Report to the Thirty-Second Legislature

2023 Regular Session

SEA LEVEL RISE VULNERABILITY AND ADAPTATION REPORT

Prepared by the

State of Hawaii Department of Land and Natural Resources,

Office of Conservation and Coastal Lands

In response to Act 32,

of the Regular Session of 2017;

December 2022

Hawai`i Sea Level Rise Vulnerability and Adaptation Report

2022 Update

Hawai`i State Climate Commission

Acknowledgements

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Mahalo to the many representatives of state and county agencies who provided editing and information regarding agency actions.

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Hawai`i Sea Level Rise Vulnerability and Adaptation Report 2022 Update Executive Summary

Introduction

The 2017 Hawai`i Sea Level Rise Vulnerability and Adaptation Report (2017 Report) was mandated by the Hawai`i Climate Change Adaptation Initiative (Act 83 (Session Laws of Hawaii (SLH) 2014)), and expanded by the Hawai`i Climate Change Mitigation and Adaptation Initiative (Act 32, SLH2017). Through this report the Legislature aimed to address the threat posed by climate change to the economic well-being, public health, natural resources, and environment of Hawai`i. The 2017 Report was prepared in recognition that sea level rise (SLR) is an inevitable outcome of global warming that will continue far into the future, even with an immediate and drastic reduction of greenhouse gas emissions.

In addition to the preparation of the 2017 Report, Act 32 charged the Hawai`i Climate Change Mitigation and Adaptation Commission to conduct a comprehensive review of implementation and submit a report to the governor, legislature, and the counties no later than twenty days prior to the convening of the regular session of the 2023 Legislature and every five years thereafter. This document serves as the five-year update to the 2017 Report and the Commission's report on recent sea level rise adaptation initiatives across State and County government, many of which are a direct result of the information and map data provided by the 2017 Report and companion State of Hawai`i Sea Level Rise Viewer (Viewer).

Scientific Observations and Predictions

In 2017, and again in 2020, the Honolulu Harbor Tide gauge recorded its highest daily mean water levels observed over its 112-year history. These record high water levels were produced by a combination of phenomena that included long-term global sea level rise, peak annual astronomical tides ("king tides"), wave setup, and migration of warm buoyant waters brought in by winds and currents. These events provide a glimpse of what will become a more regular occurrence as sea level continues to rise. Local impacts were observed throughout the State in the form of increased coastal erosion, minor wave over-wash flooding, backshore flooding from groundwater rise and storm drain backflow, and impeded and potentially hazardous beach access.

The United Nations Environment Program Emissions Gap Report, 2022 indicates that globally, nations have missed the emissions goals that may have constrained overall global warming to 1.5° C, and that given our current path and past actions, the world is likely to warm by 2.8°C by the end of the century. Sea level responds to greenhouse gas emissions more slowly than global surface temperature. This slow response leads to long-term committed SLR, associated with ongoing ocean heat uptake and the slow adjustment of the ice sheets. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report states with high confidence that "*Global mean sea level will continue to rise for thousands of years, even if future CO_2 emissions are reduced to net zero and global warming halted, as excess energy due to past emissions continues to propagate into the deep ocean and as glaciers and ice sheets continue to melt*." (Arias, et al. (2021)).

Sea level rise exposure mapping in the 2017 Hawai'i Sea Level Rise Report and Hawaii Sea Level Rise Viewer is based on an upper-end projection in the 2013 IPCC 5th Assessment Report of 3.2 feet of global mean sea level rise by 2100. Since completion of the 2017 Report, peer-reviewed scientific literature as

well as government and multinational reports increasingly point to 3 to 4 feet of sea level rise by 2100 as a mid-range, rather than high-end, scenario for Hawai'i. Long-term observational data from local tide gauge stations show that sea level is rising around Hawai'i. Models indicate that Hawai'i and other tropical Pacific sites will experience sea level rise that is 16% to 20% higher than the global average (Sweet. et al. 2022). As the science progresses towards increasingly concerning rates of sea level rise for Hawai`i, it remains imperative that the legislature and state and county agencies maintain a long-term focus on building resiliency to rising seas by reducing overall vulnerability of infrastructure and implementing adaptation measures to allow our state to continue to thrive with higher seas.

Accomplishments and Progress

The 2017 Report included nine recommendations with 49 recommended actions aimed at improving the state's capacity to address the social, economic, and environmental impacts of sea level rise.

Key Statewide Accomplishments:

Use of the Sea Level Rise Exposure Area Data and Sea Level Rise Viewer: Although the Sea Level Rise Exposure Area (SLR-XA) was not officially recognized as a state-wide vulnerability zone, the Viewer and SLR-XA are in widespread use by state and county agencies for adaptation planning purposes.

**Hawai`i Coastal Zone Management Act Updates**: Act 16, SLH2020 updated the Hawai`i Coastal Zone Management Act (HRS Chapter 205A) including strengthening protections for beach and other coastal environments by specifically prohibiting private shoreline hardening structures and minimizing public shoreline hardening structures, including seawalls and revetments, at sandy beaches where they would interfere with existing recreational and waterline activities.

Sea Level Rise Report Addendum: The *Guidance for Using the Sea Level Rise Exposure Area in Local Planning and Permitting Decisions* was published by the State as a supplement to the 2017 Report. The Addendum was prepared by the University of Hawai`i Sea Grant College Program (Hawai`i Sea Grant) with the Hawai`i Department of Land and Natural Resources - Office of Conservation and Coastal Lands (OCCL) for the Hawai`i Climate Change Mitigation and Adaptation Commission - Climate Ready Hawai`i Initiative. The Hawai`i Climate Change Mitigation and Adaptation Commission issued a statement of approval for the Addendum at its October 28, 2020 meeting.

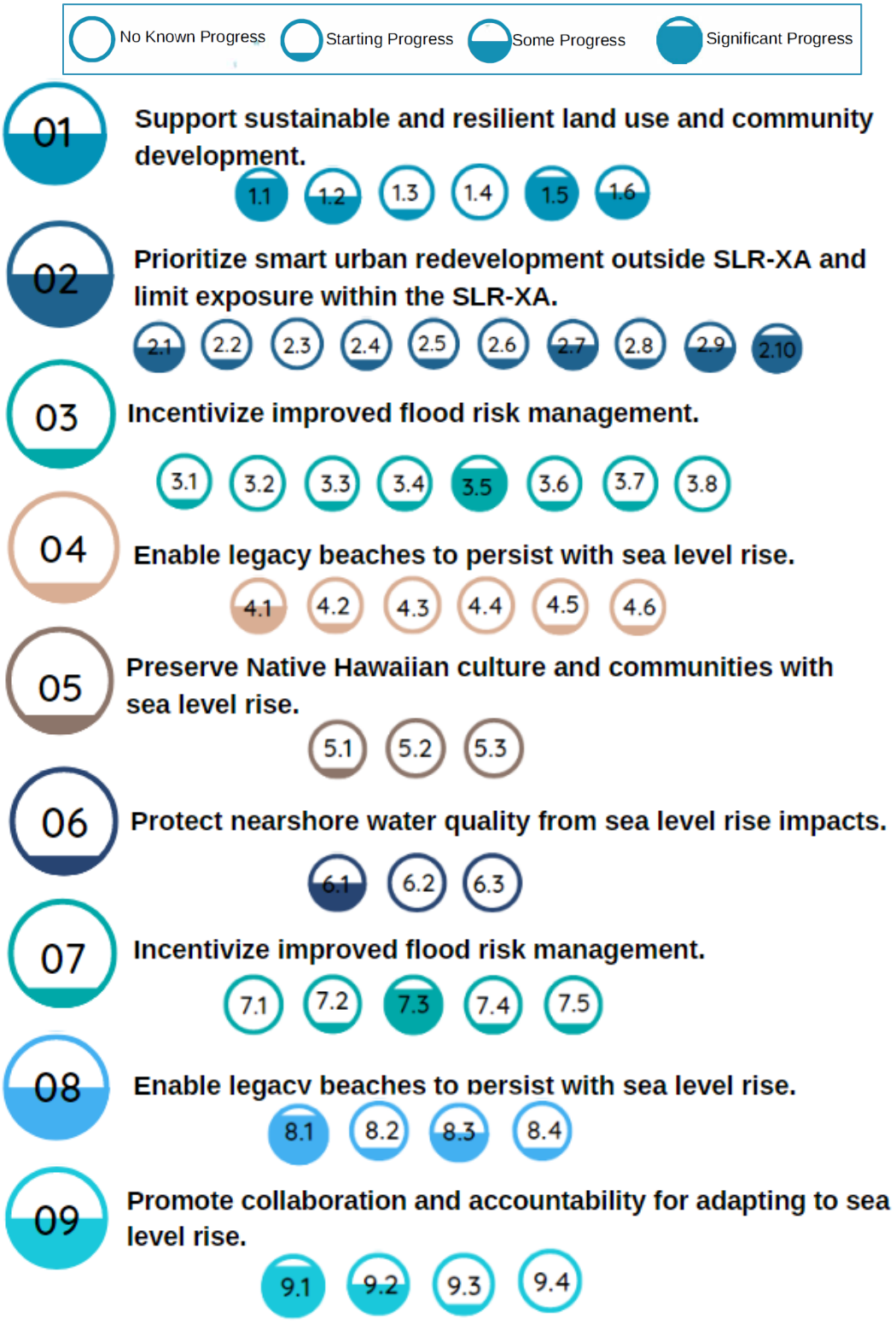
Hawai`i 2018 Hazard Mitigation Plan: The 2018 update of the State's Hazard Mitigation Plan includes expanded consideration of climate change and sea level rise hazards, including hazard assessment using the SLR-XA and a 1% Annual-Chance Coastal Flood Zone with 3.2 feet of sea level rise (1%CFZ-3.2) modeled for the Plan: https://dod.hawaii.gov/hiema/sert-resources/hazard-mitigation/

Planning for Managed Retreat: The Office of Planning and Sustainable Development Coastal Zone Management Program (OPSD-CZM) published a report titled *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i* in 2019 and is embarking on a next-step study that will assess the options for and implications of implementing managed retreat from the perspectives of (1) policy and regulation, and (2) funding and financing mechanisms in 2023.

Statewide Inventory of Vulnerable Infrastructure: Act 178 Relating to Sea Level Rise Adaptation was passed to begin the long-term planning needed to effectively address climate impacts. OPSD-CZM submitted a report to the legislature in 2021 reporting on progress towards the phased approach required by Act 178.

Summary of Accomplishments

Progress towards meeting the nine recommendations (represented by large circles) and 49 associated recommended actions (represented by small circles underneath) is presented here as measured on a qualitative scale of "no known progress" to "significant progress" as depicted by the following key:



Next Steps

New and updated recommendations provide a roadmap for bridging from this interim report to a full, comprehensive Sea Level Rise Vulnerability and Adaptation Report in 2027. This Report Update recommends continuing work on the nine 2017 Recommendations and associated recommended actions, and adds two new 2022 Recommendations with supporting recommended actions.

2022 Recommendation 1 is to fund and conduct a comprehensive update of the Sea Level Rise Vulnerability and Adaptation Report in 2027, and **2022 Recommendation 2** is to continue to implement the 2017 Recommendations with minor edits as outlined in this 2022 Report Update. The recommended actions within these two new recommendations provide a framework for further identifying gaps in progress since 2017 and meeting the overall goals of this initiative. A key updated recommended action is for the state to set a revised planning and policy benchmark of 4 ft (up from the 2017 guidance of 3.2ft) as the minimum scenario for all planning and design based on the report's Intermediate (mid-range) scenario for Hawai`i of 3.9 feet of sea level rise by 2100, and apply a 6 ft benchmark for planning and design of public infrastructure projects and other projects with low tolerance for risk based on the report's Intermediate High scenario for Hawai`i of 5.9 feet of sea level rise by 2100.

In addition to the recommendations, this report has identified the following unmet needs and areas in need of focus in the next five years which should be set as priority action areas from 2023-2027.

- **Facilitate interagency coordination for holistic adaptation planning** (e.g., comprehensive consideration and planning for natural resources, roads, communities; and improved communications between government agencies) (2017 Recommendation 9, 2022 Recommendation 1)
- **Conserve and adapt Native Hawaiian cultural resources and sites** (2017 Recommendation 5)
- **Integrate equity and justice considerations to vulnerability assessments and adaptation planning and actions** (2017 Recommendation 2)
- **Address and stop the loss of shoreline access** (2017 Recommendation 4)
- **Integrate economic valuation and ecosystem co benefits of natural coastal resources into planning and actions** (2017 Recommendations 4, 5 and 8)
- **Make managed retreat a viable option and identify funding mechanisms for adaptation** (2017 Recommendations 2 and 7)
- **Implement phased adaptation to sea level rise** (2017 Recommendation 1, 2, 7)

Our understanding of the sea level rise outlook has improved since the 2017 Report and we now have a better understanding of the most probable impacts of sea level rise in Hawai`i. This Updated Report and the recommendations within should be used as a tool by the decision makers of the State, the Counties, and community leaders. Recommendations to increase our capacity to adapt to sea level rise should be implemented across the levels of government now to address the inevitable near and medium-term rise of sea level rise.

Hawai`i Sea Level Rise Vulnerability and Adaptation Report 2022 Update

Introduction

The 2017 Report provided the first detailed statewide assessment of Hawaii's exposure to sea level rise related hazards and proposed recommendations to reduce the state's vulnerability to sea level rise and increase our capacity to adapt. This report is intended as a five-year update to the 2017 Report and is not a full review or stand-alone document. Instead, it refers to the 2017 Report and provides an overview of updates to climate and sea level rise science, the accomplishments achieved relative to the 2017 Report recommendations, and provides updated recommendations for the next five years and beyond. "Learning Questions" posed by the 2017 Report are directly addressed in Appendix (A) of this Report.

Sea Level Rise Outlook: Updated Global and Local Projections

The 2017 Hawai`i Sea Level Rise Vulnerability and Adaptation Report provided a detailed overview of climate science and sea level rise observations and predictions based on the latest and best-available science at that time including the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) and the U.S. Global Change Research Program (USGCRP) 4th National Climate Assessment. As expected, climate and sea level rise science has continued to advance since the 2017 Report, with landmark intergovernmental reports including the IPCC AR6 in August 2020 and NOAA-led Sea Level Rise Technical Reports in 2017 and 2022. An update on Sea Level Rise Science was provided as an appendix in an October 2020 Hawai`i Climate Change Commission document, Guidance for Using the Sea Level Rise Exposure Area in Local Planning and Permitting Decisions - A Supplement to the Hawai`i Sea Level Rise Vulnerability and Adaptation Report. In July 2022, the City and County of Honolulu Climate Change Commission provided an updated guidance document on the latest sea level rise science and projections with recommendations for adaptation planning. This section provides an overview of the latest climate science and sea level rise projections published in those documents with specific regional and local projections and likely impacts.

