

# South Oahu Shoreline Change: Diamond Head – Pearl Harbor

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# South Oahu Shoreline Change

- Investigate long-term shoreline changes over the past few decades - century.
- Measure change using historical shoreline positions mapped from aerial photographs and coastal survey charts.
- Shoreline positions are mapped from 0.5 m orthorectified aerial photo mosaics (typically, one mosaic per decade).
- This is the best available data for long-term shoreline history.
- Aid coastal managers in identifying coastal areas facing an increased risk of future beach erosion.



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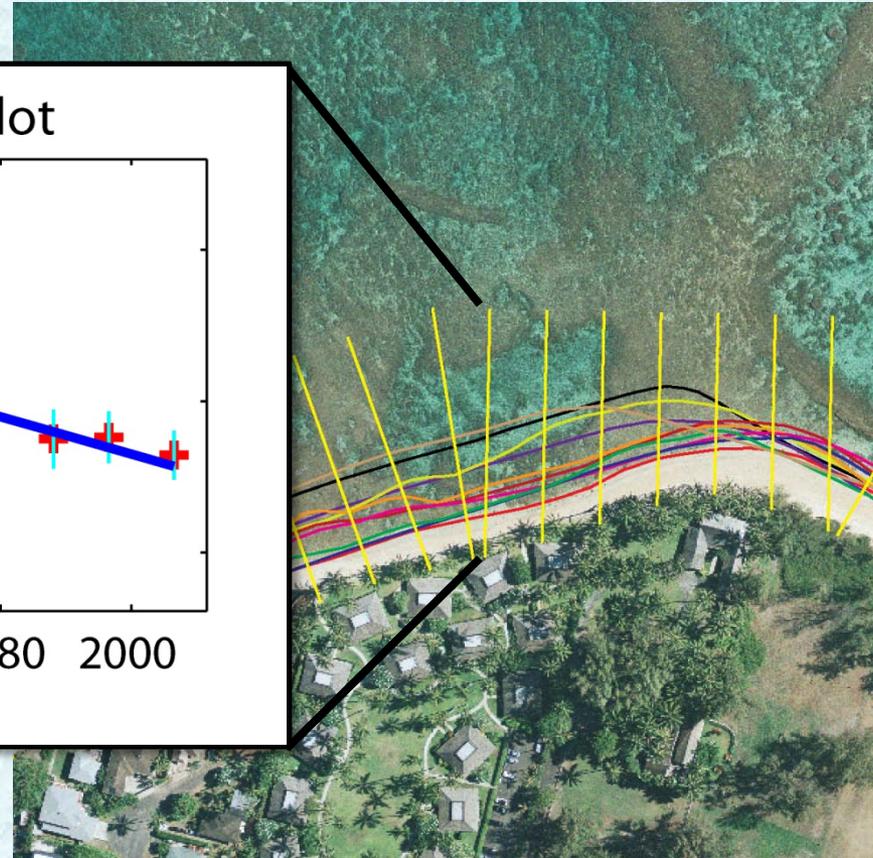
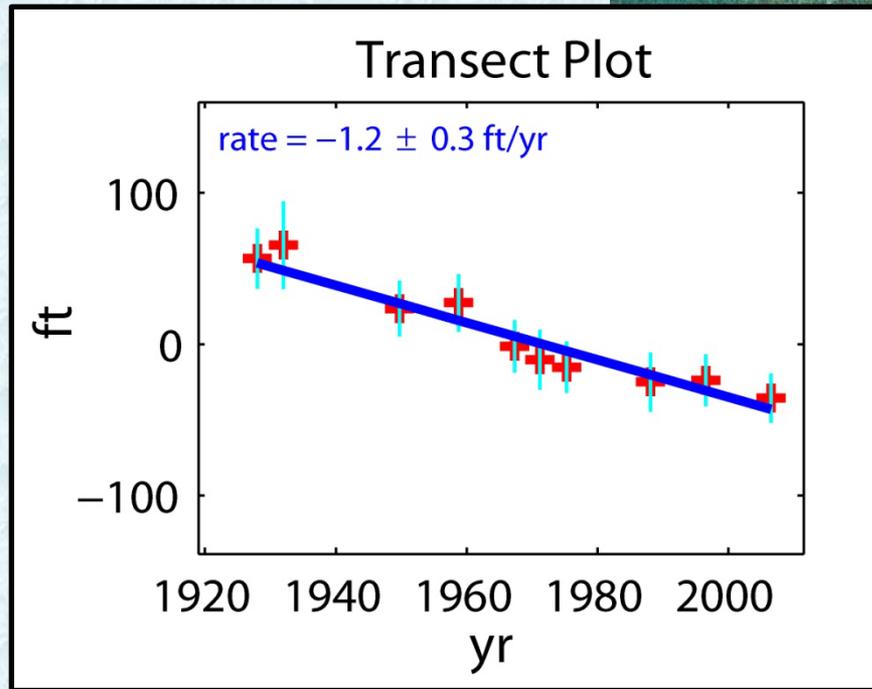
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2009

# Mapping Historical Shorelines



portion of an aerial photo mosaic



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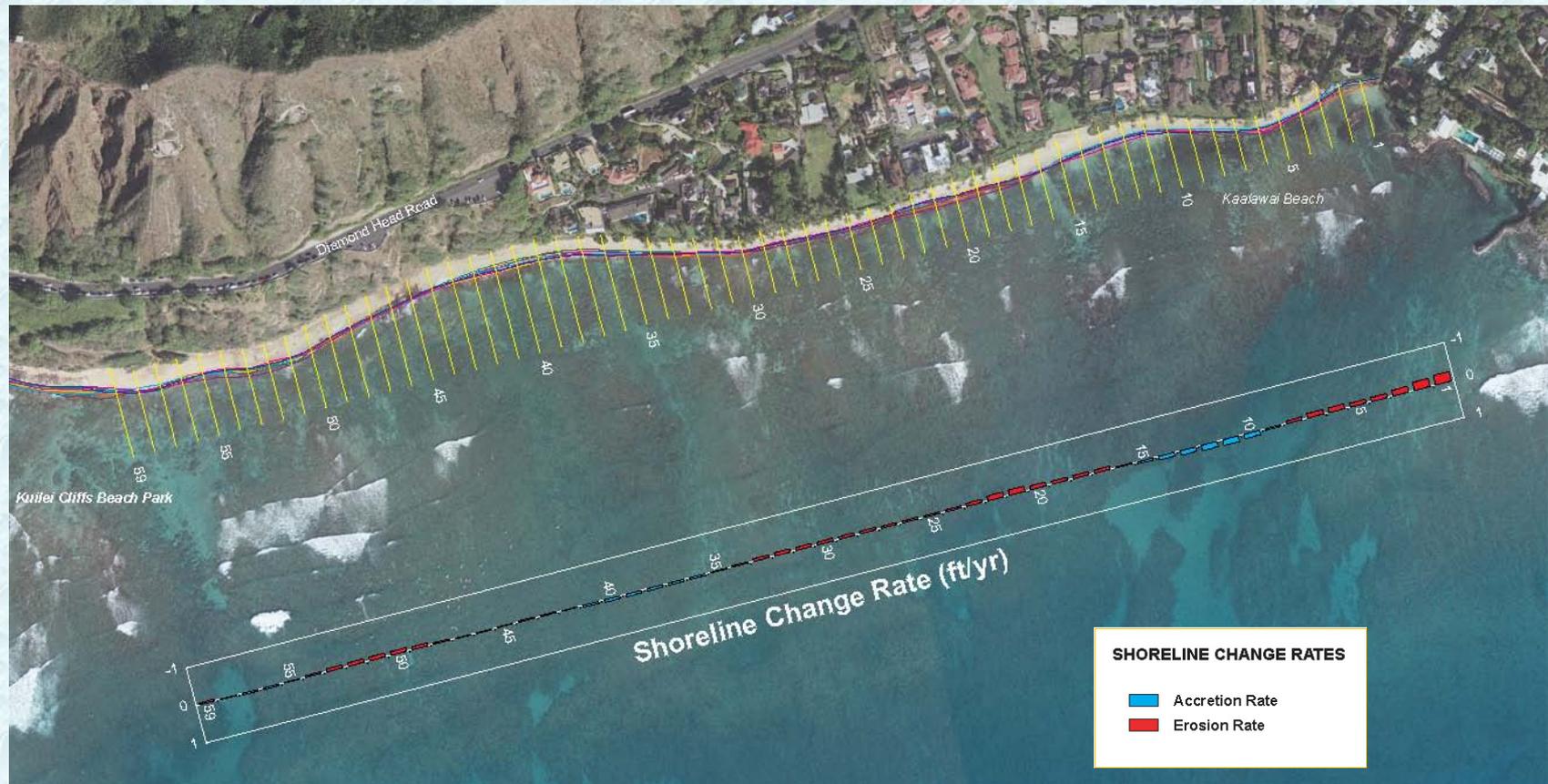
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# Diamond Head: Black Pt-Cliffs



