DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honoluludpp.org • CITY WEB SITE: www.honolulu.gov

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AUG 08 2018

KIRK CALDWELL
MAYOR

KATHY K. SOKUGAWA
ACTING DIRECTOR

TIMOTHY F. T. HIU
DEPUTY DIRECTOR

EUGENE H. TAKAHASHI
DEPUTY DIRECTOR

July 27, 2018

2018/ED-5(ST)

Mr. Scott Glenn, Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 South Beretania Street, Room 702
Honolulu, Hawaii 96813-2437

Dear Mr. Glenn:

RECEIVED
'18 JUL 27 P2:01
OFC. OF ENVIRONMENTAL QUALITY CONTROL

SUBJECT:	Chapter 343, Hawaii Revised Statutes (HRS) Draft Environmental Assessment (DEA)
Project:	Mark Button and Heidi Snow Seawall
Applicants:	Mark Button and Heidi Snow
Agent:	Gundaker Works LLC (Mark Ticonni)
Location:	68-505 and 68-511 Crozier Drive – Waialua
Tax Map Keys:	6-8-004: 018 and 031
Request:	After-the-fact Shoreline Setback Variance (SSV) Chapter 23, Revised Ordinances of Honolulu
Proposal:	To allow (retain) a continuous concrete and timber seawall along two residential lots.

With this letter, the Department of Planning and Permitting hereby transmits the DEA and anticipated finding of no significant impact (DEA-AFONSI) for the retention of an reconstructed timber and concrete seawall and backfill within the 40-foot shoreline setback of the above-referenced parcels in the Koolauloa District on the island of Oahu, for publication in the next edition of "*The Environmental Notice*."

Enclosed is the completed Office of Environmental Quality Control Publication Form, one hard copy of the DEA, and a pdf file on a flash drive. Simultaneously with this letter, these documents were also sent via electronic mail to your office.

19-056

Should you have any questions, please contact Steve Tagawa, of our staff, at 768-8024.

Very truly yours,

FOR: Kathy K. Sokugawa
Acting Director

Enclosures

APPLICANT
PUBLICATION FORM

Project Name:	Mark Button and Heidi Snow Seawall
Project Short Name:	Button Snow Seawall Reconstruction
HRS §343-5 Trigger(s):	Use within a shoreline area as defined in Chapter 205A-41
Island(s):	Oahu
Judicial District(s):	Koolauloa
TMK(s):	(1)6-8-004: 018 and 031
Permit(s)/Approval(s):	Certified Shoreline Survey Shoreline Setback Variance Building Permits Grading, Trenching, and Stockpiling
Approving Agency:	Department of Planning and Permitting, City and County of Honolulu
Contact Name, Email, Telephone, Address	Steve Tagawa, stagawa@honolulu.gov (808)768-8024, 650 South King Street, 7th Floor, Honolulu, Hawaii 96813
Applicant:	Mark Button and Heidi Snow
Contact Name, Email, Telephone, Address	Mark Ticconi, mticconi@gunderkerworks.com (808) 348-7192, 931 University Avenue, Suite 305, Honolulu, Hawaii 96826
Consultant:	Gundaker Works LLC
Contact Name, Email, Telephone, Address	Mark Ticconi, mticconi@gunderkerworks.com (808) 348-7192, 931 University Avenue, Suite 305, Honolulu, Hawaii 96826

Status (select one)	**Submittal Requirements**
_X_ DEA-AFNSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the approving agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The approving agency simultaneously transmits to both the OEQC and the applicant a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.

19-056

____ FEIS Statutory Acceptance	The approving agency simultaneously transmits to both the OEQC and the applicant a notice that it did not make a timely determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and therefore the applicant's FEIS is deemed accepted as a matter of law.
____ Supplemental EIS Determination	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.
____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary
Provide a description of the proposed action and purpose and need in 200 words or less.

The Applicants propose to retain an existing 180-foot-long concrete-reinforced vertical timber (railroad tie) seawall that they constructed along the shoreline of two beachfront lots along Crozier Drive in Waialua. The makai (seaward) face of the timber seawall varies in height depending upon the time of year (seasons), which can be as high as eight feet above the sand beach. The previous nonconforming timber-only seawall, was reconstructed with an L-shaped concrete footing placed in back (mauka) of the former structure. The L-shaped footing is six-feet wide and up to eight feet high and support the new 14-foot long which are installed vertically. The timber seawall is capped with a 6 x 10-inch beam at the top. A four-foot high wooden picket fence, about three feet in back (mauka) of the timber seawall, was built across Parcel 31. The picket fence is about 60 feet long.

The sand beach along this segment of Waialua varies in width, depending on the seasons. The Project site is in the R-7.5 Residential District. Each lot is developed with existing dwellings which have portions that are also within the 40-foot shoreline setback. The Department of Planning and Permitting has issued citations for the unauthorized reconstruction without a shoreline setback variance (Nos. 2017/NOV-19-190, 2018/NOV-01-154). The Department of Land and Natural Resources has also issued a citation for the reconstruction works conducted makai of the previous seawall and within the shoreline and State Conservation District (ENF OA 18-10 and OA 18-12).

19-056

ENVIRONMENTAL ASSESSMENT DRAFT

SHORELINE SETBACK VARIANCE

TMK: 6-8-004:018
68-505 Crozier Dr.
Waialua, Oahu, Hawaii 96791

TMK: 6-8-004:031
68-511 Crozier Dr.
Waialua, Oahu, Hawaii 96791

ACCEPTING AUTHORITY:

City and County of Honolulu
Department of Planning and Permitting

PREPARED BY:

Gundaker Works, LLC

February 2018

OEQC BULLETIN PUBLICATION FORM

(Follow instructions on other side)

1. Project Name: Shoreline Setback Variance for **68-505** and **68-511 Crozier Dr. Waialua, Oahu, Hawaii**

Type of Document (circle one): [✓ **Draft EA,**] Final EA, EIS prep notice, draft EIS, final EIS, NEPA
check if applicable: ______revised document ______supplemental document
Legal Authority: Chapter 343 HRS
Agency determination: Anticipated FONSI

Application sections:

___ Use of State or county lands or funds
___ Use of conservation district lands
X Use of shoreline area
___ use of historic site or district

___ Use of land in the Waikiki District
___ Amendment to county general plan
___ Reclassification of conservation lands
___ Construction or modification of helicopter facilities

2. Island: Oahu
Judicial District: Honolulu
Tax Map Key Number: (1) 6-8-004:018 (2) 6-8-004:031

3. Applicant or applicant agency:

(1) Mark Button	(2) Heidi Snow
Address: 68-505 Crozier Dr. Waialua, Hawaii 96791	Address: 68-511 Crozier Dr. Waialua, Hawaii 96791
Contact: Mark Button	Contact: Heidi Snow
Phone: (615) 438-7888	Phone: (808) 372-8594

Note for EAs:
When the applicant is a state or county agency, the applicant agency and approving agency are the same.

4. Approving Agency (EAs) or Accepting Authority (EISs):
City and County of Honolulu, Department of Planning and Permitting
Address: 650 South King Street
Honolulu, Hawaii 96813

Contact: Kathy Sokugawa, Acting Director Phone: (808) 768-8010

5. Consultant: Gundaker Works, LLC
Address: 931 University Avenue. Suite #304
Honolulu, Hawaii 96826

Contact: Mark Ticconi Phone: (808)268-6072

6. Public Comment Deadline: ________

7. Permits required prior to implementation: Shoreline Setback Variance, Building Permits

8. Project Summary (name of file): Button Snow Shoreline Setback Variance

9. Public Library Copy: **n/a** (Not required for final EAs)

10. This form was prepared by: Austen Dabboul Phone: (619) 947-2117

(1) Mark Button
Property - 68-505 Crozier Dr., Waialua, HI 96791
Shoreline Setback Variance
TMK 6-8-004:018

(2) Heidi Snow
Property - 68-511 Crozier Dr., Waialua, HI 96791
Shoreline Setback Variance
TMK 6-8-004:031

PROJECT SUMMARY

The two (2) residential properties listed above belonging to Mark Button and Heidi Snow are located on the northwest coast of Oahu. The properties are themselves single-family residences and are located amidst other single-family residences on either side. After-the-fact approval is being sought for modification of existing vertical timber seawall structures (*Mauka*) that were constructed across the shoreline frontage of the subject properties prior to 1967 and other miscellaneous structures located within the shoreline setback area. The area has a recorded history of erosion taking place over the last half century. Without the modification to these seawalls their structural integrity remained continually challenged as time and time again both Button and Snow were forced to repair their walls after storm weather damage, incurring considerably weighty personal cost. The alterations done to the wall were done in an attempt to offer a permanent solution to the ongoing problem.