Global and Local Sea Level Rise Trends

Sea level rise exposure mapping in the 2017 Hawai`i Sea Level Rise Report and Hawai`i Sea Level Rise Viewer (Viewer) is based on an upper-end projection in the 2013 IPCC 5th Assessment Report of 3.2 feet of global mean sea level rise by 2100. As expected, the science on sea level rise observations and forecasts has continued to advance. Since completion of the 2017 Report, peer-reviewed scientific literature as well as government and multinational reports increasingly point to 3 to 4 feet of sea level rise by 2100 as a mid-range, rather than high-end, scenario for Hawai`i. These increasing projections of sea level rise are based on greenhouse gas emissions, which continue to increase, and observations of accelerating ice mass loss to the oceans, particularly from Greenland and West Antarctica. The projections are often provided to 2100, though sea level rise will likely continue for centuries.

Since 1993, 27 years of continuous satellite altimeter measurements tied to tide gauges and averaged across the planet (Figure 1) show that global mean sea level is not only rising at a rate of 3.4 mm/yr (1.3 inches per decade, sealevel.nasa.gov), it is accelerating at a rate that will lead to 23 cm (9 inches) of global mean sea level rise by 2050 (relative to the year 2000; Nerem et al., 2022). Continued global warming is expected to increase this rate of acceleration, and therefore 9 inches of sea level rise by 2050 is likely a conservative (low-end) sea level rise scenario for that timeframe.

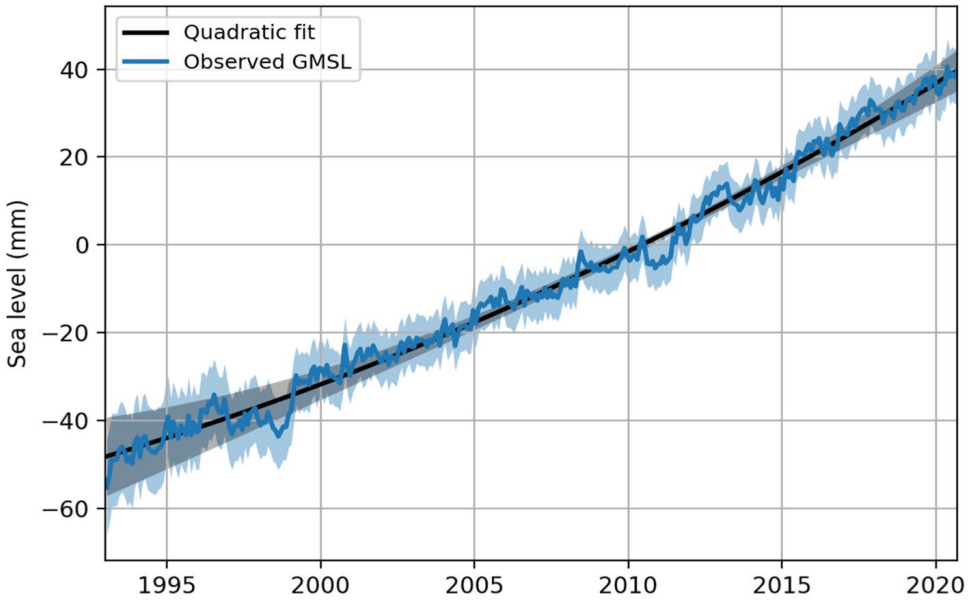


Figure 1. Global mean sea level is rising at a rate of 3.4 mm/yr (1.3 inches per decade, sealevel.nasa.gov) and this rate is accelerating (Figure: Nerem et al., 2022).

The most recent projections of global and regional sea level rise are published in a 2022 intergovernmental report led by NOAA (Sweet et al. 2022). The 2022 report builds on a 2017 NOAA report (Sweet et al., 2017) and global mean sea level rise scenarios from the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6; IPCC 2021). Key findings of the NOAA 2022 report include:

- Increased confidence, regardless of Greenhouse Gas (GHG) emissions scenario, in sea level rise projections at 2050 with sea level expected to rise as much over the next 30 years as it has over the last 100 years.
- An increase in magnitude and frequency of coastal flooding by 2050 from high tide and storm surge flood events with significant consequences to coastal infrastructure, communities, and ecosystems.
- A 50% probability of exceeding 0.5 m (1.6 ft) of sea level rise globally by 2100 with an increase in average global temperature of 2°C above preindustrial levels (global temperature has already risen 1.01°C since 1880). The probability of exceeding 0.5 m (1.6 ft) of global sea level rise increases to 80% to 99% under higher GHG emissions scenarios with 3°-5°C of warming, respectively. These probabilities do not consider the potential for faster-than-projected ice

sheet losses in Antarctica and Greenland within this century, which is a focus of ongoing research.

- There is a 50% probability of exceeding 1.0 m (3.3 ft) and 10% probability of exceeding 2.0 m (6.6 ft) of global sea level rise by 2100 when considering a high GHG emissions scenario that leads to an average global temperature increase of 5°C plus the impact of earlier and faster ice sheet losses from Antarctica and Greenland. While physically plausible, the likelihood of widespread ice sheet collapse to that extent within this century is currently unknown and is an active area of ongoing observation and research.

Long-term observational data from local tide gauge stations show that sea level is rising around Hawai`i. Models indicate that Hawai`i and other tropical Pacific sites will experience sea level rise that is 16% to 20% higher than the global average (Sweet. et al. 2022). The NOAA 2022 report provides a range of regionalized sea level rise scenarios based on differing GHG emissions pathways and associated global warming and ice sheet melt (all projections relative to sea level in the year 2000):

- Sea level will rise around Hawai`i between 0.7 and 1.5 feet by 2050.
- The Intermediate (mid-range) estimate is for a rise of 1.0 feet by 2050.
- Sea level will rise between 1.3 and 8.0 feet by 2100.
- The Intermediate (mid-range) estimate is for a rise of 3.9 feet by 2100.

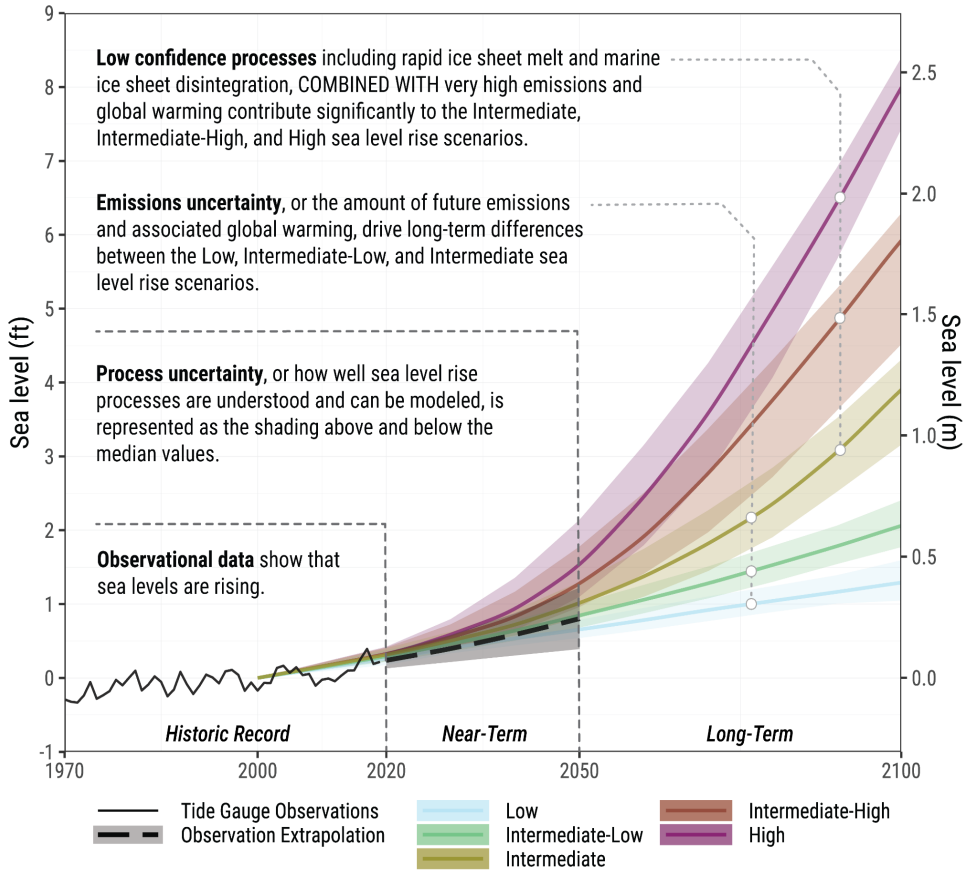


Figure 2. Sea level rise observations (solid black line), extrapolated observed trend (dashed black line), and sea level rise scenarios Hawai`i from NOAA interagency sea level rise report (Sweet, et al. 2022). The text in the figure

describes the various processes and uncertainties that contribute to the various sea level rise scenarios (Figure by Jamie Carter, NOAA).

	Year	
Scenario	**2050**	**2100**
Low	0.7	1.3
Intermediate-Low	0.9	2.0
Intermediate	1.0	3.9
Intermediate-High	1.3	5.9
High	1.5	8.0

Units in feet relative to year 2000

Table 1. Sea level rise scenarios for 2050 and 2100 for Hawai`i from interagency report (Sweet, et al. 2022).

In a study by researchers at the University of Hawai`i Sea Level Center and others, it was reported that rapid increases in tidal flooding are expected to begin locally by the mid-2030's (Thompson, et al. 2021). This increase will be the result of ongoing sea level rise in combination with natural cyclicity in tidal amplitudes, i.e., natural variations in the highest high tides. By the early 2040's Honolulu is projected to experience 2 to 3 high tide flood days per month considering NOAA's intermediate SLR scenario. However, such high tide events will be clustered over times of the year when tides are at their peak (i.e., during "king tides"), in which as many as 6-14 days per month can be expected. Thus, researchers recommend that compound flood impacts during these more extreme periods of tidal flooding be considered in flood management planning instead of annual averages (Thompson, et al. 2021).

Compound flooding describes flood sources that are additive to that generated by sea level rise alone. Compound flood sources can include the shallowing or emergence of coastal groundwater, rain events, and overwhelming of drainage systems that can ironically act as additional sources of floodwater. In a study that investigated proportions of flooding in Honolulu's Primary Urban Core caused by single, versus multiple components of sea level rise induced inundation, it was found that less than three percent was caused solely by direct overland connection to a rising ocean. Sources of compound flooding and exacerbation of such flooding by rising sea level should be a top consideration as part of ongoing research and flood management planning.

Local Observations of Coastal Impacts

The 2017 Report provided a detailed outline of the statewide results of the vulnerability assessment based on the outputs of the SLR-XA model and Viewer. Vulnerability was assessed in terms of potential impacts to land use, people, property, cultural and natural resources, and critical infrastructure. This section provides an overview of the observed local impacts since 2017 to inform the application of the SLR-XA to current and future planning efforts. This report does not include an updated assessment of the potential economic loss or impacts on people, roads, other infrastructure and ecological features within the SLR-XA. Such analyses will be included as part of planned updates to the Report and Viewer.

As was identified in the 2017 Report, chronic coastal flooding within the SLR-XA is an ongoing problem. The consequences of elevated sea level have already become apparent. In 2017, and again in 2020, the Honolulu Harbor Tide gauge recorded its highest daily mean water levels observed over its 112-year history. These record high water levels were produced by a combination of phenomena that included long-term global sea level rise, peak annual astronomical tides ("king tides"), wave setup, and migration of warm buoyant waters brought in by winds and currents. These events provide a glimpse of what will become a more regular occurrence as sea level continues to rise. Local impacts were observed throughout the State in the form of increased coastal erosion, minor wave over-wash flooding, backshore flooding from groundwater rise and storm drain backflow, and impeded and potentially hazardous beach access.

In addition to the observed coastal flooding, elevated water levels and recent extreme rainfall events have spurred concern regarding the functionality of municipal drainage systems, especially across heavily developed low-lying areas. Drainage systems in these areas were designed to convey stormwater from higher elevation to lower elevation waterways. As sea level rises, differences in these elevations have become reduced, and at times reversed, such that drainage systems are becoming increasingly inundated even in the absence of rainfall. Additionally, it is typical for these systems to feature cracks that can allow surrounding elevated groundwater to enter, further reducing drainage capacity. Reverse flow of stormwater is commonly observed in locations like Mapunapuna and Waikiki on O`ahu. Present drainage issues illustrate the fact that coastal flooding will increasingly be generated by a variety of flood sources including the contribution from stormwater conduits, particularly during heavy rainfall events.

The progressive impacts of sea level are likewise evident in the form of chronic coastal erosion. As expected, such erosion has continued along the majority of the State's coastlines, resulting in degradation of public access and nearshore infrastructure. Coastlines along West Maui and O`ahu's North Shore have become particularly stricken by the loss of coastal public trust lands and damage to backshore assets. An aggressive episode of coastal erosion in early 2022 critically undermined one single family home, leading to its collapse and deposition of dangerous debris along Pupukea Beach Park. The collapse followed four years of a progressively worsening combination of chronic and seasonal erosion between Rocky Point and Sunset Beach Park in Paumalu that has become a focal point, highlighting the need for improved management and retreat strategies. In West Maui, chronic erosion along stretches of Ka`anapali and Kahana have spurred the development of several beach and dune restoration projects with the goal of serving as natural buffers to ongoing erosion. Similarly, the degradation of coastal areas along West Maui has become a flashpoint for debate regarding public access rights to public trust

resources, private property rights, and environmentally appropriate coastal management strategies. Seasonal erosion along Ka`anapali in Summer 2022 exceeded recent historical records, revealing derelict erosion control efforts such as sandbags and highway barriers placed during the summer of 2007. The 2022 summer erosion resulted in the loss of trees and undermined the concrete beachwalk. Although the area is experiencing seasonal recovery, the shoreline has migrated mauka and similar erosion events can be expected in the future.

The impacts of coastal erosion on the state highway system are also significant. Hawai`i Department of Transportation (HDOT) Highways is proposing revetments in at least two locations along the Kamehameha Highway on O`ahu to protect the threatened roadway. On Maui, HDOT-Highways proposes to move portions of Honoapi`ilani Highway inland as a sea level rise adaptation. HDOT-Highways is also exploring the use of sand-savers and a revetment to protect against future erosion events in Wailua, Kaua`i and along the Windward O`ahu coastline.

Viewer Updates and Guidance Documents

The State of Hawai`i Sea Level Rise Viewer (Viewer) is the online atlas that supports the 2017 Report. The Viewer is designed to be useful for policy makers, government officials, and the public. There is an ongoing effort to refine the Viewer to continually provide the best available information to the users and stay in line with current science, observations, and projections. This section provides an overview of updates made to the Viewer to-date and modeling upgrades in progress to further refine the information provided by the Viewer.

In November 2018**,** the disclaimer text was updated in the Report and Viewer with the State Climate Commission's approval, stating that "having gone through peer review and publication in the Nature Journal Scientific Reports, the results of this study are sufficiently validated to be appropriately used in land management decisions as the best available information…"

In 2020, the State published the **Sea Level Rise Report Addendum: Guidance for Using the Sea Level Rise Exposure Area in Local Planning and Permitting Decisions as a** supplement to the 2017 Report. The Addendum was prepared by the University of Hawai`i Sea Grant College Program with the Hawai`i Department of Land and Natural Resources - Office of Conservation and Coastal Lands for the Hawai`i Climate Change Mitigation and Adaptation Commission - Climate Ready Hawai`i Initiative. The Hawai`i Climate Change Mitigation and Adaptation Commission issued a statement of approval for the Addendum at its October 28, 2020 meeting.

