improves water quality ☒ Improves public access to community spaces ☒ Increases public awareness/education ☒ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Protect water quality and natural resources in streams, ponds, and coastal areas Manage and protect land/water resources for future generations
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Amplify the voices of O'ahu's people through meaningful stakeholder engagement Work together to leverage resources and enable climate readiness

CRO Strategies Supported:	**#5**: Strengthen climate resilience of beach and wetland ecosystems through preservation and restoration
Relevant Adaptation Strategies:	• Area Adaptation Plan • General and Community Plan Updates – Integrate Natural Hazard Policies • Restore Beach, Dune Systems, and Coastal Floodplain • Build a Living Levee • Riparian and Wetland Buffers • Incorporate Native Vegetation • Incorporate Salt and Flood Resilient Vegetation • Study to Incorporate Native Hawaiian Practices for Resilient Design
Expected Timeline:	This project includes a study component that may lead to infrastructure projects. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the mid- or long-term timeframe.
Triggers:	**Climate Hazard:** SLR, Heavy Rain **Funding:** Implementation of shoreline management and resilience measures may be advanced when funding becomes available for projects such as beach nourishment, levee improvements, shoreline stabilization, and public access enhancements identified through the Coastal Management Plan. **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Coastal erosion, flooding, and sea level rise may affect the shoreline through multiple interconnected processes, making it challenging to identify effective long-term management strategies. Balancing shoreline protection objectives with environmental considerations, public access needs, recreational uses, and community priorities may also present challenges. Coordination among multiple agencies and stakeholders may be required to develop consensus on preferred adaptation approaches and future implementation priorities.
Additional Considerations:	• The study should also account for the area's exposure to hurricane and tsunami impacts, potential changes in beach conditions over time, environmental permitting requirements, and the long-term sustainability of shoreline management measures. Maintaining public access while preserving coastal resources and addressing future climate risks may require tradeoffs among competing objectives.
Technical Considerations:	• Future planning efforts should evaluate shoreline erosion, coastal flooding, and sea level rise vulnerabilities affecting Kāneʻohe's beach parks, public access areas, natural resources, and adjacent community assets. The study should consider the impacts of sea level rise, groundwater inundation, 100-year flood events, hurricanes, tsunami inundation, and wave-driven flooding on shoreline conditions and future beach stability. Potential adaptation strategies, including beach nourishment, levee improvements, shoreline management practices, and accessibility enhancements, should be assessed for their ability to reduce long-term coastal risks while maintaining public access and recreational use.

REFERENCES

None

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready O'ahu
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
ENV	Department of Environmental Services
LID	Low Impact Development
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

STREAM RESTORATION & REHABILITATION

PROJECT CONCEPT

GENERAL DESCRIPTION	Flooding, erosion, and sediment transport are ongoing concerns within the Wailupe, Niu, and Kuliʻouʻou watersheds in East Honolulu. During storm events, these streams can transport substantial volumes of sediment and debris, contributing to flooding, increased maintenance requirements, and impacts to downstream coastal resources, including Maunalua Bay. This project will evaluate opportunities to reduce flood risk, manage sediment transport, and improve watershed function through stream restoration and rehabilitation efforts. The project will build upon recommendations from the BWS East Honolulu Watershed Management Plan and ongoing flood-management studies, including a City-requested USACE study of Wailupe Stream. A major component of the project will be a planning and feasibility phase to identify priority locations, evaluate potential alternatives, and develop implementation strategies that improve flood resilience, reduce sediment delivery to Maunalua Bay, and enhance watershed health throughout East Honolulu. Wailupe Stream remains largely natural, while Niu and Kuliʻouʻou Streams have been channelized and are maintained through regular dredging and sediment removal.
ID #:	9
Timeframe:	Mid-term
Champion Agencies:	DFM
Potential Partnerships:	HDOT, USACE, DTS
Adaptation Strategy Type:	Infrastructure
Location of Project:	Kalanianaʻole Hwy, East Honolulu
Area Classification:	Critical Linear Network Corridor

PROJECT CONCEPT

Hotspot:	Kalaniana‘ole Hwy
Congressional District:	1
Council District:	IV
Legislative District:	House District 19
Neighborhood Board:	Kuli‘ou‘ou-Kalani Iki Subdistricts 6, 7, 8
O‘ahu SoVI Index:	Low

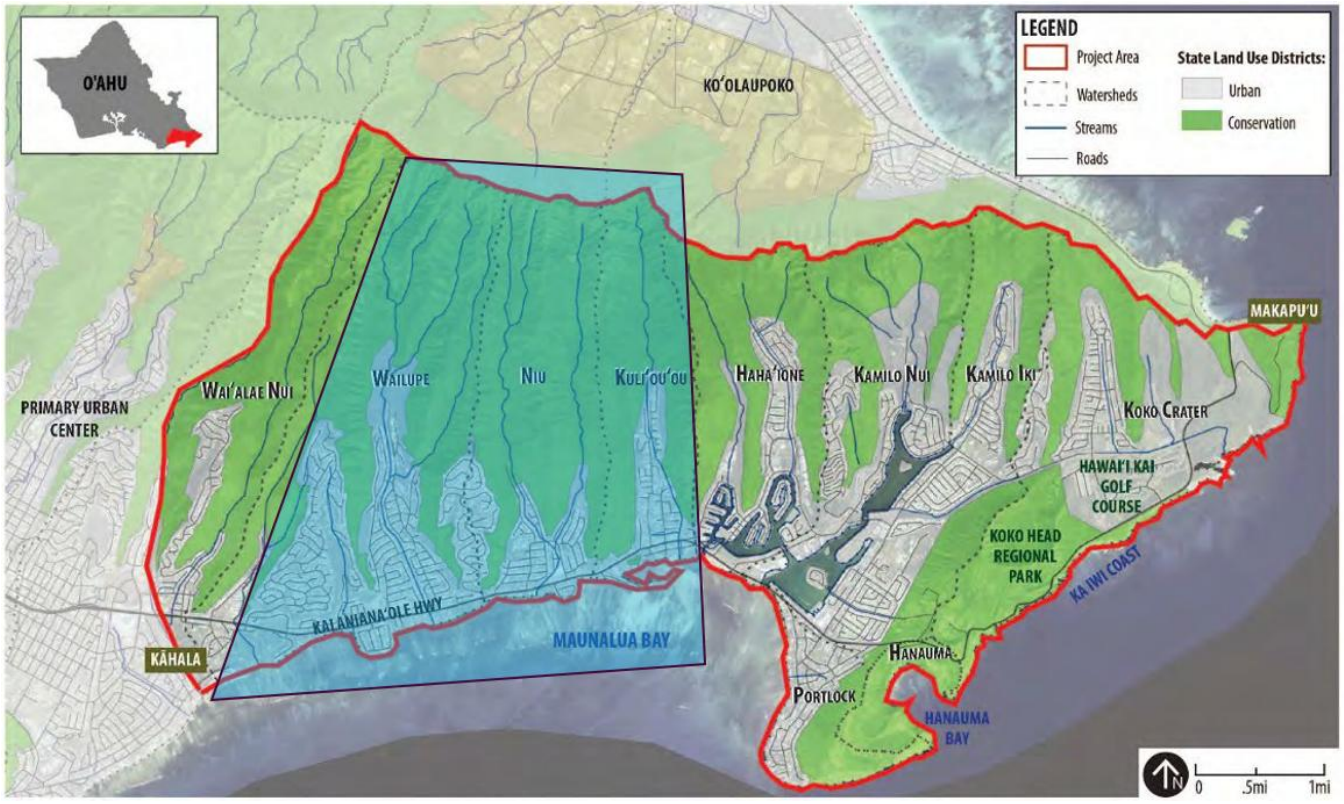


Figure 1. Figure from East Honolulu Watershed Management Plan (2024), Target OWH Project Area Highlighted in Blue

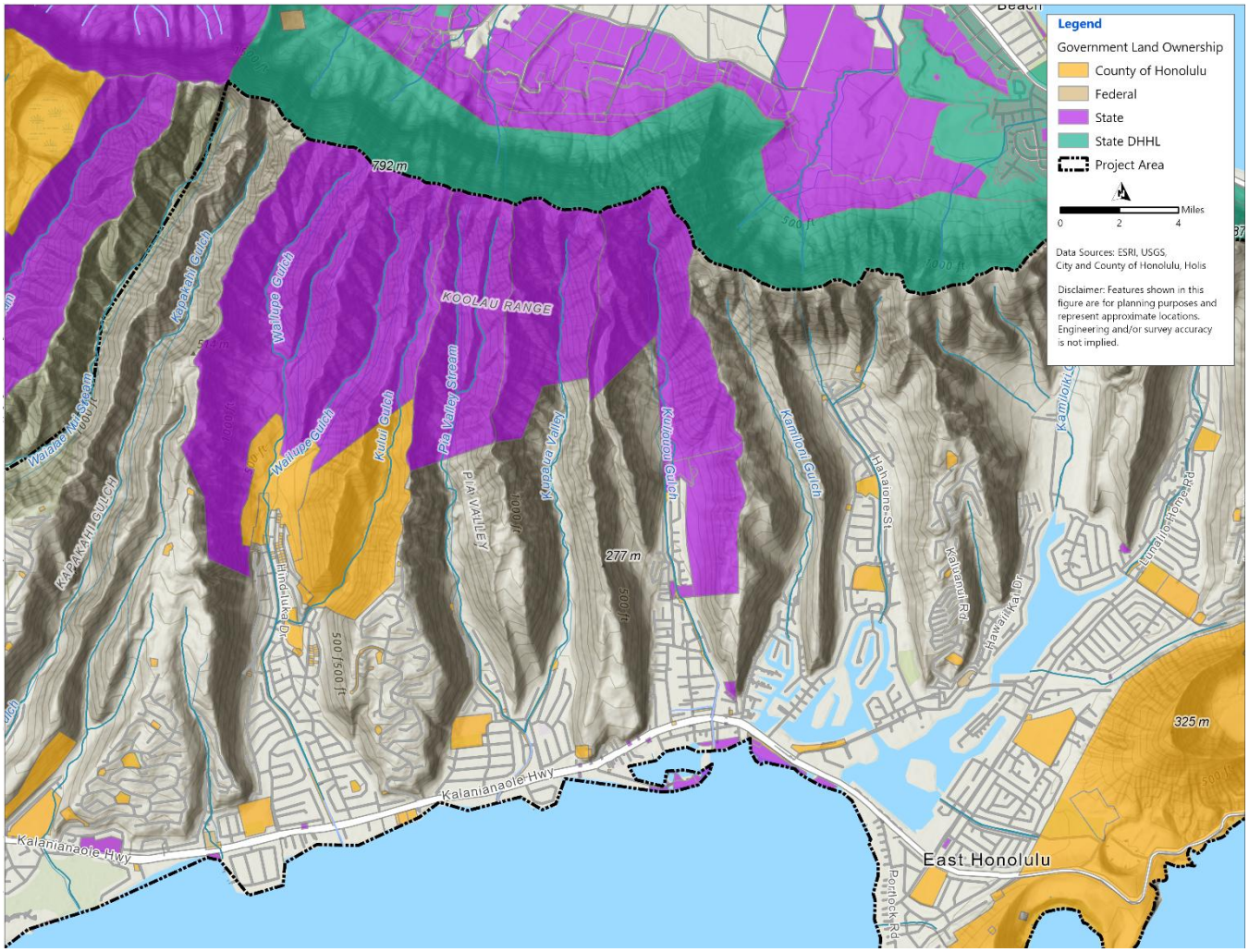


Figure 2. Government Land Ownership in East Honolulu (Hawai'i Statewide GIS Program, 2022)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Low-risk water pipeline along Kalaniana‘ole Hwy ROW, high/very high risk pipelines **Wastewater:** Sewer gravity main and laterals, Kuli‘ou‘ou WWPS and force main, Niu Valley WWPS, Paikō Dr WWPS, Kahala WWPS **Stormwater:** Various SW Conduits, catch basins, Wailupe Stream **Roads:** Kalaniana‘ole Hwy, Summer St, Maunalua Ave, Bay St, local roads mauka of Kalanianaole Hwy, local streets
Community Assets at Risk:	Kalaniana‘ole Hwy, residential community, Kanewai Fishpond, Wailupe Fire Station 23, Wailupe Beach Park, Holy Nativity Private School, ‘Āina Haina Shopping Center, ‘Āina Haina Elementary School, ‘Āina Haina Community Park, Kawaikui Beach Park, Kuli‘ou‘ou Beach Park, Maunalua Bay Beach Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **100-Year Storm:** Kalaniana‘ole Hwy experiences complete inundation from the 100-year storm event. The 100-year floodplain represents both coastal and riverine flooding. Riverine flooding can be reduced by stream restoration and rehabilitation. Stream maintenance will remove sediment that can be beneficially used for beach and dune restoration to combat coastal erosion along narrow beaches and shoreline **Hurricane:** Kalaniana‘ole Hwy experiences complete inundation up to 3 feet under Category 1 hurricane conditions. Hurricane flooding comes both from coastal storm surge and rainfall. Rainfall runoff into Wailupe, Niu, and Kuli‘ou‘ou streams can cause inundation that can be reduced by stream restoration and rehabilitation. **Coastal Erosion:** Coastal erosion in this area will occur at 1 foot of SLR. The highway itself is largely outside of the future SLR erosion zones; however, coastal erosion would impact significant portions of the shoreline makai of the highway. Stream maintenance will remove sediment that can be beneficially used for beach and dune restoration to combat coastal erosion along narrow beaches and shoreline.

PROJECT COMPONENTS

PLAN/STUDY

A study will be necessary to identify the primary mechanisms contributing to flooding, erosion, and sediment transport within the Wailupe, Niu, and Kuliʻouʻou watersheds and to identify priority sites for improvement. The study should integrate findings from previous and ongoing planning efforts, including the East Honolulu Watershed Management Plan and a City-requested USACE study on Wailupe Stream flood reduction, for which an update is anticipated by the end of 2026. Potential projects should be evaluated within a watershed context, including their ability to reduce peak flows, improve watershed function, reduce sediment delivery, and improve water quality in Maunalua Bay.

- A focus of the planning effort should be the evaluation and prioritization of nature-based solutions that reduce flooding, improve infiltration, stabilize stream corridors, and reduce sediment transport. Potential measures may include creation of floodable space, restoration of stream corridors, revegetation with native species, construction of vegetated embankments and buffers, and mauka stormwater retention, infiltration, or recharge projects.
- Ownership, easements, and stream access will be critical considerations in determining project feasibility and selecting priority implementation locations.
- There is significant City-owned and BWS-owned land located mauka of development along Wailupe Gulch, with State-owned land located further mauka. Niu Stream is fed from Pia Valley Stream and Kupaua Valley, both of which contain large privately owned parcels and additional State-owned lands further mauka. Along Kuliʻouʻou Stream there is a mixture of State-owned and privately owned land, including privately owned portions of the stream corridor. Opportunities for easements, access agreements, or property acquisition should be evaluated where additional floodable space or stream access would provide significant flood-management, sediment-reduction, or ecological benefits.

PROGRAM

Long-term maintenance will be a critical component of any restoration strategy and should be integrated into project planning from the outset. Maintenance activities may include dredging, invasive species removal, channel clearing, and debris and sediment removal. Niu and Kuliʻouʻou Streams are already channelized and undergo regular maintenance, while portions of Wailupe Stream may require continued sediment and debris management to maintain conveyance capacity and reduce flood risk.

INFRASTRUCTURE

- Potential projects may include mauka stormwater retention, infiltration, or recharge features located on publicly owned lands where available; stream-corridor restoration and rehabilitation; floodplain expansion; stream widening; and off-channel storage to reduce peak flows and increase floodable space. Additional alternatives may include partial restoration of channelized reaches, replacement or enhancement of hard-lined channel sections, and other stream rehabilitation measures that improve ecological function while maintaining flood conveyance capacity.

PROJECT COMPONENTS

- Potential erosion-control and sediment management measures may include gabions, check dams, grade-control structures, vegetated embankments, and other approaches intended to stabilize stream corridors, reduce scour, and manage sediment transport. Upsized crossing conveyances may also be evaluated to reduce flow restrictions and blockages at bridges and culverts. Specific projects, locations, and design approaches would be identified and prioritized during the planning phase based on technical feasibility, land ownership, permitting constraints, cost, and expected flood-reduction, sediment-management, and water-quality benefits.

Community Benefits:	☒ Protects cultural sites **?** Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality **?** Improves public access to community spaces **?** Increases public awareness/education ☒ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	• **Maintain safe and reliable community access** by increasing the resilience of Kalaniana‘ole Highway to flooding and coastal erosion • **Mitigate flooding and debris transport** in and along Wailupe, Niu Valley, and Kuli‘ou‘ou streams • **Improve water quality and ecosystem health** in Maunalua Bay impacted by sediment transport and stormwater runoff
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient O‘ahu
CRO Strategies Supported:	**#5:** Strengthen climate resilience of beach and wetland ecosystems through preservation and restoration
Relevant Adaptation Strategies:	• Incorporate Native Vegetation • Bank Grading/Planting

PROJECT COMPONENTS

	• Incorporate or Upsized Perimeter Floodwalls or Levees, including operable flood gates • Incorporate Backwater Flow Prevention Devices • Modify Site Drainage, Storage, and Infiltration • Debris Management Plans and Systems • Conservation or Open Space Easement to Provide Floodable Space • Add/Improve Floodgates to Stormwater Channels • Maintenance Plan for Rivers and Streams • Stream Restoration • Mauka Stormwater Treatment, Retention, and Infiltration
Expected Timeline:	This mid-term project will likely need to be coordinated/interact with the following other projects: • Standard Stream Buffer Setback Zoning Changes • OWH Project #8 Regional Shoreline Adaptation • OWH Project #33 Managed Retreat Legal and Policy Investigation Study • OWH Project #35 Road Raising Strategy
Triggers:	**Climate Hazard:** Heavy Rain **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Property Ownership and Access: Stream access will be a critical consideration for both implementation and long-term maintenance. Portions of the Wailupe, Niu, and Kuliʻouʻou stream corridors are located on private property, while other portions are owned by the City and County of Honolulu, Board of Water Supply, or State of Hawaiʻi. Potential projects will need to be evaluated based on land ownership, access constraints, permitting requirements, construction feasibility, and long-term maintenance needs.
- Dense Existing Development: Much of the lower portion of the three watersheds is highly developed, limiting opportunities for large-scale floodplain restoration or stream expansion. While watershed improvements, stormwater retention, sediment management, and stream restoration projects may reduce peak flows, erosion, and sediment transport, development within flood-prone areas may continue to be at risk of flooding during major storm events.
- Long-Term Operations and Maintenance: Many potential projects will require ongoing maintenance to preserve effectiveness and ensure continued flood conveyance, sediment management, and ecological function. Maintenance requirements should be considered during project planning and design.
- Materials Selection: Due to exposure to high salinity water and salty air, corrosion and rusting of metal elements is a concern with gabion wall systems and other infrastructure components, particularly uncoated steel. Stainless steel or PVC coatings can be used to avoid corrosion, though a cost-benefit analysis of materials selection is recommended and should consider environmental impacts.

Additional Considerations:

- Nature-Based Solutions and Multi-Benefit Outcomes: Where feasible, projects should seek to provide multiple benefits, including flood management, erosion control, habitat enhancement, water-quality improvement, groundwater recharge, and community resilience. Nature-based solutions should be prioritized alongside grey infrastructure approaches during project evaluation.
- Coordination with Ongoing Planning Efforts: Implementation should be coordinated with recommendations from the BWS East Honolulu Watershed Management Plan, ongoing USACE flood studies, and other watershed, stormwater, and resilience planning efforts to maximize project effectiveness and leverage existing technical work.

REFERENCES

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ACRONYMS

BWS	Board of Water Supply
CCH	City and County of Honolulu
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
HDOT	Hawaiʻi Department of Transportation
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
USACE	U.S. Army Corps of Engineers
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

PILOT FLOODABLE SPACES

PROJECT CONCEPT

GENERAL DESCRIPTION	This project will leverage the DFM Islandwide Stormwater Master Plan results to identify priority locations for floodable spaces through a site suitability analysis, focusing on subsurface stormwater capture that maintains safe, accessible park and public space. This project will look at partnering with a local agency to pilot floodable space projects in the broader PUC area, such as Iwilei or Waikīkī, to demonstrate multi-benefit stormwater management approaches. This project should be aligned with the OWH Projects #165 Islandwide Stormwater Master Plan, #101 Iwilei Area Adaptation Plan, #109 Green Infrastructure Implementation Plan, and #39 Onsite Stormwater Management Incentives.
ID #:	102
Timeframe:	Mid-term
Champion Agencies:	DFM, BWS
Potential Partnerships:	DPR
Adaptation Strategy Type:	Infrastructure
Location of Project:	PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Iwilei, Other suitable areas in PUC
Congressional District:	1
Council District:	VI

PROJECT CONCEPT

Legislative District:	House District 28
Neighborhood Board:	Kalihi-Pālama
Oʻahu SoVI Index:	High



Figure 1. Map of PUC (Source: Google Maps).

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nuʻuanu Stream **Roads:** Bridges on H-1, North King Street, Dillingham Blvd, Highway 92
Community Assets at Risk:	**Beaches/Parks:** Beaches and parks such as Aʻala Park (Iwilei) and Fort DeRussy Beach Park (Waikīkī) are vulnerable to flooding from extreme rainfall, coastal inundation, and rising groundwater, leading to periodic inundation, drainage backflow, and persistent saturation that can reduce usability and damage vegetation and infrastructure. **Schools, Hospitals, Access Roads:** Schools and hospitals within Iwilei, Waikīkī, and the broader PUC area are vulnerable to flooding from extreme rainfall and sea level rise, which can restrict access and disrupt services. These facilities would benefit from enhanced stormwater management, including improved drainage, subsurface capture, and integration with nearby floodable spaces to reduce localized flooding while maintaining safe access.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **100-Year Storm:** Base yards are impacted by extreme rainfall 100-year storm through partial inundation. These threats can inundate equipment and storage areas, reduce site access and damage buried utilities and foundations. Ala Wai Canal and two ocean inlets on either side of Iwilei are impacted by extreme rainfall and sea level rise. At 3 feet of SLR the streams experience overtopping and begin to impact local infrastructure. Decreases peak flood depth and extent in developed areas through capture and storage of stormwater during intense rainfall events. Prevents current drainage system from being overwhelmed and reduces runoff that reaches streets and low-lying areas. **Drought:** Stormwater capture and infiltration can help to recharge aquifers and increase water supply. **Sea Level Rise - Overland Flooding:** At 3 feet of SLR, streets near the coastline and along canals or rivers are at risk of flooding due to coastal inundation and channel overtopping. Inland streets are also at high risk from pluvial and compound flooding, where intense rainfall and constrained drainage systems cause widespread surface flooding.

	Annual high wave-driven flooding and drainage backflow is expected at 5 feet of SLR, along with 80% probability of passive flooding. Helps manage combined rainfall and coastal flooding by providing overflow storage when drainage is constrained. **Sea Level Rise - Groundwater:** Groundwater inundation is expected at 4 feet of SLR. Emergent and shallow groundwater may limit the effectiveness of subsurface stormwater management strategies. Floodable spaces may provide controlled areas to manage flooding connected to rising groundwater levels.

PROJECT COMPONENTS

PLAN/STUDY

Site Suitability Assessment:

- Conduct GIS analysis to inventory and identify candidate sites (parks, parking lots, public/green spaces).
- Overlay stormwater master plan data to identify areas with limited conveyance or flooding.
- Review geotechnical data and site constraints for feasibility.
- Identify native plant opportunities for above-ground restoration.
- Prioritize public and private sites based on need, feasibility, ownership, and partnership opportunities.
- Select publicly owned sites for pilot (nature-based, above/subsurface).

PROGRAM

Public-Private Partnership Framework Development:

- Define roles, responsibilities, ownership, and long-term O&M requirements for public and private floodable spaces.
- Establish partnerships with developers, schools, community organizations and other private entities to support implementation, funding, maintenance, and onsite stormwater capture.
- Develop outreach and education strategies that promote stormwater capture and storage practices, coordinate with stormwater incentive programs, and encourage broader participation in flood mitigation efforts.

INFRASTRUCTURE

Floodable Space Pilot Design and Construction:

- Design floodable space based on site conditions, drainage needs, and performance targets.
- Integrate with existing systems or planned infrastructure (e.g., parking lots, schools, new parks), including permeable pavement and subsurface storage strategies.
- Construct pilot to evaluate feasibility and effectiveness.

Monitoring and Adaptive Management:

- Establish monitoring framework (metrics, frequency, responsibilities) and performance targets.
- Monitor and evaluate system performance and identify improvements.
- Assess O&M needs, partnership effectiveness and define long-term requirements.
- Document lessons learned to inform design standards and scaling.

PROJECT COMPONENTS

Community Benefits:	☒ Protects cultural sites ? Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ? Improves public access to community spaces ? Increases public awareness/education ☒ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve drainage/reduce flooding (Iwilei) Protect coastal and nearshore ecosystems by improving water quality of stormwater runoff (Waikīkī) Enhance public safety and maintain access to essential services from groundwater and overland flooding (Waikīkī)
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Develop a unified roadmap and decision making process under a One Water approach Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#10**: Make buildings, homes and infrastructure more climate resilient.
Relevant Adaptation Strategies	• Stormwater Capture and Use • Modify Site Drainage, Storage and Infiltration • Implement Low Impact Design (LID) Green Infrastructure Stormwater Management Strategies • Conservation or Open Space Easement to Provide Floodable Space • Onsite Stormwater Management Incentives

PROJECT COMPONENTS

EXAMPLES

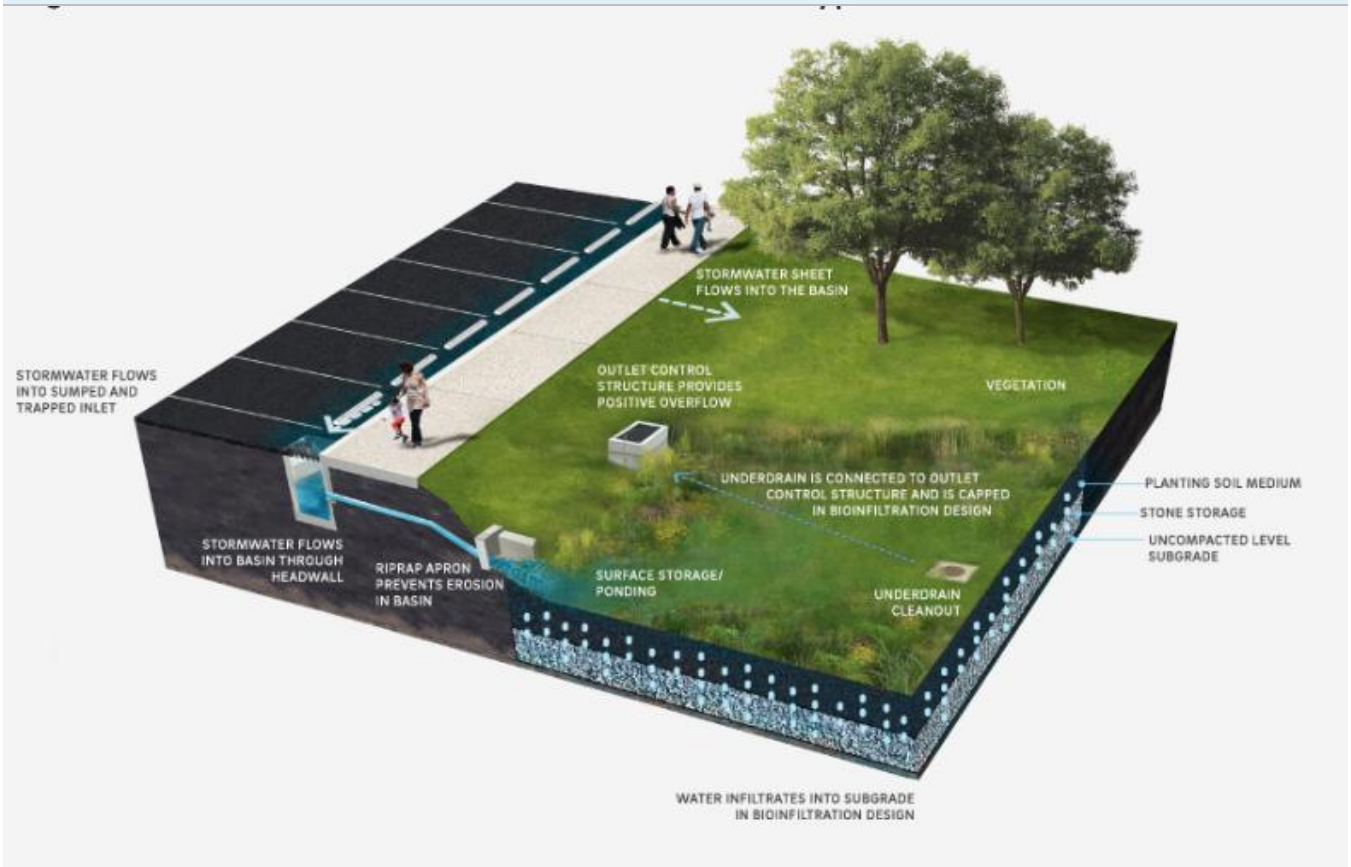


Figure 2. Bioinfiltration/Bioretention Basin with Typical Features

Source: Philadelphia Water Department - https://water.phila.gov/development/stormwater-plan-review/manual/chapter-4/4-1-

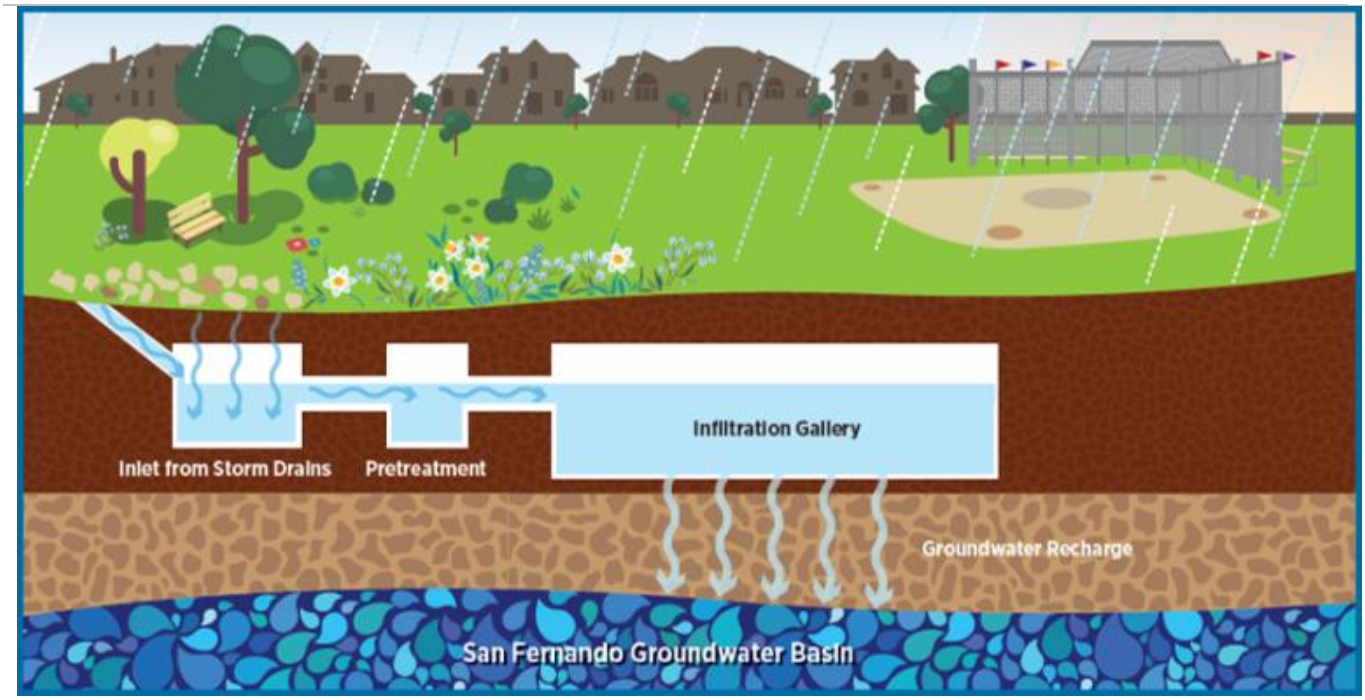


Figure 3. Subsurface Stormwater Capture (Underground Detention)

Source: LADWP - https://www.ladwp.com/community/construction-projects/other/stormwater-capture-parks-program

PROJECT COMPONENTS

Expected Timeline:	Near-Term - Alignment with Other Proposed and Ongoing Projects: • OWH Project #165: Stormwater Master Plan • OWH Project #101: Iwilei Area Adaptation Plan • OWH Project #115: Mapunapuna Area Adaptation Plan • OWH Project #109: Green Infrastructure Implementation Plan • OWH Project #39: Onsite Stormwater Management Incentives • OWH Project #123: Ala Wai Watershed Integrated Stormwater Management • OWH Project #122: Adapt Waikīkī Phase 2 Following the pilot, if results are favorable, refine the program and expand investment in subsurface stormwater management strategies. Identify favorable public-private partnerships and align investments in high-priority mitigation areas.
Triggers:	**Climate Hazard:** Heavy Rain; Increased nuisance or street flooding. **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Assumptions	• The Stormwater Utility Fee and Onsite Stormwater Management Incentives will help to provide a foundation for the pilot.
Potential Challenges:	• Space for flood mitigation is limited in highly developed areas, constraining siting options. • Limited public green space increases reliance on public-private partnerships. • Need to identify appropriate geotechnical approaches while balancing local sourcing.
Additional Considerations:	• Engage community to build understanding of floodable spaces. • Define and set guidelines for performance criteria (e.g., storage capacity for the 5-year, 24-hour storm). • Clarify ownership for construction and O&M.