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List of Figures

Appendices

1. GENERAL INFORMATION

After-the-fact approval is being sought for modification of an existing vertical timber seawall structure (*Mauka*) that was constructed across the shoreline frontage of the subject properties prior to 1967 and other miscellaneous structures located within the shoreline setback area. The structures were built without City approvals, including a Shoreline Setback Variance (ROH 1992 Chapter 23) and a Building Permit (ROH 1990 Chapter 18). Pursuant to the Revised Ordinances of Honolulu Chapter 23, Shoreline Setbacks, a Shoreline Setback Variance will be required and will be submitted pending issuance of a Finding of No Significant Impact (FONSI). The EA has been prepared incompliance with the Environmental Impact Statement (EIS) regulations of Chapter 232, Hawaii Revised Statutes.

A.	**Project:**	Shoreline Setback Variance	
B.	**Owner/Applicant (1):**	**Mark Button**	
	Mailing Address:	68-505 Crozier Dr. Waialua, HI 96791	
	Owner/Applicant (2):	**Heidi Snow**	
	Mailing Address:	68-511 Crozier Dr. Waialua, HI 96791	
C.	**Accepting Agency:**	City and County of Honolulu Department of Planning and Permitting	
D.	**Agent:**	Gundaker Works LLC Mark Ticconi 931 University Ave #304 Honolulu, HI 96826 Phone: 808-268-6072	
E.	**Property Profile (1): Mark Button**		
	Location:	68-505 Crozier Dr.	
	TMK:	6-8-004:018	
	Land Area:	Total	12,916 SF
		Erosion	411 SF
		Net	12,505 SF
	Present Use:	Single Family Residential	
	State Land Use District:	Urban	

Zoning:	R-7.5 Residential
Sustainable Communities Plan	North Shore/Rural Residential
Special District:	No
Special Management Area:	Yes
Flood Zone:	Zone AE (EL 14)

Property Profile (2): Heidi Snow

Location:	68-511 Crozier Dr.
TMK:	6-8-004:031
Land Area:	Total 5,880 SF
	Erosion 16 SF
	Net 5,864 SF
Present Use:	Single Family Residential
State Land Use District:	Urban
Zoning:	R-7.5 Residential
Sustainable Communities Plan	North Shore/Rural Residential
Special District:	No
Special Management Area:	Yes
Flood Zone:	Zone AE (EL 14)

F. Agencies Consulted:

- City and County of Honolulu, Department of Planning and Permitting, Land Use Permits Division.
- State department of Land and Natural Resources/Office of Conservation and Coastal Land/State Historic Preservation Division.
- Arden J. Torcuato- Licensed Professional Land Surveyor (#10257).
- Jamie Alimboyoguen – Licensed Professional Land Surveyor (#8216).
- Xiang Yee – Licensed Structural Engineer (PE-9373).
- Joseph Little – Licensed Coastal Engineer (PE-16050).

G. Anticipated Determination Finding of No Significant Impact (FONSI)

2. LOCATION AND GENERAL DESCRIPTION OF THE SUBJECT PROPERTY

2.1 Site Description and Background

The two subject properties, (1) TMK 6-8-004:018 and (2) TMK 6-8-004:031, are located at (1) 68-505 and (2) 68-511 Crozier Dr. in Waialua which is on the Northwest coast of Oahu. The properties are neighboring each other between single family residences and are themselves single family residences as well. Adjacent to Crozier Dr., however, there are multiple properties designated as Agricultural farmlands (AG-2) that are themselves located within XS FEMA flood zone areas. A general location map for the area surrounding the subject properties is shown in *Figure 1* and a Tax Key Map identifying the specific properties is shown in *Figure 2*.

Property (1) was built in 1940 and property (2) predates it being built in 1926. No permits or records exist in order to know the specific date of the construction of the seawalls. Although evidence exists that the walls were built prior to 1967 as it is clearly visible in the aerial photograph submitted in *Figure 5.1*.

The subject properties are located along an embayment that stretches between Waialua Christian Church and the Salvation Army’s Camp Homelani at the junction of Crozier Drive and Olohio St. The beach varies in width and is composed primarily of fine calcareous sand. The project site faces north and is subject to seasonal storm damage associated with large winter surf. Based on historical aerial photos of the Mokuleia coastline as well as a study conducted through the City and County, it is clear that there has been a loss of shoreline due to erosion activity over the last few decades. Erosion of the lot area was noted by the City and County of Honolulu Real Property Tax Office as of the mid 1960's. The 2011 report *Oahu Shoreline Study — Data on Beach Changes* that was prepared by University of Hawaii Coastal Geology Group for the City and County of Honolulu, Department of Land Utilization documents a landward recession of the erosion line since 1924 for the entire coast of Oahu, including the immediate vicinity of the subject property. Since the mid 1900's a variety of shoreline structures have been constructed along the ocean frontage of the adjoining properties to the east and west to help stabilize the retreating shoreline. This is evident as most nearby properties have also constructed seawall structures along the coast. The aforementioned Oahu shoreline study claims and proves through extensive data that the beaches in the area have experienced Chronic erosion since 1924 documenting erosion rates as high as -1.5 ft/yr. This is primarily true in areas of the beach as you approach Dillingham airfield in the Mokuleia area. However, it has been documented that in the immediate vicinity of the properties in question along Crozier Drive have eroded as much as -0.5 ft/yr which is still a considerable amount of erosion. Please refer to **Appendix B** (*Fletcher et.al., 2011*) for an excerpt with regards to these findings.

Mark Button's lot, TMK 6-8-004:018, is allotted 12,916 square feet. The shoreline is defined by the existing seawall that is located between 96 and 113 feet inland of the seaward property boundary of record. Vegetation on the site consists of yard grass, coconut trees and other various residential landscaping materials. The topography of the lot is flat as is evident in the site photos in *Figure 3B.1*; *Figure 3* is a photo key map. Heidi Snow's lot, TMK 6-8-004:031, is allotted 5,880 square feet. Snow's shoreline is defined by the existing timber seawall that is located between 99 and 98 feet inland of the seaward property boundary of record. Neither properties have incurred much loss of square footage due to the fact that they have both had seawalls on their property for at least 40 years. However, Mark Button's property has eroded more than 300 sqft which is an amount worthy of note. Both property owners however have had to continually repair their walls due to storm weather damage, incurring continual and weighty personal costs.

Mark Button's house was constructed in 1940 per Building Permit No. 228998. Heidi Snow's house was constructed in 1926 under Building Permit No. 241665. Both are shown in **Appendix A**.

<u>Additional Background Information</u>: in this particular area along Crozier Dr. no SSV's have been issued to date, however a large number of these residential properties have hard shoreline protection structures or at the very least, vegetation, proving the need for armored properties. The constant issues presented here are not isolated to Heidi and Snow alone; many other single-family residences along Crozier Dr. and along the majority of North Shore have had to continually battle the elements in order to protect their properties and homes. SSV's have been issued for many properties along the coast where seasonal waves have threatened the integrity of the inhabited environment. Following from our subject properties all the way down to the Salvation Army's Camp Homelani, all thirteen of the properties have some sort of shoreline protection (most of them hard permanent shoreline structures). Not a single one of these walls have record of building permits. Not only is this believed to be proof of the great need of armored shoreline protection, but also that there is an impending need to provide approval of these structures.

2.2 Proposed Action

The applicant received a Notice of Violation January 2018 for the existing seawall. The applicant wishes to seek approval for an after-the-fact Shoreline Setback Variance and an after-the-fact building permit for alterations to existing seawall structure; Wooden structure was reinforced with concrete footing Mauka side of vertical structure. The existing wooden members were then epoxied with dowels into the concrete footing itself in order to provide maximum strength to the weakened structure.

The applicant will apply for a zoning adjustment to permit the seawall to be altered at its foundation. Without the modifications to the foundation of the existing seawall, the outcome could be collapse. Failure of the seawall would result in erosion. This would immediately and significantly impact the shoreline frontage thereby threatening the existing residential structure and those in the surrounding area. As noted earlier, this embayment along the coastline has a history of documented chronic erosion. An excerpt from the Oahu Shoreline Study prepared by the *University of Hawaii Coastal Geology Group, School of ocean and Earth Science and Technology,* is in **Appendix B** (Fletcher et.al., 2011). This Document was prepared for the City and County of Honolulu Department of Planning and Permitting February 2011, and was commissioned in order to better understand the dominantly erosional trend of shoreline change on Oahu. (Contract Number F27934)

There is no record of any previous certified shoreline issued for the subject parcel. It appears that repairs have been continually made to the timber seawall over the years as needed and through those repairs the property lines have recessed Mauka. Mark Button’s property has eroded roughly 330sq ft over the years as made evident by comparing the TMK maps made available by the Department of Planning and a 2016 certified shoreline survey. Heidi Snow’s property has experienced less erosion, losing only 16 sq. ft. These certified Shoreline Surveys prepared by Arden Torcuato and Jamie Alimboyoguen are available in **Appendix E**.