The primary purpose of the Addendum is to assist state and county planners, natural resource and infrastructure managers, and others with understanding and using the Sea Level Rise Exposure Area (SLR-XA) from the Report and Viewer in day-to-day planning and permitting decisions, particularly at the project or property-level scale. This guidance was developed in response to requests from county planning departments and other stakeholders to provide information on how to appropriately interpret and apply the SLR-XA map data in land use planning and permitting decisions while increasing understanding of the methods, assumptions, and limitations of the data.

Within the Viewer, several updates to the supporting text and available layers were completed since 2017 with the goal of making the tool more accessible and useful to users:

- An address and TMK search tool and a TMK Parcels boundary layer were added in response to the Disclosure Requirement for Residential Real Estate in the Sea Level Rise Exposure Area . These updates were made as a result of discussions with the Hawai`i Realtors Association to enable meaningful implementation of the requirement beginning in May 2022.
- A passive flooding exposure layer at 6 feet of sea level rise from NOAA was added in support of planning guidance to consider greater than 3.2 ft of sea level rise for critical infrastructure.
- Layers depicting moku and ahupua`a boundaries were added to support visualization and understanding of sea level rise hazards in a community and cultural context.
- A 1%-Annual-Chance Coastal Flood Hazard Zone with Sea Level Rise layer from the Hawai`i State Hazard Mitigation Plan was added to depict changing coastal flood hazard risks with less frequent but more severe storm and wave events
- A Land Use Districts layer was added in support of community planning for sea level rise.
- The text within the section titled "Sea Level Rise Projections for Modeling" was updated with the latest science.
- Text describing Assumptions and Limitations for the SLR-XA and three component models: Passive Flooding, Annual High Wave Flooding, and Coastal Erosion were added to improve understanding and transparency.

As sea level rise science and projections continue to evolve, the Viewer will be updated to incorporate new data and subsequent model outputs. The Coastal Erosion exposure map data in the Viewer was updated for Kaua`i, O`ahu, and Maui in 2020 by the University of Hawai`i Coastal Geology Group. However, the combined SLR-XA was not updated accordingly. A timeline and outline for implementation of a fully updated version of the Viewer is included in the Next Steps and Future Recommendations Section at the end of this report.

The Viewer was updated to provide specific local data for West Maui in the West Maui Wave Flooding Tool and Wave Runup Forecast Tool.

In addition to the Viewer, the State has published other related guidance and tools building on the 2017 Report. These efforts are listed below:

- **State of Hawai`i Climate Adaptation Portal - HI Adaptation site**: https://climate.hawaii.gov/hi-adaptation/
- **Sea Level Rise Guidance Tool**: interactive web-based guide to incorporate sea level rise considerations into planning and permitting: https://climate.hawaii.gov/hi-adaptation/sea-level-rise-viewer-flowchart/
- **Guidance for Addressing Sea Level Rise in Community Planning**: This project led by Hawai`i Sea Grant in partnership with Hawai`i Department of Land and Natural Resources (DLNR) and Office of Planning & Sustainable Development - Coastal Zone Management Program (OPSD-CZM) worked with state and county government to produce a guidance document and conduct outreach to address sea level rise and coastal hazards in the county general and community planning process: https://seagrant.soest.hawaii.edu/resources/program-publications
- **Guidance for Disaster Recovery Preparedness in Hawai`i**: This project led by Hawai`i Sea Grant in partnership with Hawai`i DLNR and OPSD-CZM worked with state and county government to

establish resilience-focused recovery practices before a disaster hits to enable communities to recover quickly while also adapting to sea level rise and protecting sensitive coastal environments through recommended preparedness activities and model planning and policy resources: https://seagrant.soest.hawaii.edu/resources/program-publications

- **Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i**: This report by OPSD-CZM examined managed retreat programs that have been successfully implemented in post-catastrophic events and in response to chronic coastal hazards and reviewed if and how the programs may be applied to Hawai'i. The assessment identified next steps and key questions to further understanding of how to implement retreat: https://planning.hawaii.gov/czm/ormp/ormp-action-team-project-on-the-feasibility-of-managed-retreat-for-hawaii/
- **Hawai`i 2018 Hazard Mitigation Plan**: The 2018 update of the State's Hazard Mitigation Plan includes expanded consideration of climate change and sea level rise hazards, including hazard assessment using the SLR-XA and a 1% Annual-Chance Coastal Flood Zone with 3.2 feet of sea level rise (1%CFZ-3.2) modeled for the Plan: https://dod.hawaii.gov/hiema/sert-resources/hazard-mitigation/

Review of 2017 Recommendations

The 2017 Report included nine recommendations with 49 recommended actions to achieve the desired outcomes. The recommendations were focused on improving our capacity to address the social, economic, and environmental impacts of sea level rise. Over the past 5 years, the legislature and various state and county agencies undertook several initiatives which align with the recommendations and goals set out in the 2017 Report. This section provides an overview of the status of those recommendations and associated recommended actions. Several of the initiatives are in progress or are ongoing efforts to continually adjust and address the threats of sea level rise and coastal erosion. In many cases, an initiative may address more than one recommendation or recommended actions. In those cases, the initiative is listed under each recommended action it addresses to give a complete picture of the state's progress towards meeting the goals of the 2017 Report.

Each recommendation and recommended action listed here will be noted with either a description of how it has been addressed, the ongoing efforts to address it, or flagged as unaddressed. All existing recommendations should be continued to the 2027 Report, with a few updates as detailed in the Further Recommendations Section towards the end of this report. The 2017 Report contains detailed descriptions and reasoning for each recommendation; readers can refer to that report for further information regarding the purpose and goal of the recommendations. This Report does not provide an assessment of the reduction in vulnerability as a factor of exposure, sensitivity, and adaptive capacity in response to the actions taken.

Progress Towards Meeting 2017 Recommendations:

A summary of the progress towards meeting the recommendations and recommended actions is presented here as measured on a qualitative scale of "no known progress" to "significant progress" as depicted by the following key:

1.1 Recognize the SLR-XA as a state-wide vulnerability zone: The State has not officially adopted SLR-XA as a statewide vulnerability zone but has made a number of important steps including the following:

- The Hawai`i Climate Change Mitigation and Adaptation Commission adopted the Hawai`i Sea Level Rise Vulnerability and Adaptation Report (and recommendations therein) and the Hawai`i Sea Level Rise Viewer following their completion in December 2017, recognizing the SLR-XA as a statewide vulnerability zone.
- The State Climate Commission adopted Recommendations for Countering Impacts of Sea Level Rise (September 2018) including the following recommended strategies:
  - Support legislation for disclosure for private property and public offerings located in areas with potential exposure to sea level rise.
  - Request all new development, redevelopment and modifications be directed away from beach areas.
  - Urge counties to incorporate the 3.2 ft. sea level rise exposure area (SLR-XA) into their general and development plans.
  - Encourage agencies and non-governmental utility providers to identify and prioritize assets within the 3.2 ft SLR-XA or more as described in the State's Sea Level Rise report, identify adaptation measures, and to provide a status update on this activity annually to the Climate Commission.
  - Support legislation that funds State programs to meet mitigation goals, and to bring resources to assist in planning and implementation for sea level rise and other climate related impacts.
- Honolulu Mayor Directive 18-02 (July 16, 2018) requires all City departments to use the most current versions of the City Climate Change Commission's Guidance and accompanying Brief, and the 2017 Report and associated Hawai`i Sea Level Rise Viewer as resources for managing assets, reviewing permitting requests, and assessing project proposals
  - City Climate Change Commission Sea Level Rise Guidance (2017, updated in 2022) builds on findings of the 2017 Hawai`i Sea Level Rise Report and recent scientific literature to provide specific policy and planning guidance on responding to sea level rise by the City.
- A Maui Mayoral Proclamation (February 22, 2018) directs County departments to use the 2017 State Sea Level Rise Report, Viewer, and SLR-XA in their plans, programs, and capital improvement decisions.

- County of Kaua`i incorporated SLR-XA into West Kaui`i Community Plan

1.2 Seek opportunities to plan new development outside of the SLR-XA under long-term, comprehensive managed retreat strategy

- OPSD-CZM published a report titled *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i* in 2019 and is embarking on a next-step study that will assess the options for and implications of implementing managed retreat from the perspecives of (1) policy and regulation, and (2) funding and finacing mechanisms in 2023.
- Act 223, SLH2022 expands the authority of the counties to transfer development rights to address areas at risk of sea level rise, coastal erosion, storm surge, or flooding associated with climate change.
- The 2022 Draft update to the City and County of Honolulu Primary Urban Center Development Plan includes a Sea Level Rise and Coastal Hazards Planning Chapter and states Goal SLR-2: Conduct Long-Range Planning to Increase Area-Wide Adaptation and Resilience; Policy SLR 2.1: Plan for priority growth areas outside of the 3.2' SLR-XA and 6' SLR, and vent proposed solutions for highly impacted areas with the community.
- Bill 10 (2022) currently before the Honolulu City Council, Relating to Use Regulations would further expand the authority of Honolulu City and County to use transfer of development rights to support retreat from areas at risk of flooding and coastal erosion.
- Molokai Molokai Climate Change and Sea-Level Rise Adaptation and Resiliency (CCSLAR) Master Plan is a community-led climate change & sea-level rise plan for Molokai's future. Our overarching goal is to develop a Climate Change and Sea Level Adaptation and Resiliency (CCSLAR) Plan that best serves our Molokai community. It identifies areas at risk from sea level rise and areas for potential relocation.
- West Maui Community Plan (effective January 31, 2022) Section 2 Policies, Goal 2.1 Ready and Resilient Systems includes the following:
    - 2.1.1 | Proposed Community Plan Amendments for new development on existing golf course land in Kā'anapali makai of Honoapi'ilani Highway should be approved only for existing shoreline development that is retreating inland because of impacts from sea level rise or other coastal hazards.
    - 2.1.2 | To minimize impacts from future coastal erosion, new permanent structures must be located landward of the State-recognized SLR-XA for coastal erosion, except a minimum buildable area must be provided. This restriction does not apply to structures needed as part of an approved beach restoration project or cultural project, such as loko i'a, and which must be evaluated on a case-by-case basis.
    - 2.1.3 | For redevelopment and new developments within the SLR-XA, developers must proactively: a. Coordinate with the Maui County Department of Planning and adjacent or nearby property owners to understand possible collective relocation of at-risk structures; b. Incorporate results of coordination into development plans by siting any new planned structures out of harm's way; c. Make efforts to not hold the County of Maui and State of Hawai'i liable for any and all future costs associated with maintaining or protecting the property developed within the SLR-XA, including costs associated with retreat, hazard mitigation, and cleanup costs to maintain the health of the nearshore marine environment from material debris originating from the ocean or from the

structures' own erosion; and d. Make efforts to waive the ability to ever request shoreline hardening for their property or project from the County of Maui or the State of Hawai'i.

- The County of Maui adopted a Managed Retreat Revolving Fund in 2022 to take effect in July 2023. The fund is intended to help Maui homeowners manage coastal erosion and address climate change. The fund will specifically support shoreline improvements and the in-land relocation of infrastructure owned by the county and private entities. The money will come from 20% of the county's transient accommodations tax.
- West Kaua`i Community Plan (adopted 2020)
  - Includes Objectives (page 65) to provide a higher elevation area for property owners with vulnerable homes to retreat to in the future via transfer of development rights or land swap opportunities and that evacuated land serves as a buffer against future coastal hazards.
  - Encourages new development outside of the SLR-XA through zoning amendments. Several implementation zoning amendments were also approved with the plan document. This included ZA-2020-9, which established a new special treatment district called "ST-Coastal Edge" in the CZO. The new district was implemented in all residential neighborhoods vulnerable to sea level rise and located makai of a public road. Any use, structure, or development permitted with or without a Use Permit in the Special Treatment Coastal Edge District shall mitigate impacts from coastal hazards.
  - Identifies managed retreat as a priority as reflected in Resiliency Policy #1: Adapt West Kauai's low lying neighborhoods for climate change impacts and lay the groundwork for managed retreat

1.3 Conduct an inventory of existing lands designated for urban use that are located outside of the SLR-XA and prioritize these areas for new development

- The 2022 Draft of the revised Primary Urban Center Plan for the City and County of Honolulu includes the following Growth and Development Policy Goal: Invest in long-term growth in commercial corridors and mixed-density neighborhoods outside of the Sea Level Rise Exposure Area (SLR-XA). The goal contains an action to identify and create a geographic catalog of underutilized sites. Share these infill opportunities with non-profit developers.

1.4 Strive to balance managed retreat strategies from vulnerable urban areas with preservation of agriculture and conservation lands by relying on state planning act policies and tools and the State Land Use Commission boundary review process.

- No known action.

1.5 Integrate sea level rise adaptation plans and policies into state, county and community plans

- Hawai`i Sea Grant with State DLNR and OPSD-CZM developed Guidance for Addressing Sea Level Rise in Community Planning in 2020 in conjunction with county planning departments.
- In 2021, Hawai`i Department of Transportation (HDOT) Highways Division released its Climate Adaptation Action Plan, exposure assessments, and hazard viewer.
- Statewide Transportation Planning Office (STPO) is developing the 2045 Hawaii Statewide Transportation Plan (HSTP), an overarching policy document to guide system

level and master plans for the three primary modes of transportation in Hawaii. Currently, the HSTP draft plan is undergoing review and the STPO is seeking public comment via online public survey to help better determine feedback on the strategies that can help to implement the goals and objectives of the HSTP. You may find out more information regarding the HSTP at https://arcg.is/1KmHSP and participate in the public survey at https://www.surveymonkey.com/r/J8RHRTT.