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ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready O‘ahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPR	Department of Parks and Recreation
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
SW	Stormwater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

IWILEI DRAINAGE IMPROVEMENTS

PROJECT CONCEPT

GENERAL DESCRIPTION	The Iwilei Regional Flood System develops a flood control system for the Iwilei area from Kapālama Stream to Nu'uanu Stream and from Nimitz Highway (Highway 92) to approximately North Vineyard Blvd. The project builds upon recommendations from OWH Project #101 Iwilei Area Adaptation Plan and may include regional flood protection, drainage improvements, groundwater management measures, roadway adaptations, and other resilience investments identified through future planning and engineering studies.
ID #:	103
Timeframe:	Mid-term
Champion Agencies:	DFM, DDC
Potential Partnerships:	DPR, DTS, DOH, HDOT (Harbors & Airports)
Adaptation Strategy Type:	Infrastructure
Location of Project:	Iwilei, PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Iwilei
Congressional District:	1
Council District:	VI
Legislative District:	House District 28
Neighborhood Board:	Kalihi-Pālama

PROJECT CONCEPT

Oʻahu SoVI Index: High

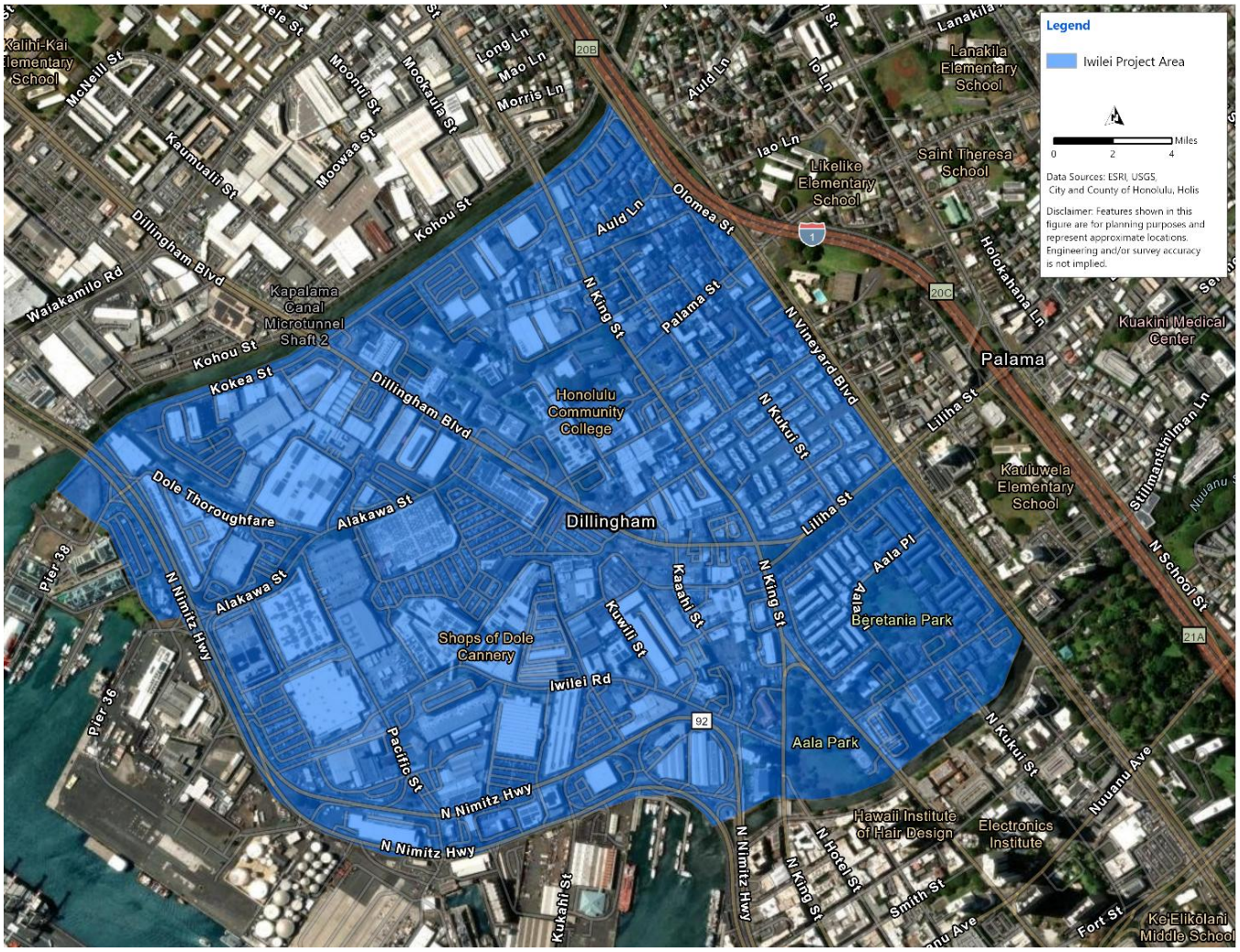


Figure 1. Map of Project Area

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, Hart Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nuʻuanu Stream **Roads:** Bridges on H-1, North King Street, Dillingham Blvd, Nimitz Highway (Highway 92)
Community Assets at Risk:	Honolulu Community College, Honolulu Harbor, Aloha Tower, Aʻala Park, nearby waterfront Fire Station 45, nearby Chinatown Substation Police Station, nearby commercial buildings

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Sea Level Rise - Overland Flooding:** Annual high wave-driven flooding and drainage backflow is expected at 5 feet of SLR, along with 80% probability of passive flooding. Infrastructure such as levees and floodwalls may protect the area from SLR-induced flooding. **Sea Level Rise - Groundwater:** Groundwater inundation is expected at 4 feet of SLR. Inclusion of groundwater pumping and cutoff walls may be used to lower the groundwater table and reduce impacts from groundwater rise. **100-Year Storm:** Iwilei experiences partial inundation from the 100-year storm event. Regional flood protection improvements could reduce coastal and riverine flooding. **Extreme Heat:** Iwilei has a high afternoon extreme heat index (above 90° F). Increased tree canopy and green spaces may reduce the urban heat island effect and reduce extreme heat.

PROJECT COMPONENTS

PLAN/STUDY

The initial study for this project has been conducted by DDC. The Iwilei Drainage Improvements builds upon and is contingent upon the planning, technical analysis, and recommendations developed through OWH Project #101 Iwilei Area Adaptation Plan. The AAP will evaluate flood risks, sea level rise impacts, groundwater emergence, infrastructure vulnerabilities, adaptation opportunities, and implementation pathways for the Iwilei area. Recommendations from Project #101 will inform the need, feasibility, phasing, and design criteria for future flood protection infrastructure within Project #103.

PROGRAM

N/A

INFRASTRUCTURE

This project provides for implementation of a regional flood management system to reduce coastal, riverine, stormwater, and groundwater flooding risks throughout the Iwilei area, generally extending from Kapālama Stream to Nuʻuanu Stream and from Nimitz Highway to the North Vineyard area. Consistent with the adaptation strategies evaluated through Project #101, potential infrastructure improvements may include floodwalls or levees, groundwater management measures, drainage conveyance improvements, pumping facilities, roadway or access improvements, interior drainage systems, and other flood-protection features identified through future planning and engineering studies. Final infrastructure components, alignments, design criteria, and implementation priorities would be determined through Project #101 recommendations and subsequent feasibility, environmental, and design efforts.

Community Benefits:

- ☐ Protects cultural sites
- ? Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- ? Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

PROJECT COMPONENTS

Hotspot Goals Supported:	Improve community access to recreational resources including multi-modal transport Maintain safe and reliable community access by increasing the resilience of drainage infrastructure to reduce flooding
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient O'ahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#4**: Center equity in climate change adaptation **#9**: Integrate climate resilience into City capital planning, operations, and policies **#10**: Make buildings, homes, and infrastructure more climate resilient **#12**: Keep our communities cool as temperatures rise and during heat waves
Relevant Adaptation Strategies	• Elevate Access Road and Associated Utilities • Incorporate Flood/Submersible Pumps for Surface Water or Groundwater • Incorporate or Upsize Perimeter Floodwalls or Levees, including operable flood gates • Incorporate Groundwater Seepage Barrier • Incorporate Backwater Flow Prevention Devices • Modify Site Drainage, Storage, and Infiltration • Upsize Stormwater Drainage Capacity • Add/Improve Floodgates to Stormwater Channels • Adapting Infrastructure for SLR
Expected Timeline:	Near-term planning and feasibility analyses will be completed through OWH Project #101 Iwilei Area Adaptation Plan. Implementation of this project will be informed by the recommendations, sequencing, and adaptation pathways identified through Project #101. Flood protection improvements should be coordinated with related transportation, redevelopment, and resilience projects in the district. This project will likely need to be coordinated/interact with the following other projects: • Iwilei, Chinatown, Downtown Stations (TOD) • OWH Project #35 Road Raising Strategy • OWH Project #101 Iwilei Area Adaptation Plan

PROJECT COMPONENTS

- OWH Project #104 Kapālama Canal Linear Park
- OWH Project #105 Resilience Corridors and Road Raising

Triggers:

Climate Hazard: SLR

Funding: Project implementation will proceed when funding is available

Regulatory: N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Regional flood protection improvements will likely require coordination among multiple City agencies, utility providers, transportation agencies, and major landowners within the Iwilei area
- Project development will require coordination with other adaptation, redevelopment, transportation, and utility projects in the Iwilei area.
- The project area lies within the Iwilei Petroleum Area District, where subsurface contamination is a known condition. Excavation, dewatering, and groundwater management activities will require compliance with the Iwilei District Environmental Hazard Management Plan administered by the Hawai‘i Department of Health, and contaminated media handling may affect construction cost, schedule, and method selection. This is a particular consideration for groundwater pumping and cutoff wall alternatives, which involve subsurface work and groundwater handling.

Additional Considerations:

- There is the opportunity to engage multiple stakeholders and build in additional community, transportation, public space, and resilience benefits as the project concept develops.
- This project may be eligible for federal funding.
- The area is within the Iwilei Petroleum Area District and must comply with the Iwilei District Environmental Hazard Management Plan by DOH.

REFERENCES

City and County of Honolulu, Department of Planning and Permitting. (April, 2025). Primary Urban Center Development Plan. https://www4.honolulu.gov/docushare/dsweb/Get/Document-355089/PUCDP%202025.pdf

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Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office. Iwilei District Areawide Environmental Hazard Management Plan. https://health.hawaii.gov/heer/files/2019/11/Iwilei-Areawide-EHMP_Final.pptx

ACRONYMS

AAP	Area Adaptation Plan
CRO	Climate Ready O'ahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DOH	Department of Health
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
EHMP	Environmental Hazard Management Plan
HDOT	State of Hawaii Department of Transportation
N/A	Not Applicable
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
TOD	Transit-Oriented Development
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

MĀPUNAPUNA FLOOD IMPROVEMENTS

PROJECT CONCEPT

GENERAL DESCRIPTION	The Māpunapuna Flood Protection project should follow the guidance set in the Māpunapuna Area Drainage Study and Action Plan (FEMA 2024). The recommended FEMA Alternative 5 includes roadway elevation, storm drain improvements, property acquisition for a detention area, floodwall implementation, and storm and groundwater pumping. This project is meant to extend the useful life of the area by 50 years until 2075.
ID #:	110
Timeframe:	Mid-term
Champion Agencies:	DFM, DDC
Potential Partnerships:	DTS, HDOT, BWS
Adaptation Strategy Type:	Infrastructure
Location of Project:	Māpunapuna, PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Māpunapuna
Congressional District:	1
Council District:	VII
Legislative District:	House District 31
Neighborhood Board:	Āliamanu/Salt Lake/Foster Village/Airport
Oʻahu SoVI Index:	High

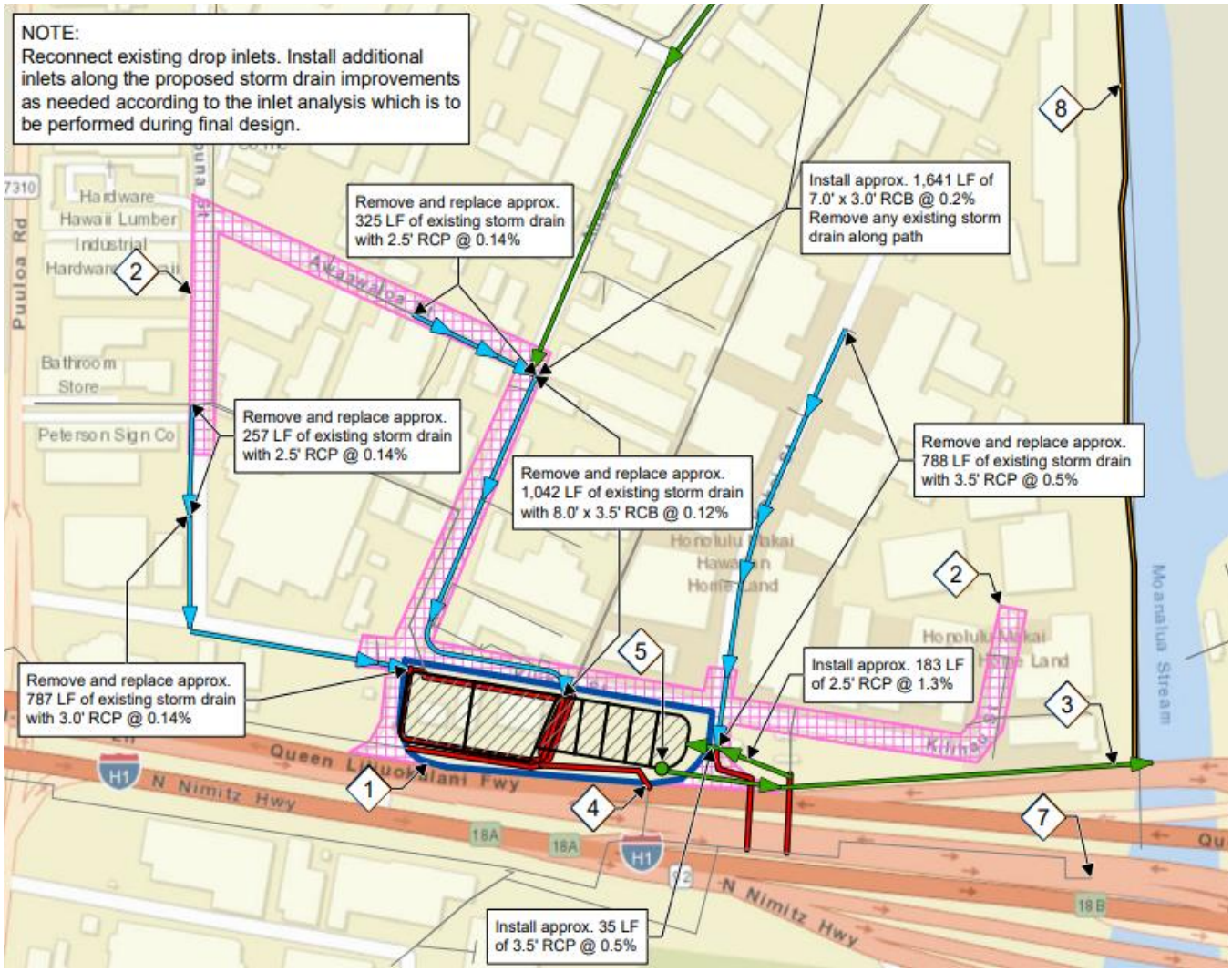


Figure 1. Image from the FEMA (2024) Māpunapuna Area Drainage Study and Action Plan

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Very high risk/high risk pipelines **Wastewater:** Kamehameha Highway WWPS, Fort Shafter WWPS, 24-in/30-in/42-in force main, 10-in/12-in/20-in/24-in/30-in/36-in/48-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in/42-in/48-in/54-in SW conduits, Moanalua Stream **Roads:** Moanalua Rd, N Nimitz Hwy, Makai Frontage Rd/Moanalua Stream Bridge, Nimitz Hwy/Moanalua Stream Bridges (E.B/W.B.), Puʻuloa Ramp/Moanalua Stream Bridge, Funston Rd/Kahauiki Stream Bridge, Walker Dr/Kahauiki Stream Bridge, Funston Loop/Kahauiki Stream Bridge
Community Assets at Risk:	Keʻehi Lagoon, DOT Base Yards, Keʻehi Lagoon Beach Park, Moanalua Gardens, Moanalua Public Middle and Elementary Schools

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Sea Level Rise - Overland Flooding:** Māpunapuna is impacted by high wave-driven flooding at 2 feet SLR, drainage backflow at 3 feet SLR, and passive flooding at 4 feet of SLR. This project is designed to address overland coastal flooding and above-ground SLR up to a 2075 projection of 4.28-foot elevation mean higher high water (MHHW). **100-Year Storm:** Māpunapuna experiences complete inundation under the 100-year storm. This project will reduce inundation from urban flood hazard. **Extreme Heat:** Māpunapuna has a high afternoon extreme heat index, above 90°F. FEMA Alternative 5 does not address urban heat. If additional green infrastructure elements are included, there could be some heat reduction realized.

PROJECT COMPONENTS

PLAN/STUDY

The planning phase of this effort should build on the Māpunapuna Area Drainage Study and Action Plan (ADSAP). Some limitations of the ADSAP were neglecting effects of inlets and drainage systems smaller than 2 feet in diameter, assuming all infrastructure is in good repair and functioning at design capacity, and neglecting groundwater, storm surge, and subsidence. More detailed condition and subsurface assessments may be necessary, including detailed groundwater modeling and a contamination study. Based on the ADSAP, the following evaluations are still necessary:

- Review the surrounding drainage infrastructure for additional improvement needs to potentially include in the project
- Evaluate the design for constructability issues and utility conflicts
- Evaluate the design for any right-of-way or easement needs
- Evaluate the design for potential permitting needs and complications
- Evaluate project water quality impacts and identify water quality improvement strategies
- Identify green infrastructure and ecosystem restoration opportunities
- Field verify the locations and connectivity of all existing storm drain infrastructure
- Obtain design-level topography
- Finalize the locations for proposed improvements
- Finalize storm drain slopes
- Perform a project-level analysis of storm drain inlets/catch basins
- Confirm the final design meets relevant design criteria to the satisfaction of the City
- Verify ancillary work required for implementation such as landscaping, restriping of roadway, etc.

The design phase of this project will require land acquisition for the proposed detention basin as described in the FEMA report. In addition, extensive permitting will be required and should also begin early in the design phase. Design scope to be determined during the Plan/Study phase.

PROGRAM

N/A

INFRASTRUCTURE

Based on the FEMA ADSAP Alternative 5, the following components will require construction:

- Construct the detention basin
- Raise roadways to an elevation of 3 feet (raising them typically 1.5 feet, up to 2.25 feet from their existing elevation)

PROJECT COMPONENTS

- Install about 1,100 LF of pressure pipe and a new outfall to Moanalua Stream
- Construct back-flow prevention between the detention basin and existing drainage channel
- Install new pumping system designed for at least 180 cfs output, including redundancy
- Install backflow prevention at the existing outfall
- Disconnect the drainage connection from the existing outfall
- Construct a sea wall along Moanalua Stream at a height based on tidal waters

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☐ Improves water quality ☐ Improves public access to community spaces ☐ Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Maintain safe and reliable community access by increasing the resilience of drainage systems and roads to flooding Improve stream and nearshore water quality and ecosystem health
OWH Objectives Supported:	Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#10**: Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies:	• Elevate Access Road and Associated Utilities • Incorporate Asset/Utility Redundancy • Incorporate Flood/Submersible Pumps for Surface Water or Groundwater

PROJECT COMPONENTS

	• Incorporate Backwater Flow Prevention Devices • Modify Site Drainage, Storage, and Infiltration • Upsize Stormwater Drainage Capacity or Sanitary Sewer Capacity • Incorporate or Upsize Perimeter Floodwalls or Levees, including operable flood gates
Expected Timeline:	The FEMA report notes that this can be a phased project. The project design and planning phase will be led by DFM, passing off at 30% design to DDC for the final design and construction phases. Infrastructure will then be owned by DFM for maintenance. This project will likely need to be coordinated/interact with the following other projects: • FEMA Māpunapuna Area Drainage Study and Action Plan (2024) • OWH Project #33 Managed Retreat Legal and Policy Investigation Study (consider Māpunapuna for a case study) • OWH Project #35 Road Raising Strategy (Islandwide) • OWH Project #106 Reuse Strategy for Redevelopment Areas • OWH Project #115 Māpunapuna Area Adaptation Plan • Future, more permanent solution (e.g. coastal hardening, relocation)
Triggers:	**Climate Hazard:** Heavy Rain and SLR **Funding:** Project implementation will proceed when funding is available **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Acceptability is a concern mentioned in the FEMA 2024 report. Relocation and large-scale hardening were both "problematic or unpopular" with technical stakeholders. • According to the ADSAP, pumping is a long-term cost and maintenance concern. • Māpunapuna is also being considered for managed retreat, which would negate the need for this type of infrastructure hardening and open the area to many possible adaptation pathways.
Additional Considerations:	• Remediation and contaminant removal may be necessary since this is an industrial area. As groundwater and stormwater are being captured and pumped into the stream, it is likely that contaminants from the industrial runoff should be captured. An analysis should be done to understand water quality and how this project could promote remediation and long-term health of the area.
Technical Considerations:	• FEMA Alt 5 is projected to protect Māpunapuna industrial area for 50 years, but this timeline is based on projected SLR at 2075. Based on the long-term timeline of the project (beginning in 25 years), by the date of completion, this alternative may no longer suffice. In addition, within the over 25 year span of waiting and planning, more informed projections of anticipated SLR can inform the design needs of the project. However, the FEMA ADSAP mentions that in the 50-year timeline, the extended useful life should be used to plan and implement a more permanent solution. • Groundwater rise was neglected in the FEMA study; however, OWH Plan risk analysis shows that groundwater inundation will affect Māpunapuna under just 1 foot of SLR. The ADSAP mentions that groundwater may inundate the area despite the many adaptations, and may require more pumping, resulting in greater operation and maintenance costs. • May require a technical advisory committee to be established as part of the planning phase.

REFERENCES

FEMA. (2024). Māpunapuna Area Drainage Study and Action Plan

One Water Honolulu Technical Memo. (n.d.). Māpunapuna Flooding Mitigation, Māpunapuna Working Group Summary.

City and County of Honolulu, Department of Planning and Permitting. (April, 2025). Primary Urban Center Development Plan. https://www4.honolulu.gov/docushare/dsweb/Get/Document-355089/PUCDP%202025.pdf

ACRONYMS

ADSAP	Area Drainage Study and Action Plan
BWS	Board of Water Supply
cfs	cubic feet per second
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
E.B.	Eastbound
FEMA	Federal Emergency Management Agency
HDOT	Hawaiʻi Department of Transportation
MHHW	Mean Higher High Water
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
W.B.	Westbound
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

KAPĀLAMA CANAL LINEAR PARK

PROJECT CONCEPT

GENERAL DESCRIPTION	The Kapālama Canal Linear Park builds upon decades of planning, community visioning, and technical study, including the Kalihi-Pālama Action Plan, Kalihi Neighborhood TOD Plan, and Kapālama Canal Catalytic Project (KCCP) Resilient Master Plan. The project advances these efforts through phased development of a linear park along Kapālama Canal that supports neighborhood revitalization, improved public access, enhanced water quality, multimodal connectivity, and resilience to future sea level rise and flooding. Potential improvements include raised and landscaped embankments, floodwalls, recreational amenities, local drainage improvements, and green street enhancements to Kohou and Kōkea Streets that create additional space for flood protection, recreation, and public access. In addition, this project will improve connectivity and multi-modal travel to the Dillingham railway station.
ID #:	104
Timeframe:	Mid-term
Champion Agencies:	DPP
Potential Partnerships:	DDC, DPR, DTS, USACE, DFM, Kamehameha Schools
Adaptation Strategy Type:	Infrastructure
Location of Project:	Iwilei, PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	Iwilei
Congressional District:	1
Council District:	VI, VII

PROJECT CONCEPT

Legislative District:	House District 28, House District 30
Neighborhood Board:	Kalihi-Pālama
Oʻahu SoVI Index:	High

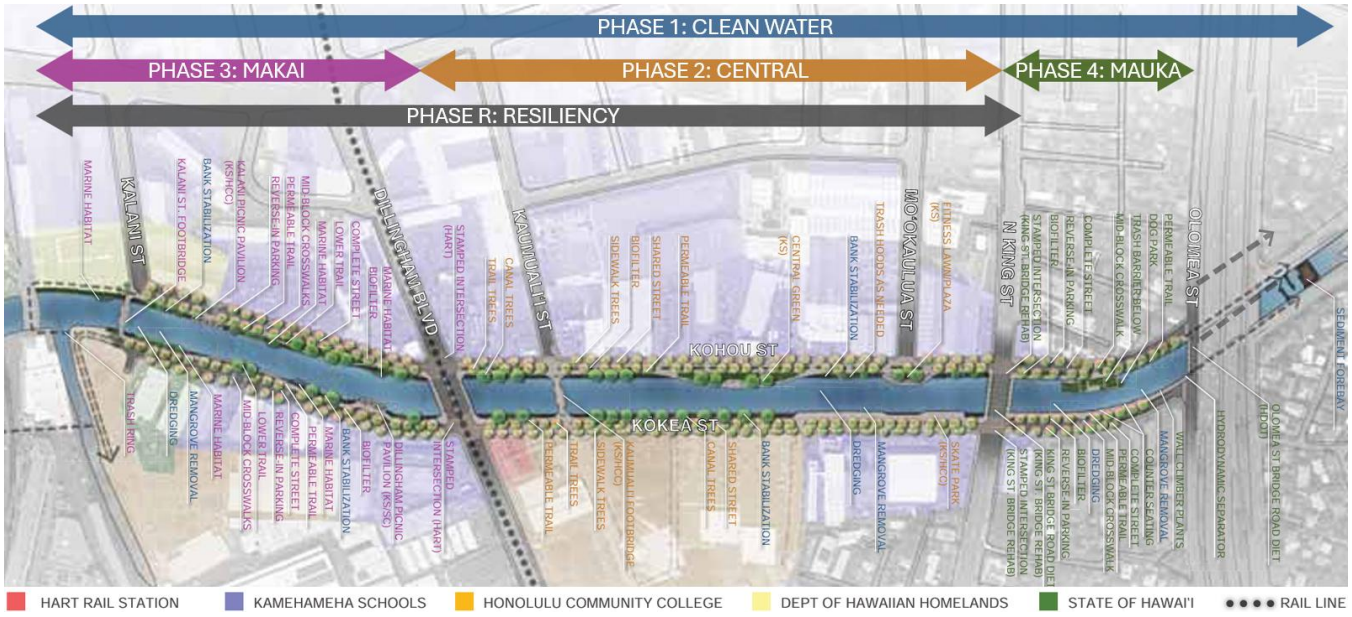


Figure 1. Kapālama Canal Catalytic Project (Source: Kapālama Canal Catalytic Project (2022); figure modified for legibility)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nuʻuanu Stream **Roads:** Bridges on Highway-1 (H-1), North King Street, Dillingham Blvd, Nimitz Highway (Highway 92)
Community Assets at Risk:	Honolulu Harbor, Aloha Tower, Aʻala Park, Nearby Waterfront Fire Station 45, nearby Chinatown Substation Police Station, Honolulu Community College, Costco Iwilei (#1 busiest location in the nation), New Dillingham DMV Location, City Square Shopping Plaza, nearby commercial development

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: HIGH** **Sea Level Rise - Overland Flooding:** Annual high wave-driven flooding and drainage backflow is expected at 5 feet of SLR, along with 80% probability of passive flooding. The linear park will provide elevation of infrastructure out of the floodplain and flood barriers to reduce the hazard. **Sea Level Rise - Groundwater:** Groundwater inundation is expected at 4 feet of SLR. The linear park will not have an impact on groundwater. **100-Year Storm:** Iwilei experiences partial inundation from the 100-year storm event. The linear park will provide elevation of infrastructure out of the floodplain and flood barriers to reduce the hazard. **Extreme Heat:** Iwilei has a high afternoon extreme heat index (above 90°F). Increased tree canopy and green spaces can reduce the urban heat island effect and reduce extreme heat.