2.3 Technical Characteristics

When the walls for Button and Snow were constructed, two different methods were used. Heidi Snow’s wall was constructed with vertical wooden columns spaced apart makai side of the property. Horizontal beams were stacked against the vertical members and then backfilled. Mark Button’s wall was constructed by using solely vertical wooden members next to each other. These members were not attached to each other and consistently shifted. Both walls, although constructed differently were both approximately 6-8 ft above MSL. The after the fact approval being sought in no way tampered with the final height. A trench was dug however in order to pour a concrete barrier into the subject property. A full section detail can be found on *Figure 8*.

2.4 Economic and Social Characteristics

No new construction is proposed; therefore, no economic or social impacts are anticipated.

2.5 Cultural and Historic Characteristics

The State department of Land and Natural Resources Office of Conservation and Coastal Land/State Historic Preservation Division was contacted in order to obtain information regarding the cultural and historical characteristics of the area in order to safeguard against violation of any such sensitivities. According to the office this area is sensitive to the iwi kūpuna. However, without positive sightings of nesting, no action has been required up to this point.

2.6 Environmental Characteristics

The subject properties are located along an embayment that stretches between Waialua Christian Church and the Salvation Army's Camp Homelani at the junction of Crozier Drive and Olohio St. The project site faces north and is subject to seasonal storm damage associated with large winter surf. In the 1960's and 70's there was sand mining in the area more specifically the area around Mokuleia; and, according to official reports, major erosion occurred during 1967 to 1971 from significant storm wave damage, which is the time frame in which the owner/applicant could have had the seawall constructed. Many of the seawalls along this embayment were built in response to the 1967/1971 period of storm wave damage and chronic erosion and there has been a seawall along the shoreline of this property for over 40 years. The subject seawalls are not tied into each other, both have a return constructed into their walls to help protect against failure and flanking of the ocean tide. The subject property does not contain unique or endangered plant or animal species.

3. ENVIRONMENTAL SETTING

3.1 General Description

The project area is a developed residential strip fronting the ocean with single-family homes along the shore. Many of these houses were constructed in the early 1960's. The State's Land Use designation is Urban and the City and County of Honolulu's zoning is R-7.5 (Residential) although the properties adjacent Crozier Dr. are AG-2 (Agricultural). Most of the shoreline lots in the vicinity of the subject property have existing seawalls or revetments to provide shoreline erosion protection. Few, if any, have permitted said walls.

3.2 Soils

4 Borings were conducted on the property of Mark Button 6-8-004:018 and Silty Sand was found from surface to 5ft. Followed below by course grain and moderately cemented sand as low as 21 feet. Detailed description of the soil boring that took place can be found in **Appendix D;** A geotechnical report created by Shinsato Engineering, Inc. for Mark Button TMK 6-8-004:018 with regards to seawall alterations within the property setback.

3.3 Flood Characteristics

The Federal Emergency Management Agency (FEMA), Flood Insurance Rate Maps (FRIvf), labels the shoreline in the project area as Zone AE a regulatory flood elevation of +14 feet MSL (*Figure 4*). The Zone AE designation indicates that the site is not subject to high velocity tsunami flow. Because the height of the seawall is lower than the base flood elevation of 14 feet, the seawall will have little or no effect on the flood characteristics. The project site is also located within the tsunami evacuation zone as determined by the Oahu Civil Defense.

3.4 Marine Flora and Fauna

There are no known endangered species either land or aquatic flora or fauna, in the vicinity of the subject property. The following information about the marine flora and fauna in the vicinity of the project area is taken from the *Hawaii Coral Reef Inventory, Island of Oahu* (AECOS, 1979): "Off the east end of Dillingham Air Field, Montipora flabellata is very abundant, with Porites lobata and Pocillopora meandrina are common. Turbinaria ornata and Asparagopsis taxiformis are the most abundant algae, with Galaxaura less common. Schools of Heniochus diphreutes, Chromis verator,Decapterus macarellus, and Acanthurus dussumieri are abundant in the vicinity of sand channels crossing the limestone bottom, the margins of which provide vertical relief. Green sea turtles (Chelonia mydas) are present."

3.5 Water Quality

As water moves through a watershed it carries sediments and pollutants to streams (e.g., *Allan 2004, Dudgeon et al. 2005, Paul and Meyer 2001*) and wetlands (e.g., *Zedler and Kercher 2005, Wright et al. 2006*). Nearshore waters are classified as "A" by the Department of Health. No major point sources discharge into these waters, but coastal waters are subject to turbidity following periods of heavy rain when sediments are washed from the land. These effects become less more westward of Kaiaka Bay. Non-point sources of pollution (i.e., pollutants carried in runoff from farms, roads, and urban areas) are largely uncontrolled (*Brown and Froemke 2012*) because the Clean Water Act only requires permits for point sources discharges of pollutants (i.e., discharges of dredged or fill material regulated under section 404 and point source discharges of other pollutants regulated under section (402).

3.6 Public Access, Coastal use and Recreational Resources

A public right-of-way (TMK: 6-8-004: 003) owned by the City and County of Honolulu is located West of the subject property. No other public beach access exists in the area.

The shoreline along Mokuleia Beach is light to moderately used by fisherman typically where there is a broader sandy beach and mostly commonly pole fishing is used to catch ulua, papio, oio, goatfish, and other reef species. Some throw-netting also occurs and some people have been observed walking out on the shallow reef headland, presumably fishing. There is a more limited amount of spear-fishing and trapping. There is no "dry beach" fronting the subject property and the sandy beach is relatively narrow, especially depending on the tidal and wave conditions. The area is also used by some for recreational diving and surfing, but more in the vicinity of Kaiahulu Bay.

Swimming along the beach is relatively safe during calm seas, but dangerous currents can develop especially during heavy surf. In some areas, swimming is not very good because of the rocky bottom and the usually turbid waters.

3.7 Archaelogical and Cultural Resources

The project site is located in the Mokuleia ahupuaa. The Hawaiian land division, known as an ahupua'a, generally runs from the top of the mountains to the edge of the coral reef in the sea. The subject property has been previously disturbed by the construction of the seawall and single-family dwelling improvements. The subject property does not contain any known archaeological or historic sites. No new construction is proposed.

The proposed action will have no effect on traditional cultural practices. On-shore and off-shore fishing along the embayment occurs now and will continue to take place if the proposed action is approved. The State of Hawaii Department of Land and Natural Resources State Historic Preservation Division is unable to offer concurrence on the project because the project site is located in an area where there is a moderate to high potential for historically significant sites, including Native Hawaiian burials and/or habitation sites, to be located beneath the ground surface and the wall was constructed prior to their review. If additional construction or renovation plans should be considered in the future and should significant archaeological features be uncovered, the applicant will be responsible for contacting the department of Land and Natural Resources, State Historic Preservation Division in accordance with applicable regulations.

3.8 Applicable Land Use Considerations

Chapter 205, Hawaii Revised Statutes (HRS) promulgates the State Land Use Law. The State of Hawaii Land Use Commission (LUC) classifies all land into four districts: Urban, Conservation, Agriculture, and Rural. The LUC has noted that the parcel was placed within the State Land Use Urban District and as such is under county jurisdiction. The fast portion of the subject parcel is within the State Urban District: and the land which has eroded is located within the State Land Use Conservation District pursuant to HAR 15-15-20(6). Section 13-227(a)(141) of the Hawaii Administrative Rules (HAR) requires government approval where the shoreline is located at the base of a man made structure. Prior to obtaining after-the-fact building permits for the structures located within the shoreline setback area, the applicant is required to obtain a certified shoreline from the State of Hawaii Department of Land and Natural Resources. The Department of Accounting and General Services Survey Division in their review of the Shoreline survey will locate placement of the certified shoreline and any foundation encroachments will be determined by the DLNR Office of Conservation and Coastal Lands in their review of the project. There is no record of any previous certified shorelines issued for the subject parcel.

The Coastal Zone Management (CZM) Program is promulgated by Chapter 205A, I-IRS. Through the CZM Program, each county is required to establish Special Management Areas (Chapter 25) and Shoreline Setbacks (Chapter 23). The affected property lies within the SMA and has been determined to have a "grandfathered" 20-foot shoreline setback. The application for an after-the-fact variance for the existing seawall involves no new construction; therefore, no Special Management Area Use Permit is required.

Chapter 23 has as its purpose to protect and preserve the natural shoreline; public pedestrian access laterally along the shoreline; and open space along the shoreline. Depending on the seasonal tides people may transit the area fronting the wall for recreational purposes and approval of the shoreline setback variance will not diminish any existing lateral access. Scenic vistas and view planes from and along the Mokuleia coastline and from the near-shore waters are enjoyed by residents. All of the residential properties along this area have similar shoreline protection structures in place and the subject seawall maintains a consistent appearance. The seawalls are located on private property and no public open space or scenic views are impacted.