- Mostly stable 1927-2005 (rates  $<0.2$  ft/yr)



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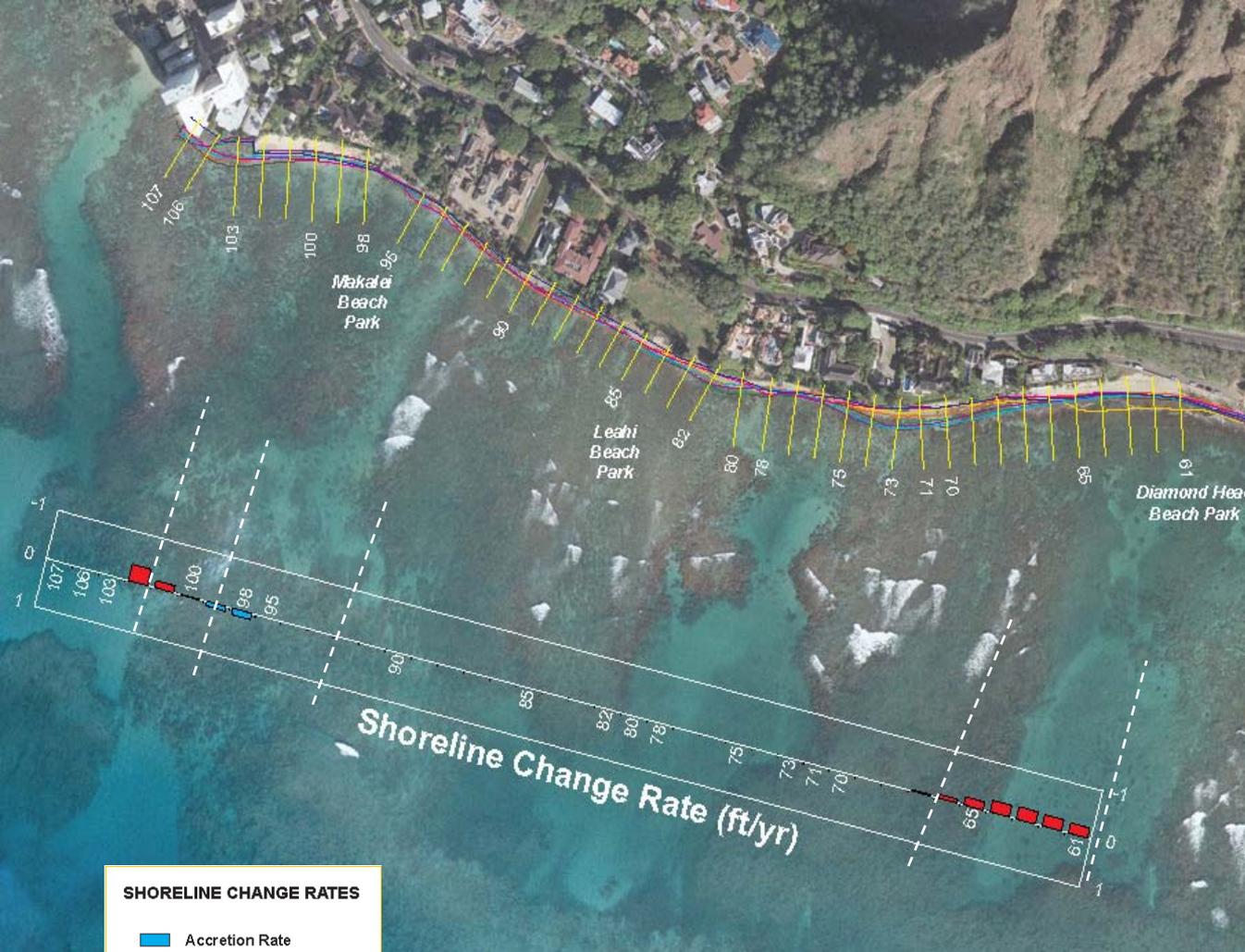
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# Diamond Head, Leahi, Makalei BP's

- Beach largely lost to erosion in the past few decades
- Waves break against seawalls fronting homes
- Beach remaining only at Makalei and D.H. Beach Parks: stable to slightly erosional



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# Waikiki

- Waikiki is an urban shoreline: revetments, groins, sand fills
- Structures divide the shoreline into separate littoral cells <sup>1</sup>
- Structures inhibit sand movement between cells
- Result: alternating pockets of erosion and accretion among the structures

1. Miller and Fletcher, 2003



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# Outrigger to Kaimana Beach

## Outrigger – Elks (1968-2005)

- 1960's: Beach and filled groin
- Erosion  $\sim 1$  ft/yr
- Beach lost near center

## Kaimana Beach (1927-2005)

- 1927: Natatorium
- Sand transport to the north
- Accretion  $>2$  ft/yr against Natatorium wall
- Beach lost at south end
- Beach occasionally graded, last grading Feb., 2002



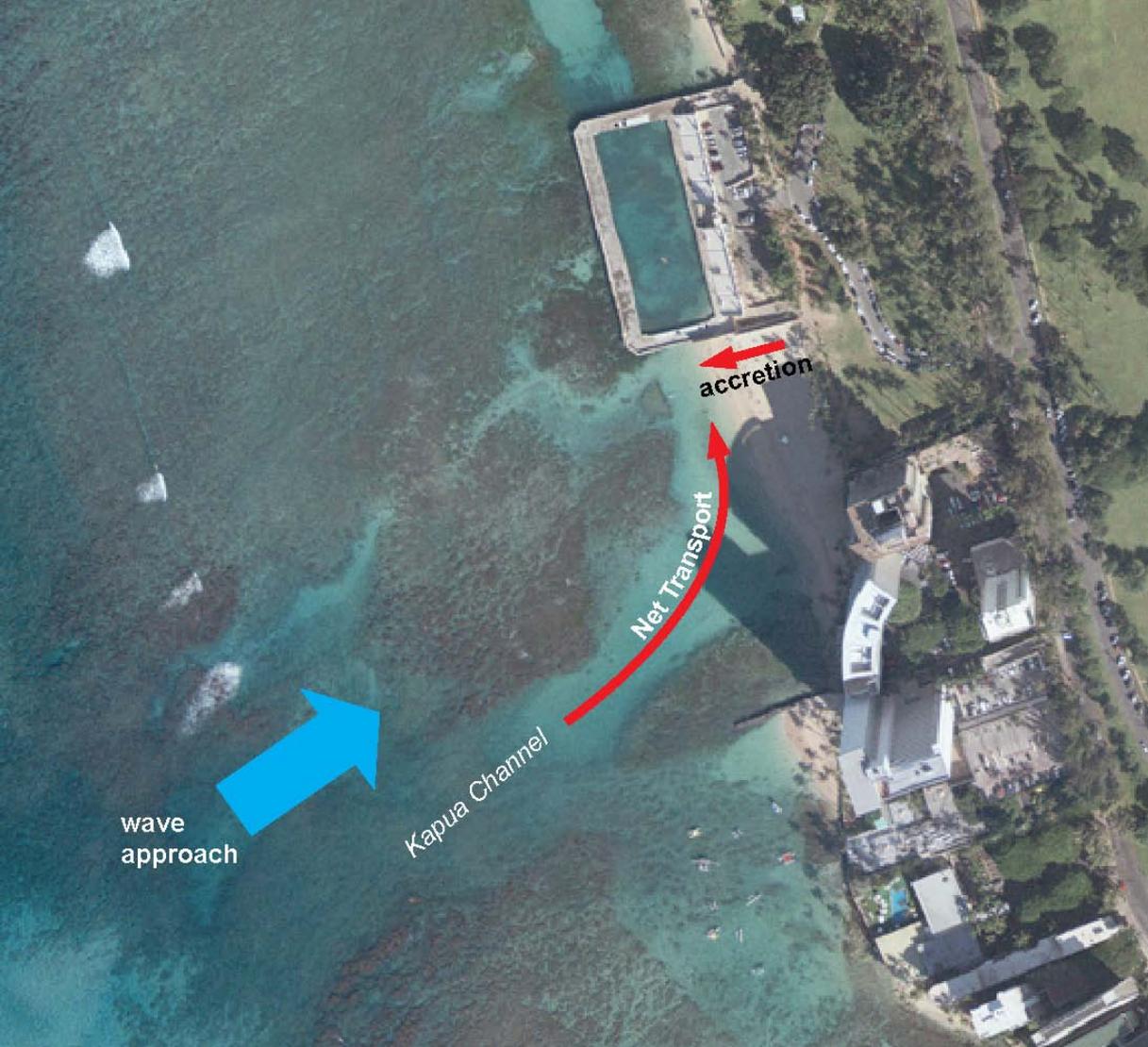
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# Kaimana Beach