PROJECT COMPONENTS

PLAN/STUDY

Significant planning has been completed for the Kapālama Canal concept through TOD planning efforts, including the Kalihi-Pālama Action Plan, Kalihi Neighborhood TOD Plan, and KCCP Resilient Master Plan. Improvements are planned near the future Niuhelewai rail transit station for the linear park and other enhancements (such as green infrastructure, multi-modal connections) along Kapālama Canal. These planning efforts identify the canal improvements as a catalyst for neighborhood revitalization, mixed-use development, improved public access, and enhanced resilience.

Design drawings, cost estimates, environmental documentation, and technical studies have already been completed, including hydraulic modeling and sea level rise adaptation analysis through the KCCP planning process.

The planning phase is anticipated to be led by DPP TOD.

PROGRAM

N/A

INFRASTRUCTURE

The design/construction phase of the project is anticipated to be led by DDC.

Infrastructure components will build upon recommendations developed through prior planning efforts and technical studies, including clean water, resiliency, trails and recreation, accessibility, and community spaces.

In phases, infrastructure work will include dredging, adding a sediment forebay, conducting bank stabilization, and constructing floodwalls, a raised promenade, a pier park, trail furniture, signage, art, footbridges, picnic pavilions, trash hoods/rings, lighting, and biofilters. The infrastructure will span multiple reaches of the canal, and will be completed in phases, beginning with the Central Canal, followed by the Makai segment, and finishing with the Mauka segment (see figure above).

Other improvements include green street components, street paving, improvements to utilities/pipes, restriping, tree planting, and creating complete streets.

Elevated pedestrian connections should be evaluated where the corridor meets the rail station and Dillingham Blvd, to improve pedestrian safety and reduce conflicts with vehicle traffic at a location expected to see substantial increases in pedestrian volume once the station opens.

PROJECT COMPONENTS

Community Benefits:

- ☐ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- **?** Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve community access to recreational resources including multi-modal transport Maintain safe and reliable community access by increasing the resilience of drainage infrastructure to reduce flooding
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu
CRO Strategies Supported:	**#6**: Improve watershed health to mitigate wildfire risk and manage flooding **#10**: Make buildings, homes, and infrastructure more climate resilient **#12**: Keep our communities cool as temperatures rise and during heat waves
Relevant Adaptation Strategies:	• Incorporate Native Vegetation • Relocate or Abandon Facility • Implement Cool Alternatives to Traditional Pavements for Roads and Sidewalks • Elevate Access Road and Associated Utilities • Increase or Preserve Site Tree Canopy Coverage, Natural Planted Areas, or Wetlands • Incorporate Shade and Cooling Structures • Incorporate or Upsize Perimeter Floodwalls or Levees, Including Operable Flood Gates

PROJECT COMPONENTS

	• Implement Low Impact Design (LID)/Green Infrastructure Stormwater Management Strategies • Urban Heat Island Reduction with Enhanced Green Spaces • Adapting Infrastructure for SLR
Expected Timeline:	Implementation is anticipated to occur in phases consistent with the KCCP Resilient Master Plan. Initial efforts focus on clean water improvements throughout the canal corridor, including dredging, mangrove removal, bank stabilization, and sediment management. Subsequent phases prioritize improvements within the Central Canal area, followed by the more flood-vulnerable Makai Canal and finally the Mauka Canal segment. This project will likely need to be coordinated/interact with the following other projects: • Iwilei, King Street, Kōkea Street Area Sewer Improvements (ENV, Project #2019067) includes a new sewer along Kōkea Street replacing existing easement sewers between Kōkea Street and Hikina Lane. ENV is sequencing design and construction to complete before the Kapālama Canal project begins. • Kapālama Station (TOD) • OWH Project #35 Road Raising Strategy • OWH Project #101 Iwilei Area Adaptation Plan • OWH Project #103 Iwilei Drainage Improvements • OWH Project #105 Resilience Corridors and Road Raising
Triggers:	**Climate Hazard:** SLR **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• DPP has been in charge of planning as the linear park is related to the TOD by Kapālama Canal; however, other agencies will need to be engaged and willing to champion the project through construction and maintenance. • Portions of the canal corridor are adjacent to privately owned properties, requiring coordination with landowners to support implementation, connectivity, and future improvements.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Traffic impacts to transition to "one way" along Kapālama Canal
- In the long term, roadway crossing elevations are needed and are not included, but work should be coordinated with transportation and harbors. Local drainage pumping may also be needed, but there are opportunities to improve local drainage and mitigate against groundwater rise.
- ENV's Iwilei, King Street, Kōkea Street Area Sewer Improvements (#2019067) is being designed and constructed ahead of this project, with new sewer along Kōkea Street replacing existing easement lines. Kōkea Street improvements under this concept should be coordinated with ENV's schedule and final alignment so that newly constructed sewer is not disturbed and the linear park design reflects as-built conditions.
- Portions of the canal corridor are currently used by people experiencing homelessness. Project planning and phasing should be coordinated with the City's homeless services and outreach programs so that construction and long-term park operation are paired with appropriate supportive services, consistent with City policy.
- Construction along the canal will affect access, circulation, and parking at Honolulu Community College. Coordination with the campus on construction phasing and maintenance of access will be needed.
- Additional commercial and residential development is being planned in the Iwilei area by private developers. Coordination on project timing and design interfaces will be needed, and development horizons may present opportunities for shared infrastructure, connectivity, or cost sharing along the canal corridor.

Additional Considerations:

- International precedents for canal corridors redeveloped as linear parks while retaining hydraulic function include Cheonggyecheon Stream (Seoul, South Korea), Grand Canal Linear Park (Mexico City, Mexico), Chong Nonsi Canal Park (Bangkok, Thailand), and Doca Linear Park (Belém, Brazil). These projects offer useful reference points for integrating flood conveyance, water quality treatment, and public open space within a constrained urban corridor, and for phasing improvements alongside continued infrastructure operation.

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ACRONYMS

CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
KCCP	Kapālama Canal Catalytic Project
LID	Low Impact Development
N/A	Not Applicable
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
TOD	Transit-Oriented Development
USACE	United States Army Corps of Engineers
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

RESILIENCE CORRIDORS AND ROAD RAISING

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes the development of a planning tool to prioritize resilience corridor and road raising projects by identifying opportunities for collaboration, maximizing grant eligibility, and advancing multi-benefit projects. This project will implement prioritized corridor improvements that plan for future compound flooding and SLR, incorporate multimodal access, include green stormwater infrastructure, and design safe pedestrian and bicycle connectivity. This project will need coordination with other ongoing redevelopment projects and planned corridor improvements across transportation, stormwater, water, and wastewater infrastructure. These improvements should reduce flood risk, maintain critical access for residents, businesses, emergency response, and transit operations during storm events, and improve long-term transportation system resilience and performance. Aligned with OWH Projects #165 Stormwater Master Plan and #35 Road Raising Strategy.
ID #:	105
Timeframe:	Mid-term
Champion Agencies:	DTS/DFM/DDC
Potential Partnerships:	DPP, CCSR, BWS, ENV, HDOT, HART
Adaptation Strategy Type:	Infrastructure
Location of Project:	PUC
Area Classification:	Opportunities within Redevelopment and Growth
Hotspot:	N/A - Regionwide

PROJECT CONCEPT

Congressional District:	1
Council District:	VI
Legislative District:	House District 28
Neighborhood Board:	Kalihi-Pālama
Oʻahu SoVI Index:	High



Figure 1. Map of PUC (Source: Google Maps)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** Awa Street WWPS, 20-in force main, 6-in/8-in/10-in/18-in/24-in/27-in/30-in/54-in sewer main **Stormwater:** 12-in/18-in/24-in/30-in/36-in SW conduits, Nu‘uanu Stream **Roads:** Ala Moana Blvd, Nimitz Hwy, N King St/Nu‘uanu Stream Bridge, N Hotel St/Nu‘uanu Stream Bridge, N King St/Kahili Stream Bridge, Bridges on H-1, North King Street, Dillingham Blvd, Highway 92
Community Assets at Risk:	**Multimodal Transportation, Transportation Infrastructure, and Access Networks** Sidewalks, bicycle lanes, public transit stops, pedestrian connections, roadways, and freight access routes are vulnerable to flooding from sea level rise and extreme rainfall, as well as elevated temperatures that reduce user comfort and accessibility during extreme heat events. Without adequate greening and flood mitigation measures, disruptions to multimodal and vehicular transportation can occur, limiting access to employment centers, businesses, industrial areas, services, and transit, while reducing mobility and increasing economic disruption. **Private Properties and Redevelopment Areas** Private properties and redevelopment areas are vulnerable to sea level rise, rainfall-driven flooding and extreme heat. These hazards disrupt access, affect site usability, cause damage and property loss and reduce opportunities to integrate resilient design features.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: HIGH** **Heavy Rain:** In the PUC there is partial inundation under 100-year storm (heavy rain) conditions. This project improves flood conveyance and reduces roadway flooding by integrating resilient corridor design with green stormwater infrastructure, enabling capture, infiltration, and delayed release of runoff. Targeted road raising maintains critical transportation and emergency access during peak flood events, reducing disruptions to residents, businesses, freight movement, and industrial activities by reducing the extent and duration of flooding on key corridors. **Sea Level Rise - Overland Flooding:** At 3 feet of SLR, streets near the coastline and along canals or rivers are at risk of flooding due to coastal inundation and channel overtopping. Inland streets are also at high risk from pluvial and compound flooding, where intense rainfall and constrained drainage systems cause widespread surface flooding. At 3 feet of SLR, drain inlets become overwhelmed as runoff volumes exceed

capture capacity, reducing the ability to intercept stormwater and leading to surface ponding and roadway flooding. This project elevates vulnerable roadways and incorporates resilient corridor strategies--enhancing system performance under compound flooding by improving drainage capacity and ensuring critical routes remain accessible.

Extreme Heat: Areas in PUC have high afternoon extreme heat index (above 90 degrees Fahrenheit). This project incorporates resilient corridor strategies that enhance shade, increase vegetative cover, and reduce heat accumulation along transportation corridors. Improves comfort and accessibility for pedestrians, cyclists, and both public and private transit users while supporting more resilient multimodal transportation during extreme heat events and daily life.

PROJECT COMPONENTS

PLAN/STUDY

Planning Tool - Corridor Screening and Project Prioritization

- Develop a corridor screening tool to identify priority corridors for roadway elevation and stormwater resilience improvements based on flood risk, sea level rise exposure, and critical transportation functions.
- Evaluate candidate corridors based on flood risk, heat vulnerability, multimodal connectivity, redevelopment potential and community benefits.

Planning Tool - Funding and Implementation Coordination

- Assess grant eligibility and funding opportunities for candidate projects across federal, state, and local programs.
- Identify opportunities to coordinate investments across transportation, drainage, water and wastewater infrastructure, and redevelopment to maximize overall project benefits and implementation efficiency.

PROGRAM

N/A

INFRASTRUCTURE

Road Raising and Corridor Adaptation

- Implement targeted roadway elevation and associated drainage improvements to reduce flooding and maintain access during storm events. Follow the framework developed in Project #35 Road Raising Strategy
- Coordinate roadway elevation with other improvements such as redevelopment and transportation improvement projects.
- Develop corridor-level adaptation strategies that improve long-term roadway performance while avoiding adverse flooding impacts to adjacent areas.

PROJECT COMPONENTS

Stormwater and Drainage Integration

- Incorporate stormwater management strategies within the corridor to address flooding and water quality concerns.
- Integrate targeted drainage elements within the right-of-way to manage runoff in areas with limited existing drainage infrastructure.

Permeable Surfaces and Depaving Opportunities

- Evaluate excess pavement and underutilized roadway areas for conversion to permeable materials and green infrastructure features.
- Assess feasibility of permeable pavement treatments within sidewalks, bicycle facilities, parking areas, and other roadway elements.

Roadway and Safety Improvements

- Coordinate road-raising projects with other planned corridor improvements across transportation (ex. the rail station), stormwater, water, and wastewater infrastructure to improve multimodal connectivity.

Pedestrian and Bicycle Infrastructure Expansion

- Construct sidewalks and shared use paths in locations where they currently do not exist to improve accessibility.
- Incorporate bicycle lanes and crossings that are coordinated with drainage solutions and material strategies.

Community Benefits:

- ☐ Protects cultural sites
- ? Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- ? Increases public awareness/education
- ? Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported: Improve drainage/reduce flooding (Iwilei)

PROJECT COMPONENTS

	Improve walkability and multi-modal transport options (Iwilei) Reduce economic disruption for residents, workers, and businesses from groundwater and overland flooding (Waikīkī) Enhance public safety and maintain access to essential services from groundwater and overland flooding (Waikīkī)
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient O'ahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Develop a unified roadmap and decision making process under a One Water approach Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#9**: Integrate climate resilience into city capital planning, operations, and policies. **#12**: Keep our communities cool as temperatures rise and during heat waves.
Relevant Adaptation Strategies	• Elevate Access Road and Associated Utilities • Elevate Occupied Spaces Above Flood Elevations (e.g., second floor), • Elevate Site Grade • Elevate Critical Assets/Equipment • Modify Site Drainage, Storage and Infiltration • Implement Low Impact Design (LID) & Green Infrastructure Stormwater Management Strategies

PROJECT COMPONENTS

EXAMPLES

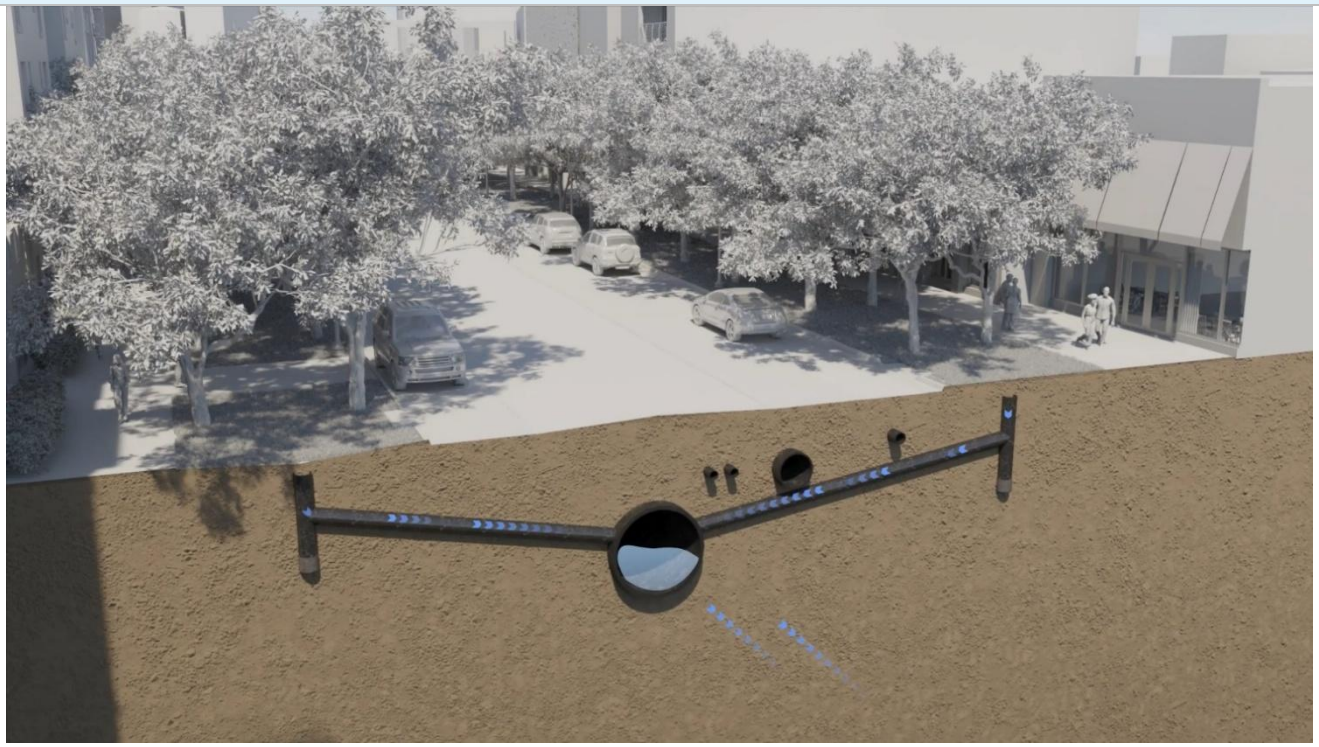


Figure 2. Miami Beach Road Raising Drainage Systems[1]

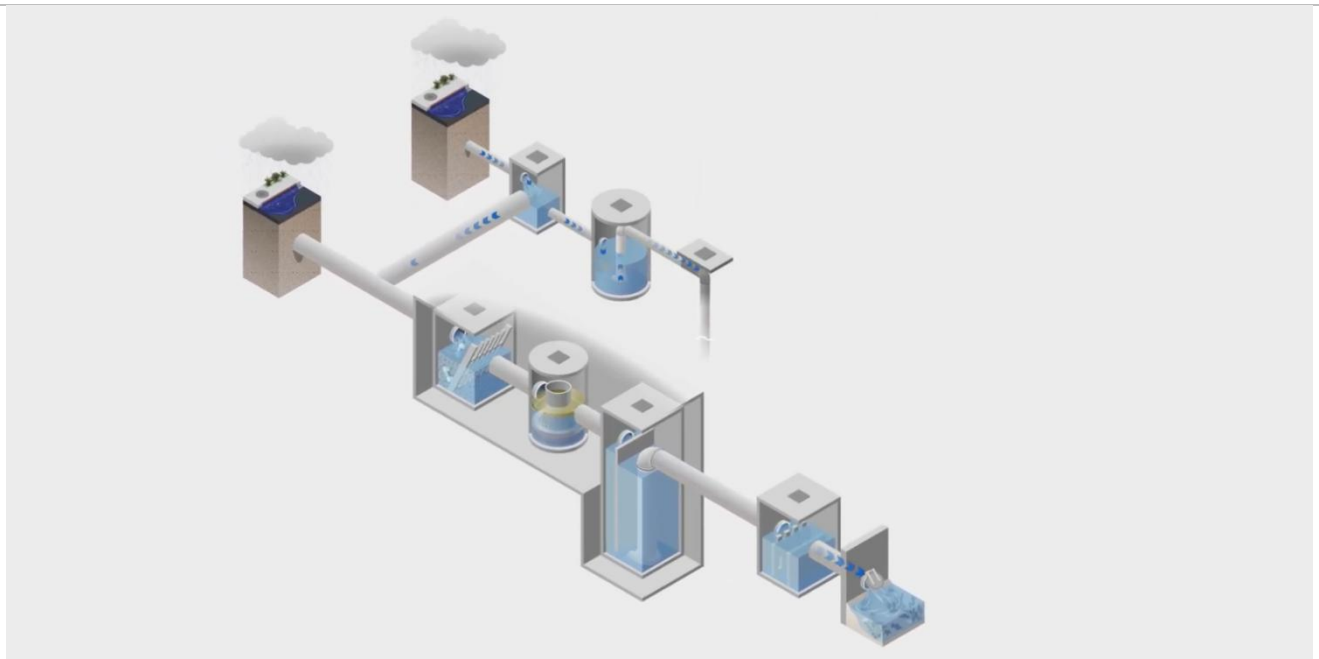


Figure 3. Miami Beach Road Raising Four Stage Filtration System[2]

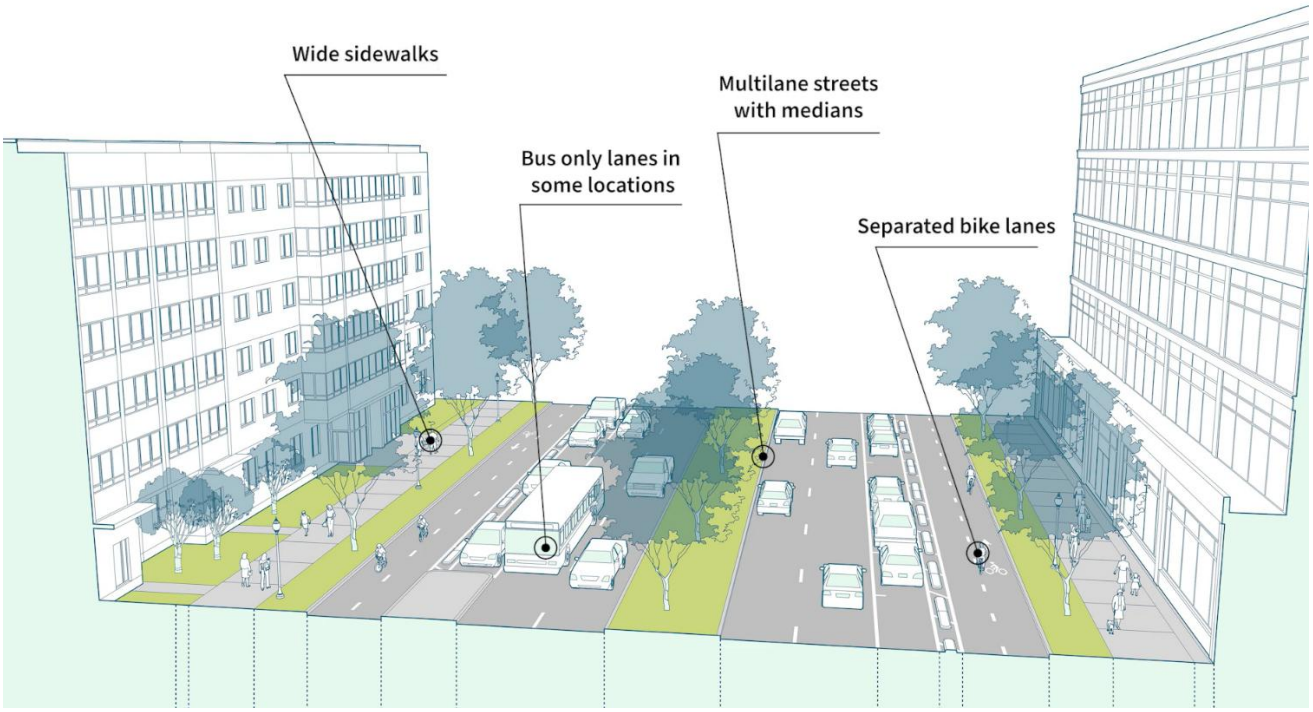


Figure 4. Montgomery County, MD -- Complete Streets Design[3]

[1] - Source: https://www.miamibeachfl.gov/projects/1-street-between-alton-road-and-washinton-avenue/

[2] - Source: https://www.miamibeachfl.gov/projects/1-street-between-alton-road-and-washinton-avenue/

[3] - Source: https://montgomeryplanning.org/planning/transportation/complete-streets/

PROJECT COMPONENTS

Alignment With Other Proposed and Ongoing Projects:

Following the completion of the OWH Projects #165 Islandwide Stormwater Master Plan and #35 Road Raising Strategy, a tool will be developed to identify and prioritize corridors within in the PUC. The tool can be informed by information collected in OWH Projects #122 Adapt Waikīkī Phase 2, #101 Iwilei Area Adaptation Plan, and #115 Mapunapuna Area Adaptation Plan.

Expected Timeline:

- Corridors with existing planned roadway or stormwater improvements should be evaluated for road raising and resilience corridor opportunities, with priority given to those most vulnerable to SLR and flooding.
- When funding becomes available for detailed design and construction, the highest-priority areas should be advanced.
- Identify corridors within the CIP that are strong candidates for federal and state funding programs.
- Alignment with related pedestrian, bicycle, and drainage initiatives across Oʻahu.

Triggers:

Climate Hazard: SLR

Funding: N/A

Regulatory: N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Assumptions	• Road Raising Strategy project will help inform criteria for selecting priority areas for road raising and resilience corridor improvements. • GIS Data Layers will be available from the Stormwater Master Plan that can be used to identify priority areas for resilience corridors.
Potential Challenges:	• Incorporating equity considerations into project prioritization with varying roadway conditions and infrastructure constraints. • Engaging private developments and landowners in areas identified for road raising. • Balancing pedestrian and traffic safety improvements with integration of stormwater strategies. • Retrofitting drainage solutions into corridors with limited existing infrastructure and high impervious surface coverage. • Ensuring improvements increase or maintain drainage capacity rather than exacerbate existing flooding conditions.
Additional Considerations:	• Limited space within existing right-of-way to incorporate drainage features, permeable surfaces, and pedestrian infrastructure. • Harmonization with private property for areas with proposed road raising. • Need to integrate stormwater strategies with roadway, bicycle, and pedestrian design elements across varied corridor types. • Managing runoff in areas with excess pavement and limited infiltration capacity. • Ensuring materials, vegetation, and infrastructure perform under both extreme rainfall and heat conditions.

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ACRONYMS

BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CIP	Capital Improvement Plan
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DTS	Department of Transportation Services
ENV	Department of Environmental Services
HART	Honolulu Authority for Rapid Transportation
HDOT	Hawaiʻi Department of Transportation
LID	Low Impact Development
N/A	Not Applicable
OWH	One Water Honolulu
PUC	Primary Urban Center
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

HONOULIULI R-1 DISTRIBUTION SYSTEM EXPANSION

PROJECT CONCEPT

GENERAL DESCRIPTION

There is ongoing work to expand the capacity of Honouliuli WWTP to support non-potable reuse. Tertiary treatment is located at the BWS Honouliuli Water Reclamation Facility, where non-potable water is currently distributed to Kapolei and ʻEwa. This project proposes to increase the distribution system to increase the use of R-1 water in ʻEwa and Central Oʻahu.

Converting Honouliuli WWTP to 100 percent R-1 will have many benefits, including a drought-proof supply from increased non-potable water availability and improved water quality and NPDES compliance. This conversion will lay the groundwork for direct potable reuse, demineralized recycled water, and advanced oxidation treatment at Honouliuli WWTP. Connecting R-1 to existing non-potable pipelines fed by spring and brackish water will increase redundancy and resilience.

Possible extensions include 3 directions:

1) West to new customers and an existing non-potable pipeline
2) East to new customers and connecting to an existing non-potable pipeline, with a potential extension along a new bike path alignment
3) Mauka to University of Hawaiʻi West Oʻahu and adjacent potential R-1 customers.

The eastern expansion could include the multi-benefit of improving the bike path, increasing connectivity and access, and increasing public education with educational signage about water reuse benefits along the bike path.