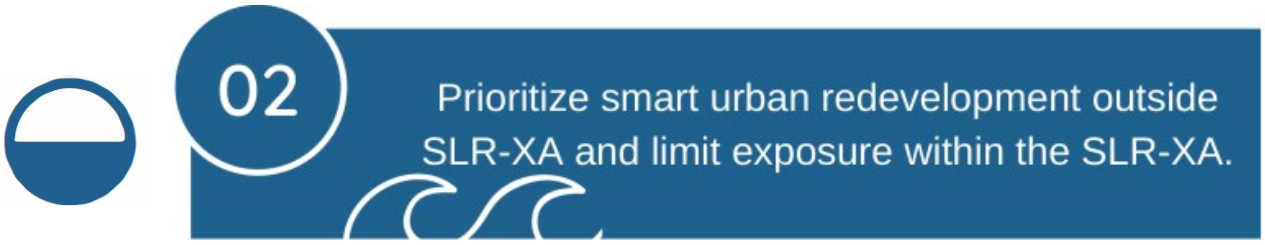
- The draft Department of Hawaiian Homelands (DHHL) General Plan, currently under final review, includes a Technical White Paper on Climate Change Impacts & Adaptation Planning with climate change adaptation strategies for sea level rise, erosion, and flooding. The draft General Plan incorporates climate change mitigation and adaptation concepts and measures into the agency's long-term vision, goals, objectives and policies, as well as DHHL's statewide land use designations, and proposes establishing overlays or other mechanisms that can be applied to areas subject to sea level rise and other climate-related hazards.
- The Hawai`i Department of Transportation (HDOT) published the Statewide Coastal Highway Program Report in 2019. The objective of the project was to develop a scientifically rigorous methodology to assess and rank the susceptibility of State of Hawaii coastal roads to erosion and structural degradation due to ocean hazards such as waves, currents, tides and sea level rise.
- HDOT's Act 100 Resiliency Report outlines the work HDOT is performing to incorporate resilience into its programs and projects.
- Draft Primary Urban Center Development Plan and North Shore Sustainable Communities Plan, currently in review from the Honolulu Planning Department include detailed consideration of sea level rise hazards with proposed actions informed by technical papers on climate change and sea level rise risks specific to the urban Honolulu and North Shore regions.
- East Honolulu Sustainable Community Plan, updated in 2022, addresses sea level rise and SLR-XA in hazard planning, zoning and permitting.
- Ko`olauloa Sustainable Community Plan, updated in 2020, sets a policy for open space to be used to provide adequate shoreline setbacks that consider shoreline changes resulting from erosion hazards and rising sea levels, based on adopted projections of shoreline erosion rates and sea level rise. The Plan also prioritizes using best-available sea-level rise science as a basis for planning.
- West Maui Community Plan adopted into Ordinance by the Maui County Council in December 2021 includes detailed sea level rise considerations and policy guidance informed by community input and a Climate Change and Sea Level Rise Technical Resource Paper.
- South Maui Community Plan currently in review includes detailed consideration of sea level rise informed by a Climate Change & Hazards Resource Paper
- The draft Hawai`i County General Plan, currently in review, includes a section on Mitigating & Adapting to Hazards and Climate Change including sea level rise informed by the SLR-XA.
- West Kaua`i Community Plan (adopted in December 2020) includes detailed sea level rise vulnerability and adaptation considerations and recommendations informed in-part by a West Kaua`i Community Vulnerability Assessment.
- Waimea 400 Conceptual Master Plan, which is a master plan for the 417-acre parcel between Kekaha and Waimea that was purchased by the County of Kaua'i in 2019, integrates the principles of Adaptation Planning in anticipation of sea level rise, flooding,

groundwater intrusion and climate change impacts within the vulnerable areas of the property. Preliminary zones were created based on existing information on potential inundation and future flooding. Appropriate uses for the conditions of each zone were identified.

1.6 Develop shoreline protection, conservation, and restoration priorities and guidelines

- Act 16, SLH2020 updated the Hawai`i Coastal Zone Management Act (HRS Chapter 205A) in many ways including strengthening protections for beach and other coastal environments by specifically prohibiting private shoreline hardening structures and minimizing public shoreline hardening structures, including seawalls and revetments, at sandy beaches where they would interfere with existing recreational and waterline activities. Further, the legislature amended HRS §205A-46 to change the standard for a variance for private facilities to clarify that "a variance to artificially fix the shoreline shall not be granted in areas with sand beaches or where artificially fixing the shoreline may interfere with existing recreational and waterline activities unless the granting of the variance is clearly demonstrated to be in the interest of the general public…".
- Act 16, SLH2020 also updated HRS Chapter 205A to increase protections of "valuable coastal ecosystems, including reefs, beaches, and coastal dunes, from disruption and minimize adverse impacts on all coastal ecosystems." Underline indicates addition from the former language. Further, it now refers specifically to protecting "beaches and coastal dunes for: (i) Public use and recreation; ii The benefit of coastal ecosystems; and (iii) Use as natural buffers against coastal hazards…".
- DLNR-OCCL completed a statewide programmatic environmental assessment and is in the process of updating its permitting program for Small Scale Beach Restoration.
- The Division of Aquatic Resources is developing the Coral Reef Restoration Action Plan. This plan will designate specific areas throughout Hawai`i to prioritize long-term coral reef restoration efforts to address specific goals. One of these goals is shoreline protection. The State will rely on community input, intersections between coral reef health and economic valuations of coastal flood risk/hazard mitigation potential, and analyses of vulnerable coastal infrastructure as likely factors in deciding specific sites for shoreline protection focused coral reef restoration.
- The Hawai`i Department of Transportation (HDOT) published the Statewide Coastal Highway Program Report in 2019. The objective of the project was to develop a scientifically rigorous methodology to assess and rank the susceptibility of State of Hawaii coastal roads to erosion and structural degradation due to ocean hazards such as waves, currents, tides and sea level rise.
- HDOT's Act 100 Resiliency Report outlines the work HDOT is performing to incorporate resilience into its programs and projects.
- Ko`olauloa Sustainable Community Plan includes the following: "To the extent possible, acquire shallow developed beach-front lots which would be impractical to redevelop given existing zoning standards or wave hazard considerations in order to improve public access and lateral shoreline views along Kamehameha Highway".
- DHHL's draft So. Molokai Shoreline Erosion Management Plan (SM_SEMP), currently under review, assesses causes, identifies effective and sustainable shoreline erosion management strategies, and educates homestead communities on best practices and nature-based solutions. The SM-SEMP will enable DHHL to develop shoreline protection, conservation and restoration priorities and guidelines and work with its lessees to proactively plan for and better manage and mitigate sea level rise-related impacts.

- County of Maui Department of Parks and Recreation published the Maui Beach Park Vulnerability and Adaptation Study with shoreline adaptation strategies for 65 beach parks.
- The West Maui Community Plan includes goal 2.1.5 | Protect the shoreline and beaches by preserving waterfront land within the SLR-XA as open space wherever possible.



2.1 Evaluate existing policies and institutional capacity of implementing smart redevelopment

- Act 208, SLH2022 expands the purpose and rationale for Special Improvement Districts to include financing of climate change and sea level rise adaptation.
- City & County of Honolulu Office of Climate Change and Resilience was established in the City Charter in 2017 increasing institutional capacity for coordinating actions and policies to improve community resilience to climate change and sea level rise impacts and integrating sustainable and environmental values into City plans, programs, and policies.
- County of Maui established an Office of Climate Change, Resiliency, and Sustainability in 2022 to increase capacity including through the ongoing development of a Climate Action and Resiliency Plan and Resilient Housing Guide.

2.2 Identify priority areas for smart redevelopment as part of a managed retreat strategy

- West Kaua`i Community Plan (adopted 2020) includes Objectives (page 65) to provide a higher elevation area for property owners with vulnerable homes to retreat to in the future via transfer of development rights or land swap opportunities and that evacuated land serves as a buffer against future coastal hazards.

2.3 Conduct a market study for priority redevelopment areas

- No known progress.

2.4 Develop detailed redevelopment strategies for priority areas and incentivize development

- West Kaua`i Community Plan (adopted 2020) includes an Objective (page 65) to Support a master-planned new community mauka within a Walkable Neighborhood designation to accommodate workforce housing, planned growth, and a potential sea level rise managed retreat area.
- The Waimea 400 Master Plan incorporates considerations of flooding and sea level rise in land use planning.

2.5 Update capital improvement planning to incorporate sea level rise and prioritize infrastructure improvements for priority redevelopment areas

- Act 178, SLH2021 requires OPSD, in cooperation with each state agency having operational responsibilities over state facilities, to identify existing and planned facilities that are vulnerable to sea level rise, flooding impacts, and natural hazards; assess a range of options to mitigate the impacts of sea level rise to those facilities. OPSD-CZM maintains a Story Map titled Sea Level Rise Adaptation in Hawai`i to track progress on meeting the Act 178 mandate.

2.6 Develop design standards for existing and proposed land uses that limits urban growth and increases flood resiliency within the SLR-XA

- Act 16, SLH2020 amended HRS § 205A-44 to ensure that permitted structures within the shoreline setback may not be rebuilt or replaced without a new variance. Specifically, it states that "permitted structures may be repaired, but shall not be enlarged, rebuilt, or replaced within the shoreline area without a variance."
- City and County of Honolulu released Climate Adaptation Design Principles identifying recommended tools and best practices to consider in designing building sites and structures to be resilient to sea level rise, flooding, extreme heat, and groundwater inundation.
- In October 2022, County of Kaua`i passed first of its kind Sea Level Rise Constraint District that uses passive flooding and wave runup models developed for Hawai`i Sea Level Rise Viewer. Using these modeled sea level rise hazards, the constraint district requires the elevation of at least two feet out of harm's way for residential structures and at least one foot out of harm's way for non-residential structures to limit the risk to public health and safety. The constraint district is a great example of resilient design standards for proposed uses within the SLR-XA.

2.7 Require the design and siting of planned new development and capital improvement projects to include an in-depth analysis of sea level rise impacts based on elevation, tolerance for risk, and lifetime of the structure

- The State Environmental Impact Statement Rules (HAR 11-200.1) were updated in 2018 to include consideration of location in the sea level rise exposure area in determining whether an action may have a significant effect on the environment. Environmental Impact Statements and Environmental Assessments must include SLR-XA maps as an indication of impact on the environment.
- The 2018 Kaua'i General Plan Policy 3.2C1 States: "In accordance with Hawai'i State Planning Act Priority Guidelines, consider multiple scenarios of SLR and associated flooding, wave inundation, and erosion impacts when developing and approving capital improvement projects."

2.8 Develop State and County guidance and a checklist for developers to assist with the integration of sea level rise in project design and encourage the use of best management practices for incorporating green and sustainable approaches in all stages of project development.

- City and County of Honolulu released Climate Adaptation Design Principles identifying recommended tools and best practices to consider in designing building sites and structures to be resilient to sea level rise, flooding, extreme heat, and groundwater inundation.

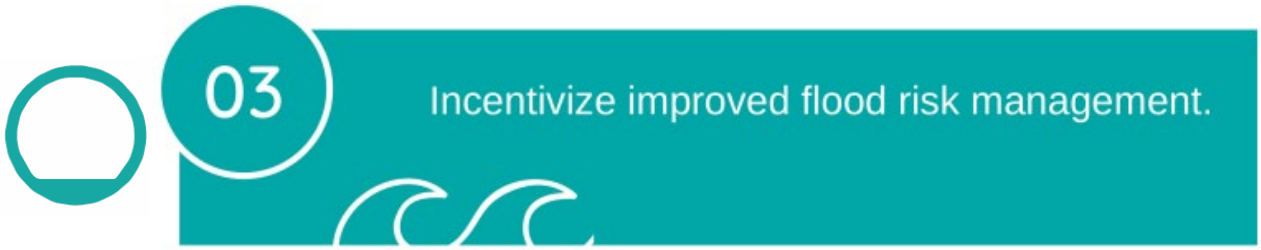
2.9 Develop guidance on integrating sea level rise and climate change in the environmental review process and incorporating environmental justice considerations

- Act 17,SLH2018 directed the environmental council to adopt and maintain rules pursuant to chapter 91, Hawai`i Revised Statutes, requiring all environmental assessments and environmental impact statements prepared pursuant to chapter 343, Hawai`i Revised Statutes, whether in draft or final form, to include consideration of sea level rise based upon the best available scientific data regarding sea level rise. Subsequent rules amendments incorporated the requirement.
- In November, 2019 the State Climate Commission released a Statement on Climate Equity which urges government entities in Hawai`i to Use a vulnerability framework that is appropriate for Hawai`i, and incorporate cultural responsiveness, reflect indigenous voices and customary law practices to identify any inequitable distribution of benefits, burdens and processes caused by climate change impacts and policy; and - Recognize and address the inequitable distribution of benefits, burdens and processes, by incorporating equity considerations into their planning, policy development and implementation for climate change mitigation, adaptation and resilience. For adaptation policies relating to sea level rise, such a framework should address equity issues surrounding access to information in the identification and prioritization of addressing the impacts of sea level rise on critical public infrastructure—such as roads, bridges, schools, hospitals, shelters and other structures. It poses the question: How will Hawaii's vulnerable communities provide input into policymaking that addresses the impacts of sea level rise?
- The State Environmental Impact Statement Rules (HAR 11-200.1) were updated in 2018 to include consideration of location in the sea level rise exposure area in determining whether an action may have a significant effect on the environment. Environmental Impact Statements and Environmental Assessments must include SLR-XA maps as an indication of impact on the environment.
- CZM's NOAA Coastal Fellow began her 2-year fellowship on August 1, 2022. The Fellow's project focuses on the nexus of coastal hazards and social vulnerability in Hawai`i and aims to better understand and identify communities with higher risk to coastal hazards due to socio-economic and demographic factors.

2.10 Integrate sea level rise vulnerability considerations into the Hawai'i Coastal Zone Management (CZM) Act

- Act 16, SLH2020 amended the Hawai`i Coastal Zone Management Act (HRS Chapter 205A) to further protect against impacts of sea level rise including adding sea level rise in the definition of "coastal hazards."
- Act 16, SLH2020 amended the Hawai`i Coastal Zone Management Act (HRS Chapter 205A) to further protect beaches by increasing the minimum shoreline setback in each county from 20 to 40 feet. Specifically, the legislature amended HRS § 205A-43 to mandate that shoreline setbacks throughout the state be "not less than forty feet inland from the shoreline."
- County of Maui and County of Kaua`i amended their shoreline setback ordinances to include a historical erosion rate-based setback. Updates are pending with the City and County of Honolulu, would update Revised Ordinances of Honolulu Chapter 23, relating to Shoreline Setbacks, to incorporate the 2020 CZMA amendments and implement a historical erosion-based shoreline setback formula on O'ahu (Bill 41, 2022).

Amendments to the Maui County ordinance to utilize a model-based erosion hazard line as the baseline for setbacks are pending.



3.1 Adopt higher flood standards to account for sea level rise

- The State of Hawai`i 2018 Hazard Mitigation Plan incorporated the results of modeling and an assessment of vulnerability to coastal flooding from storm-induced wave events with sea level rise. A 1%-annual-chance coastal flood zone with 3.2 feet of sea level rise was modeled to estimate coastal flood extents for wave-generating events including tropical storms, hurricanes, tsunamis, and other severe wave events with sea level rise and was added to the Hawai`i Sea Level Rise Viewer.
- County of Kaua`i adopted Bill 2879 to update the zoning ordinance to require the lowest floor of any new dwellings in the Sea Level Rise Constraint District be raised 2 feet above the highest sea level rise flood elevation as projected by the SLR-XA Viewer and associated Kaua`i SLR Constraint District Viewer. New, non-livable buildings need to be raised 1 foot above the flood elevation projection.

3.2 Consider adopting V zone construction standards in the Coastal A Zone

- No known action.

3.3 Provide technical and financial support to a state-wide Community Rating System program

- No known state-wide action
- County of Maui and County of Hawai`i are active Community Rating System (CRS) communities. Currently, flood insurance policy holders in the County of Maui benefit from a 15 percent reduction in their NFIP premiums due to Maui's proactive flood risk reduction measures. Residents of the County of Hawai`i already receive 10 percent reductions.
- County of Kauaii's status as an active CRS community is pending, an official announcement is expected in 2023

3.4 Encourage property owners at risk to coastal flooding to purchase flood insurance

- DLNR, FEMA and Hawai`i Independent Insurance Agents hosted a continuing education seminar on the National Flood Insurance Program (NFIP) for licensed insurance agents in August 2019.
- The City and County of Honolulu Office of Climate Change, Sustainability and Resiliency provides information flood risk and flood insurance on their Get Flood Ready website.