Adapted from Miller and Fletcher, 2003



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# Queen's - Kapahulu

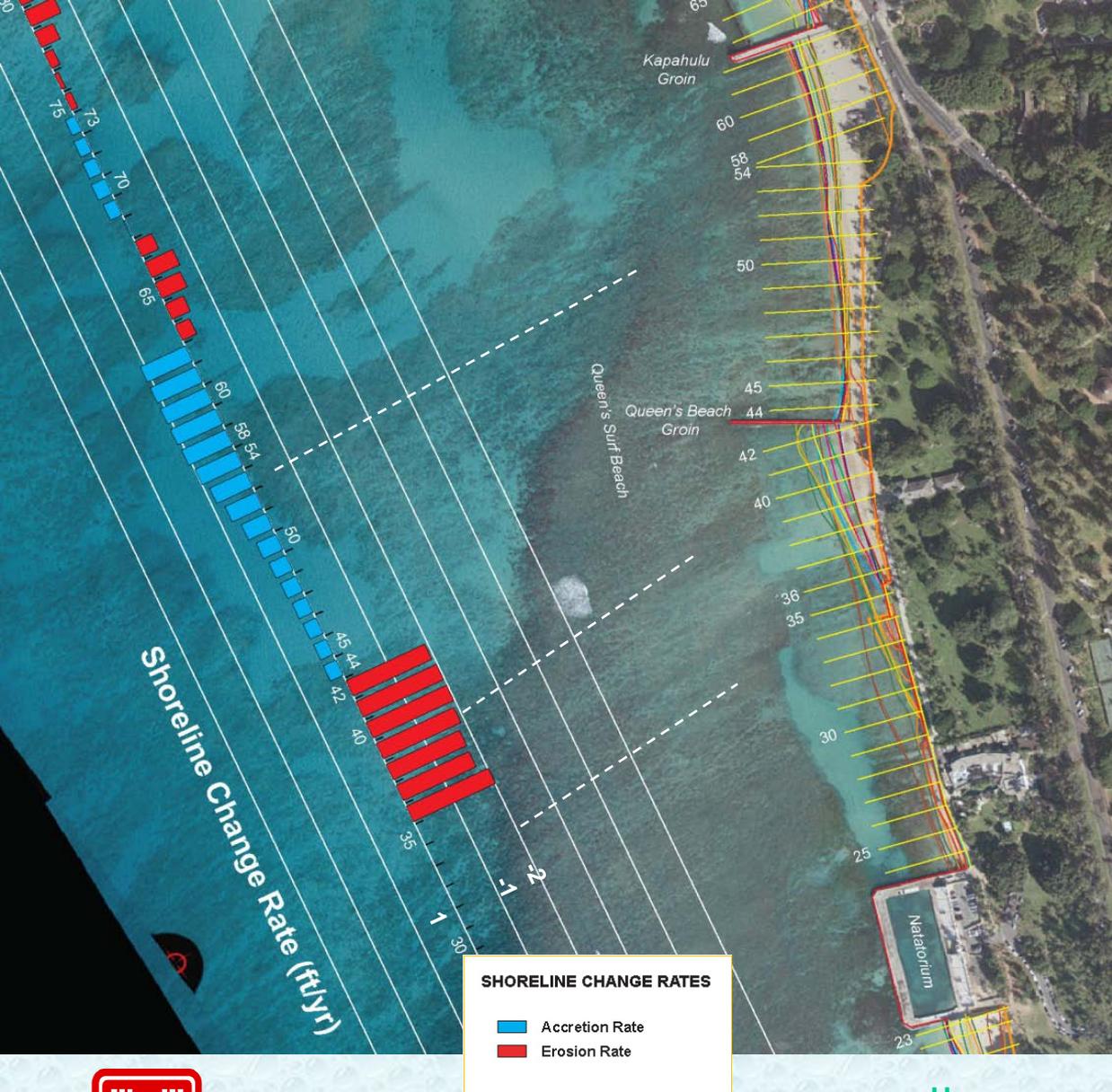
1956 : Queen's beach built  
with sand fill, central groin

## Queen's 1957-2005

- Beach lost in south half  
1970's - 1980's
- Remainder eroding 2 ft/yr
- Natatorium blocks  
northerly sediment  
transport

## Kapahulu 1957-2005

- Accreting 0.5 to 1 ft/yr
- Sand fills post-1956?



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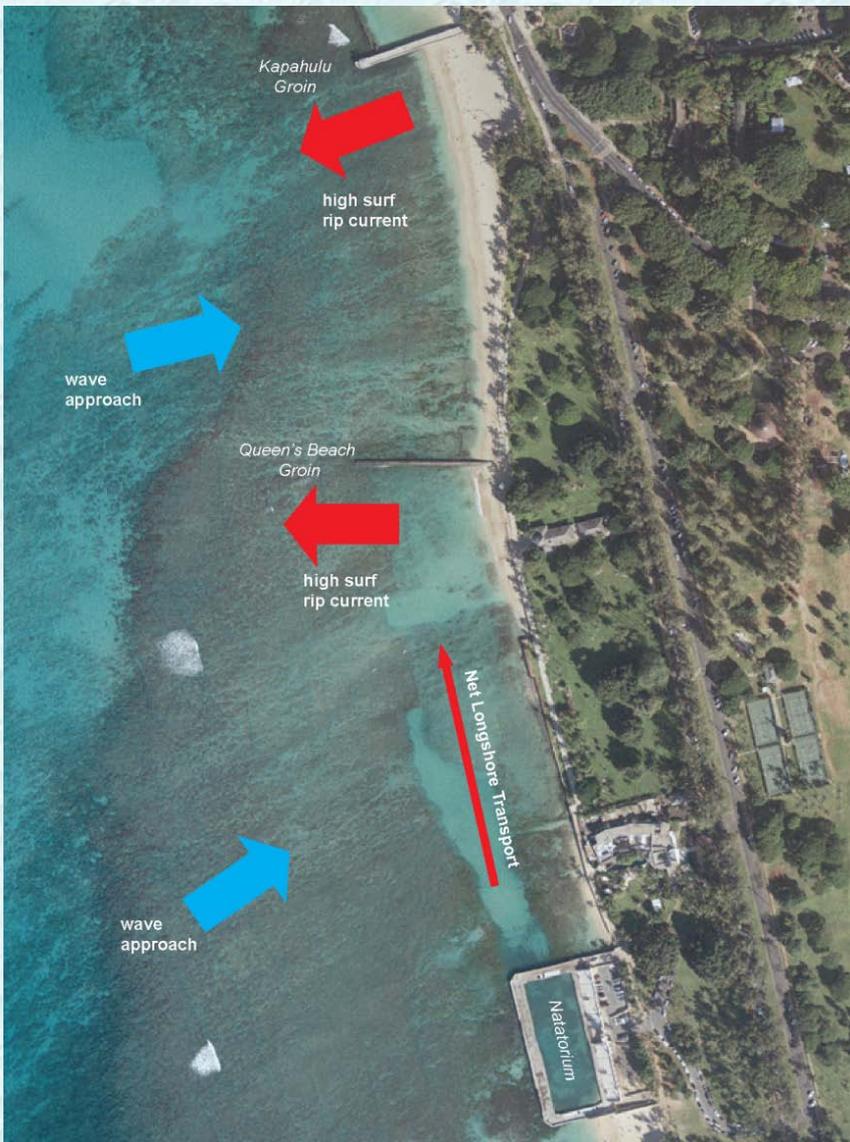
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# Queen's - Kapahulu