ID #:	4
Timeframe:	Mid-term
Champion Agencies:	BWS
Potential Partnerships:	ENV, DPR, DTS

PROJECT CONCEPT

Adaptation Strategy Type:	Infrastructure
Location of Project:	Central Oʻahu and ʻEwa
Area Classification:	Recharge and Runoff Management Opportunities
Hotspot:	Waipahu/Pouhala Marsh
Congressional District:	1
Council District:	VII, IX
Legislative District:	House District 32, House District 35
Neighborhood Board:	ʻAiea Subdistrict 1, Waipahu Subdistrict 3
Oʻahu SoVI Index:	N/A

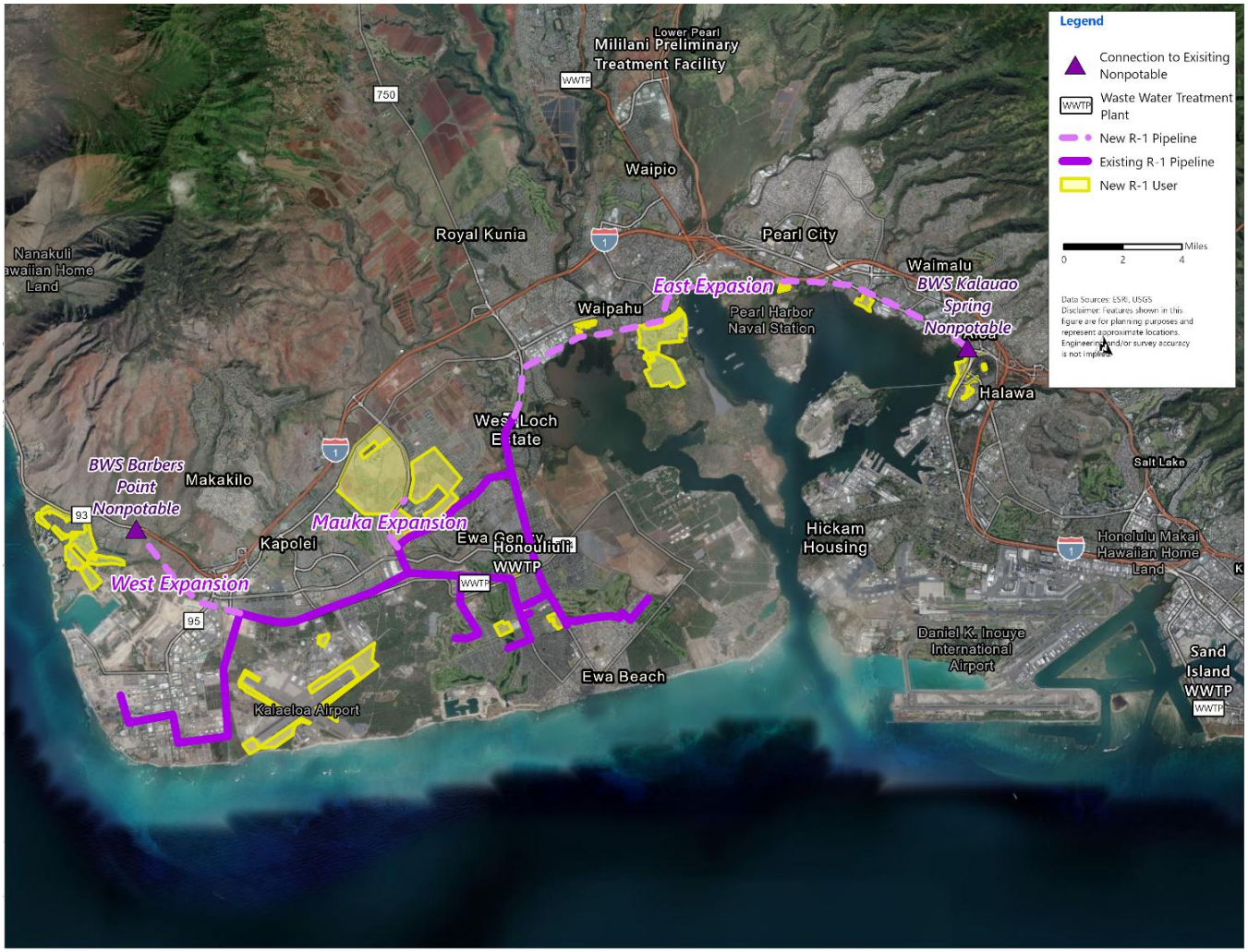


Figure 1. Proposed additional R-1 users, extended R-1 pipeline, and connections to existing pipeline and non-potable distribution. All locations are approximate.

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Nearby critical wells **Wastewater:** Honouliuli WWTP, sewer lines **Stormwater:** Waikele Stream, Hoʻaeʻae Stream **Roads:** N/A
Community Assets at Risk:	Pouhala Marsh Wildlife Sanctuary, Waipahu Fire Station 12, Kaiser Punawai Clinic, Waipahu Public Intermediate School, Waipahu Cultural Gardens, Honowai Elementary School, Waipiʻo Soccer Complex

Note: Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW-MEDIUM** **Drought:** Waipahu/Pouhala Marsh has medium risk from drought. New water supply sources are needed to support growing demand in the Primary Urban Center. R-1 reuse and distribution will reduce the potable water needs for irrigation and increase available supplies for fire suppression (or firefighting). **Extreme Heat**: Increased heat increases water demand. Supplementing source water with recycled water increases non-potable water supply that can offset potable water use.

PROJECT COMPONENTS

PLAN/STUDY

The project must begin with a planning phase to determine the best locations for R-1 reuse and expansion of R-1 distribution.

The current production of R-1 at Honouliuli WWTP is 12 mgd, with the ability to expand up to 16 mgd with an additional disc filter. Existing R-1 average daily demand (ADD) is approximately 7 mgd. The estimated demand for all potential users across the east, west, and mauka alignments totals 2.2 mgd ADD and 6.5 mgd maximum daily demand (MDD). The 16 mgd expanded capacity is expected to accommodate the maximum daily demand of all three extensions alongside existing users. R-1 supply may also increase over time as effluent volumes grow with regional development. Final user selection and alignment will be determined in the planning phase based on cost-effectiveness and delivered volume; the largest recommended users are UH West Oʻahu, DHHL, Kalaeloa Airport, Ko ʻOlina Golf Course, Ted Makalena Golf Course, and Waipiʻo Soccer Complex. Kalaeloa Regional Park could also be an end user but was not included in this preliminary analysis.

Connecting along the Pearl Harbor Bike Path, the R-1 distribution lines would pass by many potential users.

PROJECT COMPONENTS

To the west, potential users include:

Kalaeloa Airport, Kalaeloa Regional Park, Pointer Field, Ko ʻOlina Golf Course, and connecting to the BWS Barbers Point non-potable system. The estimated combined ADD and MDD of these users is 0.6 mgd and 1.8 mgd, respectively.

Mauka, potential users include:

UH West Oʻahu, DHHL, Laulani Community Park, and Geiger Community Park. The estimated combined ADD and MDD of these users is 1.2 mgd and 3.6 mgd, respectively.

To the east, potential users include:

Pupuʻole Mini Park, Waipahu Intermediate School, Ted Makalena Golf Course, Waipiʻo Soccer Complex, Lehua Elementary School, Neal S. Blaisdell Park, and a potential new irrigation along Pearl Harbor Bike Path (with improvements). This alignment would also connect to the BWS Kalauao Spring non-potable system. Within the planning phase, there would also be consideration of improvements to the Pearl Harbor Bike Path itself including a condition assessment and plans for informational signage. This plan should also consider how to maximize public outreach and education related to the upgrades, the water conservation, and climate components. The estimated combined ADD and MDD of these users is 0.4 mgd and 1.2 mgd, respectively.

The study portion will include:

1. Consider the Potential Users and Alignment. This decision should optimize for the lowest unit cost ($/acre-ft) pipeline extension alignment(s), balancing delivered volume against pipeline length and construction cost. Alignments should prioritize connecting to existing non-potable lines in Kalauao Spring and Barbers Point.
2. Determine the Alignment. Based on the above considerations, a planned alignment should be selected. This process may include historical potable water billing data analysis, site conversion analysis, and soil tests for contamination. The evaluation should also address permitting requirements, stream and bridge crossings along the eastern alignment at Waikele and Hoʻaeʻae streams, and construction impacts to bike path users and adjacent neighborhoods. If the bike path moves forward, this alignment will require collaboration with DTS and consideration of the bike path alignment and construction timeline.
3. Environmental Assessment. A new environmental assessment report will be required to extend the R-1 beyond what was previously approved. While the proposed irrigation areas are not in restricted zones, PFAS treatment may be required where R-1 would be applied over potable aquifers, in accordance with DOH restrictions. The EA should confirm which portions of the proposed service area require additional treatment and which are suitable for unrestricted use.

PROGRAM

N/A

INFRASTRUCTURE

If deemed cost-effective and beneficial, the infrastructure components would include increased R-1 treatment at Honouliuli WWTP and new R-1 distribution pipelines to additional end-users and existing non-potable pipes. Increased R-1 treatment will require an additional disk filter in the old sand filter bay.

PROJECT COMPONENTS

The R-1 distribution pipelines will need to be ductile iron rather than PVC to avoid contamination from fuel and leaching contaminants from the soil. The east alignment would require about 7 miles of pipe, the mauka alignment would require about 1 mile of pipe, and the west alignment would require about 2.5 miles of pipe.

The eastern extension may be paired with bike path improvements, either ~4 miles to the Ted Makalena Golf Course and Waipiʻo Soccer Complex, or ~8 miles to the New Aloha Stadium Entertainment District (NASED). Proposed improvements include a condition assessment of the existing path; resurfacing with asphalt or concrete; installation of bollards, striping, lighting, and signage; and R-1 irrigated native landscaping averaging 15 feet on either side of the path. A new path segment from Pupuʻole Mini Park to the Ted Makalena Golf Course, would need to be constructed, including two small pedestrian bridges. The remainder of the route uses the existing Pearl Harbor bike path, which connects to NASED. Informational signage would support public awareness of the reuse project.

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☐ Increases community flood protection ☒ Improves water quality ☒ Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

A “?” noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Reduce pressure on the Pearl Harbor Aquifer to support regional water supply reliability
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu
CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse, Desalination

PROJECT COMPONENTS

Expected Timeline:

The first phase of this project will be planning for the distribution lines. The timeline should align with ongoing efforts from DTS to improve the Pearl Harbor Bike Path/South Shore Trail.

This project will likely need to be coordinated/interact with the following other projects:

- State guidance on Reuse Guidelines
- OWH Project #106 Reuse Strategy for Redevelopment Areas
- OWH Project #162 NASED Regulatory Requirements for Reuse
- OWH Project #167 Central Oʻahu Water Recycling Facilities, Mililani
- Bike Path Improvements between Nānākuli and Mānoa

Triggers:

Climate Hazard: N/A

Funding: N/A

Regulatory: N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Assumptions

- The total effluent of Honouliuli is 25 mgd, of which 9 mgd must go to the outfall to keep the valve flap open, leaving up to 16 mgd that could be treated to R-1 standards. Existing R-1 ADD has been approximately 7 mgd. During wet weather flows, R-1 water can be returned to the plant effluent stream to dilute contaminant concentrations before discharge, supporting compliance with current and anticipated discharge requirements including dieldrin. Available effluent may increase with regional growth and development.

Potential Challenges:

- The Pearl Harbor Historic Trail contains numerous fuel and gas pipelines. The corridor may have significant soil contamination and limited space for a new pipeline alignment. The pipeline will need to be ductile iron rather than PVC to avoid leaching chemicals, and soil remediation may be necessary. An abandoned fuel line may be usable as the alignment for a portion of the R-1 pipeline.

Additional Considerations:

- Hawaiʻi Department of Health has delineated locations where R-1 irrigation is restricted, particularly over potable aquifers. Water must be treated for PFAS to be irrigated above a potable aquifer, which would require additional treatment or limiting use in some areas. Much of ʻEwa and the makai areas in Central Oʻahu are suitable for unrestricted R-1 use.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Currently, Waipiʻo Soccer Complex and Ted Makalena Golf Course are irrigated with non-potable water from Waikele Stream and Kalauao Spring. These are not feasible users of R-1 in the short term. However, if there is future desire or need to limit pulling water from the stream and spring, these could be potential large users of R-1 water.

Timing for Bike Path:

- Some improvements have been completed in 2025. Early coordination with DTS will be necessary to align the timing of the R-1 distribution expansion with ongoing bike path improvements and avoid repeated construction. Overall improvements to the bike path between Nānākuli and Mānoa are expected to be in planning by 2028 and take up to 20 years to construct.

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ACRONYMS

ADD	Average Daily Demand
BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DHHL	Department of Hawaiian Home Lands
DPR	Department of Parks and Recreation
DTS	Department of Transportation Services
ENV	Department of Environmental Services
MDD	Maximum Daily Demand
N/A	Not Applicable
NASED	New Aloha Stadium Entertainment District
NPDES	National Pollutant Discharge Elimination System
OWH	One Water Honolulu
PFAS	Per- and Polyfluoroalkyl Substances
PVC	Polyvinyl Chloride
R-1	R-1 Recycled Water
SoVI	Social Vulnerability Index
UH	University of Hawaiʻi
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

RESILIENCE CORRIDOR AND PEDESTRIAN ACCESSIBILITY STUDY

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes a resilience corridor and pedestrian accessibility study and infrastructure improvements for Koʻolau Poko near the Kāneʻohe hotspot location. The project will look for opportunities to increase resilience for both above- and below-ground infrastructure. For below-ground infrastructure such as utility pipelines and vaults, the project will consider improvements such as corrosion-resistant materials, improved pipe joint integrity, and water-tight underground structures to improve resilience to hazards such as shallow and emergent groundwater. Additionally, the project will identify opportunities to improve access and connectivity of above-ground pedestrian infrastructure by studying where sidewalk and bus stop networks are limited and suggesting improvements. The project includes both study and infrastructure components.
ID #:	60
Timeframe:	Long-term
Champion Agencies:	DTS
Potential Partnerships:	BWS, ENV, DFM, DDC (may implement design and construction)
Adaptation Strategy Type:	Infrastructure
Location of Project:	Kāneʻohe, Koʻolau Poko
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Kāneʻohe
Congressional District:	2

PROJECT CONCEPT

Council District:	III
Legislative District:	House District 48, 49, 50
Neighborhood Board:	Kāneʻohe Subdistricts 1-14, Kāneʻohe, Kailua Subdistrict 3
Oʻahu SoVI Index:	Low

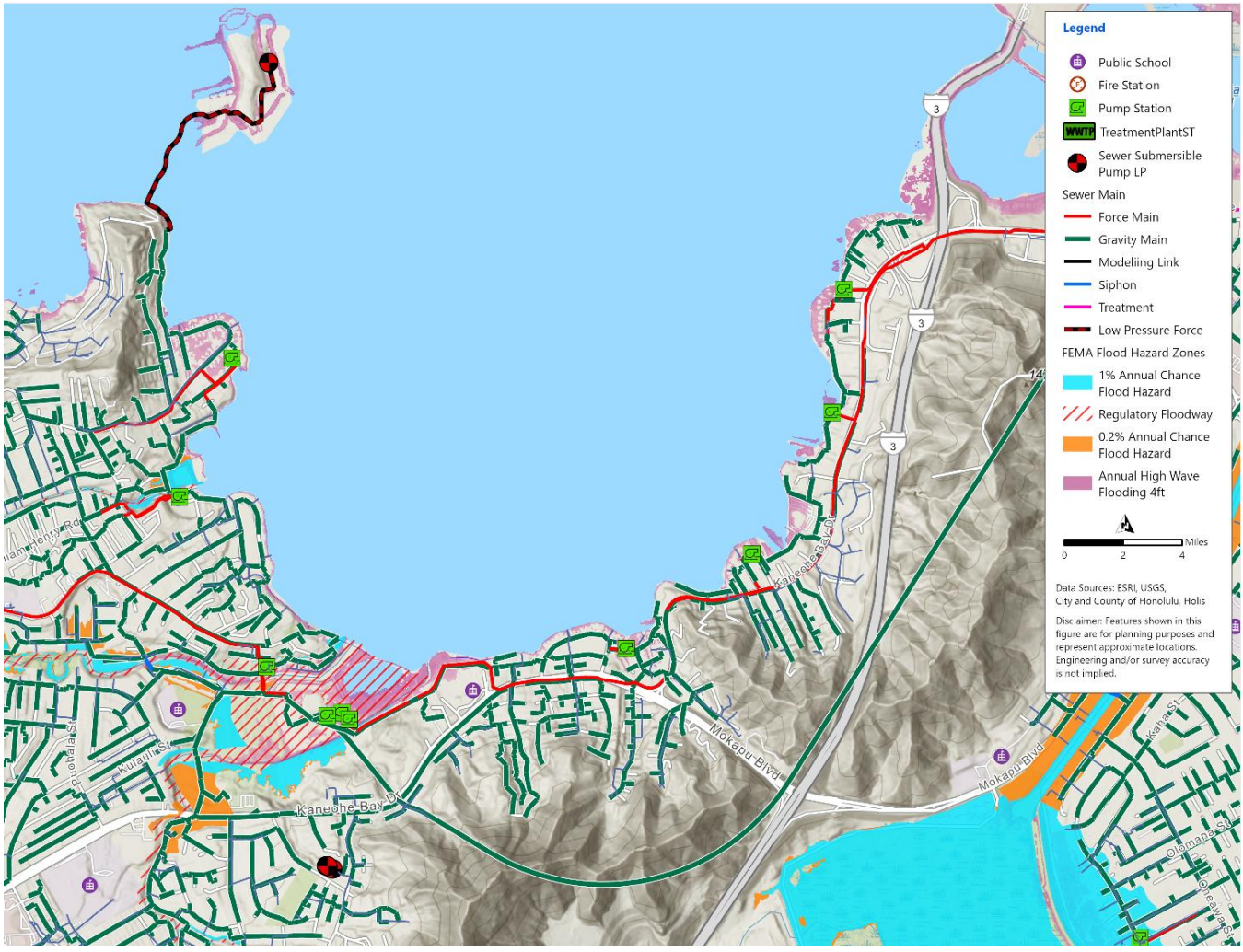


Figure 1. Project factsheet location showing hazards

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk water lines, wells **Wastewater:** Wastewater pump stations, influent facility, sewer mains **Stormwater:** Stormwater conduits **Roads:** Waikalua Rd, Holowai St/Pl , Kāneʻohe Bay Dr, Kulauli St
Community Assets at Risk:	Within the Kāneʻohe hotspot area: Kāneʻohe Stream, Kawa Stream, Puohala Public Elementary School, Ke Kula O Kamakau Lab Public School, Huakāilani Private School for Girls, Bayview Golf Park, Nāonealaʻa a Kāneʻohe, Kahua O Waikalua Neighborhood Park, Kāneʻohe Bay, Waikalua Fish Pond

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **Sea Level Rise:** Annual high wave-driven flooding begins at 2 feet of SLR, with groundwater inundation occurring at 4 feet of SLR and an 80% probability of passive flooding at 6 feet of SLR. Flooding may affect Waikalua Road, Kāneʻohe Bay Drive, Holowai Street, Kulauli Street, pedestrian routes, beaches, and access to nearby community assets. Water, wastewater, and stormwater infrastructure may also experience increasing impacts from flooding and drainage backflow. This plan will identify and enable roadways to elevate above rising sea levels. **100-year Storm:** Flood hazards are present along Keaʻahala Stream and Kāneʻohe Stream. Heavy rainfall may affect roads, pedestrian access routes, drain inlets, and nearby infrastructure, resulting in reduced access to community facilities and recreation areas. This plan will identify improvements to reduce flood risk. **Hurricane:** Complete inundation up to 3 feet under Category 1 hurricane conditions, with some areas experiencing greater depths. Flooding may affect key roads, pedestrian connections, utilities, schools, Nāonealaʻa a Kāneʻohe, Bayview Golf Park, and other community assets, limiting access during and after storm events. This plan will identify improvements to reduce flood risk. **Tsunami:** Located within tsunami evacuation zones. Tsunami flooding may disrupt access along major roadways and pedestrian corridors and impact community facilities, beaches, utility infrastructure, and areas surrounding Kāneʻohe Bay. While this plan can consider tsunami evacuation zones, tsunami risk reduction will be minimal. **Extreme Heat:** High afternoon heat index conditions may affect pedestrian comfort and accessibility, particularly along routes with limited shade. Heat may also affect the usability of parks, beaches, and other community gathering spaces. This plan will

include shade structures and recommendations to reduce extreme heat effects on pedestrian corridors.

PROJECT COMPONENTS

PLAN/STUDY

- Identify potential resilience corridors with pedestrian and underground infrastructure.
- Assess pedestrian accessibility and connectivity. Assess vulnerabilities affecting below- and above-ground infrastructure such as roads, drain inlets, streams, utility infrastructure, and other assets that support community access.
- Evaluate impact of climate-related vulnerabilities affecting these assets.
- Identify and prioritize corridors for resilience improvements based on vulnerabilities, usage, and implementation feasibility.
- Identify suggested improved for prioritized corridors for both below- and above-ground infrastructure. Improvements could include more resilient utility systems or shade structures.

PROGRAM

N/A

INFRASTRUCTURE

Implement improvements for above- and below-ground infrastructure to support pedestrian access and connectivity as well as infrastructure resilience.

Community Benefits:

- ☐ Protects cultural sites
- ☒ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ☒ Improves public access to community spaces
- ☒ Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

PROJECT COMPONENTS

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Protect water quality and natural resources in streams, ponds, and coastal areas Prevent flooding in neighborhoods, roadways, and public areas of concern Protect Kāneʻohe Bay for future generations
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Develop a unified roadmap and decision making process under a One Water approach Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#10**: Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies:	• Elevate Access Road and Associated Utilities • Implement Cool Alternatives to Traditional Pavements for Roads and Sidewalks • Incorporate Shade and Cooling Structures • Urban Heat Index Reduction with Enhanced Green Spaces • Study to Incorporate Native Hawaiian Practices for Resilient Design
Expected Timeline:	This project includes a study component that may lead to infrastructure projects. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the long-term timeframe. If flooding, erosion, or other climate impacts begin to affect key access routes, pedestrian connections, or community facilities, implementation of identified corridor and accessibility improvements may be prioritized sooner.
Triggers:	**Climate Hazard:** SLR, Heavy Rain, Extreme Heat **Funding:** Implementation of this project may proceed when sufficient funding becomes available. **Regulatory:** Existing TMDLs for Kāneʻohe Stream could trigger earlier implementation of the project.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Flooding along streams and roads may affect pedestrian access and community connectivity. Identifying routes that remain accessible during multiple hazard events may also be challenging.
Additional Considerations:	• Drain inlets, streams, pipelines, beaches may influence future corridor and accessibility recommendations. Portions of the area are located within a dam evacuation zone, and there is potential for community displacement due to flooding based on future climate risks. Coordination is needed with DFM and ENV.
Technical Considerations:	• Future recommendations should consider flooding, sea level rise, and other climate hazards that may affect key access routes, pedestrian connections, and community mobility. Improvements should support safe and reliable access during climate-related emergency events.

REFERENCES

Hawai‘i State Department of Health, Clean Water Branch. (April, 2024). State of Hawai‘i Water Quality Monitoring and Assessment Report. https://health.hawaii.gov/cwb/files/2024/09/IR-2024-final-draft.pdf

ACRONYMS

CRO	Climate Ready O‘ahu
BWS	Board of Water Supply
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
ENV	Department of Environmental Services
N/A	Not Applicable
OWH	One Water Honolulu
SoVI	Social Vulnerability Index
TMDL	Total Maximum Daily Load

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

STATE AGRICULTURE WATER SYSTEM CONNECTION TO FUTURE R-1

PROJECT CONCEPT

GENERAL DESCRIPTION

Waimānalo consists of primarily residential and agricultural water users. The area has a golf course and a large number of Agricultural Lands of Importance to the State of Hawai'i (ALISH). The State Waimānalo Irrigation System currently provides water to farmers from the Maunawili Ditch, whose source is high-level water tunnels, springs, and streams in Maunawili and Waimānalo Valley. The Honolulu Board of Water Supply (BWS) also serves customers in this area and has potable water source production needs in this area and in neighboring areas. Agricultural water users in Waimanalo rely on these City and State sources and distribution systems to irrigate their land and sustain their livelihoods using potable water for non-potable irrigation purposes.

In an effort to reduce the demand on potable water for irrigation demands and to reduce the diversion of stream water in Waimānalo, OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study was developed. This separate but relevant project focuses on the expansion of water reuse as a means to reduce potable water demands. The local Waimānalo WWTP currently does not produce recycled water. The Waimānalo WWTP currently uses injection wells for effluent disposal. However, the existing disposal method may be ruled by the State of Hawai'i Department of Health (DOH) as functionally equivalent to an unallowable point source discharge, rendering it an infeasible disposal option. To address this concern, the Department of Environmental Services (ENV) is considering modifications to the treatment capabilities at the Waimānalo WWTP which would allow at least some portion of the effluent to be reused elsewhere instead of being disposed of onsite. Expanding water reuse will help increase water supply resilience for the Waimānalo area and reduce the use of injection wells for wastewater effluent disposal.

This project will focus on developing interconnection(s) between the existing Waimānalo Irrigation System and the new R-1 recycled water distribution system that will be constructed as part of OWH Project #75. This interconnection would increase the resiliency of the irrigation system throughout Waimānalo by expanding the irrigation water distribution system in Waimānalo without having to design and construct an extensive distribution system from scratch. This would allow the Waimānalo WWTP

PROJECT CONCEPT

	to be a source of irrigation water for users much further away from the WWTP and increase the irrigation source redundancy as well. If a disruption in the surface water sources or Maunawili Ditch were to occur, it will be possible to serve users with R-1 water from the WWTP and vice versa. With the added irrigation source capacity, the completion of both projects will allow irrigation demand to be met at least partially with R-1 water rather than water diverted from the sources that supply the Maunawili Ditch. That will allow for improved streamflow and preservation of the surface water resources within and mauka of Waimānalo. In addition to infrastructure improvements, this project will help to spread awareness of recycled water as an irrigation source and help inform the community of the challenges that both BWS and ENV face when trying to maintain potable water and wastewater services with a changing climate.
ID #:	67
Timeframe:	Long-term
Champion Agencies:	ENV
Potential Partnerships:	City: BWS*, DFM State: DAB Others: Private landowners, agricultural businesses Any entity that owns/manages a large plot of land suitable for R-1 irrigation may be involved as a user/stakeholder either through this project or the related precursor OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study. The list of City and State agencies listed is not exhaustive, as it will depend on the userbase that this expanded distribution system will serve. * BWS may be considered a potential champion due to this project's primary goal of increasing potable water supply resiliency. ENV was selected as the potential champion because ENV is considered the champion of OWH Project #75 and will be highly involved in the design and construction of the R-1 system that this project will connect to. It may be more straightforward for both projects to have the same champion with BWS as one of the key partners in both projects.
Adaptation Strategy Type:	Infrastructure
Location of Project:	Waimānalo, Koʻolau Poko

PROJECT CONCEPT

Area Classification:	Country Towns and Rural Coastline
Hotspot:	Waimānalo Beach, Waimānalo near Olomana Golf Course
Congressional District:	2
Council District:	III
Legislative District:	House District 51
Neighborhood Board:	Waimānalo Subdistricts 7, 10
Oʻahu SoVI Index:	High



Figure 1. Satellite view of Waimānalo

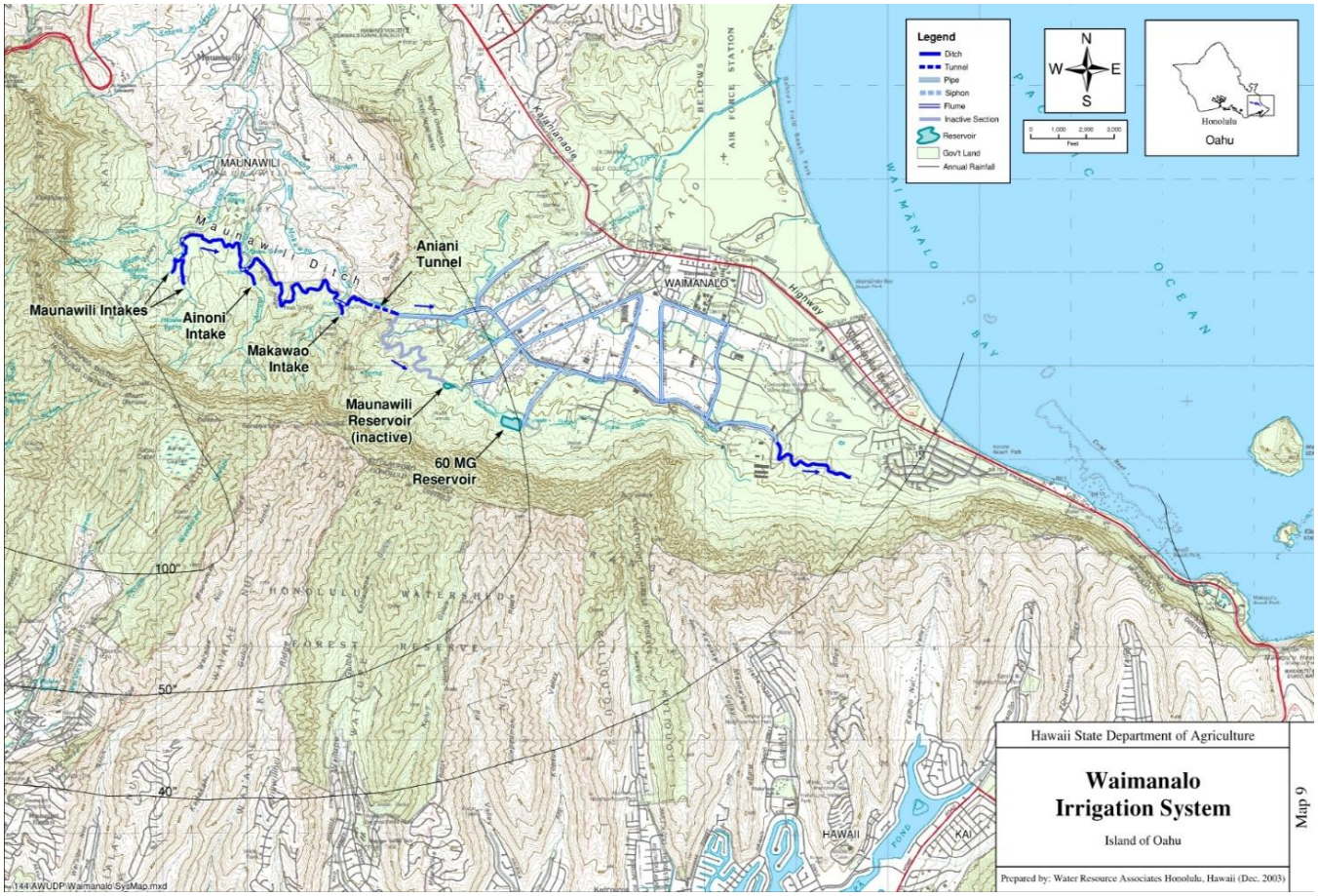


Figure 2. Map of the existing Waimānalo Irrigation System (Department of Agriculture and Biosecurity, 2012)

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Sources, distribution system (piped and ditch systems), dams and reservoirs **Wastewater:** Pipelines are not necessarily at risk from drought, but are heavily impacted by this project **Stormwater:** Streams, channels **Roads:** Roads are not necessarily at risk from drought, but may be impacted by infrastructure improvements
Community Assets at Risk:	Waimānalo Fire Station 27, Waimānalo Health Clinic, Waimānalo Elementary and Intermediate Public School, Blanche Pope Elementary School, Hūnānāniho Beach Park, Waimānalo Beach Park, Waimānalo District Park, Kaiona Beach Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM** **Drought:** The Waimānalo area has a low risk from drought. However, water supply is a concern for this area and the lack of sufficient BWS sources requires imported water to serve Waimānalo customers. R-1 reuse and distribution will reduce the potable water needs for irrigation and leave more potable water available for drinking water and maintaining streamflow. This project will make the distribution system more flexible, resilient, and increase available source capacity for customers that can be served by the new interconnection. **Extreme Heat:** Increased heat increases water demand due in part to higher evapotranspiration. This project will create additional water supply from recycled water and reduce the demand on the potable water system.