3.5 Incorporate sea level rise into state and county hazard mitigation plans

- The State of Hawai`i 2018 Hazard Mitigation Plan included expanded risk and vulnerability assessment for Climate Change and Sea Level Rise utilizing the SLR-XA data from the 2017 Report and Viewer.
- The 2020 Multi-Hazard Pre-Disaster Mitigation Plan for the City and County of Honolulu incorporates Climate Change, Sea Level Rise and coastal erosion into the vulnerability and mitigation planning.
- The 2020 County of Maui Hazard Mitigation Plan Update incorporates Climate Change, Sea Level Rise and coastal erosion into vulnerability and mitigation planning.
- The 2020 County of Hawai`i Multi-Hazard Mitigation Plan recognizes Climate Change, Sea Level Rise and coastal erosion into vulnerability and mitigation planning.
- The 2020 County of Kaua`i County Multi-Hazard Mitigation and Resilience Plan incorporates Climate Change, Sea Level Rise and coastal erosion into vulnerability and mitigation planning.

3.6 Adopt a state-wide program that supports the Building Code Effectiveness Grading Schedule(BCEGS) program for insurance rating

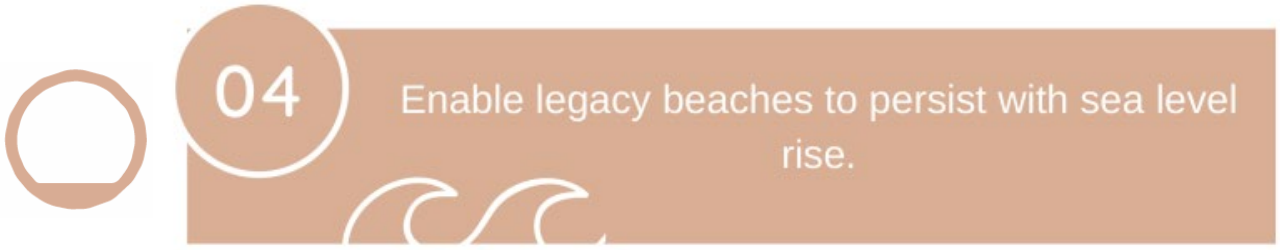
- HI-EMA conducting surveys of BCEGS eligibility ratings for each county - recently assessed Kaua`i County with a rating of 9, and currently assessing Big Island.

3.7 Develop pre-disaster recovery frameworks at state and county levels that incorporate opportunities to adapt to sea level rise through disaster recovery

- HI-EMA's 2020-2025 Five Year Strategic Plan recognizes development of disaster recovery frameworks as a key element in meeting preparedness goals.
- Honolulu Office of Climate Change, Sustainability, and Resilience has a current grant-funded project to develop a Long-Term Disaster Recovery plan and tools to help O`ahu organize and recover more quickly from a disaster.
- Hawai`i Sea Grant is in receipt of grant funding to assist County of Kaua`i develop a pre-disaster recovery plan beginning in 2023.

3.8 Perform a study to identify what other incentives could be utilized to promote improved flood risk management.

- No known action.



4.1 Conduct a state-wide assessment to identify legacy beach conservation priorities

- Act 16, SLH 2020 updated the Hawai`i Coastal Zone Management Act (HRS Chapter 205A), including strengthening protections for beach and other coastal environments and prohibitions against seawalls and other coastal armoring.
- OPSD-CZM is conducting a Regional Shoreline Management Scoping Study (ongoing) to develop and outline a recommended approach that can help define regions and subregions for the purpose of improving shoreline management. The Scoping Study will explore strategies for utilizing environmental characteristics and conditions to define "regions" for the purposes of rethinking shoreline management across the state, with the intention of facilitating larger-scale, nature-based, comprehensive management strategies.
- DLNR-OCCL completed an statewide programmatic environmental assessment and is in the process of updating its permitting program for Small Scale Beach Restoration.
- The City and County of Honolulu adopted Ordinance 22-22 Relating to Indigenous Plants in Public Beach Parks prioritizing the use of appropriate indigenous plantings to enhance the health of beaches and dunes and enhance resilience.

4.2 Establish a "willing seller" program to move development away from legacy beaches

- OPSD-CZM published a report titled *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i* in 2019 and is embarking on a next-step study that will assess the options for and implications of implementing managed retreat from the perspectives of (1) policy and regulation and (2) funding and financing mechanisms.in 2023.

4.3 Amend the State Legacy Lands Act to set aside funding for priority coastal lands and enable the use of a variety of practices and tools

- Legislation to amend the State Legacy Lands Act was considered but determined not to be the best mechanism for designating funds for coastal land acquisition. An update to this Recommended Action is detailed later in this report.

4.4 Expand the area of national, state, and county parks and wildlife refuges to preserve critical coastal wildlife habitats

- No known action.

4.5 Prioritize coral reef preservation to buffer the impacts of coastal hazards with sea level rise

- In 2021 SCR159, SD1 directed the following: "Department of Land and Natural Resources is urged to examine and consider purchasing reef insurance to support nature-based solutions to protect Hawaii's coastline and coastal infrastructure from natural disasters.". The Division of Aquatic Resources found reef insurance to be a

valuable financial tool because of its accessibility to both public and private sector funds and its ability to rapidly deploy money for reef resilience maintenance via emergency restoration. They also encouraged continued investigations into additional funding sources, as this is not the only financial tool for hazard mitigation utilizing nature-based solutions. Additional findings related to coral reef's role in coastal protection and sea level rise mitigation can be found in the Division of Aquatic Resource's Reef Insurance Feasibility Report.

4.6 Develop public-private partnerships for coastal land acquisition, beach management, and reef protection

- Act 208, SLH2022 expanded the purpose and rationale for Special Improvement Districts to include financing of climate change and sea level rise adaptation.
- Hawai`i Sea Grant published the Hawai`i Dune Restoration Manual in 2022. The manual is a resource for community groups, nonprofits, county and state agencies and departments, coastal resorts and condominiums, coastal landowners and managers, and anyone interested in conducting proactive dune restoration projects in partnership with Hawai'i Sea Grant community extension agents.

5.1 Develop an archipelagic-wide inventory of Native Hawaiian cultural resources and practices impacted by sea level rise

- OHA's Kipuka Database is a geographical information system (GIS) that utilizes the latest mapping technologies to provide a window into native Hawaiian land, culture and history. Kipuka links historic data sets to geographic locations reinforcing the concept of information embedded in the 'aina (land), encoded in the wahi inoa (place name). The foundation of Kipuka is the traditional land system, mokupuni divided into moku, ahupua'a, ili and kuleana. The mission of Kipuka is to create a repository of knowledge where information about Hawai'i's land, culture and history can be easily accessed, to develop a virtual mo'oku'auhau of land tenure in Hawai'i, and to provide an opportunity for individuals to forge new relationships between themselves and the 'aina (land) that is most important to them.

5.2 Work with Native Hawaiian Communities to develop a culturally-based adaptation process and protocols to preserve iwi kūpuna and Native Hawaiian cultural resources and practices with sea level rise

- The County of Kauai`i is engaged in developing an island-wide Climate Adaptation Plan.

5.3 Develop adaptation plans to preserve access to coastal lands and water within Native Hawaiian communities with sea level rise.

- No known action.

6.1 Identify hazard mitigation measures to address coastal flooding of hazardous material/waste storage facilities, underground storage tanks, and on site sewage disposal systems vulnerable to sea level rise

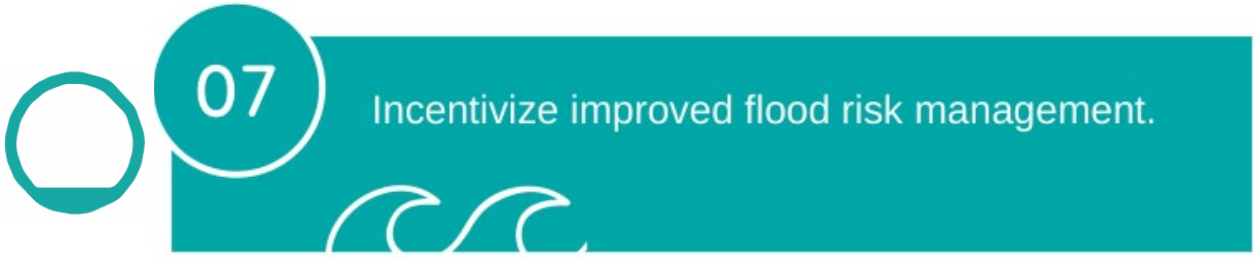
- Hawai`i Department of Health, Hazard Evaluation & Emergency Response Office released a memorandum in June 2021 describing how increased flooding, groundwater inundation and sea level rise resulting from climate change will increase risks to human health and the environment from chemical contamination.
- There are currently over 88,000 cesspools in Hawai`i and many of them are in the Special Management Area and located on beachfront properties. State has banned the construction of new cesspools and has required that all current cesspools be converted by 2050. Act 125, SLH2017 requires conversion of cesspools by 2050. Act 153, SLH2022 authorized development of a pilot program to assist low- and middle-income residents to complete the conversion.
- A state income tax credit is available for upgrading a cesspool to a septic or aerobic system or connecting to the sewer for cesspools located within 500 ft of the shoreline, a perennial stream or wetland, or within a source water assessment program area.
- The Department of Health (DOH) has been authorized by Act 132, SLH2018 to establish a cesspool conversion working group. The purpose of this working group is to develop a long-range, comprehensive plan for cesspool conversion statewide for all cesspools by 2050. The final report of the working group is due to the legislature prior to the 2023 session.
- During FFY 2022 approximately $12.3 million under the Base Clean Water State Revolving Fund (CWSRF) appropriation and $14.5 million under the Bipartisan Infrastructure Law (BIL) CWSRF appropriation will be allocated to the State of Hawai`i. The DOH Wastewater Branch is now prioritizing funding of wastewater projects that will support sustainable infrastructure to withstand the effects of rising Sea level due to climate change and provide adaptation for coastline innovation.

6.2 Review existing environmental regulations, guidance documents, and best management practices

- No known action.

6.3 Update guidance and propose legislative amendments to existing environmental regulations.

- No known action.



7.1 Conduct more detailed financial and economic analysis of sea level rise impacts in the SLR-XA

- No known action.

7.2 Develop a multi-pronged financing strategy at federal, state, county, private sector, and philanthropic levels to address costs of adaptation to sea level rise

- Act 208, SLH2022 expands the purpose and rationale for Special Improvement Districts to include financing of climate change and sea level rise adaptation.

7.3 Require mandatory disclosure for private properties and public offerings located in areas with potential exposure to sea level rise

- In 2021, the State of Hawai`i enacted an update to the Mandatory Seller Disclosures in Real Estate Transactions Law, codified within Hawai`i Revised Statutes §508D-15, requiring that real estate transactions within the State must disclose any risk of sea level rise (up to and including the 3.2-feel sea level rise scenario) to the property. The Commission released a flyer regarding the Disclosure Requirement for Residential Real Estate in the Sea Level Rise Exposure Area in 2022 to assist real estate agents and homeowners effectively navigate the new law. The promotional materials include information on how to identify whether a property is at risk, what the potential risks are, and how to use the Hawai`i Sea Level Rise Viewer.

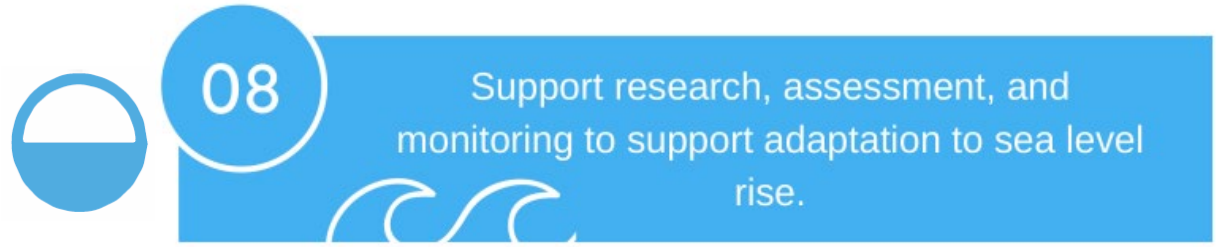
7.4 Explore the use of transfer of development rights and purchase of development rights programs that facilitate managed retreat and legacy beach preservation

- Act 223, SLH2022 expands the authority of the counties to transfer development rights to address areas at risk of sea level rise, coastal erosion, storm surge, or flooding associated with climate change.
- Honolulu City Council is considering a bill (Bill 10, 2022) with proposed updates to the Land Use Ordinance relating to transfer of development rights from properties within the special management area (SMA) to a location outside the SMA is in discussion in the City Council.

7.5 Consider the feasibility of a buy-out program for residential property owners vulnerable to sea level rise

- In February 2019 OPSD-CZM released a report titled *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i*. The report determined that at time of writing, it was unrealistic to develop a step-by-step plan to implement managed retreat areas in Hawai`i threatened by sea level rise, given

a variety of unknowns and competing priorities. Instead, the assessment reports findings regarding retreat programs and their relative significance to Hawai`i and a specific multi-prong recommendation regarding the feasibility of retreat in Hawai`i.



8.1 Update coastal hazards modeling and vulnerability assessment as needed based on new climate science, sea level rise projections, and methods

- Ongoing updates to the modeling for the SLR-XA Viewer are outlined in the Updates to the 2017 Report and Viewer above and in the Next Steps section at the end of this Report.
- In 2022 HDOT Highway's released an Asset and Hazard Map that lets users explore the intersection of transportation infrastructures and climate hazards across Hawaii.
- In 2021 Pac IOOS released a Wave Runup Tool for West Maui and theWest Maui Wave Flooding Tool to provide specific information for the region.
- County of Maui developed the Maui County Beach Park Vulnerability Tool.

8.2 Engage communities in monitoring the impacts of sea level rise

- Hawai`i Sea Grant sponsors the Hawai`i and Pacific Islands King Tides citizen science program to enable individuals to contribute to the documentation of the impacts of King Tides to better understand tomorrow's impacts from sea-level rise and other coastal hazards.

8.3 Conduct in-depth assessment of vulnerability and evaluation of adaptation strategies for critical infrastructure throughout the State

- In 2021, the State's Thirty-First Legislature recognized that climate change and sea level rise "pose significant, dangerous and imminent threats to the State's social and economic well-being, public safety, nature and environment, cultural resources, property, infrastructure, and government functions and will likely have a disproportionate impact on low-income and otherwise vulnerable communities." Act 178, SLH2021 Relating to Sea Level Rise Adaptation was passed to begin the long-term planning needed to effectively address climate impacts. The purpose of this Act is to: (1) Require the OPSD, in coordination with state agencies with operational responsibilities over state facilities, to: a. Identify existing and planned facilities that are vulnerable to sea level rise, flooding impacts, and natural hazards; b. Assess options to mitigate the impacts of sea level rise to those facilities; and c. Submit annual reports to the Governor, Legislature, and the Hawai`i Climate Change Mitigation and Adaptation Commission regarding vulnerability and mitigation assessments for state facilities and progress toward implementing sea level rise adaptation in future plans, programs, and

capital improvement needs and decisions. (2) Update and reaffirm the role of the OPSD to coordinate climate change adaptation and sea level rise adaptation among all state agencies to improve the interagency coordination of these activities; and (3) Amend the Hawai`i State Planning Act to include sustainable development, climate change adaptation, and sea level rise adaptation as objectives for facility systems.