Adapted from Miller and Fletcher, 2003



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# Waikiki - Kuhio

## Kuhio Beach (1975-2005)

- 1972: Last major redesign
- Smaller fills: 1975, 1991, 2000, 2006
- Losing sand, despite crib walls and repeated fills.

## Waikiki (1927-2005)

- 1927: R.H. groin built
- Long-term (1927-2005): Accretion 0.5 to 1 ft/yr
- Short-term (1975-2005): Erosion ~ 1ft/yr 1975-2005 (not shown)



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# Kuhio Beach

Adapted from Miller and Fletcher, 2003



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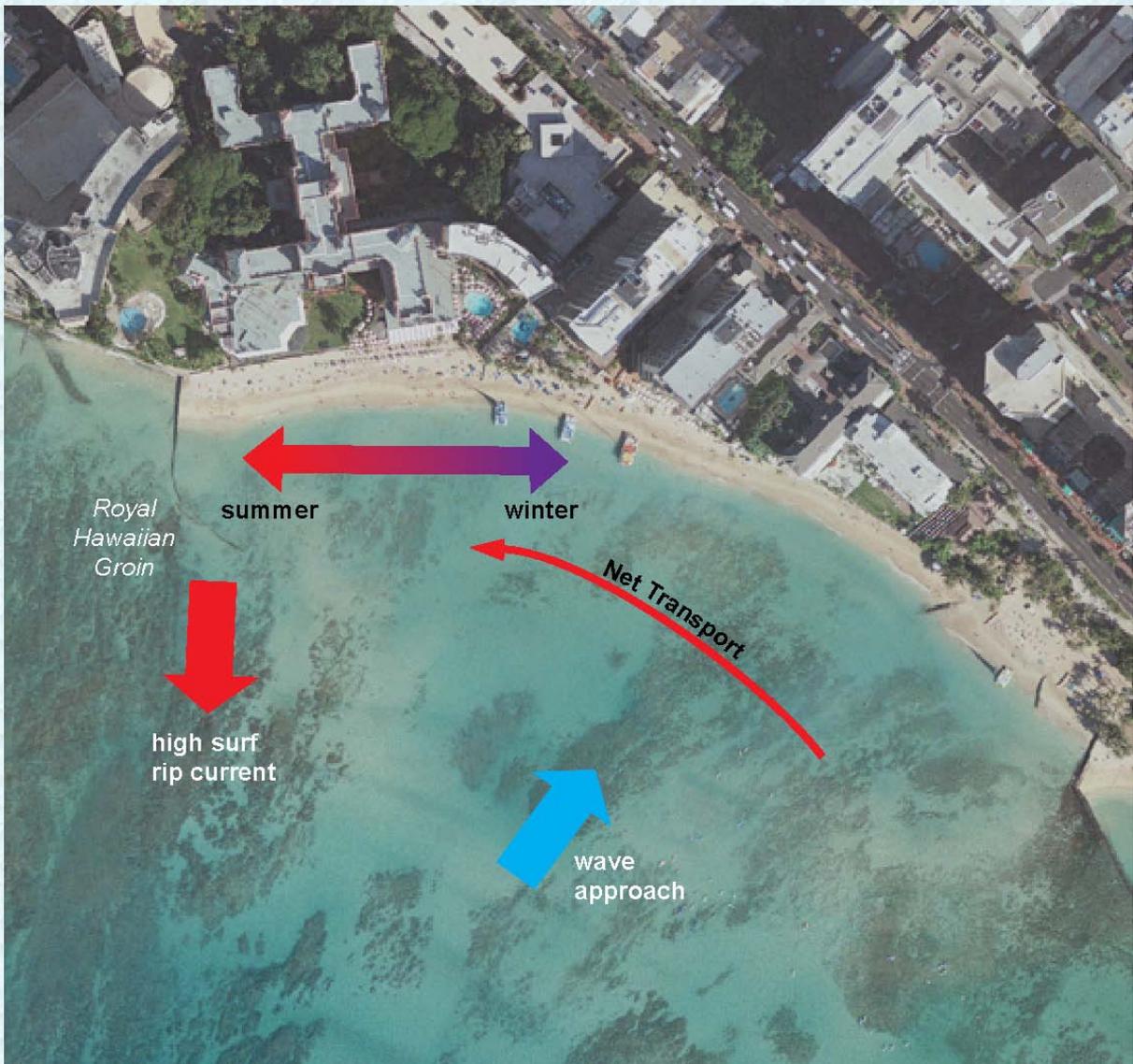
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# Waikiki Beach



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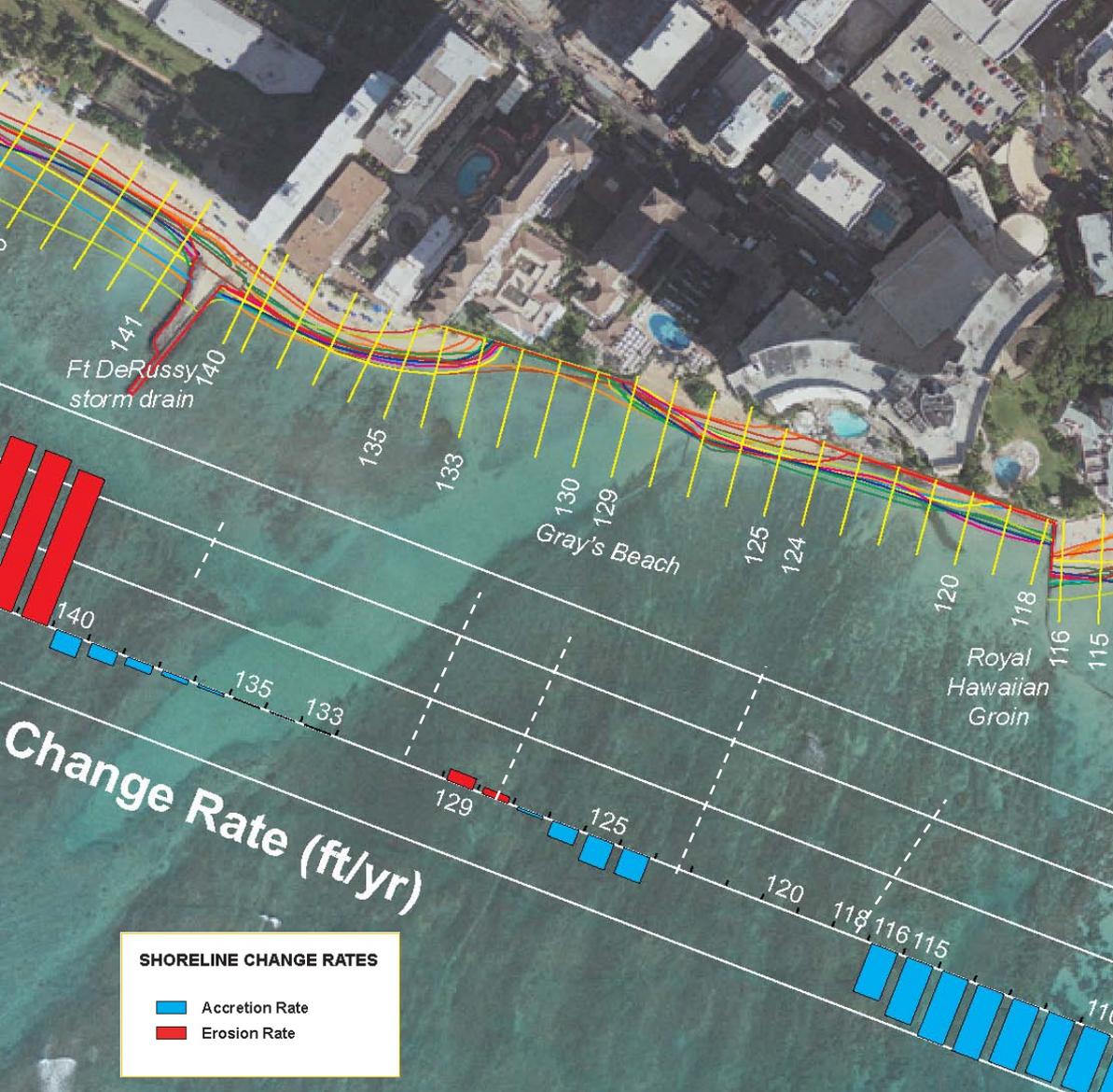
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# Gray's / Halekulani