PROJECT COMPONENTS

PLAN/STUDY

N/A for this specific project. However, the near-term plan/study component of OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study will produce the KPKW Waimānalo Effluent Reuse Feasibility R-1 reuse feasibility assessment that will inform the expansion of R-1 use in Waimānalo. This study will likely have information or recommendations that will inform the feasibility and execution of this project.

PROGRAM

N/A

INFRASTRUCTURE

Long-term construction of improvements to the existing Waimānalo Irrigation System to allow for interconnection(s) to the new R-1 distribution system proposed as part of OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study. Improvements may include repairs and/or upgrades to the Waimānalo Irrigation System that will happen at the same time as the interconnection additions to improve the condition and reliability of the existing irrigation infrastructure.

Community Benefits:	? Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☐ Improves water quality ☐ Improves public access to community spaces ☐ Increases public awareness/education ? Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:
Hotspot Goals Supported:	Respect and support Native Hawaiian culture and traditional practices reliant on healthy land and water resources Improve water supply resilience for local community use Improve water quality and flood mitigation
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Work together to leverage resources and enable climate readiness

PROJECT COMPONENTS

CRO Strategies Supported:	**#7**: Strengthen fresh water security by improving water conservation and reuse
Relevant Adaptation Strategies:	• Utilize Alternative Water Sources: Non-potable Reuse, Indirect Potable Reuse, On Site Reuse • Stream restoration
Expected Timeline:	This is a long-term project because it requires and is triggered by the OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study. That project includes the long-term development of an expanded R-1 distribution system that will then be conducted in-tandem with this project to construct both the new distribution system and the infrastructure needed to repair, upgrade, and connect to the existing Waimānalo Irrigation System.
Triggers:	**Climate Hazard:** Drought **Funding:** N/A **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• R-1 water is not a perfect substitute for potable water. Adds nutrients to soil when used for irrigation. Pricing of R-1 water may not be competitive with potable water options. • Per the KPKW Waimānalo Effluent Reuse Feasibility 30% Report (BC, 2025), potential users who were interviewed cited costs as a significant factor when considering a switch to R-1. Costs of R-1 water would have to be competitive with BWS and Waimānalo Irrigation System rates to make it financially viable to switch. At this time, there's concerns that the R-1 water would be too costly.
Additional Considerations:	• Waimānalo area relies on imported potable water. Water supply issues arose in past when Maunawili Ditch was damaged. • Reuse would help to replace a portion of the water that currently is diverted from Maunawili Stream, improving streamflow and preservation of the stream. • It is unclear if ENV, BWS, or another entity would own or maintain R-1 distribution system. BWS and ENV have begun collaboration on reuse projects and infrastructure on the Leeward side. The State will also need to be included in ownership and maintenance decisions with the new interconnection.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- The interconnection will impact and change the allowable use and permitting of Waimānalo Irrigation System infrastructure because of the introduction of non-potable reuse water to the system. The entire combined systems will need to adhere to recycled water regulations and the water cannot be used for potable uses any more. The users must be informed and educated about the change and the safe use of the water.
- OWH Project #75 Waimānalo Effluent R-1 Reuse Feasibility Study must be implemented before this project can be triggered and completed. There will be no R-1 infrastructure to connect the existing Waimānalo Irrigation System to if the OWH Project #75 is not implemented or if the project description changes significantly from what is currently proposed.

REFERENCES

Brown and Caldwell. (2025). KPKW Waimānalo Effluent Reuse Feasibility 30% Report for ENV.

Department of Agriculture. (2012). Waimānalo Irrigation System. https://dab.Hawai‘i.gov/arm/files/2012/12/Map9.pdf

ACRONYMS

ALISH	Agricultural Lands of Importance to the State of Hawai‘i
BWS	Board of Water Supply
CRO	Climate Ready O‘ahu
DAB	Department of Agriculture and Biosecurity
DOH	Department of Health
ENV	Department of Environmental Services
KPKW	Kahuku, Pa‘ala‘a Kai, and Waimānalo Facility Plans
mgd	Million Gallons per Day
N/A	Not Applicable
NPW	Non-Potable Water
OWH	One Water Honolulu
R-1	Recycled Water Meeting R-1 Standards
SoVI	Social Vulnerability Index
UH	University of Hawai‘i
WWTP	Wastewater Treatment Plant

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

REGIONAL SHORELINE ADAPTATION

PROJECT CONCEPT

GENERAL DESCRIPTION

Kalaniana‘ole Highway serves as a vital corridor connecting regions of O'ahu along the south-eastern coast. Large stretches of Kalaniana‘ole Highway are within the 100-year floodplain and are subject to future inundation under sea level rise and coastal flooding. This project focuses on the stretch of Kalaniana‘ole Highway in East Honolulu.

To protect this transportation corridor, the buried water infrastructure, and mauka developments in the long-term, regional shoreline resilience will be necessary along the coastal stretch of highway. The long-term solution will require a mixture of grey and green infrastructure measures, with the goal of incorporating as many nature-based solutions as possible where site conditions allow.

Kalaniana‘ole Highway is the only continuous corridor through the project area at a workable elevation, and publicly-owned land along the shoreline is limited. The project concept includes raising portions of the highway through the project area, with the raised roadway serving as the structural backbone of the shoreline protection system. The City is responsible for the mouths of the major streams in the area: Wailupe, Niu, and Kuli‘ou‘ou. All three streams have US Army Corps of Engineers (USACE) projects and will require coordination. Three beach parks are also along the shoreline in this region: Wailupe and Kuli‘ou‘ou Beach Parks, which are State-owned and under State Executive Order to the City for Park purposes, and Kawaikui Beach Park, which is City-owned. In addition, the State owns land around Paikō Lagoon. Because the corridor is anchored by Kalaniana‘ole Hwy, the State of Hawai‘i DOT will need to be a major collaborator on this project, along with other state agencies and private landowners. Although the project area itself has a low social vulnerability index, Kalaniana‘ole Highway is a critical linear network corridor serving communities well beyond East Honolulu, including Waimānalo and Windward O‘ahu. Loss of this corridor would sever regional access.

While the proposed shoreline adaptation does not fall entirely within the City's jurisdiction, this project factsheet focuses on improvements that are within the City's jurisdiction, the necessary collaborations, and a broader vision of the East Honolulu regional shoreline adaptation in hopes that the City will champion this project in collaboration with the State.

PROJECT CONCEPT

ID #:	8
Timeframe:	Long-term
Champion Agencies:	DDC, BWS, ENV, DPR
Potential Partnerships:	HDOT, DLNR, USACE, CCSR, DFM, DTS
Adaptation Strategy Type:	Infrastructure
Location of Project:	Kalaniana‘ole Hwy, East Honolulu
Area Classification:	Critical Linear Network Corridor
Hotspot:	Kalaniana‘ole Hwy
Congressional District:	1
Council District:	IV
Legislative District:	House District 19
Neighborhood Board:	Kuli‘ou‘ou-Kalani Iki Subdistricts 5, 7, 8
Oʻahu SoVI Index:	Low

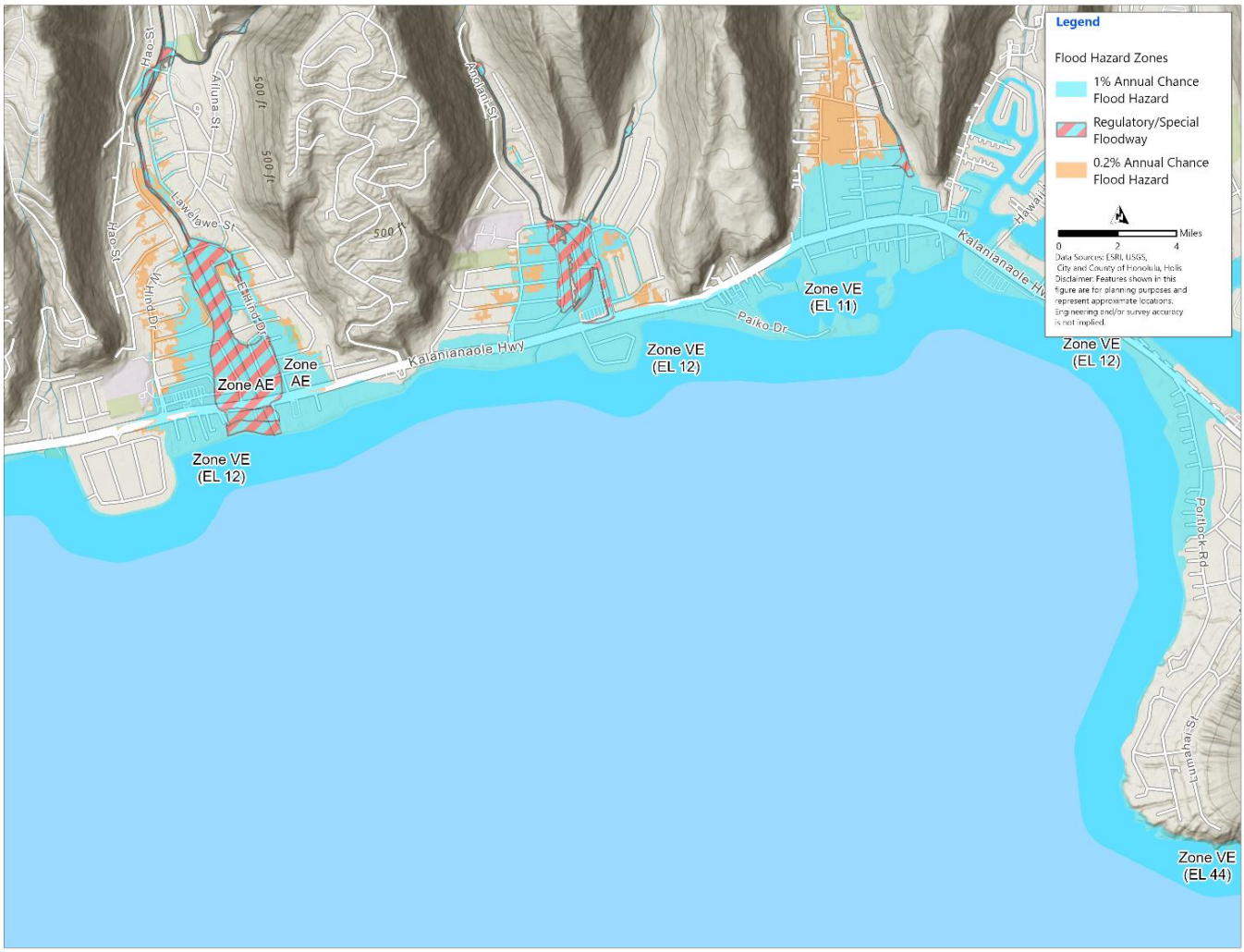


Figure 1. 100-Year Flood Impacts to Project Area

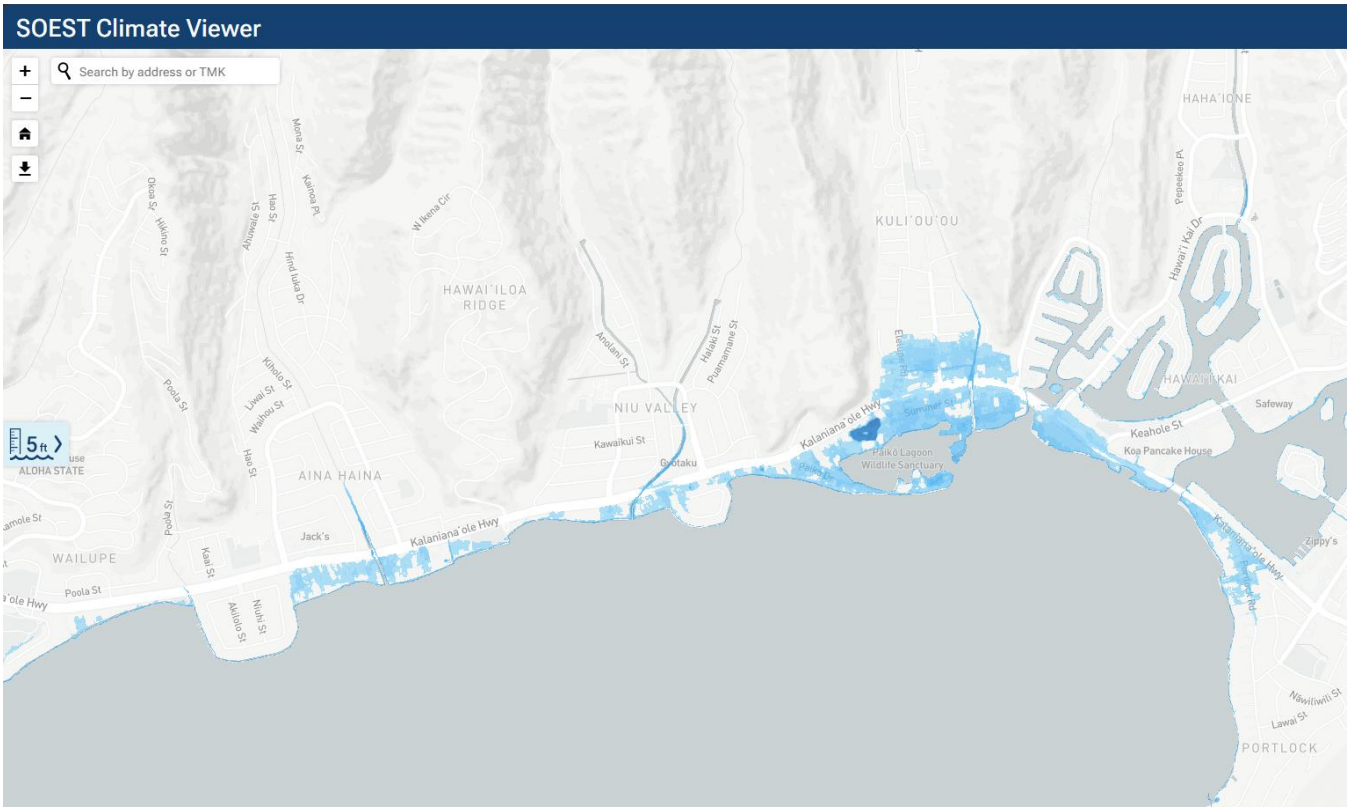


Figure 2. 5 ft SLR- Passive Flooding Impacts to Project Area. Source: SOEST Climate Viewer

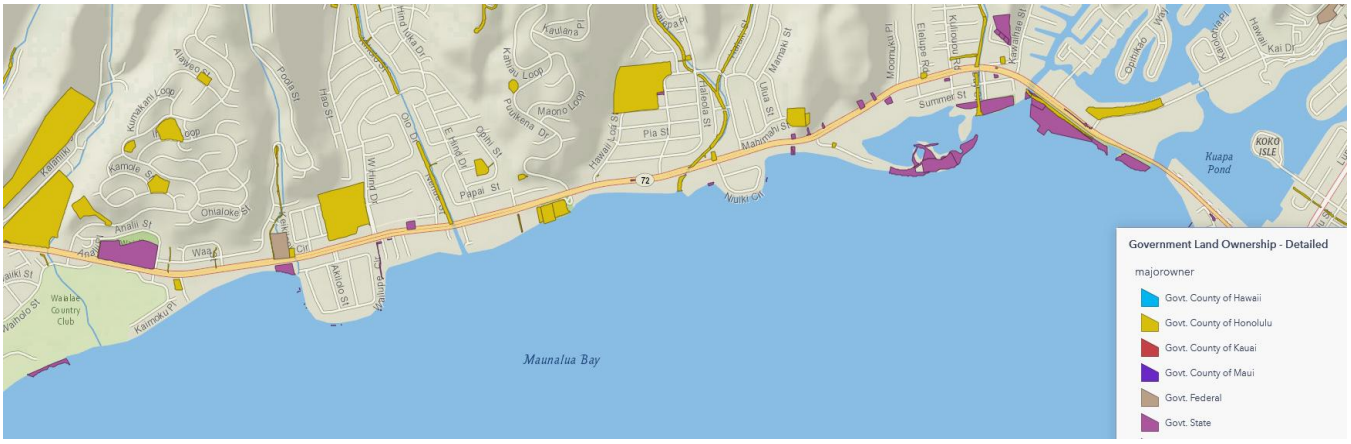


Figure 3. Government Owned Parcels (Hawai'i Statewide GIS Program, 2022). Yellow parcels are City and County of Honolulu, pink parcels are State of Hawai'i.



Figure 4. Topography showing 5 foot elevation contours. Source: City & County of Honolulu GIS, https://honolulu-cchnl.opendata.arcgis.com/datasets/cchnl::elevation-5ft/

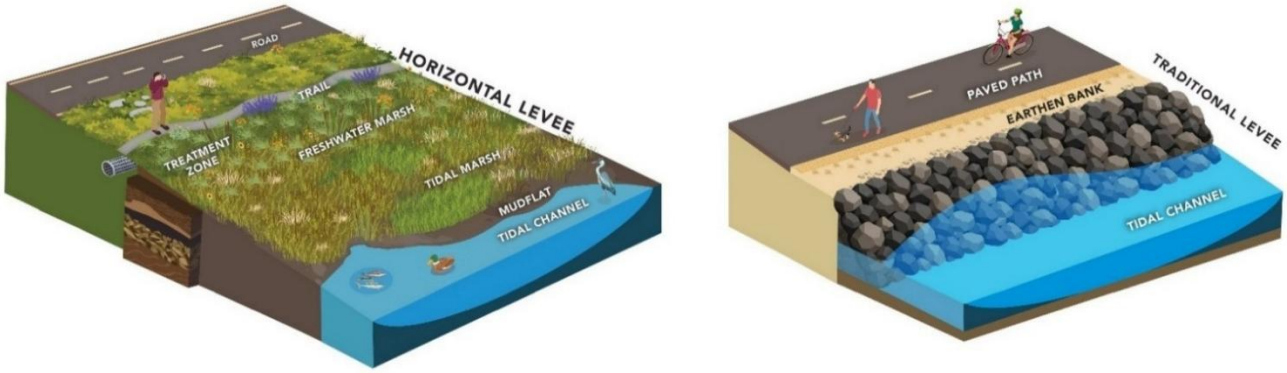


Figure 5. Horizontal or Living Levee versus Traditional Levee.

Source: Palo Alto Living Levee Project, https://www.paloalto.gov/Departments/Public-Works/Watershed-Protection/Palo-Alto-Horizontal-Levee-Pilot-Project

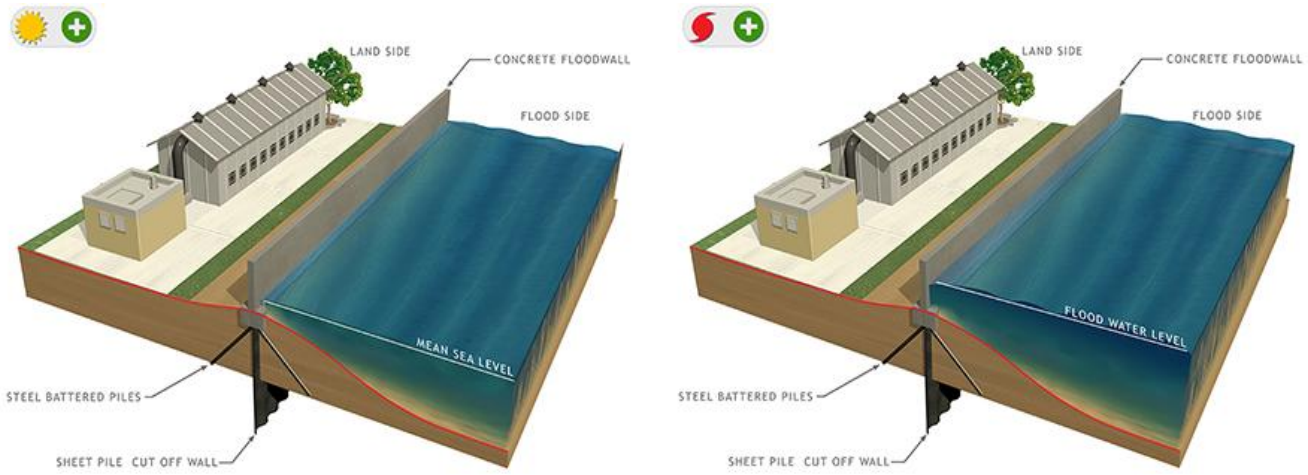


Figure 6. Floodwall Schematic under typical (left) and flood (right) conditions.
Source: USACE North Atlantic Division, https://www.nad.usace.army.mil/CompStudy/ accessed July 2026.



Figure 7. Tide Gate for Stream Outlet
Source: OneShoreline's Millbrae-Burlingame Shoreline Protection Project Conceptual Alternatives Feasibility Analysis (Schaaf & Wheeler, 2023)



Figure 8. Roadway atop a Levee.
Source: Odin Environmental Solutions, American River Common Features, Sacramento River East Levee Improvement, Contract 1, https://odinenv.com/american-river-common-features-sacramento-river-east-levee-improvement-contract-1/ Accessed July



Figure 9. Levee High Tie-in Point
Image from USACE: https://www.usace.army.mil/Media/Images/igphoto/2002503065/

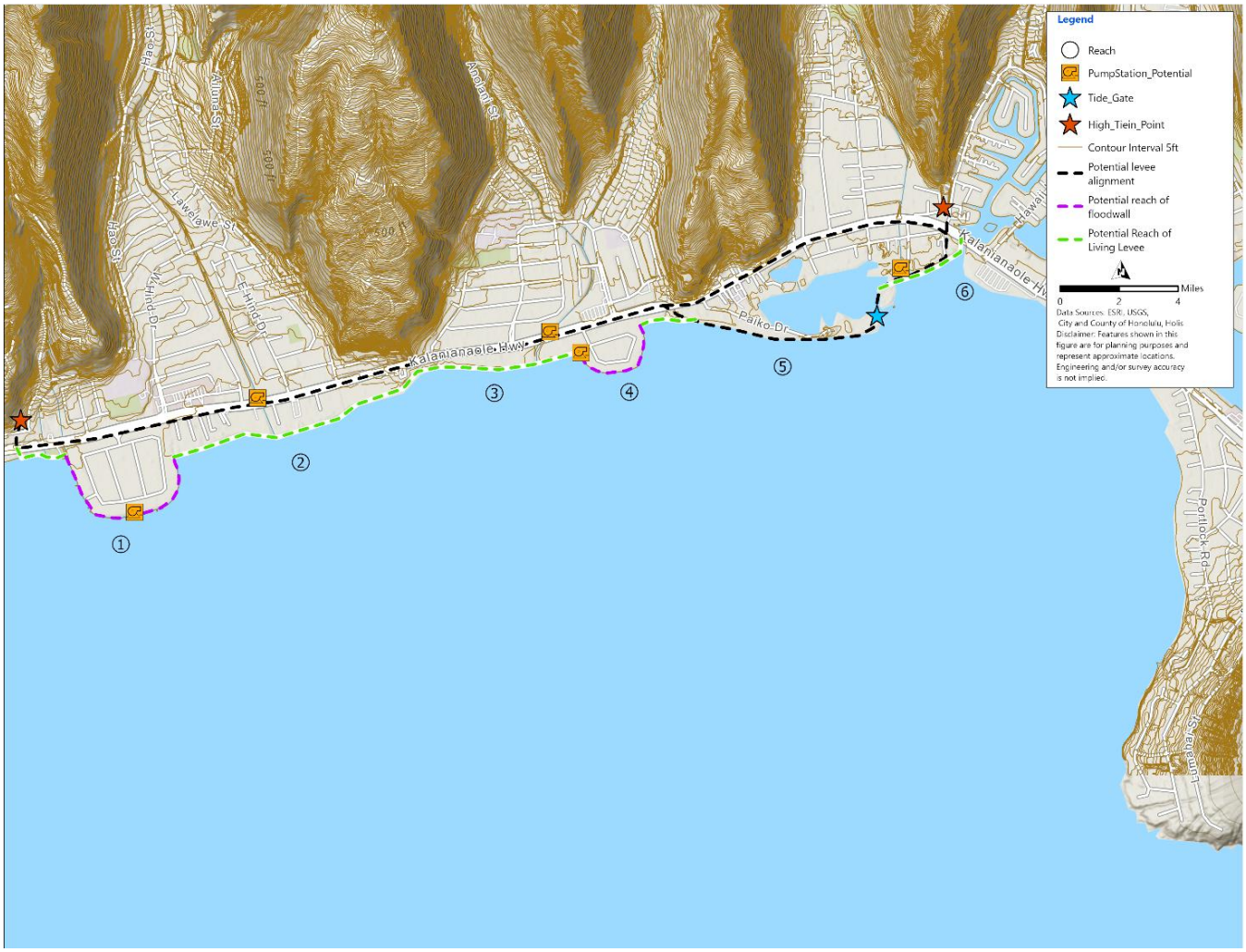


Figure 10. Potential Shoreline Adaptation Concept Locations

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Low/high/very high risk pipelines within Kalanianaʻole Hwy ROW and adjacent local streets **Wastewater:** Sewer gravity main and laterals, Kuliʻouʻou WWPS and force main, Niu Valley WWPS, Paikō Drive WWPS **Stormwater:** Various SW Conduits, catch basins, Wailupe Stream **Roads:** Kalanianaʻole Hwy, Summer St, Maunalua Ave, Bay St, local streets
Community Assets at Risk:	Kalanianaʻole Hwy, Kanewai Fishpond, Wailupe Fire Station 23, Wailupe Beach Park, Holy Nativity Private School, ʻĀina Haina Shopping Center, ʻĀina Haina Elementary School, Kawaikui Beach Park, Maunalua Bay, residential community

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** The regional-scale flood protection measure for the coastline from Wailupe Stream to Kuliʻouʻou Stream will protect Kalanianaʻole Hwy and mauka assets. Ultimately, the goal of this project is to significantly reduce the impacts from sea level rise, coastal flooding, and coastal erosion along the shoreline. **Sea Level Rise - Overland Flooding**: Impacts to the highway begin in the area of Kuliʻouʻou Stream around 3 feet of SLR (passive flooding). At 4-5 feet of SLR, there is extensive community flooding both mauka and makai of Kalanianaʻole Hwy. SLR inundation could be largely reduced in the local area by a shoreline levee, with the extent of the risk reduction depending on the levee design. **100-Year Flood:** Portions of Kalanianaʻole Hwy are within the 100-year floodplain. Wave runup and storm surge will be reduced by a shoreline protection structure such as a levee. Exact risk reduction will depend on the levee design. However, the addition of a levee may exacerbate interior drainage impacts without proper pumping. Interior drainage analysis is necessary to confirm appropriate capacity is maintained. **Hurricane:** Portions of Kalanianaʻole Hwy will be inundated by Category 1 hurricanes, particularly around Kuliʻouʻou Stream. Category 2 hurricanes are expected to impact the highway around all three streams, and Categories 3-4 hurricanes have anticipated higher surge heights and impacts further mauka of Kalanianaʻole Hwy. Hurricane risk reduction is not the primary goal of this coastal resilience structure, though some minor risk reduction benefits may be realized, particularly in reducing impacts from storm surge. **Coastal Erosion:** The highway itself is located largely outside of the future SLR erosion zones; however, coastal erosion could impact significant portions of the shoreline makai of the highway. Coastal erosion could have the downstream impact of worsening wave

energy and storm surge. Design of shoreline protection will need to consider potential negative impacts for erosion, and will need to dissipate energy through riprap, green infrastructure, or other means. Where possible, implementing green, sloped, living levees and natural shorelines along with beach nourishment would create natural sloping areas for waves to wash, reducing erosion and dissipating wave energy. A more detailed study will be necessary under specific designs to understand impacts to the coastline.