Provisions of the Land Use Ordinance of the City and County of Honolulu regulate the utilization of land in a manner intended to encourage orderly development in accordance with adopted land use policies. The project site is located in Mokuleia, Waialua within a rural residential designated area on the North Shore Sustainable Communities Plan (SCP) Land Use Map. (This designation is not a site-specific designation but is illustrative of land use policies stated in the text of the SCPO Section 3.1 which discusses open space and the natural environment notes that open space preservation, which includes shoreline areas, is a key element for the North Shore and promotes effective management of these resources and deter land-based activities which contribute to their degradation. Section 3-1.32 contains guidelines pertaining to shoreline areas including:

- Protect nearshore coral reefs from damaging such as soil erosion.
- Discourage development or which result in beach loss.
- Maintain and expand public beach access to the shoreline and lateral shoreline access along the coast, especially in areas with high recreational or scenic value, including the shoreline along Sunset and Kawailoa where access to popular sandy beaches and surf spots are in demand.

Comment: According to our research and the information provided in this document (*Figure 6*), the existing seawalls do not alter seasonal erosion/accretion patterns. The entire coastal reach has been experiencing net long-term erosion over the past 50 years (*Fletcher et al. 2011*). The area is not specifically noted as an area of high recreational or scenic value. In any case, the seawalls, which are on private property are not a barrier to lateral access along the beach.

4. COASTAL SETTING

4.1 General Description

The Mokuleia coastline stretches between Kaena Point to Kaiaka Bay at Haleiwa town on the northwest coast of Oahu. This area is characterized by low-lying platforms of fossil reef-rock that are elevated 3 to 6 feet above mean sea level (MSL). These platforms have been subjected to broad inter-tidal and sub-tidal wave abrasion which has carved into the Waimanalo-age limestone. The coastline contains isolated sandy beaches between breaks in the rocky bench. These beaches widen towards Mokuleia and connect with small offshore sand fields.

4.2 Shoreline Characteristics

Little Environments PLLC was contracted to prepare a Coastal Engineering Assessment for the seawalls of both the subject properties. This report has been made available in **Appendix C** and contains information about coastal processes, waves and water levels, potential littoral impacts, and design input. The following information is taken from this 2018 Coastal Engineering Assessment.

The beach profile in the area is rather constant and varies with slopes between 10% and 20% depending on the status of the littoral system. Where the normal water level intersects the beach profile and seaward of this line, there is the foreshore. The foreshore has about 4 feet in elevation change resulting in about 8-12 feet of lateral distance into the water. The bottom at this depth is crushed coral and at about the same elevation as reported in previous geotechnical investigations in the yard that terminate at this depth. The foreshore and backshore are both comprised of the uniformly graded calcium carbonate sand.

4.3 Existing Shoreline Structures

According to the Coastal Engineering Assessment, the existing shoreline structures have provided adequate protection against the elements. However, they have also proven themselves necessary as an armored boundary protection. Taken from **Appendix C**, Little Environment identifies that minimal to no net change of the shoreline since 1967 it is reasonable to assume the system is at littoral equilibrium and while erosion may occur normal of the area identified in the beach profile, further erosion is not anticipated except during discrete events that are not reasonably probable. Thus, the maintenance of the front face of the sea wall and backing seawall is therefore dually recommended without exception.

4.4 Shoreline History

Historical aerial photographs depict the significant loss of shoreline along the coast. The subject areas have lost property to erosion. The Assessment reports that cyclical changes in beach form in this area are minimal. The minor cyclical shifts that do occur are the result of a balance in sand shifting in the fore shore as a result of wind driven waves balancing out the net sand movement that results for north east winter swell. Some reports in this vicinity identify that the area is eroding to various extents. The most quantitatively informed study or estimation was carried out using an army corps of engineers ST Wave model. While the ST wave model is a good model for making estimations and sizing structures for longevity, the assumptions that are incorporated into the model such as neglecting to incorporate impacts from waves reflected from steep bottom features, wind waves being limited by the duration of the winds, assuming constant currents throughout a water column and also incorporating bottom friction. In the past the beach here has not varied significantly in height. Historical photographs do show erosion over time, but data is limited in regards to identifying the direct cause of the erosion due to developments that have also occurred in the area over time that were done so without establishing a baseline for monitoring. Significant erosion of the fore shore at the properties of concern is not reasonable anticipatable in the near future and hence the improvements to the wall assume a reasonable continuous level of foreshore for which to protect the base of the seawall. Given the seawall frontage will not vary from the current seawall frontage, no impact to the natural cyclical changes will occur.

Please refer to **Appendix C** for the complete report and additional information by Little Environments PLLC regarding the history of the shoreline.

4.5 Coastal Processes and Sand Transport

The following information is taken from the Little Environments PLLC Coastal Engineering Assessment (2018) (**Appendix C**). Littoral transport driven primarily by swell and wind waves dominates the coastal sand transport processes in the area offshore and affronting the properties of consideration. The reef structures also play a role in the balance of the sand transport. Given the primary direction of swell from the north west, waves are set-up and split by the reefs in random patters. The withdrawal of the waves through submerged trenches and propagation of waves over these trenches creates a stirring and mixing effect that allows sand to be taken from the shoreline and also re deposited along the shoreline. Given the minimal to no net change of the shoreline since 1967 it is reasonable to assume the system is at littoral equilibrium and while erosion may occur normal of the area identified in the beach profile, further erosion is not anticipated except during discrete events that are not reasonably probable. The maintenance of the front face of the sea wall and backing seawall is therefore dually recommended without exception.

4.6 Potential littoral Impacts

According to Little Environments assessment, given the minimum to no net change of the shoreline since 1967 it is reasonable to assume the system is at littoral equilibrium thus should be concluded that there will be no littoral impact due to the alterations on the existing wall. As a matter of fact, stated in the assessment is the conclusion that loss of the seawall amongst the other applied coastal protection strategies along the shoreline would result in significant t disruption of the system's littoral sand drift potentially discharging large amounts of sand out to sea that could not be reclaimed.

Finally, according to the report, Given the area's stability and resilience to maintain littoral equilibrium during large swell events and that the sea walls were like present back to the original construction of the properties in 1940 and 1926, maintaining a face at or about the current location of the face of the sea wall is recommended without exception to prevent abnormal changes to the beach form. The erosion that is occurring along the Mokuleia shoreline can be described as "passive" erosion. It is not "active" erosion, which is induced or accelerated by shore protection structures. Passive erosion designates the process that occurs when a protective structure is built along an already eroding shoreline and erosion continues to occur. Passive erosion proceeds independent of the type of shore protection constructed. The unprotected shoreline adjacent to a protective structure will continue to erode and will eventually migrate landward beyond the protection structure. This is the most common result of shoreline hardening in Hawaii.

4.7 Coastal Hazards

The Atlas of Natural Hazards in the Hawaiian Coastal Zone (2002) rates the "overall hazard assessment" along the Kaena Point coast from "moderate (4) at Kaena point to high (6) along the low-lying sandy beaches of Camp Erdman and Mokuleia Beach, where the coastal slope is lowest and chronic erosion is diminishing Mokuleia's sandy beach". Tsunami and stream flooding are other concerns in this area. They are ranked high along the lower slopes between Camp Erdman and Mokuleia (*C.H. Fletcher III et al., 2002*).

The hazards of high wave action throughout this region of the North Shore are rated as high. This northwestern tip of Oahu is also subject to Kona storms, high trade winds and hurricanes. The storm hazard is ranked moderate for the eastern portion of this coast (including the vicinity of the project area) where it become a bit more sheltered from hurricane and Kona storm energy.[r], as compared to the western portion towards Kaena Point. The *Atlas*, rates the erosion hazard as high along the isolated sandy beaches of Camp Erdman and Mokuleia, whereas erosion hazard becomes more moderate along Kaena Point's hard limestone shoreline where it is rocky.

5. ALTERNATIVES CONSIDERED

Alternatives were not considered by Little Environment's engineers. According to their assessment, the existing wall has allowed the coastline to maintain littoral equilibrium and removal of said shoreline protection would in fact disrupt said stability. Without the wall in place, ocean tides and conditions were attempt to create a stable slope resulting in the loss of a great amount of square footage of personal property belonging to Button and Snow as well as others with protection walls along their property lines. This would result in massive amounts of sand loss and could inevitably result in hardening of the shoreline in this area proving detrimental to the cultural and recreational activities that take place at present. Although Little Environments did not consider alternatives below are options that prove to be insufficient for the protection of the properties.

5.1 Sloping Revetment

Replacing the seawall with a sloping revetment structure will not improve the existing shoreline access and will not halt the ongoing erosion along this coast. Although there is sufficient space on the property to construct a sloping revetment removing or relocating the dwelling, at least 20 feet of flank walls would need to be constructed to protect the adjacent properties, since the top of the revetment slope would be located about 20 feet inland of the adjacent seawalls.