## Gray's / Halekulani (1927-2005)

- East end (Sheraton):  
Beach lost to erosion
- Central (fronting H.K.):  
No sig. beach in air photos,  
1927-2005
- Remaining beach is approx.  
stable to accreting



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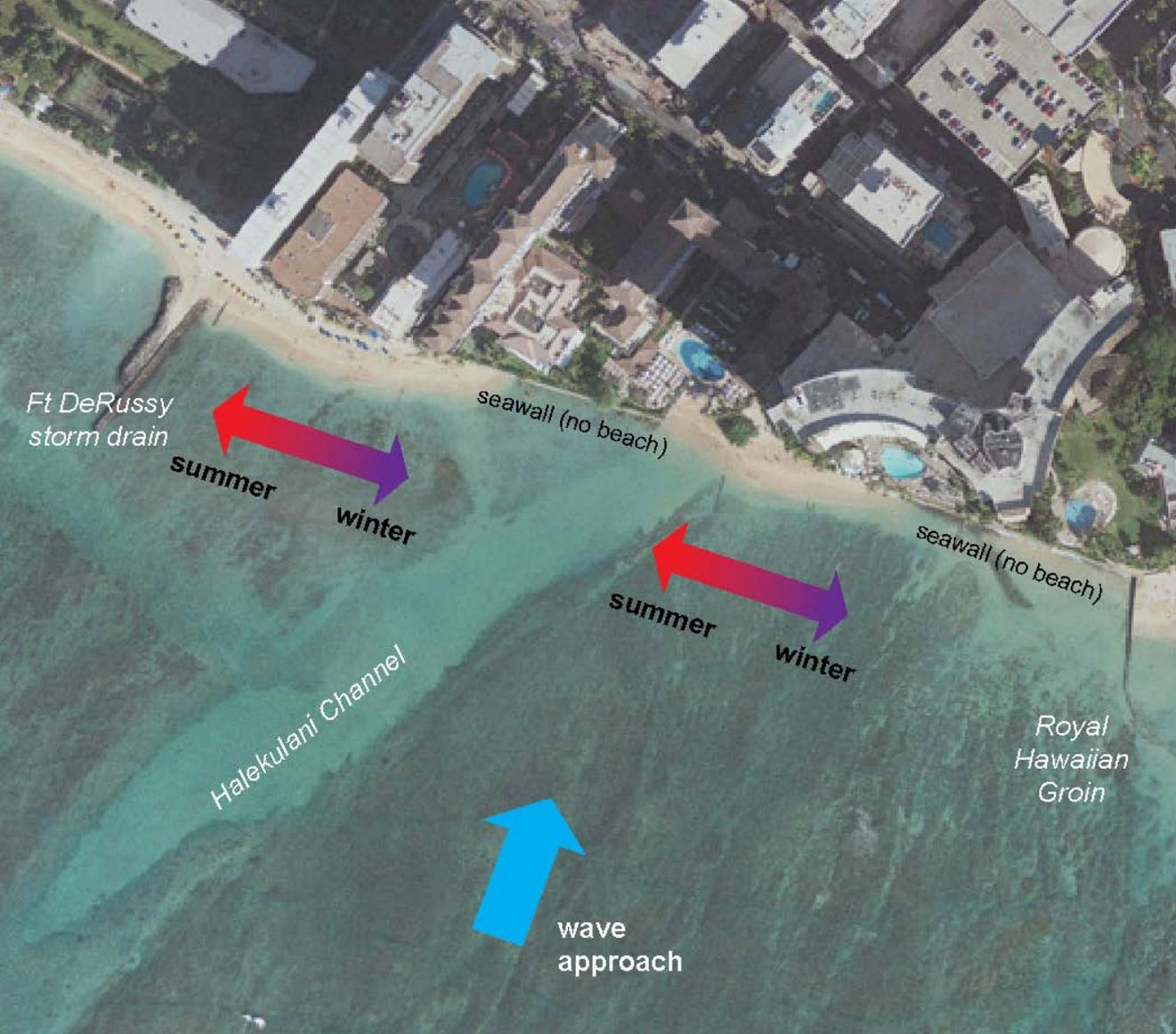
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# Gray's / Halekulani



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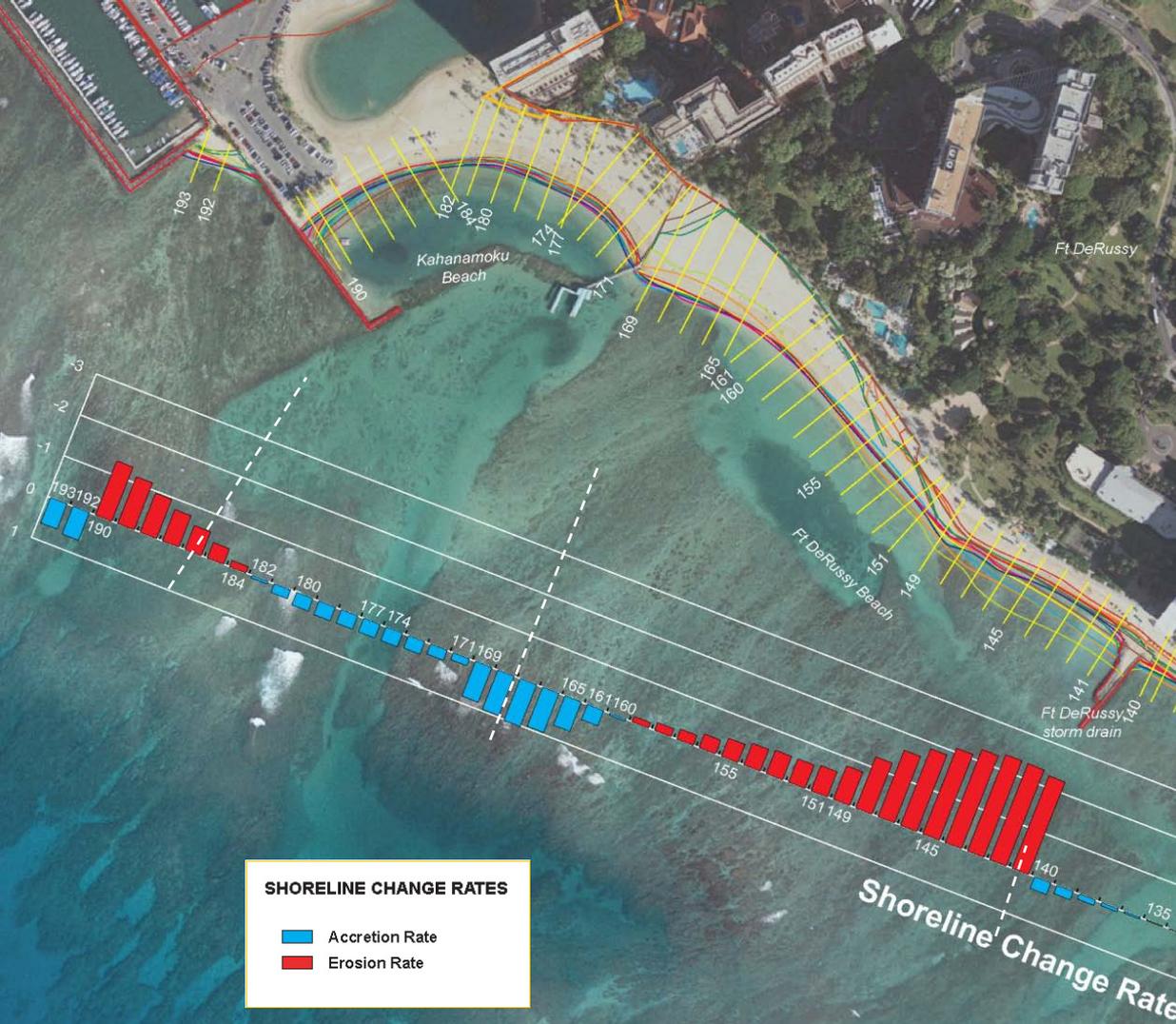
# Ft DeRussy– Kahanamoku