- OPSD-CZM released a 2021 Annual Report for Act 178, SLH2021. The report describes OPSD's activities and progress related to the implementation of Act 178, Relating to Sea Level Rise Adaptation, including a discussion on the findings of an initial state facility inventory and exposure assessment, considerations for future assessments, and recommendations for next steps. The report identifies a three phased approach: 1) conduct a high-level inventory of state facilities vulnerable to sea level rise; 2) conduct a vulnerability assessment of facilities in order to prioritize needs; and 3) identify a suite of mitigation and adaptation strategies for vulnerable facilities.
- OPSD-CZM is developing a Menu of Coastal Hazard Adaptation Strategies Suitable for Hawai`i Coastlines. The project deliverable is a comprehensive, informational resource that outlines potential coastal adaptation strategies. Each strategy will have its own "Strategy Info Card" which highlights the strategy's pros and cons, appropriate site conditions, potential permits, etc. The project is scheduled to be completed by November 2022.
- OPSD-CZM is developing a Regional Shoreline Management Scoping Study. This scoping study is an exploratory step towards a regional shoreline management strategy for the State of Hawai`i. Current shoreline management is done at the parcel level which often leads to "harder" adaptation solutions. This study will result in a proposed methodology for defining "coastal regions and subregions" that considers environmental and land use factors. The project is scheduled to be completed by December 2022.
- Hawai`i Sea Grant, University of Hawai`i Department of Urban and Regional Planning, and County of Kaua'i conducted a 2-year community-based vulnerability assessment for climate change and sea level rise on West Kaua`i using the decision support tool: Vulnerability, Consequences, Adaptation, Planning Scenarios or VCAPs. The assessment covered 6 management concerns and profiled 5 towns. This involved mapping of exposed community assets, and 7 four-hour workshops with the community. All the community participants combined resulted in over 100 hours sharing important information on how West Kaua`i is vulnerable to sea level rise, and options for adaptation. The final report was produced in June 2020. The County of Kaua`i incorporated the results of the WKCVA into the West Kaua`i Community Plan, a land use and policy document for the west side, which was adopted in 2020.

8.4 Develop a sea level rise research, assessment, and monitoring agenda to support the 5-year update process

- The Climate Resilience Collaborative (CRC) is a research program at the University of Hawai`i at Mānoa, School of Ocean and Earth Science and Technology, that is funded through the Office of Naval Research and led by Dr. Chip Fletcher. CRC is an affiliation of researchers, technicians, modelers, architects, attorneys, economists, planners, and undergraduate and graduate students spread across the Mānoa campus working on challenges related to climate change. CRC personnel conduct investigations of sea level rise and community design, increasing resilience to extreme weather events, projecting future climate stresses and shocks, marine and reef impacts, and better understanding

community exposure to rising heat, storms, and drought. This requires cross-disciplinary and integrated research investigation on a range of spatial and temporal scales.

9.1 Develop sea level rise adaptation priorities for the Hawai`i Climate Commission

- The Hawai`i Climate Commission adopted Recommendations for Countering the Impacts of Sea Level Rise in September, 2018.

9.2 Continue to support the Office of Planning and DLNR-OCCL to provide leadership, technical support, education and outreach, and interagency coordination to the Hawai`i Climate Commission and other stakeholders for sea level rise

- Working closely with the OCCL Administrator, Hawai`i Climate Mitigation and Adaptation Commission Coordinator, and planning staff at the DLNR-OCCL through cooperative funding agreements, University of Hawai`i Sea Grant extension specialists aid the DLNR-OCCL and partner State and county government agencies in making sound, science-based decisions promoting responsible and proactive coastal land use planning and coastal zone management and assist the DLNR with its climate change and sea level rise adaptation efforts.
- The 2020 Ocean Resources Management Plan: Coastal Zone Management Mauka to Makai provides guidance for a focused effort to improve State policies for ocean resources by addressing management gaps in the State. Within the focus area of Development and Coastal Hazards, the Plan identifies community action opportunities, main entities in the action team, and recommendations for stakeholders to consult. The Plan also lists out proposed projects and initiatives addressing this focus area, based on closing identified management or knowledge gaps. The ORMP's Coordinated Working Group, program managers representing a variety of agencies at the state, county and federal levels, meet quarterly to exchange information and build collective knowledge.
- OPSD-CZM worked with the USACE to officially establish the Hawai`i Silver Jackets Team in 2021. The Team's first initiative, approved in 2022, is to develop a framework for decision-making along Hawaii's shorelines. Actions planned through this proposal include identification of specific decision-making roadblocks and possible resolutions through 1) review of state and county regulations & 2) proposed revisions to facilitate consistent land use decisions that ensure the inclusion of current and projected environmental conditions, coastal hazard risks, and types of development. CZM will collaborate with county planning departments, OCCL, HI-EMA, NOAA OCM and USACE. The proposal is designed to obtain alignment of agency responses to chronic coastal hazards and provide homeowners/developers/planners with predictability on what mitigation strategies are acceptable. The Silver Jackets team acknowledges that this proposal may not allow for resolved decision-making for all of Hawaii's diverse coastal

geologies, hydrodynamics, and development patterns and will work collectively towards identifying highest priority typologies.

- 9.3 Develop a multi-agency, multi-media, and multi-stakeholder education and outreach program as part of a long-term commitment to building an informed and active constituency on climate change mitigation and adaptation
    - The Hawai`i Climate Change Portal hosted by the Climate Commission hosts a consolidated inventory of climate adaptation and mitigation documents and tools.

- 9.4 Develop a monitoring and evaluation plan with benchmarks and indicators to support the 5-year update process
    - No known action.

Further Recommendations and Next Steps

As we continue to make progress towards achieving the recommendations set forth in the 2017 Report, we must also focus on realigning our path and goals to continue to progress over the next five years. This includes proposing updated recommendations to guide State and County Agencies in continued planning and implementation of sea level rise related adaptation and mitigation efforts, as well as identification of new and unmet needs. Together, the updated recommendations and identification of unmet needs present a roadmap for bridging to a next-generation State of Hawai`i Sea Level Rise Viewer and a comprehensive update to the Hawai`i Sea Level Rise Vulnerability and Adaptation Report in five years.

Recommendations

The accomplishments achieved since 2017 provide a solid foundation for continued action for the state to meet the challenges and impacts of sea level rise. All 2017 recommendations and recommended actions should be continued over the next five years, with some minor edits and additions as outlined below. This report includes new recommended actions that align with existing recommendations from the 2017 Report and updates to some 2017 recommended actions.

This section presents the following:

- Two new recommendations, labeled as **2022 Recommendations,** with associated Recommended Actions, labeled as **2022 Recommended Actions**,
- One updated 2017 Recommendation, labeled as **Updated 2017 Recommendation** with three associated updated 2017 Recommended Actions, labeled as **Updated 2017 Recommended Actions,** and
- Thirteen new Recommended Actions aligned with 2017 Recommendations, labeled as **2022 Recommended Actions**.

2022 Recommendation 1: Conduct a full update of the Sea Level Rise Vulnerability and Adaptation Report in 2027.

- 2022 Recommended Action 1.1: Develop a next-generation State of Hawai`i Sea Level Rise Viewer and complete a more extensive update of the Hawai`i Sea Level Rise Vulnerability and Adaptation Report in 2027 utilizing the latest and best-available climate change and sea level rise

scientific information and sea level rise exposure map data (e.g., Climate Resilience Collaborative at the University of Hawai`i). The state should allocate funding to complete a comprehensive report in 2027 with a focus on community-level impacts and actions and implementation of identified adaptation recommendations from 2017. This recommendation builds on the existing mandate for a review and update every five years by proposing that the 2027 Report include a full vulnerability assessment and documentation of ongoing initiatives to reduce vulnerability and increase resiliency and adaptation. Contracting and drafting for the 2027 Report should begin at least two years in advance of the reporting deadline mandated by Act 32, SLH2017. Current progress towards developing the next-generation Sea Level Rise Viewer is detailed in the Next Steps Section, below.

- 2022 Recommended Action 1.2: Develop a centralized tracking system to coordinate all efforts that are responsive to the 2017 and 2022 Report Recommendations. Establish a position within DLNR, in coordination with the Climate Commission, to improve cooperation and coordination between State and county agencies for all issues relating to sea level rise mitigation and adaptation, and to raise the visibility and understanding of these efforts to the public and across the state and county government agencies. The state should create a reporting tool potentially housed by the State Climate Commission, to consolidate reporting of progress towards meeting the objectives and recommendations of the 2017 Report and this Update. Ongoing accounting for the initiatives and progress from state and county agencies will enable greater visibility between agencies and will support the completion of the 2027 Report. This Recommended Action also aligns with 2017 Recommended Action 9.4 Develop a monitoring and evaluation plan with benchmarks and indicators to support the 5-year update process.
- 2022 Recommended Action 1.3: Identify emerging issues and unmet needs for sea level rise adaptation and mitigation not addressed by the 2017 Report. State and county agencies, in coordination through the State Climate Change Commission, should review current and ongoing initiatives to determine unaddressed issues for consideration in the 2027 Report.
- 2022 Recommended Action 1.4: Conduct an updated and more detailed vulnerability assessment within the SLR-XA: As part of the 10-Year Update the state should conduct a full review of all actions taken in response to these recommendations and the 2017 recommendations to determine the changes in vulnerability within the SLR-XA as a factor of exposure, sensitivity, and adaptive capacity. The vulnerability assessment should include a detailed analysis of socio-economic factors including community sensitivity and adaptive capacity**.**

2022 Recommendation 2: Continue to implement the 2017 Recommendations with minor edits as outlined in the 2022 Report Update.

- 2022 Recommended Action 2.1: Identify gaps in progress since 2017. State agencies should work towards completing and where necessary, revising the recommendations from the 2017 Report with a particular focus on areas where significant progress is lacking in the past five years. The state should ensure that agencies are adequately resourced to implement programs and policies to address the increased risk of sea level rise.

2017 Recommendation 1: Support sustainable and resilient land use and community development

- Updated 2017 Recommended Action 1.1: Recognize the SLR-XA as a statewide exposure zone: The phrase “vulnerability zone” should be replaced with “exposure zone” to more accurately

reflect what the SLR-XA depicts. Vulnerability within the exposure area can be reduced through adaptation measures for infrastructure that cannot be moved. Although all infrastructure within the SLR-XA is vulnerable to sea level rise, several factors can impact the extent of vulnerability or resiliency.

- 2022 Recommended Action 1.7: Update planning guidance to reflect most recent sea level rise projections:
  Following the latest Sweet, et al., 2022 NOAA-interagency sea level rise report, the state should set a revised planning and policy benchmark of 4 ft as the minimum scenario for all planning and design based on the report's Intermediate (mid-range) scenario for Hawai`i of 3.9 feet of sea level rise by 2100, and apply a 6 ft benchmark for planning and design of public infrastructure projects and other projects with low tolerance for risk based on the report's Intermediate High scenario for Hawai`i of 5.9 feet of sea level rise by 2100. The latest science suggests that the SLR-XA for 3.2ft of sea level remains valid as a planning overlay for the mid century at this time. The State should continue to use the 3.2 foot Sea Level Rise Exposure (SLR-XA) and NOAA 6 foot passive flooding map data available in the Viewer until updated SLR-XA data is available. Agencies should incorporate the revised planning benchmarks into adaptation planning to account for the more accurate regional projections prior to the availability of revised SLR-XA data as possible. This recommendation is consistent with recent recommendations from the City and County of Honolulu Climate Change Commission which recommends an increase from 3.2 feet of sea level rise by 2100.
- 2022 Recommended Action 1.8: Implement the recommendations of the February 2019 Office of Planning and Sustainable Development - Coastal Zone Management Program report titled "Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i": The state should establish and fund programs at the state and county level to incentivize relocation (e.g., willing-seller managed retreat) to benefit community resilience and protect public trust resources. Such programs include the ongoing work to:
  - Expand the State's and counties' ability to implement voluntary managed retreat "tools" including but not limited to transfer of development rights (TDRs), rolling easements, and land transfers;
  - Review state and county land use to determine where it may be possible to retreat to, i.e, "receiving areas";
  - Engage communities to obtain their input and priorities for retreat location strategies;
  - Identify and establish federal, state, and county funding for retreat and restoration of coastal lands to natural conditions or lightly developed parklands for public benefit of conserving shoreline access and improving community resilience;
  - Review state and county plans to determine where they may be amended and updated to support retreat;
  - Review laws and regulations that may have to be amended and adopted to facilitate retreat;
  - Prioritize support for voluntary relocation of multi-generational shorefront landowners; and
  - Establish managed retreat pilot implementation areas.

- 2022 Recommended Action 1.9: Conduct long-term strategic planning for maintenance, repair and replacement of critical infrastructure within the SLR-XA in advance of emergent need: State

agencies should undertake long-term strategic planning initiatives to reduce the use of emergency measures for maintenance and repair of facilities and infrastructure within the SLR-XA. Emergency authorizations and implementation of adaptation measures reduce public input to the planning and permitting process. While immediate emergency action is sometimes necessary for public health and safety, it should not be used to circumvent public involvement. Proactive and comprehensive long-term planning for sea level rise impacts prior to emergency situations is necessary to safeguard natural resources while ensuring ongoing maintenance and potentially relocation of critical infrastructure. Accurate SLR-XA data available via the Viewer provides an advanced look at future sea level conditions and is a key planning tool for applying planning benchmarks outlined in this report.

2017 Recommendation 2: Prioritize smart urban redevelopment outside the SLR-XA and limit exposure within the SLR-XA

- 2022 Recommended Action 2.10.1 Incorporate existing and emerging scientific data in updates to shoreline setback ordinances: The state should support the counties in updating shoreline setback and zoning ordinances to reflect the increasing threat of coastal erosion and sea level rise.

2017 Recommendation 3: Incentivize improved flood risk management; Recommended Action 3.1 Adopt higher flood standards to account for sea level rise

- 2022 Recommended Action 3.1.1: Improve guidelines and regulations for planning and design in the SLR-XA and FEMA Special Flood Hazard Zones: Establish a position within DLNR, in coordination with the Climate Commission, to improve cooperation and coordination between State and county floodplain management and planning departments to integrate sea level rise considerations into floodplain management and hazard mitigation.
- 2022 Recommended Action 3.1.2 Utilize passive flooding and wave runup model projections in building and zoning ordinances (e.g., "Constraint District"): The state should support counties in updating zoning ordinances and building codes to incorporate model projections of passive flooding and wave runup.