PROJECT COMPONENTS

PLAN/STUDY

The initial planning phase for this regional shoreline protection project establishes the foundational framework for long-term climate adaptation. This phase encompasses the entire stretch of coastline from Wailupe Beach Park to Kuliʻouʻou Beach Park, including the following tasks:

1. Outreach, Funding, and Organization

- Outreach: Outreach should begin early to incorporate input from the community and create awareness around the planning process.
- Funding: Raising funds for the planning phase of the shoreline adaptation will need to leverage City, State, Federal, and other sources of funding.
- Targeted Acquisitions and Partnership Agreements: Exploration of land acquisitions and partnerships with landowners such as a joint powers authority and memorandums of understanding across agencies that will benefit from this project. Determine locations where easements will be sufficient rather than acquiring land.

2. Baseline Assessment & Constraints Analysis

- Existing Conditions: Conduct comprehensive surveys of roadway elevations, current flood protection measures, and historical climate-driven impacts to beach parks and coastal infrastructure. This task will identify available footprint width by reach and candidate high-ground tie-in points at each end of the protected alignment. Existing conditions review should incorporate ENV's wet weather SSO history and the improvements planned under ENV Project #2002037 Kalanianaʻole Highway Sewer System Improvements, since areas with documented wet weather sewer surcharging are also those most sensitive to mauka-side ponding behind a levee.
- Legal & Regulatory Review: Evaluate land ownership, existing easements, special area designations, and policy constraints to streamline future land acquisition or permitting.
- Cultural & Historic Resource Inventory: Assess potential impacts to cultural sites, iwi kūpuna, and historic landmarks to fulfill regulatory requirements and honor local context.

3. Engineering, Siting, & Alternatives Analysis

- Hazard Modeling: Utilize advanced hydrodynamic modeling to assess current inundation risks and validate the flow-path and flood-reduction potential of proposed alternatives.

PROJECT COMPONENTS

- Alternatives Evaluation: Conduct a rigorous comparative analysis of potential resilience infrastructure, including levees, nature-based "living levees," and conventional seawalls, against a "do nothing" baseline.
- Infrastructure Design: Select the proposed alignment and appropriate shoreline protection measures for each reach. This task includes designing mitigation for "mauka-side" ponding, assessing the need for stormwater pumping stations, and evaluating the potential for hard armoring to exacerbate erosion in adjacent areas.
- Environmental & Resource Management: Evaluate impacts to nearshore water quality and local sediment transport patterns to support state and federal environmental permitting processes.

4. Implementation, Strategy & Engagement

- Stakeholder & Community Engagement: Organize and host public workshops, community feedback loops, and coordination with local neighborhood boards to provide transparency and receive input from a wide group of stakeholders.
- Phased Development: Establish a structured roadmap for the multi-year design and construction of flood protection assets along each reach.
- Strategic Realignment: Define clear pathways for property management tasks, including land acquisition, potential buyouts, managed retreat, and the planned transition or discontinuation of utility services for vulnerable makai developments.
- Cost-Benefit & Lifecycle Planning: Conduct a formal benefit-cost analysis (BCA) to support funding applications and develop an Operations & Maintenance (O&M) framework to assign long-term institutional responsibility for infrastructure performance.

PROGRAM

N/A

INFRASTRUCTURE

The regional shoreline protection will include a combination of grey and green infrastructure to protect East Honolulu from flooding, storm surge, and sea level rise. Utilizing Kalaniana‘ole Highway as the alignment, some portions of Kalaniana‘ole Hwy will need to be raised, and the entire highway should become the back portion of the shoreline protection measure. In some areas, such as the developed peninsulas or Paikō Lagoon, the flood protection may come out from the highway alignment and encapsulate a wider area. Where the alignment crosses Wailupe, Niu, and Kuli‘ou‘ou Streams, closure structures (tide gates or gated crossings) with associated pumping will be required to maintain continuity of protection while preserving stream conveyance. Exact alignment will be determined in the planning and design phase.

Potential Reaches:

1. Wailupe Circle
2. Wailupe to Niu Stream

PROJECT COMPONENTS

3. Niu Stream to Niuiki Circle
4. Niuiki Circle (Niu Peninsula)
5. Paikō Lagoon
6. Kuliʻouʻou Stream

Potential infrastructure elements of the regional shoreline protection include the following items and refer to Figure 10.

1. Reaches of living levees. Living levees require a 10:1 to 30:1 H:V slope, around 150 feet wide for a reach around 200-500 feet alongshore. Potential locations for living levees are existing beach parks and reaches 2, 3, and 6. Living levee construction will likely require some fill into nearshore waters.
2. Reaches of traditional levees. Significant portions of the regional adaptation project will include more traditional levee alignments using Kalanianaʻole Highway as the alignment for the structural backing of the levee.
3. Reaches of floodwall. Some portions will require a narrow footprint and may require a floodwall rather than a sloped levee. These reaches may include areas developed near the shoreline such as reaches 1 and 4.
4. Road raising along Kalanianaʻole Hwy. To ensure that the highway is high enough to be the tie-in points of the shoreline protection, along with raising local streets with intersections with the highway, the roadway should be raised to at least the BFE plus freeboard that accounts for sea level rise.
5. Pump stations will be required along the length of shoreline to remove stormwater and prevent ponding mauka of the levee. Pump stations will be required at the 3 stream outlets and any large stormwater trunk lines.
6. Stormwater storage capacity and tide gates. Locations for stormwater detention mauka of the levee, associated with the large pump stations, may be necessary to prevent ponding and increase resilience. In reach 5, the shoreline alternative makai of Paikō Lagoon could utilize the lagoon for stormwater storage, with a tide gate to control the water level inside the lagoon.

Community Benefits:

- ? Protects cultural sites
- ? Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☒ Improves water quality
- ? Improves public access to community spaces
- ? Increases public awareness/education
- ☒ Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

PROJECT COMPONENTS

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	• **Maintain safe and reliable community access** by increasing the resilience of Kalanianaʻole Highway to flooding and coastal erosion • **Improve water quality and ecosystem health** in Maunalua Bay impacted by sediment transport and stormwater runoff
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu
CRO Strategies Supported:	**#10:** Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies:	• Build a Living Levee • Restore Beach, Dune Systems, and Coastal Floodplain • Incorporate Native Vegetation / Incorporate Salt and Flood Resilient Vegetation • Incorporate or Upsize Perimeter Floodwalls or Levees
Expected Timeline:	**Potential long-term regional SLR resilience timeline:** 1. Study and plan for land-use changes and property acquisition along the entire shoreline, considering what the triggers and mechanisms should be. There will be some time before designs or decisions need to be finalized so that the plan can be flexible to what SLR impacts are actualized. 2. Shoreline protection around Kuliʻouʻou Stream. This project should begin by mid-century so that all planning phases can occur before there is realized need for the project to protect from permanent inundation. This portion of shoreline has the most immediate impacts, and is a good candidate for a hybrid green/living levee pilot solution. 3. Flood protection at the Wailupe and Niu Stream outlets may be triggered by property acquisition in those areas. These specific areas already experience impacts from a 100-year flood, and have similarly near-term SLR impacts to Kuliʻouʻou. However, since they are under private ownership, they will require first for a plan of property acquisition, and the properties must be obtained before project development can begin. Once those properties are acquired, planning and construction of flood protection, incorporating nature-based solutions if possible, should begin. 4. Flood protection at Wailupe Beach Park and Kawaikui Beach Park will be triggered by SLR. These flood protections should come before permanent inundation, but be

PROJECT COMPONENTS

triggered by higher projections and higher experienced flooding at those points along Kalaniana‘ole Highway. These locations do not require property acquisition, but they do not yet have the flooding impacts that the stream outlets experience.

5. Flood protection along the remainder of Kalaniana‘ole Hwy between Wailupe and Kuli‘ou‘ou Streams will be triggered by both higher amounts of SLR and property acquisition. The rest of Kalaniana‘ole Highway will require higher SLR before being impacted and is not in the present-day 100-year floodplain. Once projections show more certainty towards significant SLR, or those properties are obtained due to large damages or coastal erosion leading to managed retreat, then they can be converted to flood protection.

This project will likely need to be coordinated/interact with the following other projects:

- Kalaniana‘ole Highway Sewer System Improvements (ENV, Project #2002037)- first phase converts residents in the Wailupe-to-Niu area to a low pressure sewer system and re-routes the existing gravity sewer to Kalaniana‘ole Hwy to address historical wet weather SSOs, with additional sewer improvements along the highway to follow.
- OWH Project #9 Stream Restoration & Rehabilitation (East Honolulu)
- OWH Project #33 Managed Retreat Legal and Policy Feasibility Study
- OWH Project #35 Plan for Future Road Adaptations
- Potential Future Replication in other shorelines such as ‘Ewa and Ko‘olau Loa.

Triggers:

Climate Hazard: Heavy Rain and SLR

Funding: N/A

Regulatory: N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- A regional shoreline protection measure will require significant collaboration across agencies within the City, the State of Hawai‘i, and federal agencies such as USACE. This regional shoreline protection can build on the learnings from a pilot living levee, particularly with respect to collaborative and permitting processes.
- Past stream flood protection projects from USACE have been deemed infeasible. It will be important to build from ongoing efforts within Wailupe, Niu, and Kuli'ou'ou Streams from an engineering and planning perspective. Since all three streams have federal projects, any work altering or tying into them will require USACE multi-year review that should be initiated early and treated as a schedule driver.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- Additional study could be conducted to understand what improvements within the City's jurisdiction could be completed before a full shoreline project.

Additional Considerations:

It is recommended that the regional shoreline adaptation project start with a pilot living levee project. A living levee is a nature-based solution that contains a hard, engineered floodwall with a wide ecotone slope to promote wave attenuation, sand accrual, ecosystem restoration, combatting coastal erosion, and water quality improvement. A living levee will be possible on stretches of shoreline that have a wide area available. Considerations for a pilot project location include:

- Area is within the 100-year floodplain and anticipates overland flooding from SLR.
- Area has exposed One Water infrastructure; best if it also has exposed residential buildings or other community assets. For funding purposes, locations with repetitive loss properties under the National Flood Insurance Program will demonstrate a favorable BCA.
- Public ownership of available land on either side of a flood area, with high ground tie-in points on either side.

Kuliʻouʻou Beach Park is an option of a living levee site that could be the first stretch of the regional solution. Within the 14 priority hotspot areas, Waiʻanae is identified as a potential living levee site, though other suitable locations may exist around Oʻahu that were not within the priority hotspot areas.

Locations that are not feasible for a living levee are flat coastlines such as ʻEwa, locations with more riverine than coastal flooding such as Central Oʻahu, or locations with highly utilized recreational beaches, such as North Shore.

Technical Considerations:

- Beyond raising the highway, hardening may be necessary for long-term resilience. It may be necessary to mitigate negative impacts of shoreline hardening such as erosion. Shoreline setbacks may need to be put in place, increased, or more strictly enforced to enable land acquisition and construction along the shoreline. These setbacks should be put in place as early as possible so that actions can be taken in advance of design.
- Available footprint is the governing physical constraint. Much of the shoreline lacks width for a sloped levee section, which is what drives the hybrid levee/floodwall approach. Reach-by-reach footprint analysis is a prerequisite to alternatives evaluation.
- ENV's Kalanianaʻole Highway Sewer System Improvements (#2002037) will re-route gravity sewer into the Kalanianaʻole Highway corridor, the same alignment proposed here as the structural backing for shoreline protection. Coordination with ENV during their design phase is needed so that sewer profile, structure elevations, and low pressure system components account for potential future road raising, avoiding rework when shoreline protection advances.

REFERENCES

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Oro Loma Sanitary District. (2025). Palo Alto Horizontal Levee Pilot Project.

ACRONYMS

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DLNR	Hawaiʻi Department of Land and Natural Resources
DOT	Department of Transportation
DPR	Department of Parks and Recreation
HDOT	Hawaiʻi Department of Transportation
N/A	Not Applicable
O&M	Operations and Maintenance
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
USACE	United States Army Corps of Engineers
WWPS	Wastewater Pump Station

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

LONG-RANGE POST-RETREAT STUDY

PROJECT CONCEPT

GENERAL DESCRIPTION

There are coastal areas at risk of climate hazard impacts that are projected to increase in frequency and/or magnitude as climate change and sea level rise advance over time. Although not unique to the ʻEwa region, the threat of frequent or constant inundation of assets above and below ground due to sea level rise, as well as the erosion of beach and shoreline areas, necessitates adaptation planning and strategizing for this area. Should these coastal areas become impacted to the extent that the communities can no longer feasibly exist in place as they do today, managed retreat would be an extensive but potentially necessary adaptation option to implement. There are numerous legal, financial, and social implications tied to managed retreat and many changes and decisions must occur before this could be implemented on any part of the island.

This project aims to explore and study the impacts to an area if managed retreat should hypothetically occur. This study would be a first step in understanding the feasibility and impacts of managed retreat in an area before, during, and after retreat. The selection of ʻEwa does not mean that this region is the highest priority region or that it is the only region that this type of study can/should be conducted for. The ʻEwa region is proposed as a pilot/example for this type of study that focuses on one coastal area and can later be replicated for other areas facing similar climate pressures.

This proposed study will evaluate the options for using the land and infrastructure within the retreat zone. It will evaluate the potential advantages and disadvantages of abandoning all structures in place versus demolishing structures and leaving the land undeveloped versus demolishing structures and using the land for a new purpose like a green space or community park. Although there may be no community permanently inhabiting the retreat area, there may be opportunities identified in this study to gain some beneficial use out of the land and change how the natural resources in the area are utilized.

This project is meant to explore potential options and identify potential challenges and opportunities. It is not meant to be a plan for retreat, nor generate recommendations that must be acted upon. The study may suggest components of plans or policy gaps that could be further evaluated in the future, but is outside of the project scope to firmly

PROJECT CONCEPT

	develop any plan, framework, or infrastructure improvement to be implemented.
ID #:	26
Timeframe:	Long-term
Champion Agencies:	CCSR
Potential Partnerships:	DPP, DPR
Adaptation Strategy Type:	Plan/Study
Location of Project:	Pūpū St/Pūpū Pl, ʻEwa
Area Classification:	Mid-Density Communities
Hotspot:	Potentially any of the coastal hotspots in the ʻEwa region. Includes: ʻEwa Beach/Fort Weaver Rd, Pūpū St/Pūpū Pl, Kalaeloa/Campbell Industrial Park, Barbers Point Harbor, Ko ʻOlina/Mālakole Harbor, Ko ʻOlina/Farrington Hwy, Kahe Point
Congressional District:	1
Council District:	IX
Legislative District:	House District 41
Neighborhood Board:	ʻEwa
Oʻahu SoVI Index:	High



Figure 1. Aerial Map of Project Location

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** Potentially all coastal assets impacted by climate hazards and/or plans for abandonment (pipelines, wells, reservoirs, etc.) **Wastewater:** Potentially all coastal assets impacted by climate hazards and/or plans for abandonment (sewer lines, pump stations, etc.) **Stormwater:** Potentially all coastal assets impacted by climate hazards and/or plans for abandonment (drainlines, outfalls, etc.) **Roads:** Potentially all streets in the area impacted by climate hazards and/or plans for abandonment (Pūpū St, Pūpū Pl, Pohakupuna Rd)
Community Assets at Risk:	Potentially all coastal assets. Examples of assets include but are not limited to: Pōhākea Elementary School, Kaimiloa Elementary School, ʻEwa Beach Elementary School, Ilima Intermediate School, Campbell High School, ʻEwa Beach Community Park, Oneʻula Beach Park, White Plains Beach Park, Kalaeloa Beach Park, Ko ʻOlina beaches and resorts, etc.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: LOW** **Sea Level Rise (Overland Flooding):** Sea level rise is projected to increase passive coastal flooding and wave-driven inundation in this region, particularly in low-lying shoreline areas. More frequent flooding may reduce beach usability, affect public access, and increase stress on coastal infrastructure and community assets. Post-retreat planning allows coastal land use to be informed by sea level rise projections and reduce risk of overland flooding. **Sea Level Rise (Groundwater):** Rising sea levels are expected to elevate groundwater levels, resulting in emergent groundwater and groundwater inundation in vulnerable areas. Elevated groundwater can contribute to chronic flooding, reduce drainage effectiveness, and impact coastal infrastructure and natural systems. Post-retreat planning allows coastal land use to be informed by sea level rise projections and reduce risk of groundwater inundation. **Coastal Erosion:** Coastal erosion threatens the long-term stability of the shoreline by narrowing beaches and increasing the vulnerability of coastal resources to flooding and wave impacts. Continued shoreline retreat may limit public access, reduce recreational opportunities, and degrade coastal habitats. Post-retreat planning allows coastal land use to be informed by coastal erosion projections and to slow erosion. **Drought:** There is concern for long-term aquifer recharge and potable water supply for this area. Drought may contribute to the long-term infeasibility of maintaining communities in this area, regardless of proximity to the coast. However, sea level rise

and other hazards impacting water infrastructure in coastal areas may exacerbate water supply concerns caused by drought conditions. Post-retreat planning can prioritize drought-resistant and low water demand landscapes.

PROJECT COMPONENTS

PLAN/STUDY

This study will define several theoretical scenarios of what post-retreat options could be implemented in ʻEwa region coastal areas assuming that managed retreat inland has occurred. The focus would not be on when or how to implement retreat but rather what would happen to the area after retreat. The list of broad options for using the retreated land may include, but is not limited to, abandoning all properties and infrastructure and leaving the land unused; demolishing infrastructure and leaving the land unused; and demolishing infrastructure and developing the land for some other purpose. The study will provide options for safe uses of the land depending on the extent of inundation and/or erosion, which could include shoreline protection measures, vegetated green spaces for runoff management, new recreational spaces, etc.

PROGRAM

N/A

INFRASTRUCTURE

This study will likely produce recommendations for changes to infrastructure for consideration, but implementation of those improvements will require the need (retreat to actually occur) and an infrastructure project that follows this project.

Community Benefits:

- ☐ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☐ Increases community flood protection
- ☐ Improves water quality
- ☒ Improves public access to community spaces
- **?** Increases public awareness/education
- **?** Provides ecosystem restoration
- ☒ Enhances recreational benefits
- ☐ Other:

Note:

An “X” noted in the box represents a community benefit that is a key component or driver of the project.

PROJECT COMPONENTS

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	• Enhance awareness of flooding risks to residents • Proactively plan to protect communities and the environment
OWH Objectives Supported:	• Practice a shared kuleana for a climate resilient Oʻahu • Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies • Amplify the voices of Oʻahu's people through meaningful stakeholder engagement
CRO Strategies Supported:	**#9**: Integrate climate resilience into City capital planning, operations, and policies
Relevant Adaptation Strategies:	• Incorporate Non-Structural Hazard Mitigation Measures (e.g., watershed/district scale communication network, public education) • Timeline for City to Provide Services to Private Property at Risk of SLR • Public Infrastructure Services Adaptation Phasing Study for Permanent SLR Flooding • Pre-disaster Recovery and Redevelopment Plan • Study most effective responses to rising groundwater • Area Adaptation Plan
Expected Timeline:	This project examines the theoretical scenario where sea level rise and other coastal hazards have already triggered managed retreat as the desired adaptation strategy for the area. While the actual occurrence of threats to that extent would need to occur for the options in this study to be implemented, this study should be completed well in advance of managed retreat actually occurring. Not only does a study/preliminary planning for the retreat need to happen long before retreat is deemed necessary, planning for use of the retreated land should also be considered at the same time as retreat planning. In the near-term, the OWH Project #33 Managed Retreat Legal and Policy Feasibility Study should be completed, as it directly addresses the considerations and decisions that need to be made before managed retreat could feasibly occur. That study should be used to inform this project, as the review of policies and legal implications of retreat can inform the potential allowable uses of the retreated areas, who would be responsible for planning and implementing retreat, what climate hazard triggers would need to be met to facilitate retreat, etc. While this project should be completed proactively to prepare for the potential of managed retreat at some point in the future, there are many existing and potential projects that address resilience strategies for addressing these same climate hazards

PROJECT COMPONENTS

without having to implement managed retreat. These projects or projects of a similar nature should be implemented before managed retreat is considered a realistic option for any part of the island, including the OWH projects listed below that detail coastal adaptation studies/measures that could reduce the need for retreat. Although some of these projects are specific to a region, the adaptation options presented could apply to the ʻEwa region where applicable to improve the resilience of the coastal areas prior to retreat.

- OWH Project #8 Regional Shoreline Adaptation in East Honolulu
- OWH Project #19 Raise main arterials further inland (in ʻEwa)
- OWH Project #53 Coastal Management Plan for Erosion and Flooding (in Koʻolau Poko)

Triggers:

Climate Hazard: SLR

Funding: N/A

Regulatory: N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:

- Significant progression of climate hazards and significant planning and coordination would have to occur before managed retreat can be considered a realistic adaptation strategy, therefore the opportunity to implement any options presented in this study may or may not occur within the planning horizon of this OWH Plan as established currently.
- A significant funding source would be necessary to demolish infrastructure. Abandoning infrastructure may have associated costs and/or the loss of revenue for certain agencies as well.
- A significant amount of coordination would need to occur between City, State, and private entities to successfully coordinate the retreat while still maintaining key services such as water and sewer to both the new and existing developments while the retreat is taking place. Services would need to be maintained in an area until all users have permanently moved elsewhere.
- Would abandoning structures lead to illegal uses of the structure or other criminal activity in the area?
- If the retreat area is converted to some other use, how can the area or new facility be maintained safely and reliably if frequent or constant inundation is impacting the area?

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

- How will the use of the retreat area be decided? Will the public be involved in that decision making process?

REFERENCES

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ACRONYMS

CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready O‘ahu
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
N/A	Not Applicable
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI Index	Social Vulnerability Index

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

RAISE MAIN ARTERIALS FURTHER INLAND

PROJECT CONCEPT

GENERAL DESCRIPTION	There are coastal areas in the ʻEwa region at risk of climate hazard impacts that are projected to increase in frequency and/or magnitude as climate change and sea level rise advances over time. Although not unique to the ʻEwa region, the threat of extreme events like hurricanes, frequent or constant inundation of assets above and below ground due to sea level rise, as well as the erosion of beach and shoreline areas necessitates adaptation planning and strategizing for this area. This project includes a preliminary climate hazard impact study to identify and characterize potential flooding and drainage issues in the area that would impact the use of roadways. This study should identify which roadways are most critical and highly used and which roads are most vulnerable to flooding and/or coastal erosion. Finally, the study should identify and propose adaptation strategies to address critical roads at elevated risk of hazard impacts, with an emphasis on road raising as a potential strategy. This study will not only address potential impacts to roadways near the coast, but also roadways further inland that could be impacted by flooding from a 100-year storm or other extreme event that can cause inland flooding. After the study is completed, planning and construction of potential infrastructure improvements proposed by the study should be implemented to improve drainage and mitigate impacts from flooding. Should raising arterials be identified as a recommended and feasible strategy, planning, and coordination efforts in accordance with the OWH Project #35 Road Raising Strategy should be done in order to facilitate the raising of the selected roads and associated utilities.
ID #:	19
Timeframe:	Long-term
Champion Agencies:	DTS
Potential Partnerships:	BWS, ENV, DFM, CCSR, DPP, DDC

PROJECT CONCEPT

Adaptation Strategy Type:	Infrastructure
Location of Project:	ʻEwa and ʻEwa Beach
Area Classification:	Mid-Density Communities
Hotspot:	Pūpū St/Pūpū Pl
Congressional District:	1
Council District:	IX
Legislative District:	House District 41
Neighborhood Board:	ʻEwa
Oʻahu SoVI Index:	High



Figure 1. Aerial Map of Project Location

PROJECT CONCEPT

Infrastructure Assets at Risk:

Water: Coastal water lines in City ROW

Wastewater: Coastal sewer lines in City ROW

Stormwater: Roadway drainage infrastructure

Roads: Coastal roadways

Community Assets at Risk:

One‘ula Beach Park, coastal access roads/pathways to beach parks, community spaces, residential and commercial areas within flood plain.

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:

Climate Resilience: HIGH

100 Year Flood: Raising or relocating roadways subject to inundation during a 100-year flood event would provide some benefit related to temporary flooding, but this hazard would not be the trigger to raise roadways due to the inherit occurrence frequency.

Hurricane: Complete inundation up to 3 feet under Category 2 conditions. Heavy rainfall and flooding may exceed the capacity of existing drainage facilities, leading to roadway flooding and reduced access along Pūpū Place/Pūpū Street and local roads. Raising roadways provides a limited solution to hurricane flood risks by keeping evacuation routes accessible and allows first responders a pathway.

Tsunami: Located within the tsunami evacuation zone. Tsunami flooding could affect local roads and drainage infrastructure. Tsunami risk can be reduced by relocating emergency routes outside of the evacuation zone.

Sea Level Rise (Above Ground): There is an 80% probability of passive flooding at 7 feet of SLR. Raising roads above SLR inundation is a long-term solution, depending on the raised height of the roadway and depth of sea level rise. Adaptation would be a permanent solution if the roadway is moved out of the coastal area susceptible to SLR. The goal will be to raise critical roadways above projected SLR inundation over the selected planning horizon. Alternatively, where appropriate, roads and adjacent areas may be able to be protected with shoreline hardening solutions, such as floodwalls/berms/dikes, that benefit areas subject to SLR inundation beyond the road subject to flooding itself as long as rising groundwater is not present or can be mitigated.

Sea Level Rise (Groundwater): Raising roadways above groundwater is a long-term solution, depending on the pace and magnitude of sea level rise and groundwater rise. Adaptation would be a permanent solution if roadways are moved out of the nearshore area susceptible to shallow groundwater rise. The goal will be to raise highway subsurface above the high groundwater table. Alternatively, targeted groundwater

pumping to reduce groundwater levels may be a solution that could benefit structures along and surrounding the roadways at risk of groundwater inundation.

Coastal Erosion: Coastal areas in ʻEwa like Pūpū Place and Pūpū Street are very near to the coast line and are susceptible to coastal erosion. Elevating roadways is not a solution for coastal erosion. Coastal erosion may be a primary trigger to adapt a roadway, likely leading to realignment or shoreline hardening as potential adaptations. Adaptation should be a permanent solution if coastal erosion is the primary trigger to adapt a roadway. The goal will be to move the roadway out of the eroding area and to reduce or slow coastal erosion. Coastal erosion could still affect roadways with raised elevation, and without additional regional adaptation to reduce erosion, raising roadways alone would not be sufficient.

PROJECT COMPONENTS

PLAN/STUDY

Based on the results of the OWH Project #35 Road Raising Strategy study, apply findings to assess main arterials in ʻEwa. Determine timing of impacts from overland and groundwater flooding. This assessment will inform the prioritization of different areas or stretches of roadways with the highest risk of damage or inundation from SLR. Additionally, roads should be classified by their criticality, particularly if they are access routes, major connectors, or bus routes.

PROGRAM

N/A

INFRASTRUCTURE

Implement roadway raising as identified from the study with the use of findings from the OWH Project #35 Road Raising Strategy study. Guidance on road raising design guidelines will be available and will be applied to the selected roads from the study. This portion is anticipated to require being led or receiving significant support from DDC or other agencies that are able to implement design and construction projects.

PROJECT COMPONENTS

Community Benefits:

- ☐ Protects cultural sites
- ☐ Incorporates living and traditional Hawaiian practices
- ☒ Increases community flood protection
- ☐ Improves water quality
- ☒ Improves public access to community spaces
- **?** Increases public awareness/education
- ☐ Provides ecosystem restoration
- ☐ Enhances recreational benefits
- ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:

- Maintain critical water infrastructure to provide reliable service to residents and adequate drainage of streets.
- Enhance awareness of flooding risks to residents.
- Proactively plan to protect communities and the environment.

OWH Objectives Supported:

Enhance and sustain coordination to recognize interconnections and to co-create and implement projects and strategies

CRO Strategies Supported:

#11: Reduce flood risk and coastal erosion by directing development to safer and higher ground

Relevant Adaptation Strategies:

- Relocate or Abandon Facility
- Elevate Access Road and Associated Utilities
- Incorporate Groundwater Seepage Barrier
- Public Infrastructure Services Adaptation Phasing Study for Permanent SLR Flooding
- Stabilize Roadbeds and Protect Roadbed Integrity
- Resilient Roadway Design Guidelines
- Purchase of Development Rights
- Pilot Study on the Use of an Adaptive Design Process (for Highways)

PROJECT COMPONENTS

	• Adapting Infrastructure for SLR
Expected Timeline:	**Near-term:** Completion of OWH Project #35 Road Raising Strategy that will create a framework for identifying target flood elevation triggers for raising roadways, standard details, and guidance for design details on feasible adaptation strategies. This will inform the ʻEwa-specific study outlined in this project. **Long-term:** Fund and implement the adaptation strategies and infrastructure improvements recommended by this project and OWH Project #35 Road Raising Strategy if road raising is identified as a desirable option.
Triggers:	**Climate Hazard:** SLR **Funding:** Implementation of infrastructure improvements may be advanced when sufficient funding becomes available. **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Roadway ROWs contain many utilities including gravity mains for sewer and stormwater. Redesign of these gravity systems will be necessary and may be costly, particularly if new elevations require pump stations and force mains. • Miami experienced lawsuits from homeowners due to the increased flooding experienced on private property along raised roads. Public support and accessibility may be a challenge for roads that will be raised above the grade of homes or properties.
Additional Considerations:	• Potential to propose resilient street design guidelines, particularly for new roadway construction and having design elevations that account for SLR, shallow groundwater rise, and coastal erosion. • Explore tools such as improvement districts, cost-sharing mechanisms, and incentives or rebates for affected private property interfaces. Adaptation will likely require easements and cause impacts to private properties.