## Fort DeRussy (1975-2005)

- 1970: beach constructed
- Smaller fills: 1975, 1981
- North: Stable to accreting  
~1 ft/yr
- South: Erosion >2 ft/yr

## Kahanamoku (1957-2005)

- 1950's: beach constructed
- West : erosive, 0.5 to 1 ft/yr
- East : stable to accreting



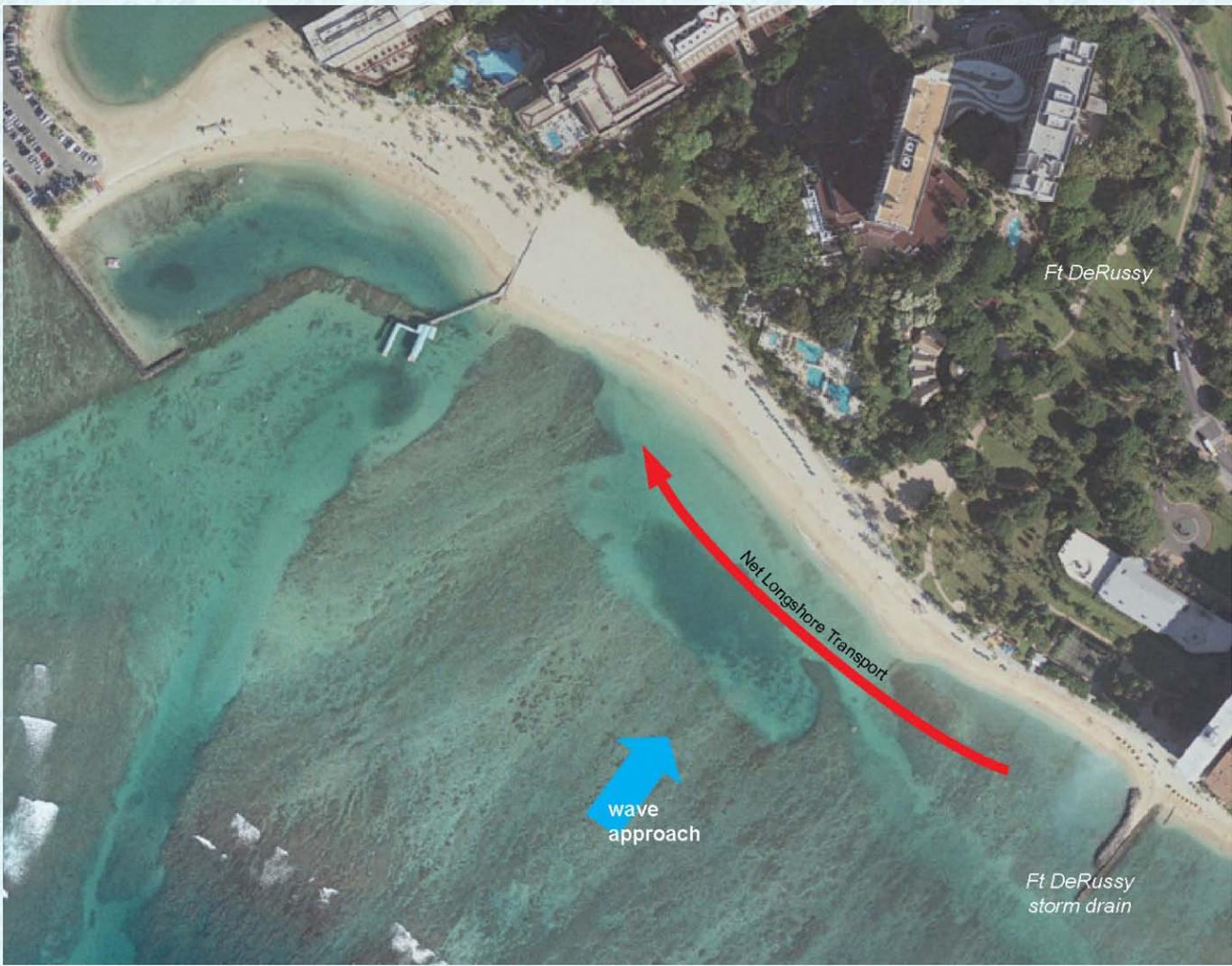
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# Ft DeRussy– Kahanamoku

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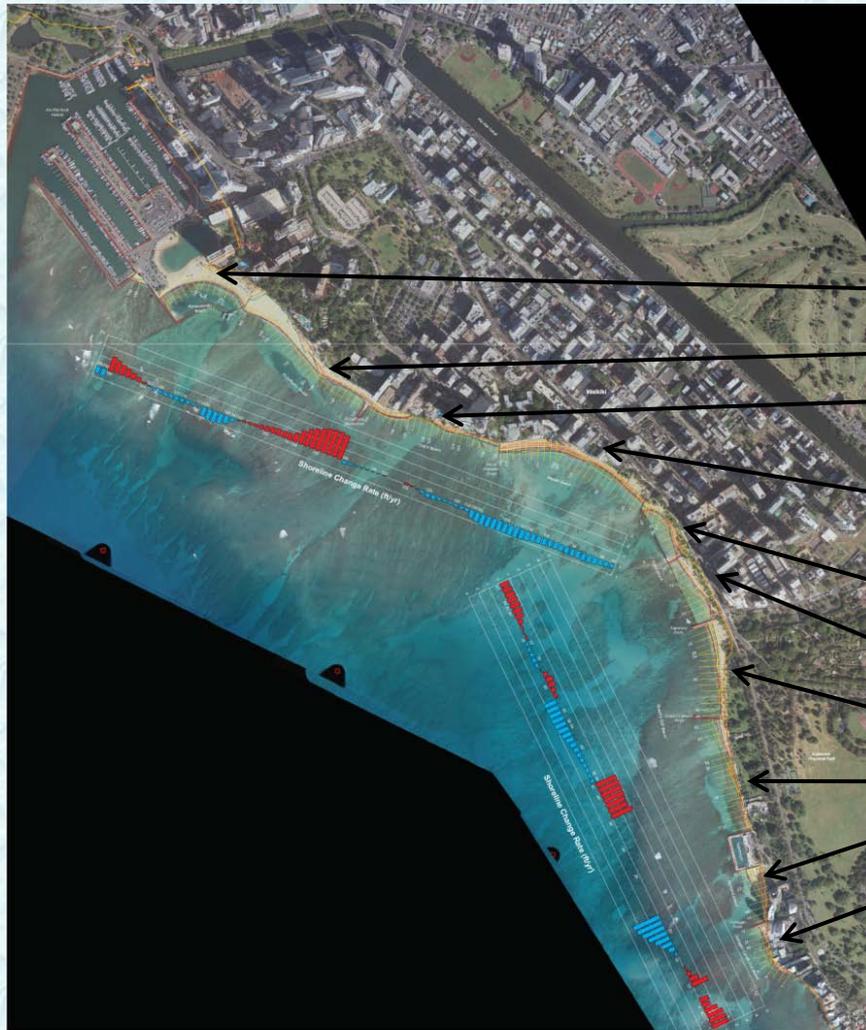