5.2 Sand Bags

While large geotextile sand bags have been used as temporary erosion control in several areas, including Lanikai, use of the bags has drawbacks. The bags are prone to damage from storm wave attack and vandalism, require frequent and continual maintenance, and cannot be considered a permanent protection measure. The large sand bags are solid, hard building materials when fully filled, and a sand bag revetment structure is more reflective than a rock revetment. Another potential concern is that bags that are under water become very slippery due to algal and therefore pose a safety problem in terms of people walking across them.

5.3 Beach Restoration

The State of Hawaii Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL) is developing a comprehensive coastal lands policy that strives to mitigate negative impacts to the coastal system from shore protection structures by encouraging alternatives to the construction of seawalls and revetments. In the foreseeable future, the DLNR will implement new, proactive and sustainable shoreline management practices in accordance with the objectives and policies that pertain to Hawaii's beaches, which are a State public resource protected by the State Constitution and Hawaii Revised Statute 205A and 183C. Policies for the protection and preservation of Oahu's natural shoreline and sandy beaches are further promulgated by the Revised Ordinances of Honolulu Chapter 23.

Beach and dune restoration with sand nourishment can slow coastal erosion and restore lost beach areas. The recent Kuhio Beach restoration project involved the replacement of 10,000 cubic yards of reclaimed sand from nearshore deposits. The project, which was executed between November 27, 2006 and January 6, 2007, cost approximately $475,000 and was funded by the DNLR- Land Development Fund (DLNR, 2007). In 2000, approximately 10,000 to 12,000 cubic yards of dredged sand from Kaelupulu Stream in Kailua was used in a demonstration project to re-nourish south Lanikai Beach (Shapiro 2000). A news release pertaining to the project indicated that it "provided about half of the total amount that will be needed to more fully nourish south Lanikai Beach" (DLNR 2000). It is not known when another beach nourishment project would be accomplished for south Lanikai Beach since adequate funds and sources of sand would first need to be secured.

Soft shore protection measures are not feasible from the perspective of a single landowner because they require resources and coordination on a large-scale. Beach restoration must occur along numerous residential properties in order to be effective. In addition to the challenges of finding suitable sand and navigating the permitting process, a successful beach nourishment project may require coordination and cooperation among a group of homeowners who maintain a long-term commitment to undertake sand replenishment on a periodic basis. It is likely that a groin or offshore breakwater structure would also need to be constructed to prevent sand from being quickly redistributed by wave energy. Due to intense storm wave activity on the north shore these solutions do not appear to be practical. Beach replenishment may be the best long-term solution, but these measures are beyond the capacity of the applicant who is simply trying to permit a seawall revision that has been in existence for more than 40 years in order to protect his property from further damage.

5.4 No Action

This alternative is not viable because it implies that no action would be taken to resolve the issues surrounding the seawall. The unpredictability of ocean storm and wave action for the North shore of Oahu and its cause for concern over potential damage to the properties required the construction of the seawalls in the first place. Evidence presented in this document support the need for the seawall; this is not in question. The original construction of the wall has proved to be less than optimal as time and time again owners such as Button and Snow have had to repair their damaged walls due to the ocean tides and swells. The alterations to the seawall not only protects the existing wall but does so in a way that causes no negative impact on the environment. Granting of the Shoreline Setback Variance is the means for legalizing the seawall under ROH Chapter 23 and would provide a means for the owner to legally repair the wall but it is no guarantee that the structure will be permanent.

However, in general, a legal structure is more likely to be repaired in accordance with building code regulations than an illegal structure.

5.5 Removal of Alterations to the Existing Seawall

Removal of the alterations to the existing wall is also not a viable option. The simple fact of the matter is that this issue is in fact an issue and the wall’s poor construction has proven itself time and time again to be insufficient in the defense of the property against the ocean tides and swells. Removing the alterations to the existing seawall would in fact debilitate the wall and could result in the retaining wall failing altogether. This would be catastrophic as loss of the seawall would result in immediate loss of at least 30 feet of property as the shoreline attempts to achieve a stable slope. The adjacent properties would be impacted as their exiting seawalls become flanked. In addition, loss of the existing seawall along 160 feet of coastline would not release enough sand to restore a beach in an area where the entire shoreline has been armored and would hasten erosion of the applicant's parcel. Areas behind existing shoreline structures on adjacent properties may eventually erode if the applicant’s seawall fails.

6. PROJECT IMPACTS

Potential impacts are addressed in terms of how proposed action relates to the thirteen criteria below. Chapter 200 of Title 11, Administrative Rules of the State Department of Health establishes criteria for determining whether an action may have a significant impact on the environment (11-220-12).

1. **Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;**

The subject property lies along an eroded sandy shoreline. No new construction is proposed. The subject property does not contain any significant flora or fauna. No known cultural resources are located on the property. No impacts to natural or cultural resources are anticipated due to the proposed action. The application is for an after-the-fact shoreline setback variance which involves no construction activities and no irrevocable commitment, loss or destruction of resources.

2. **Curtails the range of beneficial uses of the environment;**

There is no impact on public access to the shoreline. There will be no impacts on fishing or ocean use due to the proposed action. Existing seawall configuration and related improvements do not curtail the beneficial use of the environment. The property is zoned residential and is committed to private residential use. The existing seawall and others along this coastal reach have no effect on the existing littoral processes at this site.

3. **Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;**

Chapter 343, 1--IRS requires environmental assessment for any use within a shoreline area as defined in section 205A-41. It is the policy of Chapter 205A to discourage all shoreline hardening that may affect access to, or the configuration of our island beaches. However, the existing seawall is consistent with the longstanding history of government decisions that approved shore protection structure along this stretch of the Mokuleia coastline in order to protect the rights of homeowners. Many properties to the east and west of the applicant's property (specifically more in Mokuleia), have all received shoreline setback variance approvals and building permits (1993/1997) for their respective seawalls. These issues have been discussed at length with the DLNR and there is no simple answer or statewide policy that has been implemented.

4. **Substantially affects the economic welfare, social welfare, and cultural practices of the community or State;**

The economic and social welfare, and cultural practices of the community or State are not affected by the existing seawall and related improvements or the proposed action to seek after-the-fact approval. No new construction is proposed.

5. **Substantially affects public health;**

There are no public health concerns relating to the existing seawall and related improvements. No new construction is proposed.

6. **Involves substantial secondary impacts, such as population changes or effects on public facilities;**

There are no anticipated secondary impacts to population or public facilities. No new construction is proposed. The proposed action does not impact public services or facilities.

7. **Involves a substantial degradation of environmental quality;**

The existing seawall prevents erosion of the applicant's property and therefore minimizes the potential for runoff entering the ocean. The subject seawall ties into seawalls on both sides of the subject property. Historical aerial photographs and studies depict the significant loss of shoreline along the Mokuleia coast and it’s vicinity since 1949. The majority of homes have vertical seawalls or some form of shore protection along this embayment.

8. **Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;**

No new construction is proposed. The adjacent properties are developed as residential properties. Along the shoreline and up towards the town of Mokuleia, residences along this embayment experienced loss of 25-30 % of property lot area due to wave action and erosion prior to construction of the seawalls between 1967-70. Nine of the properties have undergone environmental review in order to obtain after-the-fact shoreline setback variances to legalize the existing seawalls. There has been no determination of significant cumulative impact by the approving government agency. The process of obtaining the after-the-fact shoreline setback variance for the subject property will not result in any significant cumulative impact and does not involve a commitment for larger actions. As such, a Finding Of No Significant Impact is being requested. There is no commitment for a larger action; the subject property will remain single family residential.

9. **Substantially affects a rare, threatened, or endangered species, or its habitat;**

The project site has been previously disturbed and developed when the single family residence and improvements were constructed. There are no known endangered, threatened, or rare plants or animal species at or near the subject property.

10. **Detrimentally affects air or water quality or ambient noise levels;**

No new construction is proposed. The existing seawall and related improvements do not detrimentally affect air or water quality or ambient noise levels.

11. **Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;**

The property is located in Flood Hazard Zone AE (*Figure 4*) with a base flood elevation of fourteen feet and the tsunami evacuation zone. The seawall protects the property from further erosion and protects the house structure from wave energy, wave run-up and overtopping. The existing seawall is not expected to increase the flood hazard for the surrounding properties or the subject property. Because the height of the seawall is lower than the base flood elevation of 14 feet, the seawall will have little or no effect on the flood characteristics. Any tsunami which would breach the wall would most likely cause damage to both the wall and property.

12. **Substantially affects scenic vistas and view planes identified in county or state plans or studies; or**

Views of the shoreline and subject property's rear yard are not possible from Crozier Dr. due to the existing private residential structures, garages, fences, vegetation and hedges lining the road. Scenic vistas and view plans from and along the coastline and from the near-shore waters are enjoyed by residents alone – very few views, if any exist from public property. All of the residential properties along this area have similar shoreline protection structures in place and the subject seawall maintains a consistent appearance. No scenic views are impacted.

13. **Requires substantial energy consumption;**

Not applicable.