REFERENCES

Harris, A. (2021). Miami Beach is raising roads for sea rise. Lawsuits say they're causing flooding too. WUSF. https://www.wusf.org/environment/2021-11-13/miami-beach-is-raising-roads-for-sea-rise-lawsuits-say-theyre-causing-flooding-too

One Water Honolulu. (January, 2026). Project Development Workshops.

ACRONYMS

BWS	Board of Water Supply
CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPP	Department of Planning and Permitting
DTS	Department of Transportation Services
ENV	Department of Environmental Services
OWH	One Water Honolulu
ROW	Right-of-Way
SLR	Sea Level Rise
SoVI	Oʻahu Social Vulnerability Index
WW	Wastewater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

DRY FLOOD PROOF WAIʻANAE HIGH RISK AREAS

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes dry floodproofing and elevation of critical aboveground assets within the Pōkaʻī Bay Street hotspot area, as well as the greater Waiʻanae area, to reduce risks from flooding, tsunami, hurricane, and sea level rise hazards. Relevant assets include emergency infrastructure such as schools as well as police and fire stations. Improvements are intended to increase the resilience of community facilities and critical infrastructure and support continued service during hazard events.
ID #:	132
Timeframe:	Long-term
Champion Agencies:	DDC, BWS, ENV, DFM
Potential Partnerships:	N/A
Adaptation Strategy Type:	Infrastructure
Location of Project:	Pōkaʻī Bay St./Waiʻanae
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Pōkaʻī Bay St.
Congressional District:	2
Council District:	I
Legislative District:	House District 45

PROJECT CONCEPT

Neighborhood Board:	Waiʻanae Coast Subdistrict 1
Oʻahu SoVI Index:	High

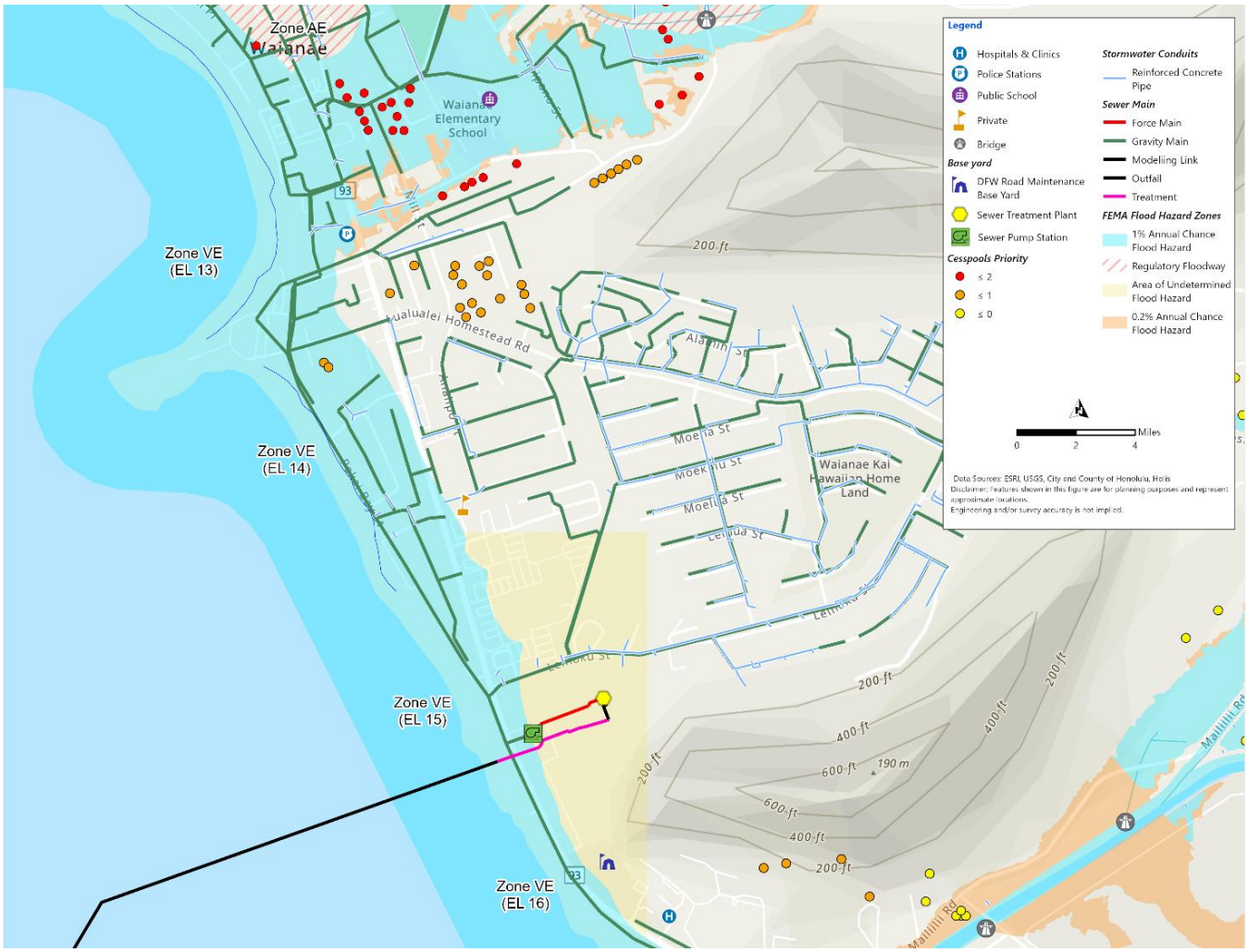


Figure 1. Waiʻanae Flood Hazard Map

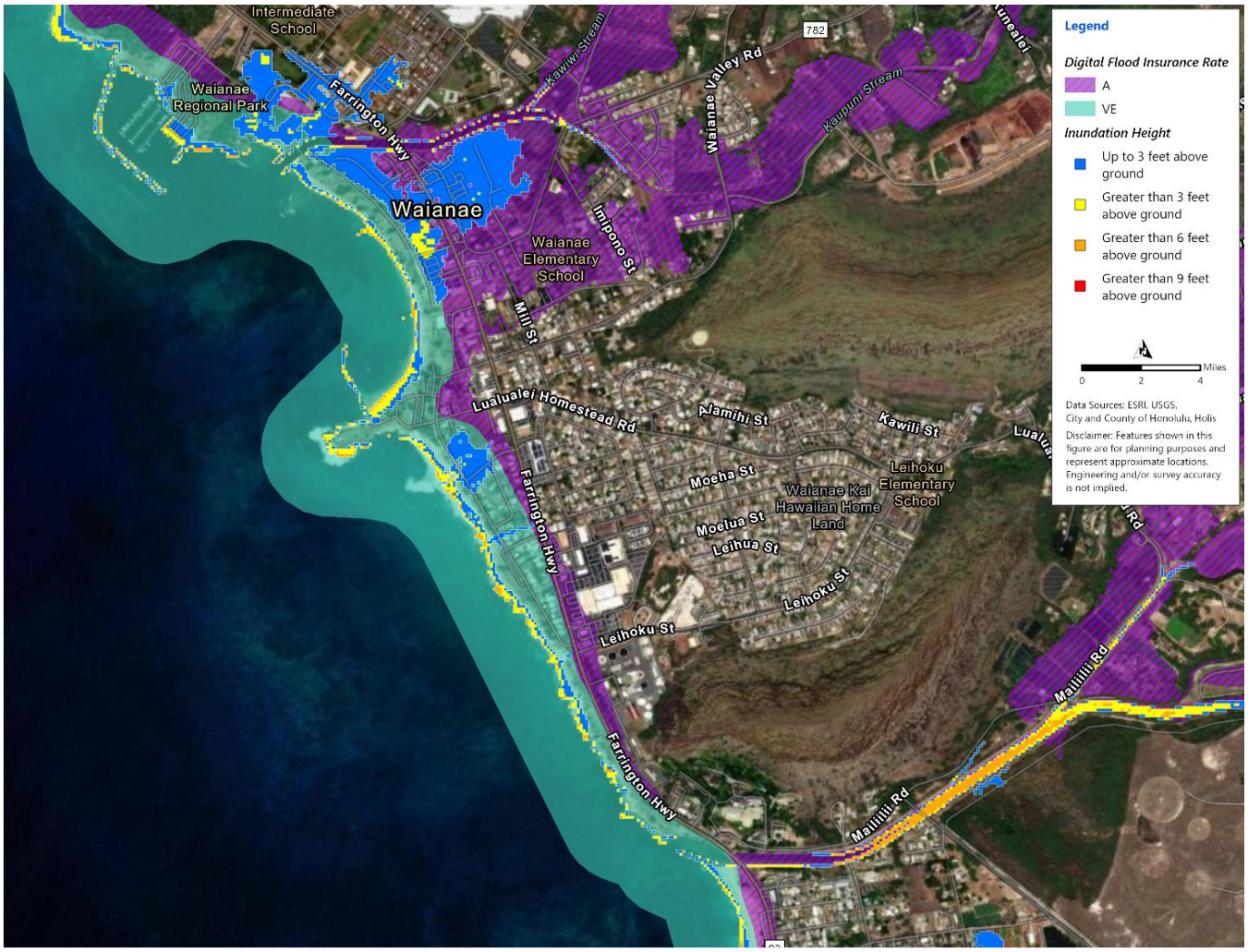


Figure 2. 100-Year Storm and Category 3 Hurricane Inundation Height



Figure 3. Tsunami Evacuation Zone

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** 10-in/12-in/36-in sewer mains **Stormwater:** 18-in/24-in/30-in SW conduits **Roads:** Farrington Hwy, Pōkaʻī Bay St.
Community Assets at Risk:	Within the Pōkaʻī Bay St. hotspot area: Pōkaʻī Bay, Kuilioloa Heiau, Adventist Mālama Elementary School, Waiʻanae Police station

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **Sea Level Rise - Overland Flooding:** Impacts begin at approximately 1 foot of SLR and include coastal erosion and increased flooding. Rising sea levels may affect high-risk buildings and community assets near Pōkaʻī Bay, including schools, public facilities, and other critical assets. At 4 feet of SLR, there is an 80% probability of passive flooding. Dry flood proofing can reduce the risk from temporary inundation, but will not be a solution to permanent inundation or access lost to assets. **100-year Storm:** Partial inundation. Dry flood proofing assets may reduce their risk from coastal and riverine flooding from the 100-year storm. **Hurricane:** Complete inundation up to 3 feet under Category 3 conditions. Flooding during major storm events may affect high-risk buildings, community assets, Farrington Highway, and Pōkaʻī Bay Street. Dry flood proofing assets may reduce their damage from hurricane-induced flooding. **Tsunami:** Located within the tsunami evacuation zone. Tsunami flooding may affect community assets, including the Adventist Mālama Private Elementary School and Waiʻanae police substation, as well as Farrington Highway and Pōkaʻī Bay Street. Flooding may disrupt access to these facilities. Dry flood proofing assets may reduce their damage from inundation, though the structural loading will have to be assessed.

PROJECT COMPONENTS

PLAN/STUDY

1. High Risk Areas/Asset Assessment

- Identify community assets located within flood hazard areas, including schools and emergency services facilities.
- Review potential risks from sea level rise, 100-year flooding, hurricanes, and tsunami events.
- Identify assets that may benefit from dry floodproofing and/or elevation.

2. Alternatives Analysis

- Evaluate potential dry floodproofing measures for vulnerable community assets.
- Develop conceptual options for protecting or elevating critical assets.
- Compare alternatives and identify opportunities to reduce flood-related impacts.

PROGRAM

N/A

INFRASTRUCTURE

1. Asset Protection Planning

- Prioritize community assets for floodproofing or elevation.
- Develop planning-level recommendations for future implementation. Identify implementation priorities and phasing needs.

2. Asset Protection Improvements and Implementation.

- Implement selected dry floodproofing measures for community assets within high risk areas.
- Elevate critical assets/buildings where appropriate.
- Improve the resilience of schools, emergency services facilities, and other community assets located within flood hazard areas.

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☒ Improves public access to community spaces ☐ Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve infrastructure to effectively manage wastewater and stormwater flows Respect and support Native Hawaiian culture and traditional practices reliant on healthy land and water resources
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Enhance coordination and recognize interconnections to develop and implement projects and strategies Work together to leverage resources and enable climate readiness
CRO Strategies Supported:	**#10**: Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies	• Elevate Access Road and Associated Utilities • Elevate Critical Assets/Equipment • Dry Floodproof the Building/Asset/Utility (e.g., seal windows, doors, vents, drainage systems, manholes) • Incorporate Flood/Submersible Pumps for Surface Water or Groundwater • Elevate Site Grade • Elevate Occupied Spaces Above Flood Elevations (e.g., second floor) • Raise Building Ground Floor Elevation

PROJECT COMPONENTS

Expected Timeline:	This project includes project component that may depend on studies such as OWH Project #132 Dry Flood Proof Waiʻanae High Risk Areas and #145 Mākaha Roads Drainage Study and Improvements. The studies should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the mid-term timeframe. Implementation may be advanced if community assets such as schools, emergency services facilities, and other critical facilities experience repeated flooding or increased exposure to coastal inundation. Flooding of Farrington Highway and loss of access to critical facilities may also trigger implementation.
Triggers:	**Climate Hazard:** SLR, Heavy Rain **Funding:** Implementation of drainage improvements may be advanced when sufficient funding becomes available. **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Some community assets may experience flooding from multiple hazard types, requiring different protection approaches. Facility access during flood, hurricane, and tsunami events, as well as the effectiveness of floodproofing measures under future sea level rise conditions, may also present challenges. • There is potential for road closures due to sand and/or debris from storm events and hurricanes.
Additional Considerations:	• Future improvements should consider the flood exposure of community assets within the Pōkaʻī Bay area, including schools, public facilities, and emergency services facilities. Dry floodproofing and asset elevation measures should be evaluated based on projected impacts from sea level rise, 100-year storm events, hurricanes, and tsunamis. • Future improvements should also consider the area's location within the tsunami evacuation zone, the potential for increased flooding under future sea level rise conditions, potential community displacement associated with long-term coastal inundation.

REFERENCES

None.

ACRONYMS

BWS	Board of Water Supply
CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
ENV	Department of Environmental Services
Hwy	Highway
N/A	Not Applicable
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

MĀKAHA ROADS DRAINAGE STUDY AND IMPROVEMENTS

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes a drainage study focused on local roads in Mākaha to evaluate stormwater drainage needs and identify potential improvements. The study will support the development of stormwater infrastructure solutions to increase drainage capacity and reduce flooding impacts on local roads. Project implementation may include construction of selected drainage improvements identified through the study, such as new or upgraded storm drains, catch basins, and related drainage facilities, with final infrastructure components to be determined based on study findings.
ID #:	145
Timeframe:	Long-term
Champion Agencies:	DFM
Potential Partnerships:	DTS, DDC (may implement design and construction)
Adaptation Strategy Type:	Infrastructure (Plan/Study at the beginning)
Location of Project:	Mākaha
Area Classification:	Critical Linear Network Corridor
Hotspot:	Mākaha Stream/Farrington Highway
Congressional District:	2
Council District:	I
Legislative District:	House District 45

PROJECT CONCEPT

Neighborhood Board:	Waiʻanae Coast Subdistrict 2
Oʻahu SoVI Index:	High

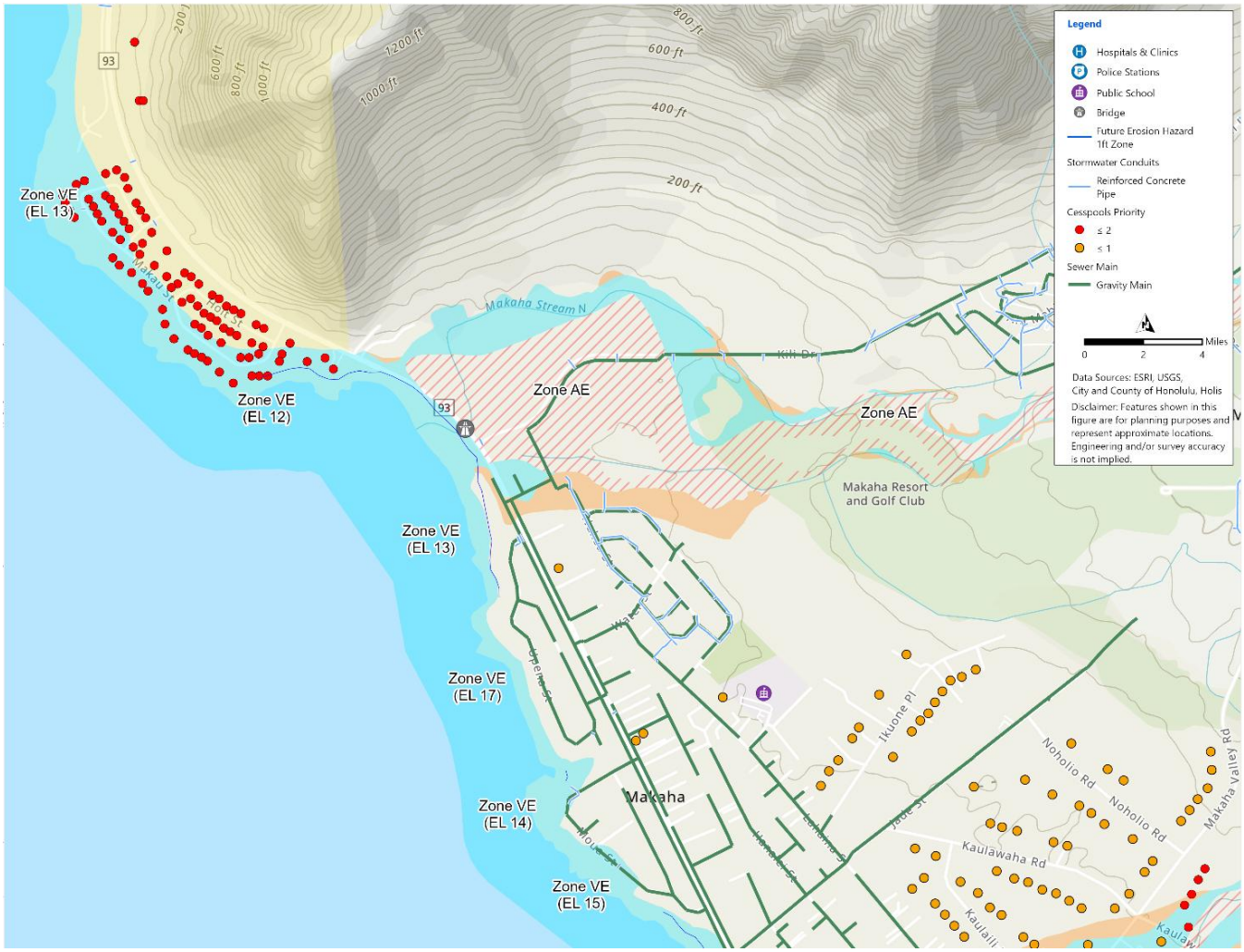


Figure 1. Mākaha Hazards Map

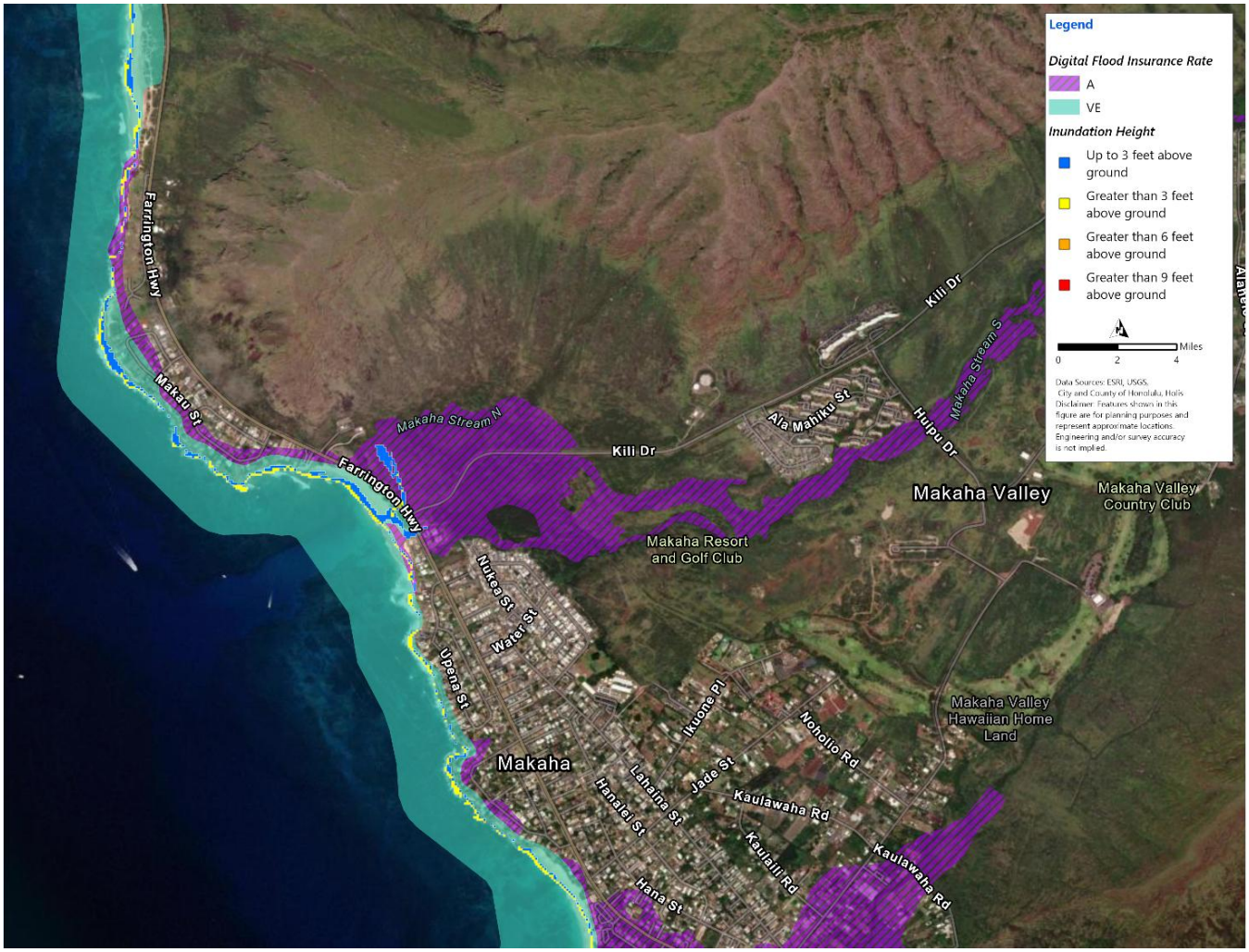


Figure 2.100-Year Storm and Category 2 Hurricane Inundation

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High priority water lines **Wastewater:** 10-in/12-in/15-in/18-in 30-in sewer mains **Stormwater:** 18-in/24-in/42-in/48-in/54-in/60-in SW conduits, Mākaha Stream North & South, Keaʻau Stream **Roads:** Farrington Hwy, Mākaha #3A Bridge, Mākaha #3 Bridge, Farrington Hwy/Waikomo Stream bridge
Community Assets at Risk:	Mākaha Beach Park, cesspools, nearby Mākaha Public Elementary School, nearby Mākaha Community Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **Hurricane:** Complete inundation up to 3 feet under Category 2 hurricane conditions, mid-term threat. Heavy rainfall and flooding may exceed the capacity of existing drainage facilities, leading to roadway flooding, reduced access along Farrington Highway and local roads, and impacts to nearby community assets. Extreme precipitation and other rainfall-induced flooding will be the primary focus of improved roadway drainage. **100-year Storm:** Partial inundation. Extreme precipitation and other rainfall-induced flooding will be the primary focus of improved roadway drainage. **Extreme heat:** Extreme afternoon heat. May stress vegetation and reduce green space benefits that help manage runoff and erosion. Green stormwater infrastructure solutions may have heat reduction benefits.

PROJECT COMPONENTS

PLAN/STUDY

Drainage assessment, stormwater infrastructure evaluation, identification and prioritization of local road drainage improvements, including storm drains, catch basins, drainage outlets, detention/retention features, and related facilities, planning-level cost, phasing, and implementation recommendations.

1. Existing Conditions and Drainage Assessment

- Evaluate existing stormwater drainage conditions along local roads in Mākaha.
- Identify drainage deficiencies, capacity constraints, and locations vulnerable to flooding.
- Assess existing stormwater infrastructure, including storm drains, catch basins, and related drainage facilities.

2. Stormwater Improvement Alternatives

- Identify and evaluate potential improvements to address stormwater drainage needs and increase drainage capacity along local roads.
- Develop conceptual alternatives for new or upgraded storm drains, catch basins, and other related stormwater infrastructure.
- Compare potential improvement options and their ability to reduce flooding impacts.

PROGRAM

N/A

INFRASTRUCTURE

1. Infrastructure Improvement Planning

- Prioritize recommended stormwater infrastructure improvements.
- Develop planning-level implementation recommendations to support future project development and construction.
- Advance selected improvements into design and permitting. Establish project phasing and implementation priorities.

2. Infrastructure Improvements Implementation

- Implement selected drainage improvements identified through the study.
- Construct new or upgraded storm drains, catch basins, drainage outlets, detention/retention features, and related facilities, as appropriate.
- Improve drainage capacity and reduce flooding impacts along local roads.

PROJECT COMPONENTS

Community Benefits:	☒ Protects cultural sites ☐ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☒ Improves public access to community spaces ☒ Increases public awareness/education ☐ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Reduce flood impacts to Farrington Highway and Mākaha Beach during heavy rains/coastal inundation Address sedimentation and soil deposit challenges within Mākaha Stream to decrease flooding risks Maintain access for emergency services along Mākaha roads
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Develop a unified roadmap and decision making process under a One Water approach Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#10**: Make buildings, homes, and infrastructure more climate resilient
Relevant Adaptation Strategies	• Elevate Access Road and Associated Utilities • Stormwater Capture and Use • Distribution System Resilience • Modify Site Drainage, Storage, and Infiltration • Drainage System Plan • Upsize Stormwater Drainage Capacity or Sanitary Sewer Capacity

PROJECT COMPONENTS

	• Implement Low Impact Design (LID)/Green Infrastructure Stormwater Management Strategies
Expected Timeline:	This project includes a study and programmatic component that may lead to infrastructure projects such as OWH Projects #130 Increase Green Infrastructure and Green Space and #141 Mākaha Stormwater Infrastructure. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the mid-term timeframe. The project may be implemented sooner if repeated flooding of local roads, Farrington Highway, stream crossings, or community assets occurs during major storm events, or if sea level rise results in more frequent inundation and drainage system limitations.
Triggers:	**Climate Hazard:** Heavy Rain, SLR. **Funding:** Implementation of drainage improvements may be advanced when sufficient funding becomes available. **Regulatory:** TMDL priority in Mākaha Beach is currently low but existing impairments (total nitrogen, chlorophyll-a, ammonium ion, and turbidity) could lead to future TMDL development.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Recurring pluvial flooding, limited drainage capacity, and the need to improve conditions along Farrington Highway and local roads may complicate identification of effective drainage solutions.
Additional Considerations:	• Future drainage improvements should consider existing drainage limitations, flooding along local roads, and interactions with Mākaha Stream and Keaau Stream. Improvements should also support continued access along Farrington Highway and other key community roadways during storm events. • Existing sewer mains, water lines, stormwater conduits, stream bridges, and nearby community assets, including Mākaha Beach Park, Mākaha Elementary School, and the Mākaha Community Park, may affect future improvement options.

