

## Ocean 201 week 6 Lecture 1: Coastal Erosion (M.J. Mottl)

Text from slides

### Sea Level Summary

- Sea level is rising!
  - Sea level fell from ~30Ka to ~20 Ka due to ice buildup.
  - Sea level has been (generally) rising for the past 20 Ka. (evidence from drowned reefs).
  - Global sea level has risen about 20 cm over past century, largely due to melting of glacial ice.
  - There is a local effect of Hawaiian geology on sea level rise.

Sea level is rising as Earth's climate warms!

6-8 inches in the last century and faster in the future!

“Sea level is likely to rise 26 cm (10 inches) by 2050 and 55 cm (2 feet) by 2100.”

U.S. EPA <http://www.epa.gov/globalwarming/>

Erosion will only worsen with time. This issue will not go away!

### Global and Local Sea-Level Rise

Every island has its own rate of sea-level rise.

Downward push at hotspot causes upward bulge under Oahu.

As the Pacific Plate moves, every island rides over the bulge causing uplift.

The young Big Island is so heavy it bends the lithosphere.

**Oahu has lost 25% of its beaches over the past few decades! Maui has lost 30%!**

Tourism supports over 60% of Hawaii's jobs.

As visitors see beaches disappearing, *they won't return!*

Over 50% of Waikiki Beach is lost!

An example of chronic coastal erosion:

a 1970's condominium at Honokowai Point, West Maui

Sandy shorelines erode 150 increments for every 1 increment of sea-level rise.

For a 0.24 m rise by 2050, beaches will recede 36 m (118 ft).

***Erosion is caused by:***

1. ***Sea-level rise*** forcing shoreline retreat
2. Waves and currents moving sand
3. ***Human impacts*** to sand availability.

**Seasonal changes in waves can cause temporary erosion.**

Summer vs. Winter Beach Profiles: in winter, beach sand is stored in offshore bar

**Longshore Drift:** movement of sand along the shore in response to a current along shore, that results from waves hitting the shore at an angle

**Human Impacts:**

1. Sand impoundment
  2. Longshore trapping
  3. End scour
  4. Drainage channel dredging
  5. Dune leveling/filling
  6. Sand mining
- = **Poor Sand Management!**

Sand mining at Waimea Bay caused over 200 feet of erosion.  
Beach sand was used as lime to fertilize sugar cane crops.  
Jump rock used to be buried in sand!

*Lanikai, 1995: the traditional approach to erosion management in Hawaii has been to armor the coast to save the land. But walls and lawns impound the sand!*

Hardening: Seawalls are constructed where there is erosion, but they do not solve the erosion problem; they protect the land without protecting the beach.

Private rights vs. public rights

Whose rights should prevail? The public owns the beach, but the landowner has the right to protect private land.

Seasonal beach changes can threaten houses even though the erosion soon ends.  
Armoring this shoreline will eventually impact the sand volume available for natural beach dynamics.

**Water quality suffers on armored shores:**

- High turbulence from wave reflection
- Fleshy algal growth
- Septic discharge
- Tidal ecosystem heavily damaged.

Chronic coastal erosion is a statewide problem.

More walls are built in response, saving the land but eliminating the beach.

Homeowner trying to protect his land from erosion –public beach is being destroyed to save private land. (This house was built 100’ from the shoreline!)

**Is this fair to the public? Is it fair to stop the homeowner ?**

FEMA National coastal erosion study of 60 year erosion hazard, 1996

**Beach Loss**

17 miles on Oahu, 9 miles on Maui

***Beaches are 50-75% narrower in front of walls!***

### **Impacts**

Access to the ocean is lost.  
Marine ecosystem is damaged.  
Dune plants and ecosystem damaged.  
Cultural practices with ocean are lost.  
Tourism economy is impacted.

Present setbacks do not offer adequate protection.  
Older lots are being subdivided. Development density continues to rise on all shores.  
Despite recommendations of many studies, SMA rules still fail to discriminate chronically eroding shores, and zoning ordinances make no allowance for long-term erosion trends and rates.

Beaches lie in a jurisdictional no-man's land! State protects beach. County develops land.  
--Setback  
--Zoning

Erosion problems and complexities lead to conflicts (= politics!)  
Walkway closed to protect hotel pool from erosion – Kaanapali, Maui

***Political problems can never be resolved, only managed.*** The way to manage them is through education, demonstration, information and leadership.  
Leadership can be displayed by involved citizens and active state and county government – elect people who care about the environment!

### **Five options for erosion management**

1. **Harden** the shoreline – *beach loss, access decreased, environmental impacts*
2. **Control** the erosion rate with sand fill and structures  
- *expensive, community rejection of structures*
3. **Adapt** human occupancy to accommodate erosion  
- *difficult, impractical, requires new zoning*
4. **Abandon** the shoreline  
- *impractical on heavily developed shores*
5. **Restore** the beach - *increasing costs with time, long-term sand mining impacts?*

**Erosion Control:** Kuhio Beach, Waikiki

**Abandonment** – what criteria support abandoning the shoreline?  
(economics, environment, public use)

Beach restoration by sand nourishment is a world-wide tool in managing coastal erosion.

Sand fields are found adjacent to most Hawaiian shorelines. Is beach-grade sand

abundant in offshore fields?

Can offshore sand be sustainably mined with minimal environmental impact?

Small-Scale Beach Nourishment State Program General Permit:

Designed to streamline permitting for 10,000 yd<sup>3</sup> sand replenishment projects.

Lanikai demonstration project showed minimal impact:

No turbidity

Stable beach configuration (30-100 yds<sup>3</sup>/ft)

Community acceptance (20 ft increase)

Unfortunately, the largest and most immediate source of beach sand often lies under our homes and roads. This sand is released by erosion of the coastline.

### **Policy Development**

**Avoid** development of eroding lands.

**Discourage** additional development in erosion hazard zones.

**Plan** at the littoral level.

**Acquire** high value coastal lands.

**Develop construction guidelines** for hazard areas.

**Nourish** eroding shores.