Restorative Reefs
Less than 1% of the earth's surface
Less than 2% of the ocean floor
25% of all marine life
Protect coastlines

Produces billions of dollars
Reefs

Four main types of reefs:
- Fringing
- Barrier
- Platform
- Atoll
Fringing Reefs

Fringing reefs are the most common type of reef

Directly attached to the shore

Expand seaward
Barrier Reefs

Resemble later stages of fringing

Barrier reefs are separated from the mainland or island

Expand farther out into the open sea
Platform Reef

Form on the continental shelf and open ocean

Platform reef can grow in any direction
Atoll Reef

Circular reef

Extend around a lagoon without a central island

Developes when an island erodes away or sinks below the level of the sea
Reef Locations

Tropical and temperate water

30 degrees north to 30 degrees south of the equator

Depths no deeper than 50 meters

Temperature from 79-81 degrees
Biodiversity in Reefs

Coral reefs are some of the most productive ecosystems

Protect coast line, provides protection for smaller marine life, feeding ground and homes

Algae
Sponges
Fish
Invertebrates
Sea snakes
Sea turtles
Giant clams
Threats to Coral Reefs
Reef Threats

In 1998 an underwater heat wave killed about 16% of reefs.

2015 the world’s longest ever bleaching event recorded.
What is Coral Bleaching?

Coral loses its symbiotic algae.

Water temperatures, sunlight, dilution

Bleached coral does not die right away.

Dies from starvation or diseases.
Global Threats

Warming water temperatures

Lose of the microscopic algae that produces its food

Severe or prolonged bleaching can kill coral
Local Threats

Over fishing

Boats and their anchors

Invasive species

Runoff

Sewage

Soil erosion
Reef Protection

Healthy fish community
Fish eat seaweed
Fish eat predator

Water around the reef should be clean
Reef Stabilization

Stabilize reefs framework can speed up the recovery time

Adding structure with complex topography or that mimic natural reef framework

Increasing public awareness through coral nurseries and gardening
Outplanting Coral

Coral is grown in nurseries

Taken to a reef restoration site

Directly attached to the reef

Maintained and monitored
Design Question

What can landscape architects do to help counteract the effects of coral bleaching and educate the public in an interesting way while providing every one with access to the reef?
My site: Hanauma Bay

Located on O’ahus along the southeast coast

Hawaiian words “hana” and “uma”

Formed in a volcanic cone
Hanauma Bay Time Line

1800s
Bay was used by royalty

1900s
The Bay was then purchased but the city and county of Honolulu

1930
The road leading to the bay was paved and a few other amenities were added

1941
Barbed wire and bunkers were built. Reef was blasted for a transoceanic cable

1967
Declared the Bay a marine protected area
13,000 visitor a day, people kicked up sediment killing coral

1980

The city clears more reef

1990

Measures were taken to limit the use of the bay

2002

Marine education center was opened

Today

Bay is closed on Tuesday to give the reef time to rest and recover
The Bay

400 species of fish

Abundance of green sea turtles

2014 and 2015 47% of the bay was suffering from coral bleaching close to 10% of the coral died.
**Thesis Statement**
Preserving the Hanauma Bay Nature Preserve coral reefs through recreational opportunity and public education

**Project Goal**
Reef Restoration
Recreational Education
Accessibility
Site Analysis
Slope Analysis

The steepest slope is shown in a dark blue ranging from a 30-80% slope this mean these areas will be hit with strong ocean currents.
Aspect Analysis

The aspect map shows the direction the sea floor is facing area in the 135-225 degree zone will get the most direct sunlight for the longest time.
Reef Area Analysis

This reef map shows the area of the bay that I feel would be in the most danger of bleaching due to their location on the steepest slopes and in the longest direct sunlight.
Design Concepts
Master Plan
Educational Center Site
Designed around the existing coral reef

Boardwalk would be cantilevered out over the water

Designed to bring people close to the reef
Recreational Area & Underwater Walk

- Entry to underwater reef walk
- Planters
- Table seating
- Seating under shade structure
- Viewing area
- Steps down to water
- Ramp
- Water recreation area
- Rental building
- Walkway
- Steps down to water
- Research building
- Seating under shade structure
- Custom designed benches
- Viewing area
- Walkway
- Rental building
- Entry to underwater reef walk

Scale: 1:10
Recreational Area & Underwater Walk Section

Access to view the coral restoration garden

This walk makes the reef accessible to everyone
Recreational Area Boardwalk
Reef Sculpture Garden
Design Details

Raft Detail

Stopping point for paddle boarder
Anchored down
Scuba dive
Custom storage benches

Boardwalk Detail

Constructed very carefully
Withstand years of sea water
Materials that won’t harm the reef
Through my design I believe that providing people with access to areas of recreational education, people will come to understand and value the reefs while also helping to restore them to a natural state.

Throughout this project I have learned so much about coral reefs and all they do for the world. I hope to continue learning about reefs and designing ways to help them in the future.
Restorative Reefs

Thank you

Questions?