

CLIMATE CHANGE ADAPTATION AND PLANNING: AN EXAMPLE FROM KAILUA BEACH, OAHU, HAWAII

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Introduction

The University of Hawaii Sea Grant College Program (UHSG) in partnership with the Hawaii Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL) is developing a beach and dune management plan for Kailua Beach on the eastern shoreline of Oahu. The objective of the plan is to develop a comprehensive beach management and land use development plan for Kailua Beach that reflects the state of scientific understanding of beach processes in Kailua Bay and abutting shoreline areas and is intended to provide long-term recommendations to adapting to climate change including potential coastal hazards such as sea level rise. The development of the plan has led to wider recognition of the significance of projected sea level rise to the region and provides the rationale behind some of the land use conservation strategies. The plan takes on a critical light given global predictions for continued, possibly accelerated, sea-level rise and the ongoing focus of intense development along the Hawaiian shoreline. Hawaii's coastal resource managers are faced with the daunting prospect of managing the effects of erosion while simultaneously monitoring and regulating high-risk coastal development that often impacts the shoreline. The beach and dune preservation plan is the first step in a more comprehensive effort to prepare for and adapt to sea level rise and ensure the preservation of the beach and dune ecosystem for the benefit of present and future generations. The Kailua Beach and Dune Management plan is intended to be the first in a series of regional plans in Hawaii to address climate change adaptation through land use planning.

Project Objectives

- Identify threats to the beach resources
- Document coastal processes and land use issues that negatively impact the dune ecosystem.
- Assess adaptation/mitigation options for coastal hazard exposure of abutting owners.
- Assess effectiveness of existing laws for beach and dune conservation.
- Expand understanding of appropriate beach and dune management practices and the potential impacts of climate change.
- Foster a community-based management approach for Kailua Beach.
- Develop Planning Strategy and *Implementation Plan*
- Develop recommendations for dune and beach management and restoration.
- Develop recommendations for new or revised rules related to dune and beach management.

Description of Setting

Kailua Beach is located on the windward coast of Oahu, Hawaii. Kailua Beach is a wide, crescent-shaped, fine calcareous sand beach fronting Kailua Bay that stretches approximately 2.6 miles between two rocky points -- Kapoho Point to the north and Alala Point to the south (Figure 1). Near Alala Point, the beach is traversed by Kaelepulu Stream. Most of the beach, from Kapoho Point to just north of the Kaelepulu Stream mouth, abuts adjacent residential single family homes. The portion of beach near the mouth of Kaelepulu Stream and south to Alala Point encompasses the City and County of Honolulu's Kailua Beach Park. Kailua Beach is well known for its scenic beauty and recreational value and is widely marketed as a visitor attraction. Its shallow clear waters, gentle waves, soft white sands, and absence of coral or rock bottoms make this beach amenable to a wide variety of age groups, users, and activities.

Beach Loss and Human Impacts

The beaches in Hawaii are subject to both socioeconomic and natural influences. Seasonal surf, wind intensity and direction, episodic coastal storms, foot traffic on the dunes and shoreline development all influence the shoreline. Natural retreat of the shoreline while retaining width is referred to as coastal erosion. When the beach erodes too far

landward and begins to threaten private property, landowners often erect seawalls or other forms of shoreline armoring to protect their investment. The armoring, in turn, often causes scour of the beach instead of the natural shoreline retreat. This is referred to as beach erosion or beach loss¹. Kailua Beach is currently not armored; however, continued coastal erosion, combined with the potential long-term effects of sea level rise, may result in property loss and a desire to armor the shoreline. The purpose of a beach management plan is to identify potential hazards and provide recommendations for planning alternatives that will prevent or lessen the impetus to armor the shoreline.