Updated 2017 Recommendation 4: Enable ~~legacy~~ beaches to persist with sea level rise;

- Updated 2017 Recommended Action 4.1: Conduct a state-wide assessment of beaches applying the objectives of the Hawai`i Coastal Zone Management Act (HRS §205A-2). The DLNR, Office of Conservation and Coastal Lands (OCCL), together with federal, state, and county governments, nongovernmental organizations, and local stakeholders, should undertake a state-wide assessment to identify beaches and dune systems that are important for recreational uses, cultural practices, wildlife habitat, and coastal resilience. The state should further coordinate with county agencies to prohibit development in such areas, and even consider removing development from areas with upland sand deposits if we hope to retain this vital natural and cultural resource for future generations.
- Updated 2017 Recommended Action 4.2: Establish a "willing seller" program to move development away from beaches: The State should establish a "willing seller" program that pre-identifies property owners that would be willing to sell or relocate their property outside of the

state-wide vulnerability zone. There are many successful examples of "willing seller" programs, the most notable of which is the City of Portland, Oregon's "Johnson Creek Willing Seller Program" which helps move people and property out of areas that frequently flood. Restoration projects on land acquired through the program increase flood storage, improve fish and wildlife habitat, restore wetlands, and create passive recreational activities for city residents. For more information regarding this program, please visit https://www.portlandoregon.gov/bes/article/106234.

- Updated 2017 Recommended Action 4.3: Explore legislative and policy mechanisms to designate funding for priority coastal lands and enable the use of a variety of practices and tools and utilize existing programs to acquire beaches and other coastal lands for recreational, cultural, ecosystem and resilience objectives: The state and counties should consider additional legislative actions to identify a dedicated sources of funding for coastal land acquisition. The state should further pursue opportunities to leverage programs such as the Federal Coastal and Estuarine Land Conservation Program, as detailed in the Hawai`i Coastal and Estuarine Land Conservation Plan, and other federal or state land acquisition grant programs as they become available to acquire coastal property for conservation purposes. In addition to land acquisition for beaches, a variety of tools, including buffer zones and conservation easements, are needed to support conservation of coastal lands through incremental changes in the shoreline. Buffer zones could be used to restrict development within specified distances of natural and cultural resources. Expanding buffer zones around beaches, sand dunes, and coastal wetlands would provide space for these environments to migrate landward with rising sea levels. State law authorizes public bodies and nonprofit organizations to hold conservation easements for the purposes of preserving and protecting open space, natural landscapes, cultural and historical sites and resources, and agricultural lands.
- 2022 Recommended Action 4.4: Support County Parks Departments in the management of county beach parks. The State should coordinate closely with the County Parks Departments to ensure that beach parks are managed holistically and with natural resource protection as a key priority. Beach Parks present the best opportunity for the preservation of public access and conservation of natural shorelines and beach habitat.

2017 Recommendation 6: Protect nearshore water quality from sea level rise impacts

- 2022 Recommended Action 6.1.1: Support research and development efforts to identify and implement affordable alternatives to cesspools in shoreline areas: Following on the outcomes of the cesspool conversion working group, the state should sponsor research and development efforts to expand affordable and actionable conversion options for shoreline property owners. Such options should account for SLR-XA projections of coastal erosion and associated land loss, and potential failure of onsite sewage treatment systems resulting from SLR-induced groundwater inundation. Removal of cesspools is imperative to the health of nearshore waters for all properties within the SLR-XA and for members of the public accessing coastal resources. Removal may not be achievable by 2050 as directed by state law without viable alternatives for replacement.

- 2022 Recommended Action 6.4: Develop clear policy and guidance for onsite sewage disposal systems in the sea level rise exposure area to protect public health: The state should expand policy directives beyond the existing income tax credits and requirement for removal by 2050. Specifically, policy must address existing cesspools in the coastal zone in relation to

enforcement of existing laws and regulations and removal of unpermitted shoreline hardening. Cesspools on the shoreline and in the coastal zone will be an increasing source of nonpoint-source pollution as groundwater rises and coastal erosion accelerates. Applicable to Recommendation 6.1.

Recommendation 7: Develop innovative and sustainable financing and incentives to support adaptation to sea level rise

- 2022 Recommended Action 7.6: Explore the use of the FEMA funding for use in Hawai`i**:** The state should explore FEMA funding options to support moving homeowners away from flood zones in support of a comprehensive managed retreat plan. Specifically work with FEMA for Building Resilient Infrastructure and Communities (BRIC) grants, hazard mitigation programs and other funding opportunities to identify options for federal support to Hawaii's adaptation priorities. Additionally, the state should work with federal representatives to explore exemptions from prohibitive FEMA policies, particularly on DHHL Land where the lessee model may prohibit individuals from participating in the National Flood Insurance Program (NFIP).

2017 Recommendation 9: Promote collaboration and accountability for adapting to sea level rise

- 2022 Recommended Action 9.5: Incorporate community-scale vulnerability assessments and adaptation planning into the 2027 Sea Level Rise Vulnerability and Adaptation Report. The state should develop detailed and comprehensive community-based climate change and sea level rise vulnerability assessments and adaptation strategies that prioritize areas experiencing the most immediate and severe impacts with early and continuous community engagement and input.
- 2022 Recommended Action 9.6: Improve cooperation between state and county government agencies to strengthen enforcement and compliance with existing coastal laws The state should encourage and support its agencies to cooperate across jurisdictional frameworks and with the counties' various agencies to manage coastal resources. The state should encourage progessive action by its agencies to enforce coastal conservation laws and public and private compliance with coastal conservation laws. For county agencies that have conducted vulnerability assessments for their sectors, the state should review the assessments for consistency and consolidate them to comprehensively visualize and track vulnerabilities across the state.
- 2022 Recommended Action 9.7: Increase state agency capacity to enforce existing laws and regulations. The state should prioritize enforcement and compliance for natural resource protection by increasing staffing in regulatory, legal and enforcement agencies.

Next Steps

As an immediate next step, the State Climate Commission should adopt this report and forward it to the Legislature.

In addition to the recommendations listed above, the process of preparing this report has identified the following unmet needs and areas in need of focus in the next five years.

- **Facilitate interagency coordination for holistic adaptation planning** (e.g., comprehensive consideration and planning for natural resources, roads, communities; and improved communications between government agencies) (2017 Recommendation 9, 2022 Recommendation 1)
- **Conserve and adapt Native Hawaiian cultural resources and sites** (2017 Recommendation 5)
- **Integrate equity and justice considerations to vulnerability assessments and adaptation planning and actions** (2017 Recommendation 2)
- **Address and stop the loss of shoreline access** (2017 Recommendation 4)
- **Integrate economic valuation and ecosystem co benefits of natural coastal resources into planning and actions** (2017 Recommendations 4, 5 and 8)
- **Make managed retreat a viable option and identify funding mechanisms for adaptation** (2017 Recommendations 2 and 7)
- **Implement phased adaptation to sea level rise** (2017 Recommendation 1, 2, 7)

The Climate Commission should set these unmet needs as priority action areas from 2023-2027. To facilitate coordination among state agencies, the Commission should host a staff-level workshop or series of workshops for discussion of this report and the actions for each agency going forward. Such a workshop will set the agenda for the next five years, create a mechanism to ensure ongoing interagency collaboration, and provide a baseline for action.

Next Steps for the SLR Viewer

To increase our ability to plan for sea level rise The Climate Resilience Collaborative at the University of Hawai`i is working to update and expand the State of Hawai`i Sea Level Rise Viewer. Utilizing federal funding, researchers are developing the next generation of passive flooding, high wave flooding, coastal erosion, compound events and other relevant sea level rise exposure map data that will be available in three to five years. Specific elements of the work towards as Sea Level Rise Viewer 2.0 are as follow:

- Augment existing imagery database and increase spatial and temporal resolution of coastline observations by incorporating imagery from satellites and small unmanned aerial systems (sUAS or drones). This will allow for enhanced detail in analyses and modeling. Calculating historical rates of shoreline change with increased precision will improve future predictions of shoreline locations.
- The USGS-developed Coastal Storm Modeling System - Coastal On-line Assimilated Simulation Tool (CoSMos-COASTS) is being adapted to Hawai`i-specific wave conditions, and future sea level rise projections to emulate how the ocean behaves in the near shore environment in two directions – along-shore and cross-shore to expand on the existing SLR-XA modeling.
    - Development of a full transect grid along the islands' coastlines, including digitizing the shoreline and identifying non-erodible areas, as well as correctly classifying beach types and littoral cell boundaries for the CoSMos-COASTS model. This team is also working to set up the framework for collecting LandSat, Sentinel, and Planet Labs satellite imagery through the CoastSat package, written by Kilian Vos (UNSW).
    - Collecting aerial imagery and modeling the Island of O'ahu in phases. Orthomosaics have been generated for some areas in the islands, the shoreline positions have been

digitized and beach width determined, and historical and future shoreline change rates and hazard zones have been produced. Finally, aerial surveys are being conducted of all the shorelines.

The current SLR viewer has given the state of Hawai`i an opportunity to look ahead and understand the risks of sea level rise well into the future. In a collaborative effort, this new research will help to provide improved estimates of future shoreline positions for all beaches in Hawai`i with increased spatial and temporal accuracy. Ultimately, these predicted shoreline positions will continue to inform policy decisions for shoreline management, and community resilience for the State. With this knowledge, as the state adapts to higher sea levels, priority should be given to adaptation tools that protect, and enhance the public coastal resources and access. It is critical that developments, and redevelopments be sited and designed to not require future protection that may alter a natural shoreline.

Conclusion

As sea level rise continues to accelerate, the State of Hawai`i must maintain a constant and ongoing effort to adopt policies and programs to support adaptation to a changing world. Although there has been progress made towards reducing vulnerability and enhancing adaptability, we must maintain a diligent focus on continual and ongoing improvement of community engagement, laws, regulations, and policies to meet the challenge ahead and safeguarding our cultural and natural resources while also providing adaptation tools to the people of Hawai`i in an equitable manner. The recommendations contained in the 2017 Report and this update provide key steps towards increasing the islands' resiliency to sea level rise and many of the recommended actions provide co-benefits such as mitigating impacts from storms and tsunami and improving overall community vitality. In the next five years, the state must continue to work towards identifying and implementing programs which sustain vibrant communities while improving resilience to sea level rise and mitigating other natural hazards.

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Appendix A

Responses to Learning Questions from the 2017 Hawai`i Sea Level Rise Vulnerability and Adaptation Report

Sea Level Rise Outlook: Global and Local Observations and Projections

1. What are the observations of change in sea level in the vicinity of the Hawaiian Islands, and how do they correspond with the recent global acceleration in mean sea level rise?

Long-term observational data from local tide gauge stations show that sea level is rising around Hawai'i. Models indicate that Hawai'i and other tropical Pacific sites will experience sea level rise that is 16% to 20% higher than the global average (Sweet. et al. 2022). The NOAA 2022 report provides a range of regionalized sea level rise scenarios based on differing GHG emissions pathways and associated global warming and ice sheet melt. The report finds that sea level will rise around Hawaii between 0.7 and 1.5 feet by 2050. The Intermediate (mid-range) estimate is for a rise of 1.0 feet (relative to sea level in the year 2000). The observed rate of sea level rise measured from tide gauges in Hawaii lead to a median estimate of 0.8 feet by 2050, though this rate is expected to accelerate in coming decades similar to global trends. Sea level will rise between 1.3 and 8.0 feet by 2100 (relative to the year 2000) with an Intermediate estimate of 3.9 feet (Sweet, et al. 2022).

2. To what extent has the magnitude and timing of the sea level rise projections from IPCC AR5 changed with new projections from the IPCC AR6?

Sea level rise exposure mapping in the 2017 Hawai'i Sea Level Rise Report and Hawaii Sea Level Rise Viewer is based on an upper-end projection in the 2013 IPCC 5th Assessment Report of 3.2 feet of global mean sea level rise by 2100. As expected, the science on sea level rise observations and forecasts has continued to advance. Since completion of the 2017 Report, peer-reviewed scientific literature as well as government and multinational reports increasingly point to 3 to 4 feet of sea level rise by 2100 as a mid-range, rather than high-end, scenario for Hawai'i.

3. What are the observations and projections of the frequency and intensity of tropical cyclones and El Niño events and their effects on coastal water levels and tidal flooding?

Major tropical cyclones (hurricanes) in Hawaii's region of the Central North Pacific are much less common than in the Eastern and Western tropical Pacific. From 1991-2020, an average of 3.6 tropical storms, 1.7 hurricanes (Category 1 or above), and 0.9 major hurricanes (Category 3 or above) occurred per year in the Central Pacific (J. Marra and H. Diamond, NOAA, personal communication, November 21-22, 2022). Of particular note in the past five years, Hurricane Walaka reached Category 5 status on October 1, 2018 passing south and west of the main Hawaiian Islands but traveled directly over Kānemiloha'i (French Frigate Shoals) in Papahānaumokuākea Marine National Monument as a Category 3 hurricane (https://www.nhc.noaa.gov/data/tcr/CP012018_Walaka.pdf). East Island, a low-lying sand and gravel atoll island in French Frigate Shoals and an important green sea turtle nesting site, was almost completely washed away by Walaka's waves and storm surge. Elevated sea surface temperatures in the Central North Pacific (1.0º to 1.5º Celsius above average) and low wind shear contributed to Walaka's unusual strength (H. Diamond, NOAA, personal communication, November 21, 2022). While it

is difficult to blame climate change on a single storm event, Walaka may serve as an example of increasing tropical cyclone activity and impacts for Hawaii likely to occur in coming decades.

Advancing research since the 2017 SLR Report using climate models points to similar frequency but increasing intensity of tropical cyclones around Hawaii, linked primarily to increased warming of ocean surface waters (Widlansky, et al. 2019). El Nino conditions generally mean increased occurrence of tropical storms around Hawaii. The "triple dip" La Nina conditions over the past three years has likely suppressed tropical cyclone activity around Hawaii over that time period due to cooler waters and increased windshear (changes in wind speed and direction with altitude). Record high sea levels in 2017 have been linked to delayed effects from a strong El Nino in 2015 and climate model projections point to increased periods of weak trade winds following El Nino events that have been linked to the occurrence of high sea levels around Hawaii (Long, et al. 2020).

Methodology

1. **To what extent do new global sea level rise projections differ from those used in this hazard modeling?**

Sea level rise exposure mapping in the 2017 Hawai'i Sea Level Rise Report and Hawaii Sea Level Rise Viewer is based on an upper-end projection in the 2013 IPCC 5th Assessment Report of 3.2 feet of global mean sea level rise by 2100. As expected, the science on sea level rise observations and forecasts has continued to advance. Since completion of the 2017 Report, peer-reviewed scientific literature as well as government and multinational reports increasingly point to 3 to 4 feet of sea level rise by 2100 as a mid-range, rather than high-end, scenario for Hawai'i.

2. To what extent have data and coastal hazard modeling improved to warrant updating this hazard modeling?

As current science, observations and projections evolve, the University of Hawai`i Climate Resilience Collaborative is working to update and expand the State of Hawaii Sea Level Rise Viewer. Utilizing federal funding, researchers are developing the next generation of passive flooding, high wave flooding, coastal erosion, compound events and other relevant sea level rise exposure map data that will be available in three to five years.