6.1 Summary of Unavoidable Adverse Environmental Impacts

Construction of the original seawalls in the 60’s may have prevented the erosion of coastal land behind the shoreline structures but, combined with other factors such as sea-level rise, may have refocused erosion that can contribute to beach loss. Allowing the applicant's existing seawall to remain reinforced will help keep the wall in place, preventing property losses due to erosion and wave damage, however, the structures may be impounding a substrate beach quality sand that would naturally nourish a healthy beach. Efforts to restore the beach in southern Lanikai where, as is the case along this shoreline, the entire shoreline has been armored for many years, the sand supply has decreased, and the State public resource has been severely compromised for several decades would require the removal of many contiguous armaments along the affected coastline. Removal of the reinforcing of the seawall will not further alter the environment in any way. The original wall will remain in place causing the same impacts it would with its reinforcement. Maintaining status quo by allowing the applicant's existing shoreline protection structure to remain in place as-is, is not expected to create any new significant adverse impact on littoral processes along the shoreline.

6.2 Findings and Reasons Supporting Anticipated Determination

The significance criteria of Title 11 Chapter 200-12 HAR have been applied and it is proposed that the proposed action to approve the after-the-fact shoreline setback variance for the existing seawall and related improvements will not have a significant effect on the immediate or surrounding environment and that an Environmental Impact Statement will not be required. Based upon this Environmental Assessment document and the evaluation of the determination, it is recommended that a Finding of No Significant Impact (FONSI) be issued for the proposed action.

7. MITIGATION MEASURES

As indicated in Section 6.0 Project Impacts, the proposed action would cause no significant short-term or long-term impacts to recreational, biological or scenic resources. The Coastal Engineering Assessment states that the existing seawall has no effect on the existing littoral processes at this site; it does not alter seasonal erosion/accretion patterns, and does not affect lateral access along the beach. No mitigation measures are proposed.

8. REQUIRED APPROVALS, AGENCY AND PUBLIC CONSULTATION AND REVIEW

8.1 Required Approvals

The project will require the following:

- Shoreline Setback Variance pursuant to Chapter 23, Revised Ordinances of Honolulu
- After-the-fact Building Permit from the City and County of Honolulu

8.2 Shoreline Setback Variance

The applicant will need to submit an application for an after-the-fact Shoreline Setback Variance for the following primary structures.

1. Below grade alterations to existing timber wall Mauka of TMK 6-8-004:018
2. Below grade alterations to existing timber wall Mauka of TMK 6-8-004:031

As set forth in the Revised Ordinances of Honolulu (ROH) Section 23-1.8(b)(3), the variance application will contain the three tests of hardship that the landowner will incur if he is not allowed to retain the structures

1) **The applicant will be deprived of reasonable use of the land.**

All 13 of the properties along this coastline are protected with similar structures to prevent the effects of shoreline erosion and wave damage that would otherwise occur due to North Pacific swell events (From Button's property to the Salvation Army to the West). Previous erosion from wave action had already proven itself a threat to the residential properties in the area prior to construction of the shoreline protection structures. It is reasonable to assume that property losses will occur if the applicant is required to remove the illegal seawall structures that have been in place since the 60's. Granting of the Shoreline Setback Variance is the means for legalizing the existing seawall and its reinforcement below grade under ROH Chapter 23 and would provide a means for the owner to legally repair the wall should a severe storm event undermine and collapse an unconsolidated shoreline, thereby creating a public hazard on the beach. Any other action would deprive the applicant of reasonable use of his property.

2) **The applicant's proposal is due to unique circumstances and does not draw into question the reasonableness of ROH Chapter 23 and the shoreline setback rules.**

The beach fronting the property began to be narrowed since the original subdivision in 1960. The original seawall was constructed without building permits prior to the implementation of the shoreline setback rules and subsequently repaired in response to wave damage. Chapter 23 allows shoreline protection structures that have received a shoreline setback variance on the basis that the structure does not adversely affect beach processes, public access along the shoreline or shoreline open space. Retreat of the shoreline along this sketch of coast has been in existence prior to the building of the first seawall; and, would most likely continue without the shoreline protection structure.

People can transit the area fronting the walls for recreational purposes at low tide and the open space and view planes are not impacted by the existence of the seawall. It is also a policy of Chapter 23 to reduce hazards to property from coastal flooding and retreat of the shoreline; and, as the wall has been in existence for almost 60 years and is connected to a series of seawalls protecting the residential properties along the embayment, it is reasonable to allow the wall to remain and to allow it to be repaired as needed in accordance with government regulations.

3) The proposal is the practical alternative which conforms to the purpose of the shoreline setback regulations

The applicant concurs that while the preferable alternatives would be to redesign the wall to include a sloped revetment and/or engage in a program of beach restoration, the proposal to retain the existing seawall is the only solution. To demolish and reconstruct the wall would unduly impact beach processes and beach restoration is beyond the scope of a single landowner. Legalization of the existing shoreline protection structure, so that it can be repaired as necessary, is the best alternative given the history of erosion and wave action for this portion of the north shore of Oahu.

These criteria and any specific engineering solutions will be expanded on in the application for the Shoreline Setback Variance and will include a request and justification to retain other minor structures.

9. References

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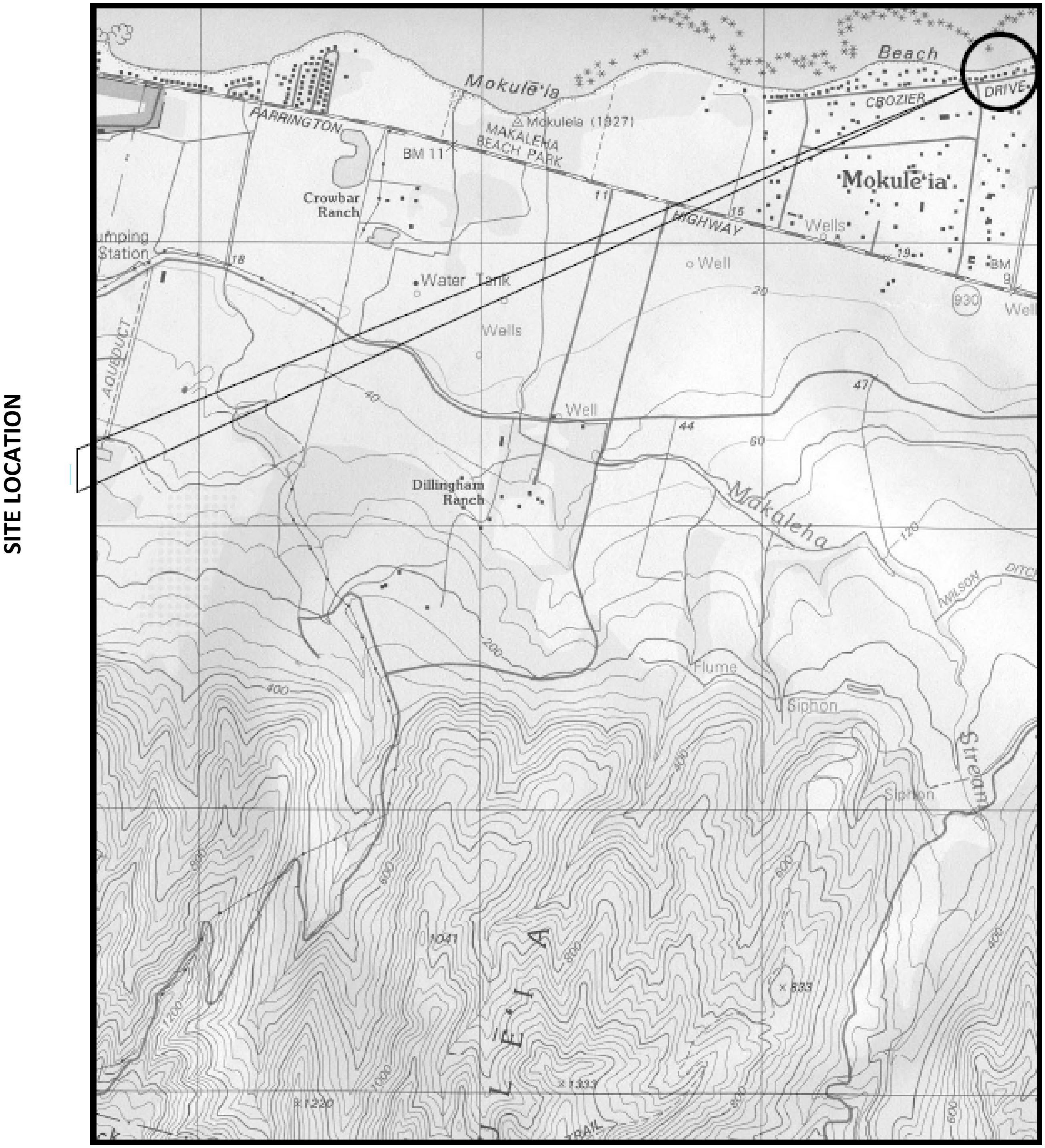