REFERENCES

2024 State of Hawai‘i Water Quality Monitoring and Assessment Report, The Hawai‘i State Department of Health, Clean Water Branch, April, 2024 https://health.hawaii.gov/cwb/files/2024/09/IR-2024-final-draft.pdf

ACRONYMS

CRO	Climate Ready Oʻahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DTS	Department of Transportation Services
LID	Low Impact Development
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
TMDL	Total Maximum Daily Load

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

MĀKAHA STORMWATER INFRASTRUCTURE

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes stormwater infrastructure improvements in the Mākaha area to support watershed health, mitigate wildfire risk, and manage flooding. The project is separate from the local road drainage study and improvements identified in OWH Project #145 Mākaha Roads Drainage Study and Improvements and is intended to increase community flood protection and improve water quality.
ID #:	141
Timeframe:	Long-term
Champion Agencies:	DFM
Potential Partnerships:	DPR, DDC (may implement design and construction)
Adaptation Strategy Type:	Infrastructure
Location of Project:	Mākaha
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Mākaha Stream/Farrington Highway
Congressional District:	2
Council District:	I
Legislative District:	House District 45
Neighborhood Board:	Waiʻanae Coast Subdistrict 1
Oʻahu SoVI Index:	High

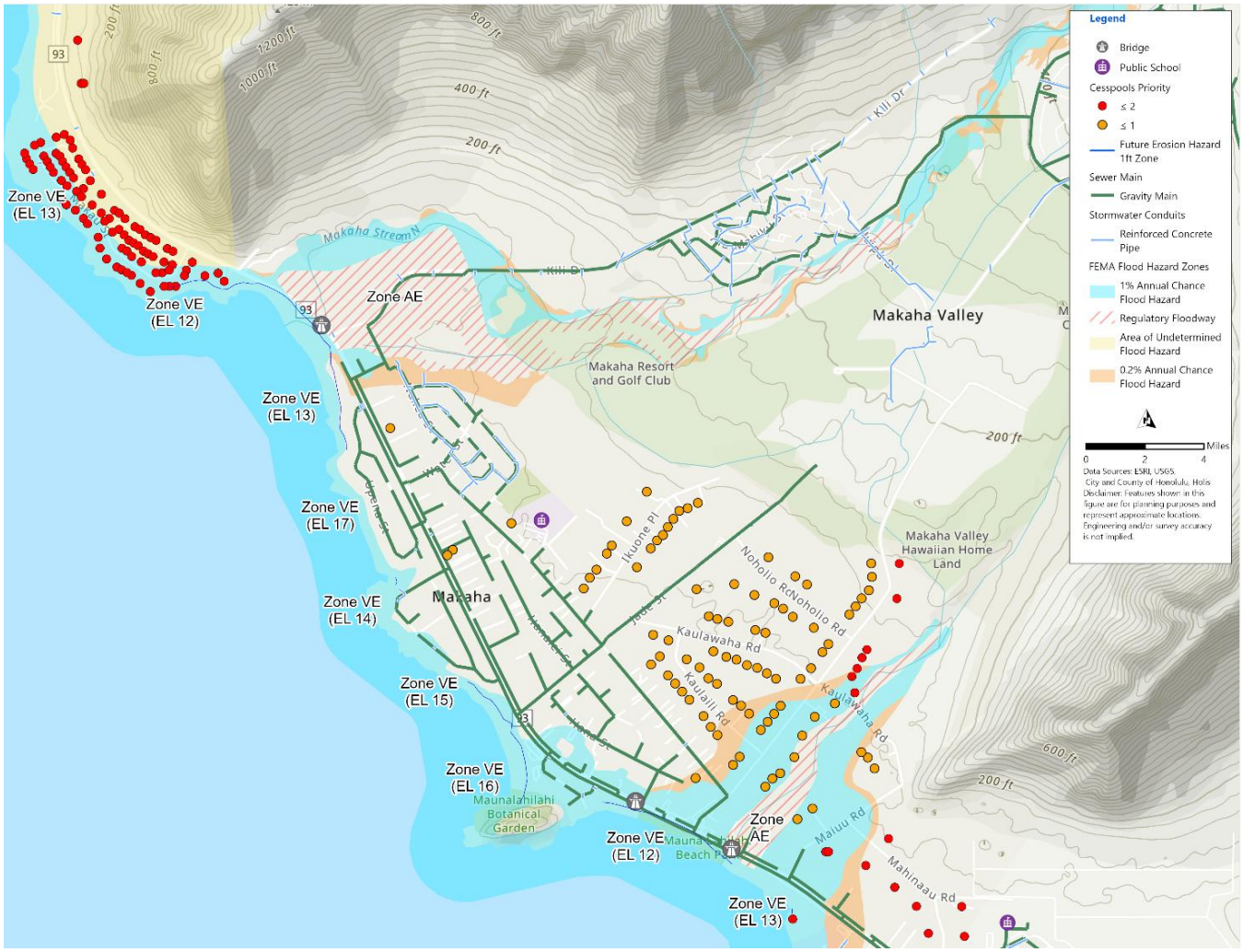


Figure 1. Waiʻanae Hazards Map

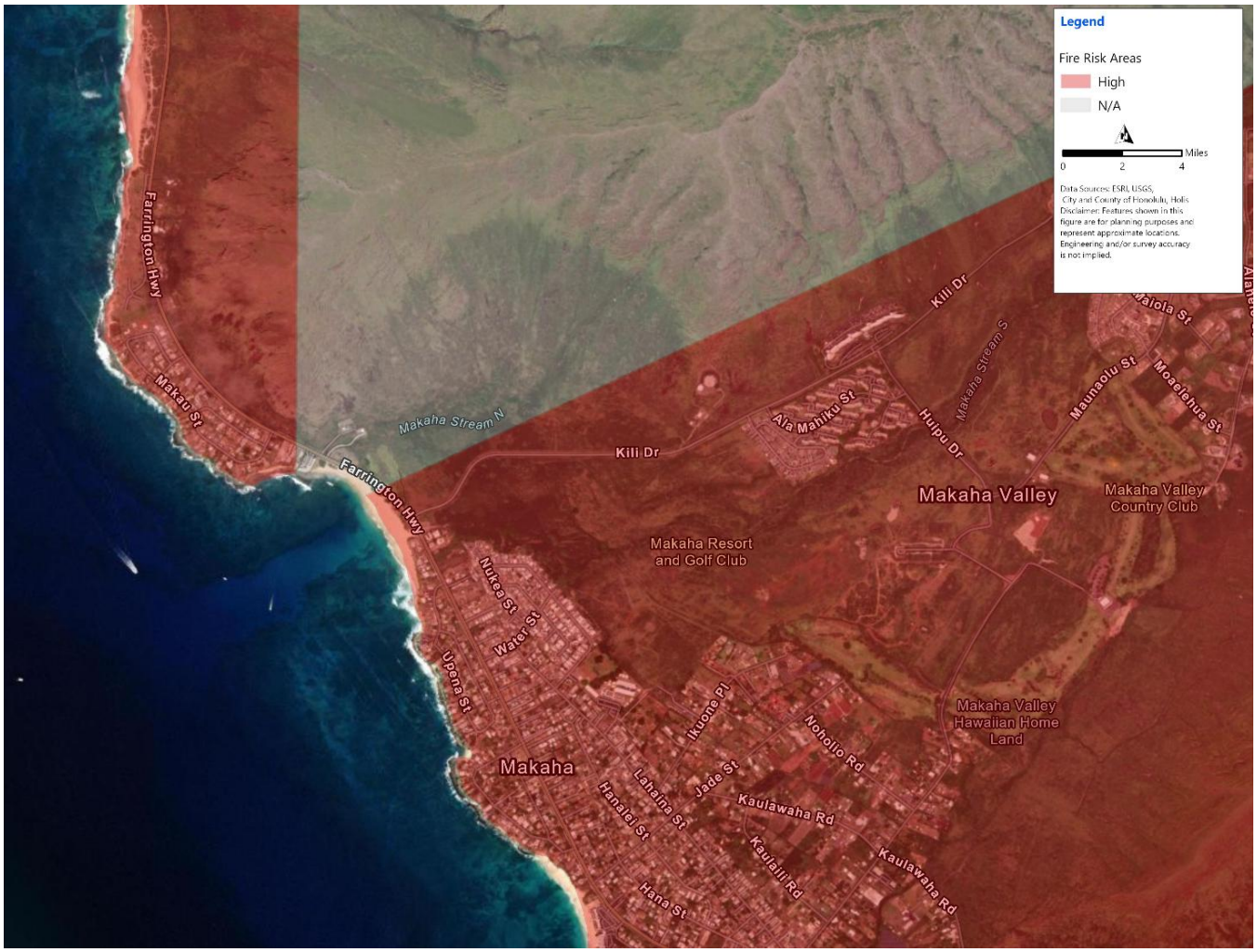


Figure 2. Wildfire Map for Mākaha

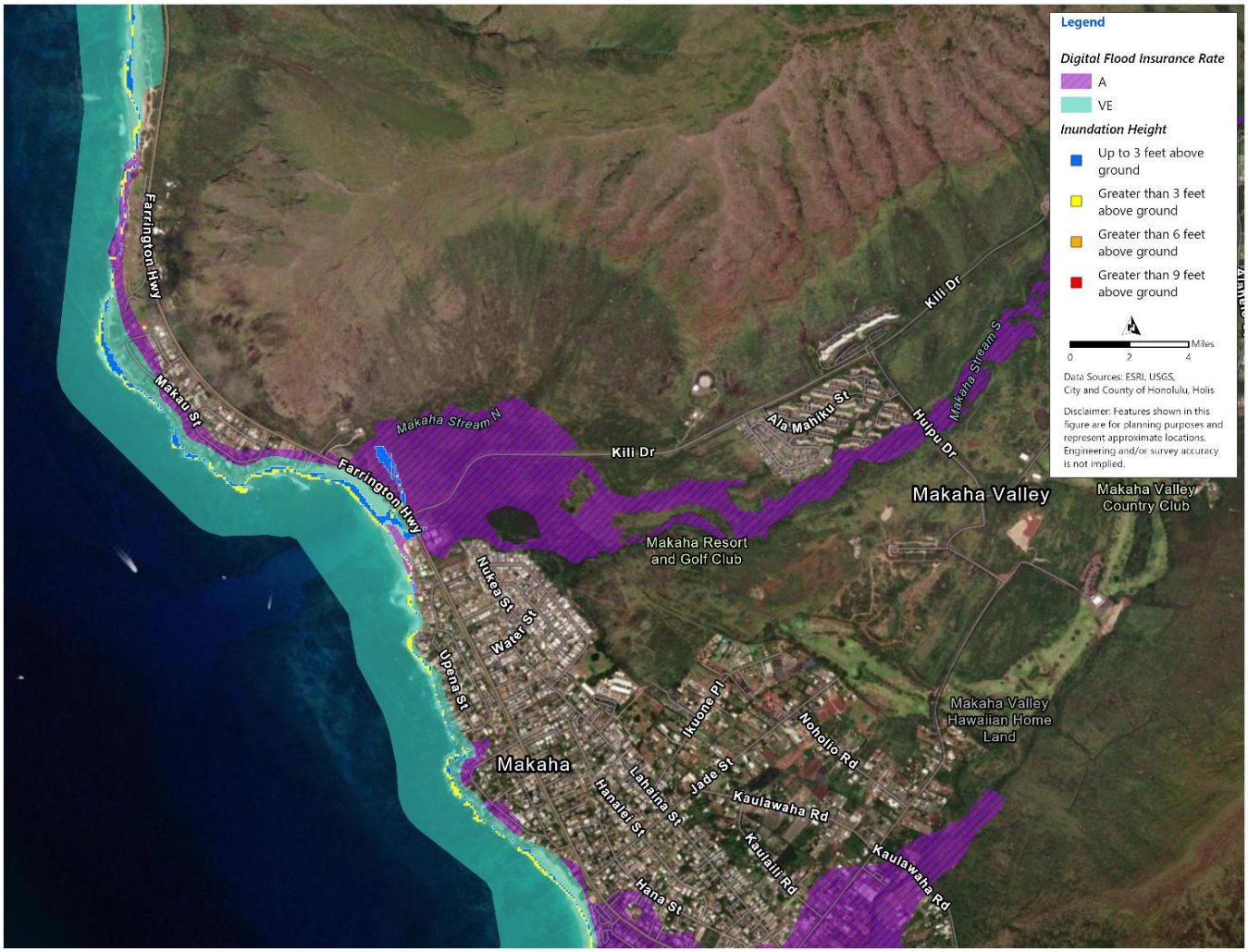


Figure 3. 100-Year Storm and Category 2 Hurricane Inundation

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High priority water lines **Wastewater:** 10-in/12-in/15-in/18-in 30-in sewer mains **Stormwater:** 18-in/24-in/42-in/48-in/54-in/60-in SW conduits, Mākaha Stream North & South, Keaʻau Stream **Roads:** Farrington Hwy, Mākaha #3A Bridge, Mākaha #3 Bridge, Farrington Hwy/Waikomo Stream Bridge
Community Assets at Risk:	Mākaha Beach Park, cesspools, nearby Mākaha Public Elementary School, nearby Mākaha Community Park

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **Hurricane:** Complete inundation up to 3 feet under Category 2 hurricane conditions, mid-term threat. Heavy rainfall and flooding may exceed the capacity of existing drainage facilities, leading to roadway flooding, reduced access along Farrington Highway and local roads, and impacts to nearby community assets. Stormwater infrastructure improvements will be focused on reducing flood risk and water quality impacts from extreme precipitation. **100-year Storm:** Partial inundation. Stormwater infrastructure improvements will be focused on reducing flood risk and water quality impacts from extreme precipitation such as the 100-year storm. **Extreme Heat:** Extreme afternoon heat. May stress vegetation and reduce the effectiveness of natural systems that help manage runoff and support watershed health. Increased green stormwater infrastructure can replace paved or impervious surfaces, reduce urban heat island effects, and increase cooling.

PROJECT COMPONENTS

PLAN/STUDY

1. Stormwater Infrastructure Assessment and Prioritization

- Evaluate stormwater management needs and flooding concerns in the Mākaha area.
- Identify priorities to support flood protection, watershed health, and water quality.
- Assess existing stormwater infrastructure, including stormwater conduits and related facilities.

2. Stormwater and Watershed Improvement Alternatives

- Develop and evaluate alternatives to improve flood protection, water quality, and watershed function.
- Consider improvements such as stormwater conveyance facilities, drainage channels, culvert upgrades, detention/retention facilities, green infrastructure, and erosion control measures.
- Evaluate opportunities to reduce sediment and pollutant loading to downstream waterways and coastal areas.

PROGRAM

N/A

INFRASTRUCTURE

1. Project Development and Design

- Advance selected stormwater improvement projects into planning, design, and permitting.
- Develop implementation strategies, cost estimates, and phasing.
- Coordinate improvements with ongoing and planned projects in the Mākaha area.

2. Stormwater Infrastructure Implementation

- Construct selected stormwater infrastructure improvements.
- Improve flood protection in Mākaha.
- Support watershed health, water quality improvements, and resilience to flooding and wildfire-related runoff.

PROJECT COMPONENTS

Community Benefits:	☒ Protects cultural sites ☒ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☐ Improves public access to community spaces ☐ Increases public awareness/education ☒ Provides ecosystem restoration ☐ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Improve infrastructure to effectively manage wastewater and stormwater flows Respect and support Native Hawaiian culture and traditional practices reliant on healthy land and water resources Protect local water sources and the natural habitat to provide water for our future generations Improve community resilience to wildfire
OWH Objectives Supported:	Enhance coordination and recognize interconnections to develop and implement projects and strategies Develop a unified roadmap and decision making process under a One Water approach Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#6**: Improve watershed health to mitigate wildfire risk and manage flooding
Relevant Adaptation Strategies	• Elevate Access Road and Associated Utilities • Stormwater Capture and Use • Distribution System Resilience • Modify Site Drainage, Storage, and Infiltration • Upsize Stormwater Drainage Capacity or Sanitary Sewer Capacity

PROJECT COMPONENTS

	• Implement Low Impact Design (LID)/Green Infrastructure Stormwater Management Strategies
Expected Timeline:	This project includes infrastructure projects that may be preceded by studies such as OWH Project #145 Mākaha Roads Drainage Study and Improvements. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the long-term timeframe. Implementation may be advanced sooner if stormwater infrastructure experiences recurring flooding, capacity constraints, or reduced performance due to major storms and sea level rise.
Triggers:	**Climate Hazard:** Heavy Rain, SLR **Funding:** Implementation of stormwater infrastructure improvements may be advanced when sufficient funding becomes available. **Regulatory:** TMDL priority in Mākaha Beach is currently low but existing impairments (total nitrogen, chlorophyll-a, ammonium ion, and turbidity) could lead to future TMDL development.

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	• Flooding, sediment buildup, and existing stormwater infrastructure limitations may reduce system performance during major storm events. Balancing flood protection, water quality improvements, and wildfire resilience across the Mākaha area may also present challenges.
Additional Considerations:	• Future stormwater improvements should consider flooding, erosion, water quality, and stormwater management needs in the Mākaha area. Improvements should support protection while improving watershed health. • Existing sewer mains, stormwater conduits, roadway facilities, and nearby community assets, including a school, park, recreational facilities, and emergency services facilities, may influence future improvement options.

REFERENCES

2024 State of Hawai‘i Water Quality Monitoring and Assessment Report, The Hawai‘i State Department of Health, Clean Water Branch, April, 2024 : https://health.hawaii.gov/cwb/files/2024/09/IR-2024-final-draft.pdf

ACRONYMS

CRO	Climate Ready O‘ahu
DDC	Department of Design and Construction
DFM	Department of Facility Maintenance
DPR	Department of Parks and Recreation
LID	Low Impact Development
OWH	One Water Honolulu
SLR	Sea Level Rise
SoVI	Social Vulnerability Index
SW	Stormwater
TMDL	Total Maximum Daily Load

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.

INCREASE GREEN INFRASTRUCTURE AND GREEN SPACE

PROJECT CONCEPT

GENERAL DESCRIPTION	This project includes green infrastructure and green space improvements across Waiʻanae to help reduce extreme heat and flooding impacts as well as lower wildfire risk. Improvements will be planned and implemented with consideration of the local watershed to support community resilience and provide benefits across the watershed. In addition to community benefits, the project is intended to increase community flood protection and improve water quality. DFM is the expected project champion, though DTS will need to be involved for any project components within the right-of-way of any roads. The project includes both study and infrastructure implementation phases.
ID #:	130
Timeframe:	Long-term
Champion Agencies:	DFM
Potential Partnerships:	CCSR, DPR, DTS, DDC (may implement design and construction)
Adaptation Strategy Type:	Infrastructure
Location of Project:	Waiʻanae
Area Classification:	Country Towns and Rural Coastline
Hotspot:	Pōkaʻī Bay St.
Congressional District:	2
Council District:	I

PROJECT CONCEPT

Legislative District:	House District 45
Neighborhood Board:	Waiʻanae Coast Subdistrict 1
Oʻahu SoVI Index:	High



Figure 1. Wildfire Risk Areas in Waiʻanae

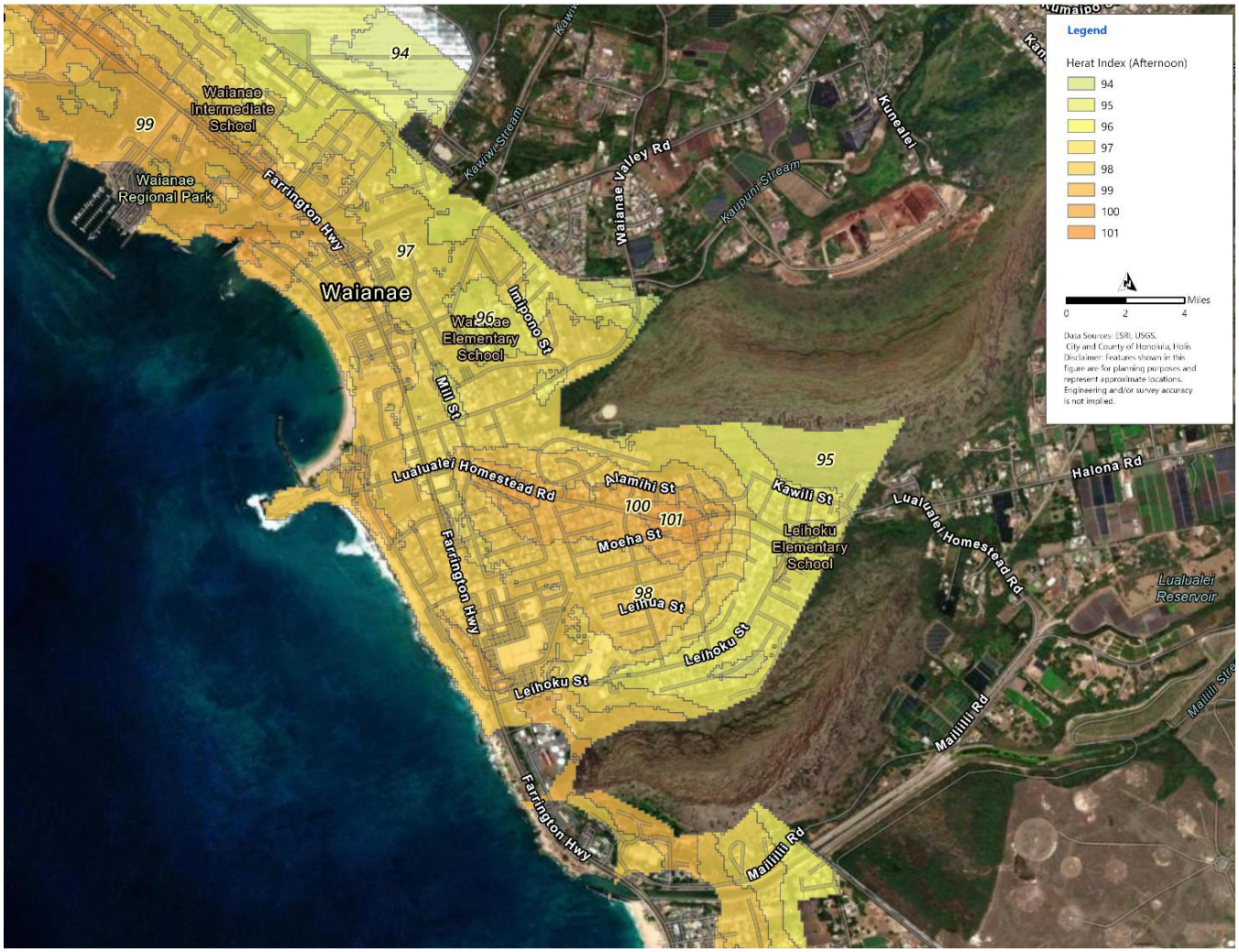


Figure 2. Afternoon Heat Index for Waiʻanae

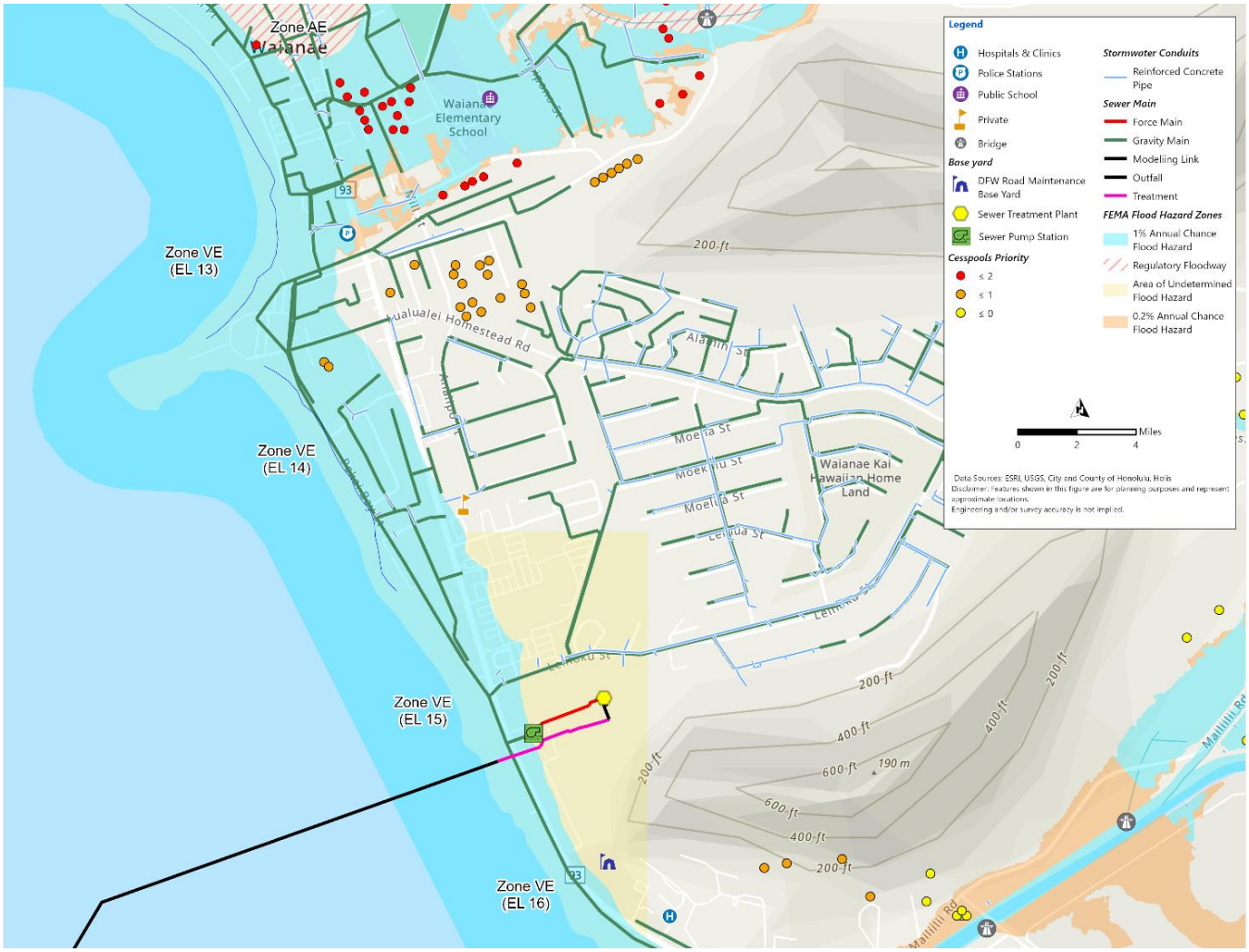


Figure 3. Waiʻanae Flood Hazard Map

PROJECT CONCEPT

Infrastructure Assets at Risk:	**Water:** High risk pipelines **Wastewater:** 10-in/12-in/36-in sewer main **Stormwater:** 18-in/24-in/30-in SW conduits **Roads:** Farrington Hwy, Pōkaʻī Bay St
Community Assets at Risk:	Pōkaʻī Bay, Kuilioloa Heiau, Adventist Malama Elementary School, Waiʻanae police station

Note:

Definition for Community Assets at Risk: assets that provide non-utility services or key emergency, social, cultural, and/or economic uses. These can include schools, hospitals/medical facilities, fire departments, police departments, recreational and/or community & cultural centers, fish ponds, shrines, burial sites

Climate Resilience:	**Climate Resilience: MEDIUM-HIGH** **Wildfire:** High wildfire risk. Green space improvements and increased landscape buffers may help reduce wildfire risk near community assets and public spaces. **100-year Storm:** Partial inundation under the 100-year storm. Green infrastructure increases infiltration and reduces ponding and localized flooding. **Extreme Heat:** Extreme afternoon heat conditions, with heat index values exceeding 90°F. Elevated temperatures may affect public spaces, community assets, and overall community well-being. Green infrastructure improvements and expanded green space may help reduce heat exposure in public spaces and around community assets.

PROJECT COMPONENTS

PLAN/STUDY

1. Extreme Heat and Wildfire Risk Assessment

- Identify areas vulnerable to extreme heat and wildfire risk.
- Review existing green space, vegetation cover, and publicly accessible areas.
- Identify opportunities to increase shade, vegetation, and other applicable green infrastructure features to support community resilience.

2. Green Infrastructure Alternatives Analysis

- Evaluate potential green infrastructure and green space improvements to reduce extreme heat and wildfire risk.
- Develop conceptual alternatives for tree planting, shade improvements, landscape buffers, and other nature-based solutions.
- Compare alternatives and identify opportunities to improve community resilience and environmental benefits.

PROGRAM

N/A

INFRASTRUCTURE

1. Green Infrastructure Planning

- Prioritize locations for green infrastructure and green space improvements.
- Develop planning-level recommendations for future implementation.
- Identify implementation priorities

2. Green Infrastructure Improvements and Implementation

- Implement selected green infrastructure and green space improvements.
- Improve resilience and usability of community spaces and public facilities.

PROJECT COMPONENTS

Community Benefits:	☐ Protects cultural sites ☒ Incorporates living and traditional Hawaiian practices ☒ Increases community flood protection ☒ Improves water quality ☐ Improves public access to community spaces ☒ Increases public awareness/education ☒ Provides ecosystem restoration ☒ Enhances recreational benefits ☐ Other:

Note:

An "X" noted in the box represents a community benefit that is a key component or driver of the project.

A "?" noted in the box represents a potential additional community benefit that should be considered during project development.

Hotspot Goals Supported:	Respect and support Native Hawaiian culture and traditional practices reliant on healthy land and water resources Improve community resilience to wildfire
OWH Objectives Supported:	Practice a shared kuleana for a climate resilient Oʻahu Work together to leverage resources and enable climate readiness Collectively advocate for and pursue funding to support multi-benefit projects
CRO Strategies Supported:	**#12**: Keep our communities cool as temperatures rise and during heat waves
Relevant Adaptation Strategies	• Incorporate Green Roof Design • Incorporate Heat and Drought Resilient Vegetation • Incorporate Native Vegetation • Increase or Preserve Site Tree Canopy Coverage, Natural Planted Areas, or Wetlands • Wildfire Analysis and Inventory • Urban Heat Index Reduction with Enhanced Green Spaces

PROJECT COMPONENTS

Expected Timeline:	This project includes infrastructure projects that may be preceded by studies such as OWH Project #145 Mākaha Roads Drainage Study and Improvements. The study should be completed such that the recommended infrastructure improvements can be planned, designed, and constructed/implemented in the long-term timeframe. Implementation may be advanced if wildfire risk increases and heat impacts worsen.
Triggers:	**Climate Hazard:** Wildfire, Extreme Heat, Drought. **Funding:** Implementation may be advanced when funding becomes available for heat and wildfire resilience improvements. **Regulatory:** N/A

POTENTIAL CHALLENGES & ADDITIONAL CONSIDERATIONS

Potential Challenges:	Long-term maintenance of vegetation, irrigation needs during drought conditions (medium drought risk area), and selection of appropriate drought- and fire resilient plant species may present challenges.
Additional Considerations:	Project should consider locations with limited shade, high afternoon heat exposure, and high wildfire risk. Green infrastructure and green space improvements should be evaluated based on their ability to increase tree canopy, provide shade, reduce heat impacts, support drought resilience, and create a safe space around community assets and public spaces. Project should consider existing land use, available open space, and nearby community assets, including Adventist Malama Private Elementary School, Waianae police substation, Kuilioloa Heiau, and Pōkaʻī Bay.

REFERENCES

The Hawaiʻi State Department of Health, Clean Water Branch. (April, 2024). State Of Hawaiʻi Water Quality Monitoring and Assessment Report https://health.hawaii.gov/cwb/files/2024/09/IR-2024-final-draft.pdf

ACRONYMS

CCSR	Office of Climate Change, Sustainability and Resiliency
CRO	Climate Ready Oʻahu
DFM	Department of Facility Maintenance
DPR	Department of Parks and Recreation
N/A	Not Applicable
SoVI	Social Vulnerability Index
SW	Stormwater

The purpose of the factsheets is to offer a starting point for a more detailed scope, providing a project description, explanation of resilience benefits, anticipated components, and to document any challenges, concerns, and references.