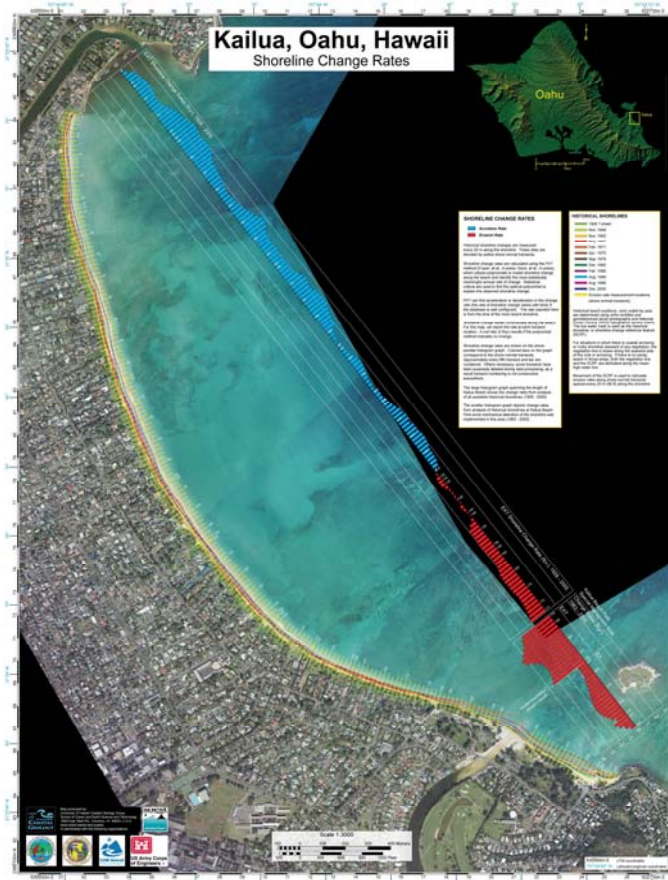


Figure 1: Kailua Bay, Oahu, Hawaii showing historical shoreline erosion (red) and Accretion (blue) rates. (Image Courtesy of Dr. Chip Fletcher).

Beach Processes: Historical Accretion/Erosion Patterns

Kailua Beach is an extremely dynamic coastal system, a result of the variable wind and wave forces that affect and influence the beach and dune. Beach loss and coastal erosion are not new phenomena at Kailua Beach, which has experienced periods of accretion and erosion, both seasonal and long-term in the recent past and the present. A 1981 beach erosion study of Oahu using historic aerial photographs revealed patterns of erosion and accretion at Kailua Beach.² A subsequent coastal erosion study showed that, between 1978 and 1988, Kailua Beach continued the long-term accretion trend along the center of the beach averaging a 27 foot increase.³ At the southern portion, near Kailua Beach Park, the beach history showed an average beach width increase of 23 feet during the same 10-year

¹ Department of Land and Natural Resources, *Hawaii Coastal Erosion Management Plan (COEMAP)*, p. 12.

² Hwang, Dennis, *Beach Change on Oahu as Revealed by Aerial Photographs*, 1981, p. 67-71.

³ Sea Engineering, Inc. for Department of Land Utilization, *Oahu Shoreline Study, Part I Data on Beach Changes*, 1988, p. 34-35.

period. A 2009 University of Hawaii erosion mapping study of Kailua Beach reveals a similar picture of the erosion/accretion pattern confirming a long-term accretion trend in the North-Central section, an erosion trend in the southern section.⁴

Future Scenario for Sea Level Rise at Kailua Beach

Kailua Beach has been spared much of the shoreline erosion effects of a rising sea because it continues to have a sufficient supply of sand to replenish the beach. In fact, Kailua is one of the few accreting beaches on Oahu, having grown wider by a half meter per year over the last 70 years despite sea-level rise during the same period.⁵ Nevertheless, the effects of sea level rise will eventually appear at Kailua Beach, as well as other beaches statewide, resulting in beach erosion and flooding.

Sea Engineering, Inc., (SEI) created future shoreline simulations for Kailua Beach based on current scientific knowledge, including the sources cited above. This effort maps the location of the simulated shorelines and the approximate projected year when the shorelines will be at the locations indicated. These projections are based on current knowledge, and represent the current state of understanding but are not confirmed quantitative predictions. Nevertheless, these shoreline projections provide a useful picture of what may occur if sea level continues to rise at Kailua Beach as predicted by the global scientific community. These maps suggest the long-term trend of beach accretion will eventually reverse, and the shoreline will retreat landward beginning in the coming decades.

Management Approaches

Beach management and restoration should be a holistic site-specific process. There are many different factors to take into account when developing a resource management plan, such as implementation time frame, coastal hazards, regulatory agencies, engineering and planning techniques, and all the compounding and complex interactions between environmental ecosystems. A comprehensive management plan should emphasize assessment and recognition of hazards early in the development process rather than waiting until after subdivision and construction to address hazards. Comprehensive beach management plans should address the need to protect the beach and dune resources based on scientific realities of environmental processes and climate trends. The international scientific community anticipates that sea-level rise will be a significant factor in the loss of many low-elevation tidal areas and beaches in the coming decades. Increased rates of sea-level rise in recent decades must be taken into account when developing general community and management plans.⁶ Future management options may include: Managed Retreat – Allow the beach to behave naturally regardless of the cause of erosion or the impacts that shoreline retreat may have upon inland properties. Adaptation – Modify development patterns and principles to allow erosion to occur naturally without interfering with development. Protect natural shoreline attributes from the impact of human alterations to coastal processes. Restoration – Replace sand and natural vegetation within a littoral system.

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⁴ Fletcher, C., Romine, B., Barbee, M., Lim, S., Vinson, A., University of Hawaii Coastal Geology Group, School of Ocean and Earth Sciences and Technology, 2009.

⁵ Norcross, et al, 2002.

⁶ Davis, R., *Voice of San Diego*, *A Sea Change: Worries Over Rising Tide*, December 14, 2006