REFERENCE:
USGS TOPOGRAPHIC MAP
KAENA QUADRANGLE
DATED 1998

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Figure 1
VICINITY MAP
68-505/511 CROZIER DRIVE, Waialua, Oahu, Hawaii 96791

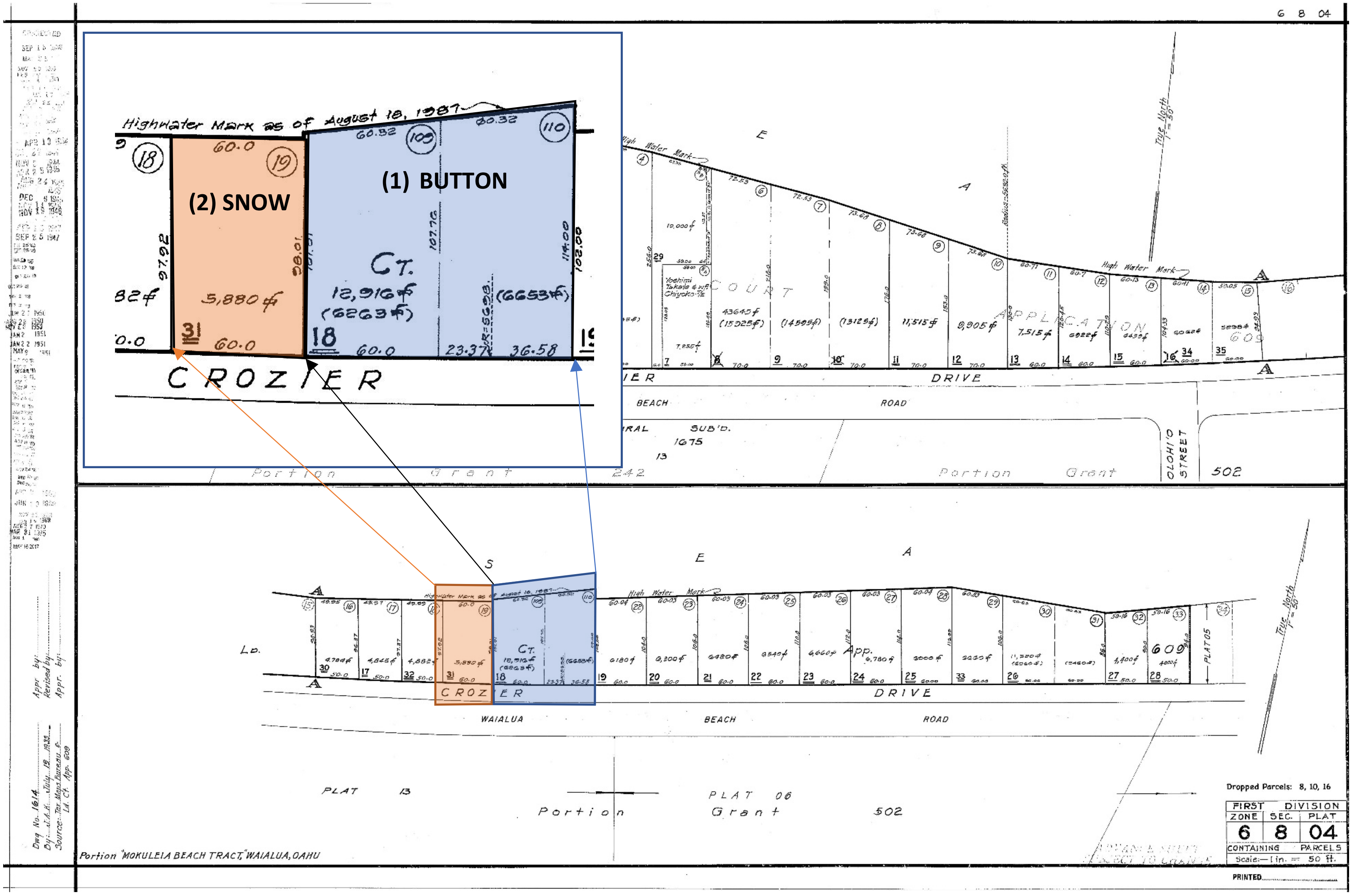

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Figure 2
VICINITY TMK MAP
SUBJECT PARCELS 18 & 31

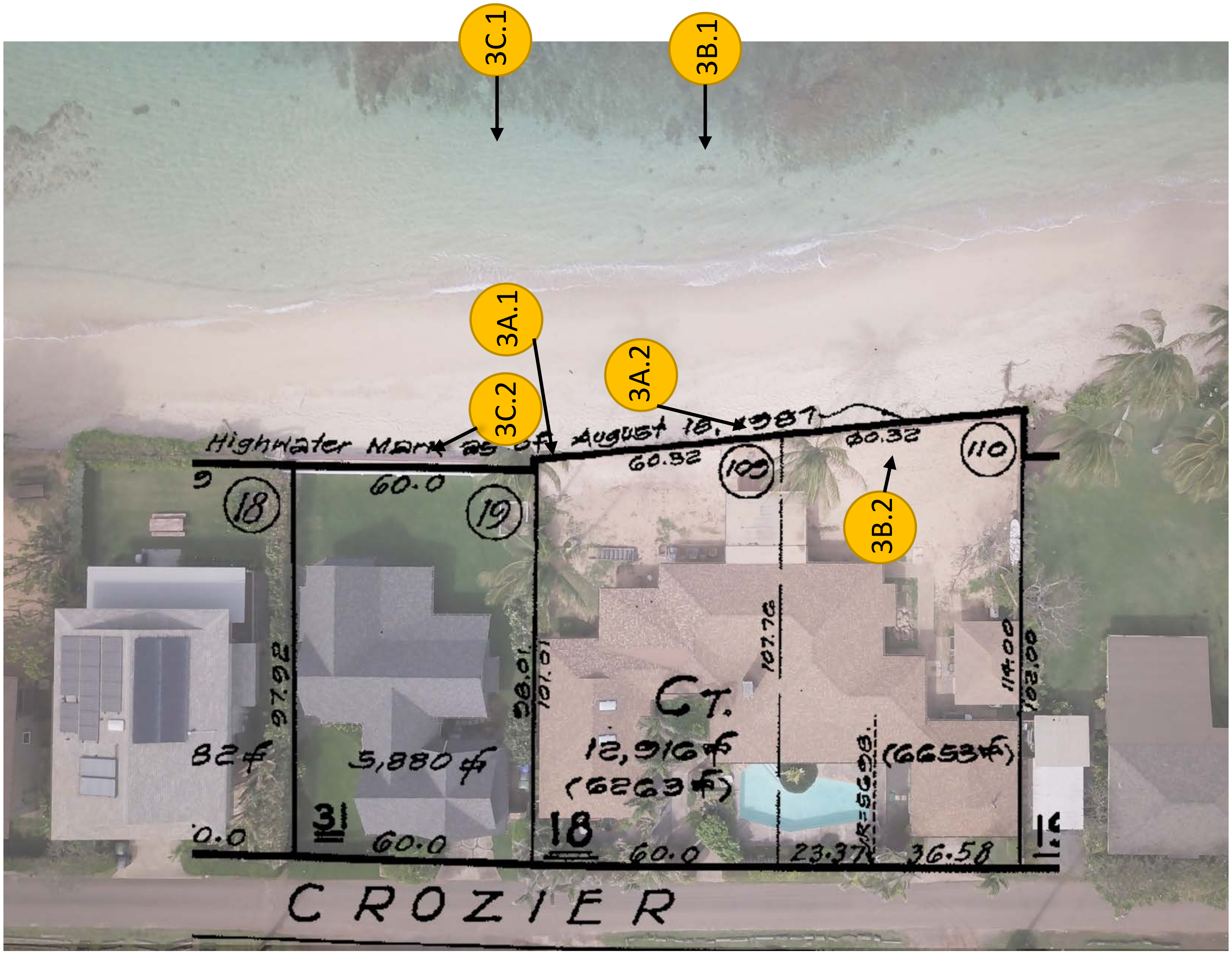

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Figure 3
PHOTO KEY MAP
68-505/511 CROZIER DRIVE, Waialua, Oahu, Hawaii 96791

Figure 3A.1

(1) TMK 6-8-004:018
Photo Above: October 2016
Photo Below: December 2017

Figure 3A.2

(1) TMK 6-8-004:018
Photo Right: December 2017
Description: Although photo was taken during low tide, High tide of ocean swell is shown clearly by the positioning of the drift wood in the photo.

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Figure 3A
SUBJECT SEAWALL (1) TMK: 6-8-004:018
68-505 CROZIER DRIVE, Waialua, Hawaii 96791

Figure **3B.1**

(1) TMK 6-8-004:018 (2) TMK 6-8-004:031

Photo Above: January 2018

Figure **3B.2**

(1) TMK 6-8-004:018

Photo Left: February 2016

Description: Incoming Ocean Swells clearly making contact with Subject property's wooden seawall.