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# Waikiki Summary



- Shoreline change analyzed at 172 transects, 3762 yd of beach
- Beach Lost: 25 transects, ~550 yd

## Average Rates

- Kahanamoku:  $-0.16 \pm 0.14$  ft/yr
- Ft DeRussy:  $-0.62 \pm 0.31$  ft/yr
- Gray's:  $0.12 \pm 0.15$  ft/yr
- Waikiki ('27-'05):  $0.74 \pm 0.16$  ft/yr
- Waikiki ('75-'05):  $-1.00 \pm 0.39$  ft/yr
- N. Kuhio:  $-0.61 \pm 0.36$  ft/yr
- S. Kuhio:  $-0.09 \pm 0.48$  ft/yr
- Kapahulu:  $0.70 \pm 0.12$  ft/yr
- Queen's:  $-1.85 \pm 0.37$  ft/yr
- Kaimana:  $1.51 \pm 0.19$  ft/yr
- Outrigger:  $-0.99 \pm 0.46$  ft/yr

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# Ala Moana – Magic Island

1950's – 1960's: Ala Moana and  
Magic Island Beaches  
constructed with dredge fill  
1976: Ala Moana BP fill 30k yd<sup>3</sup>

## Magic Island (1968-2005)

- Erosion west
- Accretion east
- Avg. rate:  $-0.09 \pm 0.18$  ft/yr

## Ala Moana BP (1968-2005)

- Alternating cells of erosion and accretion
- Avg. rate:  $-0.04 \pm 0.14$  ft/yr



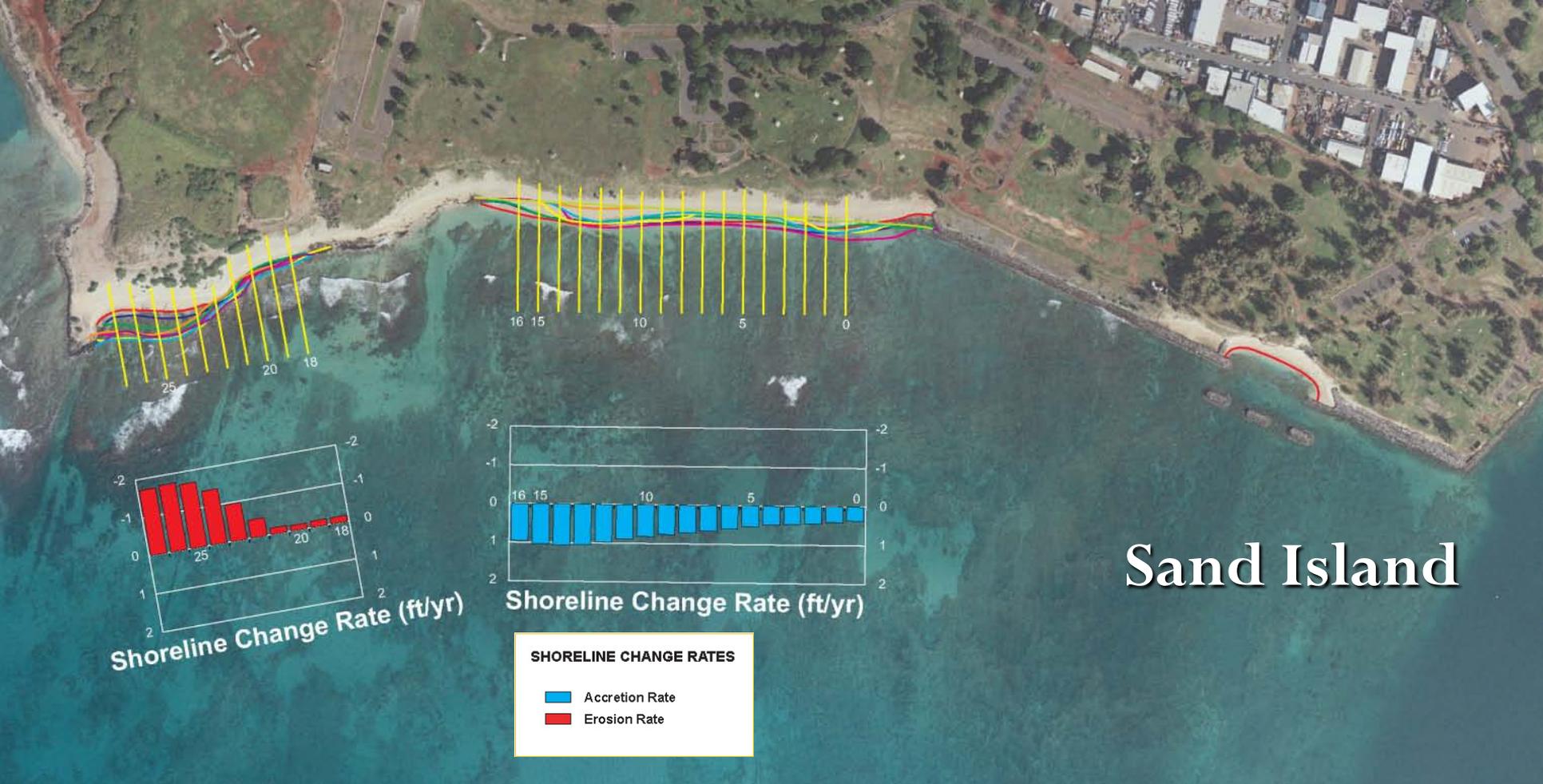
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# Sand Island

- 1940's: Sand Island, beaches constructed with dredge fill
- 1949-2005: Central beach accreting up to 1 ft/yr; East eroding >1ft/yr



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# Ewa Beach – Keahi Pt

- Keahi – Iroquois Pt: Erosion up to 5 ft/yr (1928, 1950 -2005)
- Central Ewa Beach: Accreting (<1ft/yr) to approx. stable (1928-2005)
- West Ewa Beach: Eroding (<1 ft/yr) to approx. stable (1928-2005)