3. To what extent have property values, population, and other development trajectories changed from the baseline data used in this report?

<u>Property Values</u>
The 2017 Report estimated that the value of private lands and structures within the SLR-XA on O'ahu was roughly $12.9 billion. A precise answer to this question was not attainable for the purposes of this report. Calculations of the change in property value are in progress by the University of Hawai'i Institute for Sustainability and Resilience (ISR), led by Dr. Makena Coffman (personal communications, 2022).

<u>Population</u>
The 2017 Report states that "[o]ver the next 30 to 70 years, chronic flooding with sea level rise will increase, impacting homes and businesses located near the shoreline. Approximately…19,800 people statewide would be exposed to chronic flooding in the SLR-XA with 3.2 feet of sea level rise." A precise answer to this question was not attainable for the purposes of this report. Updated population calculations are in progress by the ISR.

Development

The 2017 Report states that "[o]ver the next 30 to 70 years, chronic flooding with sea level rise will increase, impacting homes and businesses located near the shoreline. Approximately 6,500 structures…statewide would be exposed to chronic flooding in the SLR-XA with 3.2 feet of sea level rise."

Development trends throughout the state have not significantly changed since 2017, however the recent and pending updates to county SMA and shoreline setback ordinances may affect coastal development patterns moving forward.

4. Is the SLR-XA for 3.2 feet of sea level rise modeled in the Report still valid as the exposure overlay for the mid to latter half of this century?

The latest science suggests that the SLR-XA for 3.2ft of sea level remains valid as a planning overlay for the mid century at this time. Following the latest Sweet, et al., 2022 NOAA-interagency sea level rise report, the State should update the guidance to set a planning and policy benchmark of 4 ft for all planning and design for actions and infrastructure planned to 2100, and apply a 6 ft benchmark for planning and design of public infrastructure projects and other projects with low tolerance for risk.

Results

1. To what extent is potential chronic flooding in the SLR-XA with 1.1 foot of sea level rise aligned with areas currently exposed to chronic flooding?

In 2017, and again in 2020, the Honolulu Harbor Tide gauge recorded the highest daily mean water levels observed over its 112-year history. These record high water levels were produced by a combination of phenomena that included long-term global sea level rise, peak annual astronomical tides ("king tides"), wave setup, and migration of warm buoyant waters brought in by winds and currents. During both events, observed sea levels tracked between 0.5 and 1 ft higher than predicted, providing a glimpse of what will become a more common occurrence in the near future as sea level continues to rise. Flooding observed during these events was widely documented as part of the Hawai`i and Pacific Islands King Tides citizen science program. Local impacts were observed throughout the State in the form of increased coastal erosion, minor wave over-wash flooding, backshore flooding from groundwater rise and storm drain backflow, and impeded and potentially hazardous beach access. Observations in low-lying areas like Mapunapua on Oahu confirmed flooding characterized by SLR-XA passive flood layers representing the 1.1 ft scenario.

2. Are there any new developments or critical infrastructure in the SLR-XA with 3.2 feet of sea level rise not accounted for in the vulnerability assessment?

State and County updated policies are designed to reduce the building of new homes and infrastructure within the SLR-XA. In preparing this report, a full assessment of new development or critical infrastructure within the 3.2ft SLR-XA was not conducted. This report recommends a full vulnerability assessment for the 2027 Report.

3. To what extent have land and structure values for parcels in areas potentially impacted by sea level rise changed as a basis for estimating potential economic loss?

It is not clear that there has been any trend in shoreline development or retreat that would meaningfully change the basis for estimating economic loss in the SLR-XA since the 2017 Report.

4. To what extent has human migration from other Pacific Islands and wildlife migration from the NWHI to the main Hawaiian Islands changed?

It is unknown at this time whether there has been a change in human and wildlife migration patterns since the 2017 report.

5. What adaptation measures have been taken to reduce vulnerability to sea level rise?

Several adaptation measures have been taken throughout the state which reduce vulnerability to sea level rise. Most of these are detailed in the Recommendations section of the report, and are highlighted here briefly as specific measures which may reduce individual vulnerability to sea level rise.

The following is a general listing of actions which are further detailed in the Recommendations section in the body of this report:

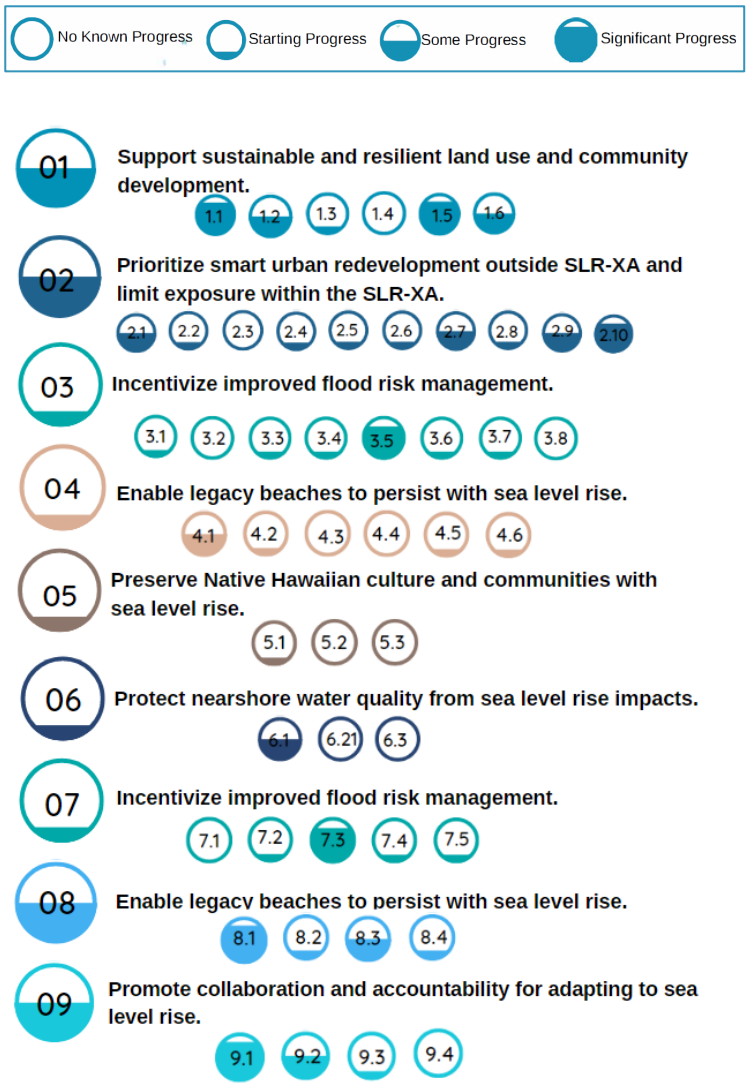
- County of Kaua'i passed first of its kind Sea Level Rise Constraint District that uses passive flooding and wave runup models developed for Hawai'i Sea Level Rise Viewer. The constraint district is a great example of resilient design standards for proposed uses within the SLR-XA.
- The state implemented a disclosure requirement for real estate transactions for all properties located within the sea level rise exposure area.
- The state has sponsored or permitted beach nourishment activities in Waikiki and elsewhere which improve resiliency by augmenting the beach profile and replacing eroded sand onto the beach. Coupled with sand nourishment, some projects have also included groin construction in an effort to keep nourished sand on the beach.
- In 2020, County of Kaua`i established a Special Treatment Coastal Edge District (ST-CE) as areas that are highly vulnerable to coastal hazards including but not limited to sea level rise, coastal erosion, high wave run-up, passive flooding, and an increased frequency and intensity of storms. Within the ST-CE any use, structure, or development permitted with or without a Use Permit in the Special Treatment Coastal Edge District shall mitigate impacts from coastal hazards, including but not limited to sea level rise, coastal erosion, high wave run-up, passive flooding, and an increased frequency and intensity of storms.
- Along the elevated portions of the Honolulu Rail Transit Project between Chinatown and Ala Moana Center the stations were redesigned so no electronics below 6ft and elevated portions meet federal requirements even if roads are raised by 6ft. Additionally, all hanging elements were removed to allow for 6ft of adaptation.
- Sidewalks and entryways in Kaka`ako are elevated above street level to account for flooding.
- The City and County of Honolulu and the Maui County both issued Mayoral Declarations requiring executive departments to consider and incorporate SLR-XA data for capital planning.
- City and County of Honolulu Department of Planning and Permitting instituted a requirement for consideration of sea level rise for all building permits and for all properties conducting renovations within the SLR-XA.

Recommendations

1. What recommendations have been implemented and why?

The status of the recommendations and recommended actions contained in the 2017 Report is covered in detail in the body of this report. Progress towards meeting the nine recommendations (represented

by large circles) and 49 associated recommended actions (represented by small circles) is presented here as measured on a qualitative scale of “no known progress” to “significant progress”.



Some key statewide accomplishments that address the recommendations are noted as follows:

Use of the Sea Level Rise Exposure Area Data and Sea Level Rise Viewer: Although the Sea Level Rise Exposure Area (SLR-XA) was not officially recognized as a state-wide vulnerability zone, the Viewer and SLR-XA are in widespread use by state and county agencies for adaptation planning purposes. The use of the SLR-XA data as identified by the Viewer for policy decisions was enabled by the peer reviewed publication of the methods, which allowed for the removal of the original disclaimer language cautioning against such use. Easy availability and the establishment of guidance for SLR-XA data interpretation via the viewer made it critically important to the success of planning efforts and new policies. We recommend a continual peer review of ongoing research to strengthen the research products used in policy decision making.

**Hawai`i Coastal Zone Management Act Updates**: Act 16, SLH2020 updated the Hawai`i Coastal Zone Management Act (HRS Chapter 205A) in many ways including strengthening protections for beach and

other coastal environments by specifically prohibiting private shoreline hardening structures and minimizing public shoreline hardening structures, including seawalls and revetments, at sandy beaches where they would interfere with existing recreational and waterline activities.

Sea Level Rise Report Addendum: Guidance for Using the Sea Level Rise Exposure Area in Local Planning and Permitting Decisions was published by the State as a supplement to the 2017 Report. The Addendum was prepared by the University of Hawai`i Sea Grant College Program with the Hawai`i Department of Land and Natural Resources - Office of Conservation and Coastal Lands for the Hawai`i Climate Change Mitigation and Adaptation Commission - Climate Ready Hawai`i Initiative. The Hawai`i Climate Change Mitigation and Adaptation Commission issued a statement of approval for the Addendum at its October 28 2020 meeting.

Hawai`i 2018 Hazard Mitigation Plan: The 2018 update of the State's Hazard Mitigation Plan includes expanded consideration of climate change and sea level rise hazards, including hazard assessment using the SLR-XA and a 1% Annual-Chance Coastal Flood Zone with 3.2 feet of sea level rise (1%CFZ-3.2) modeled for the Plan: https://dod.hawaii.gov/hiema/sert-resources/hazard-mitigation/

Planning for Managed Retreat: OPSD-CZM published a report titled *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai`i* in 2019 and is embarking on a next-step study that will assess the options for and implications of implementing managed retreat from the perspectives of (1) policy and regulation, and (2) funding and financing mechanisms in 2023.

Statewide Inventory of Vulnerable Infrastructure: Act 178 Relating to Sea Level Rise Adaptation was passed to begin the long-term planning needed to effectively address climate impacts. OPSD-CZM submitted a report to the legislature in 2021 reporting on progress towards the phased approach required by Act 178.

In addition to the above listed state-wide highlights, the ongoing support from University of Hawai`i entities such as the Sea Grant College Program, the Climate Resilience Collaborative, and others) to state and county agencies provided expertise for interpretation of the report and practical implementation of recommendations and use of data. The capacity to address the impacts of sea-level rise grew at county and state levels of government. For example, the City and County of Honolulu established the City and County of Honolulu established the Climate Change Commission. The City and County of Honolulu and the County of Maui established an Office of Climate Change, Sustainability and Resiliency; the County of Hawaii maintains a Climate Change Action program within its Office of Research and Development and the County of Kauai maintains a Sustainability Program Area within its Office of Economic Development.

2. What recommendations have not been implemented and why?

Although the state made progress towards implementing the recommendation of the 2017 Report, there are areas of unmet need that require a renewed focus over the next five years.

- **Facilitate interagency coordination for holistic adaptation planning** (e.g., comprehensive consideration and planning for natural resources, roads, communities; and improved communications between government agencies) (2017 Recommendation 9, 2022 Recommendation 1)
- **Conserve and adapt Native Hawaiian cultural resources and sites** (2017 Recommendation 5)

- **Integrate equity and justice considerations to vulnerability assessments and adaptation planning and actions** (2017 Recommendation 2)
- **Address and stop the loss of shoreline access** (2017 Recommendation 4)
- **Integrate economic valuation and ecosystem co benefits of natural coastal resources into planning and actions** (2017 Recommendations 4, 5 and 8)
- **Make managed retreat a viable option and identify funding mechanisms for adaptation** (2017 Recommendations 2 and 7)
- **Implement phased adaptation to sea level rise** (2017 Recommendation 1, 2, 7)

The status of the recommendations and recommended actions contained in the 2017 Report is covered in detail in the body of this report.

The summary graphic in the answer to question 2 in this section captures recommendations and recommended actions for which no action and/or little progress was reported.

The 2017 Recommendations were adopted by the State Climate Commission but were not specifically assigned to individual agencies for action. As a result, individual agencies prioritize and implement new programs or policies aligned with their strategic goals, and not in response to all recommendations from the 2017 Report. Overall funding and personnel capacity also hinder progress towards implementing the recommendations and recommended actions.

3. What have been barriers to implementation and measures taken to overcome these barriers?

The COVID pandemic caused delays to action across the federal, state and county government agencies. Although capacity to address climate change and sea level rise increased at the state and county levels, there is a need for additional personnel and funding as outlined in the updated recommendations in this report. Additionally, specific to the implementation of progressive shoreline setback ordinances, there is a need for public engagement and education regarding the need and benefit for increased setback distances. Opposition from property rights advocates will continue to be an issue when attempting to implement stricter setback rules.

There is also a lack of funding mechanisms to enable managed retreat. The ongoing work of OPSD-CZM to study the various possibilities should be supported and the findings of the initial study should be implemented.

4. To what extent has Hawaii's capacity to adapt to sea level rise increased based on benchmarks and measurable indicators?

Among the updated recommendations presented in this interim report is a focus on the facilitation of interagency coordination for holistic adaptation planning and greater resources dedicated to tracking and integrating agency initiatives and efforts towards adaptation. There are currently no benchmarks or measurable indicators to measure the State's progress towards sea level rise adaptation. In order to objectively assess Hawaii's capacity to adapt to sea level rise, we must set benchmarks for measurement and all state and county agencies must adopt and utilize those benchmarks.

This Report did not undertake an effort to assess reductions in vulnerability or increased capacity to adapt to sea level rise based on the implementation of the recommended actions. We recommend that the state should conduct a full review of all actions taken in response to the 2017 and 2022 recommendations to determine the reduction in vulnerability for areas within the exposure area. as part of the 10-Year Update.