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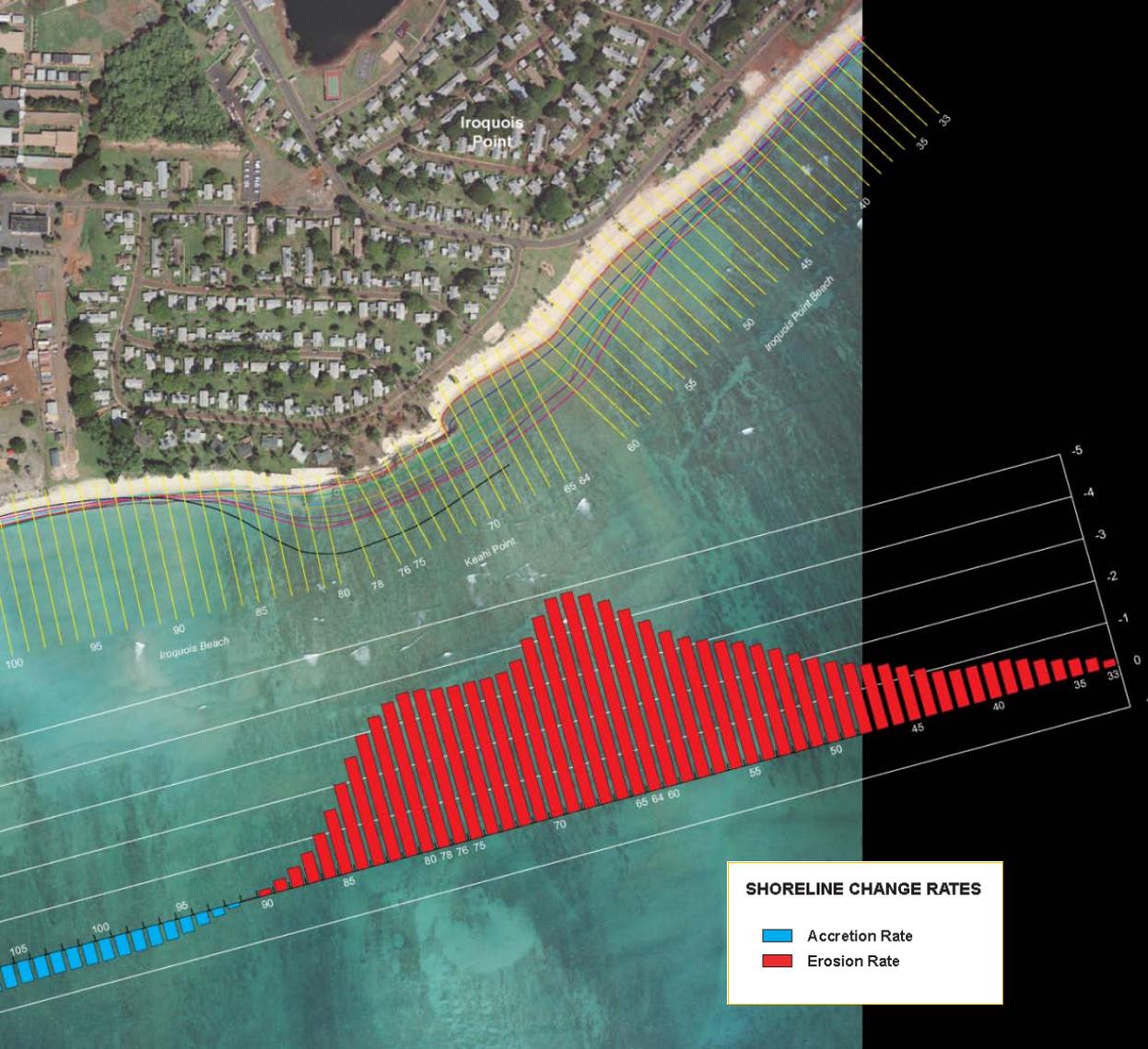
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# Keahi– Iroquois Pt

## Keahi Point (1928, 1950 -2005)

- Erosion up to 5 ft/yr
- 1976 to 1988 Beachfront homes removed and bolder revetments installed
- Erosion continues between and around revetments



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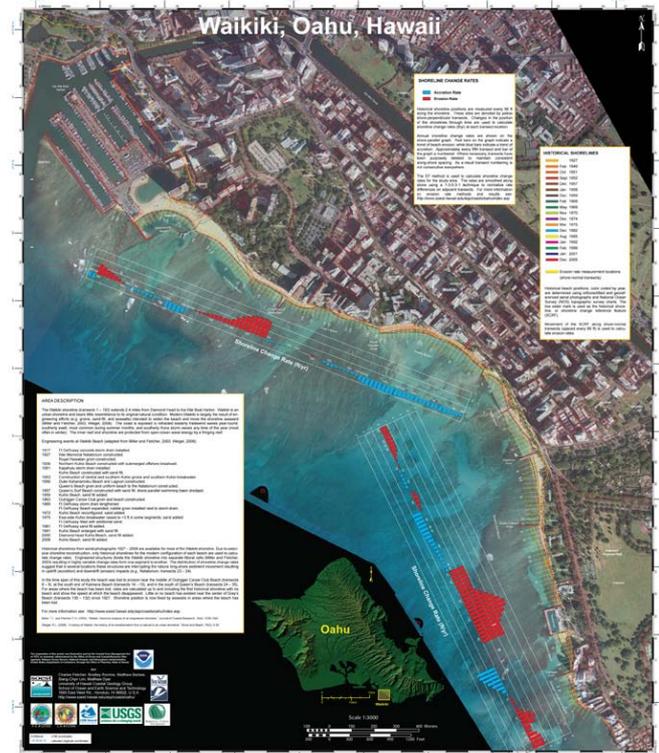
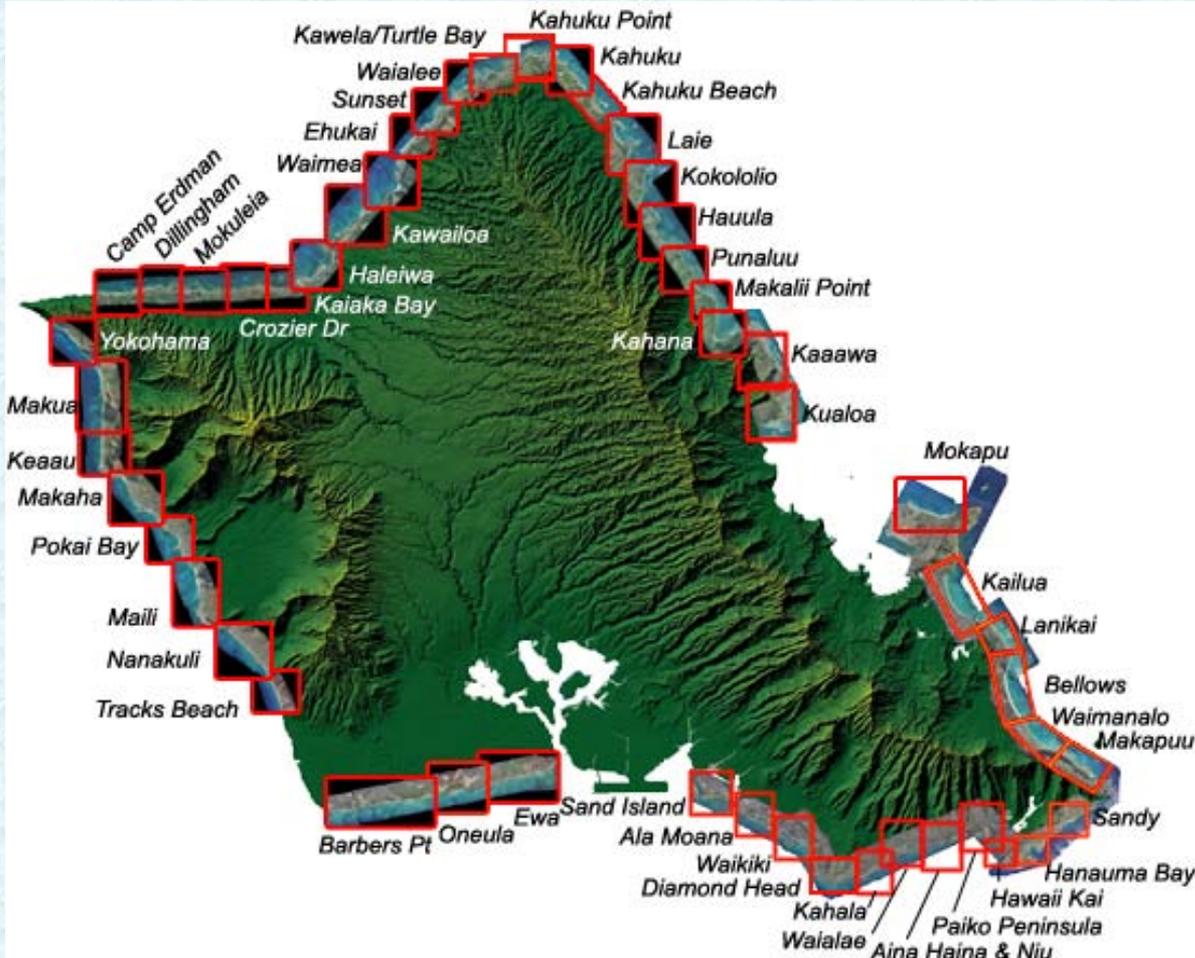
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Shoreline change maps available at:

<http://www.soest.hawaii.edu/asp/coasts/oahu/>



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# Thank you!



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