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Figure 3B

SUBJECT SEAWALL (1) TMK: 6-8-004:018

68-505 CROZIER DRIVE, Waialua, Hawaii 96791

Figure **3C.1**

(1) TMK 6-8-004:018 (2) TMK 6-8-004:031

Photo Above: January 2018

Figure **3C.2**

(2) TMK 6-8-004:031

Photo Left: October 2017

Description: Existing wooden seawall

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Figure 3C

SUBJECT SEAWALL (2) TMK: 6-8-004:031

68-511 CROZIER DRIVE, Waialua, Hawaii 96791

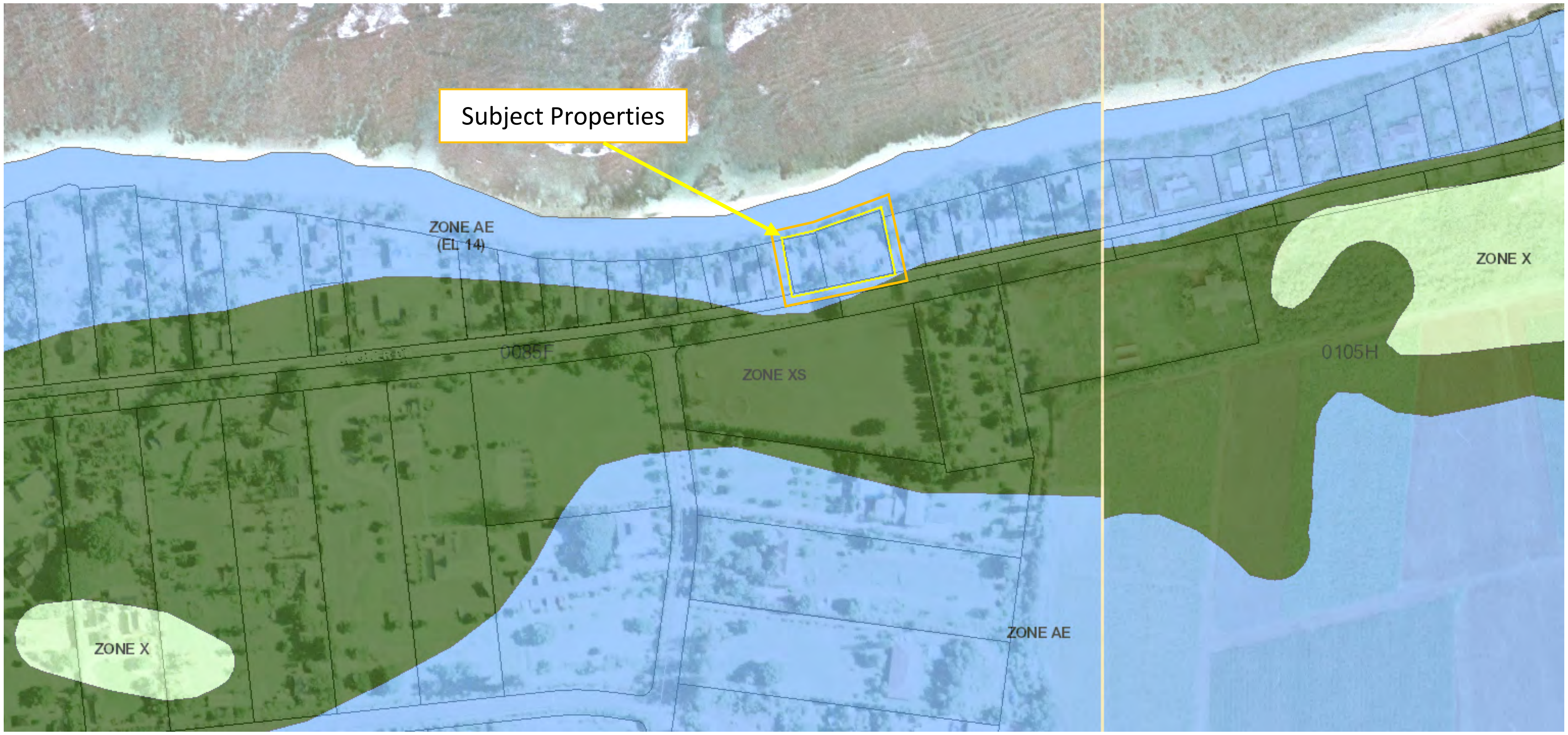

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Figure 4
FLOOD ZONE MAP

Figure **5.1**

Historical Aerial photo

April 22, 1967

Figure **5.2**

Modern Aerial Photo

January 2018

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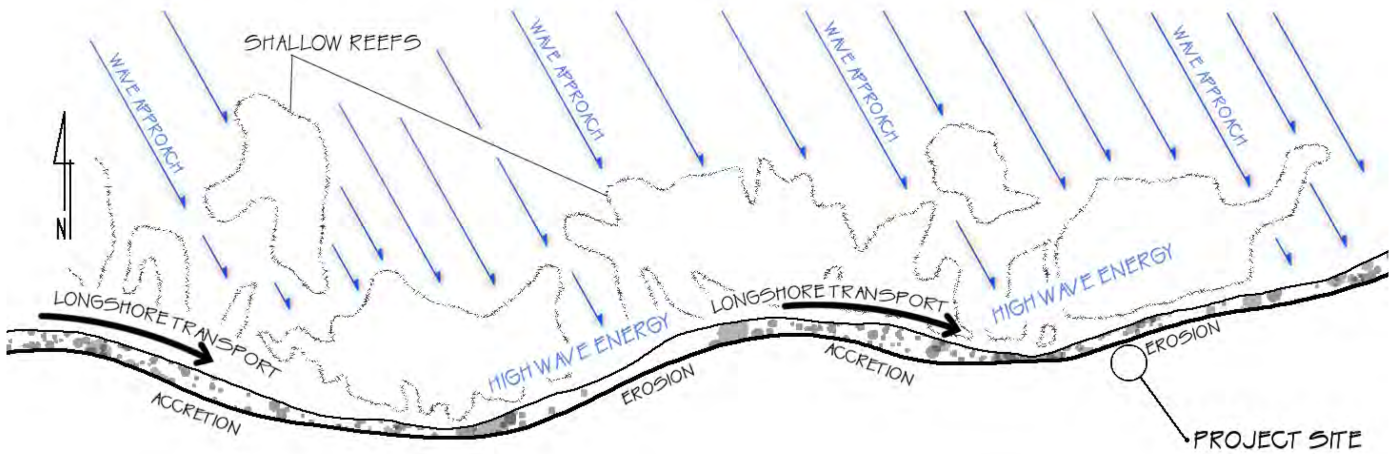
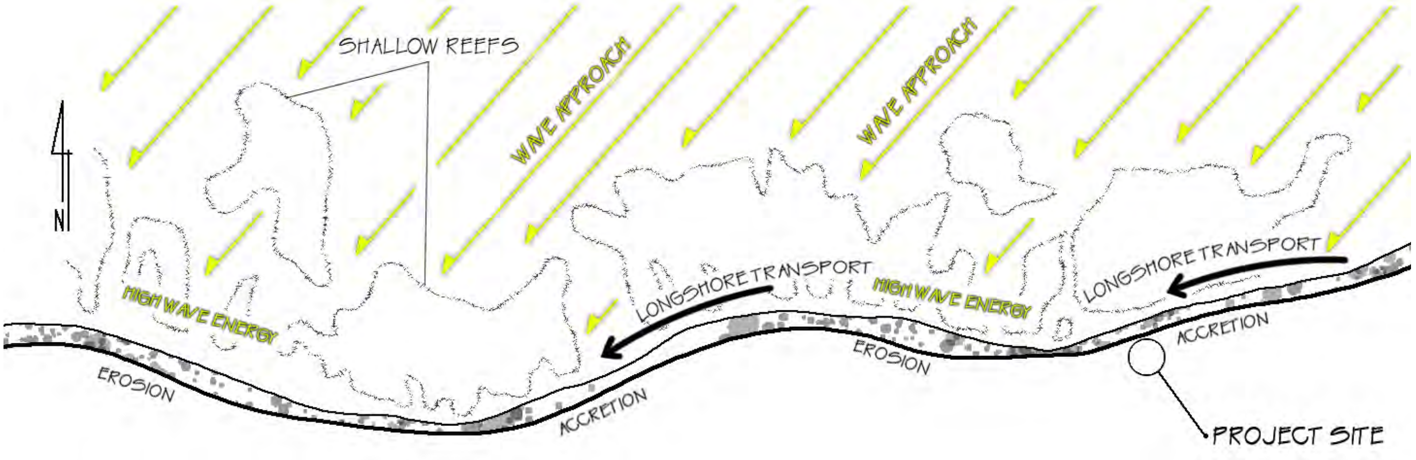
Figure 5

SUBJECT PROPERTIES (1) TMK 6-8-004:018 (2) TMK 6-8-004:031

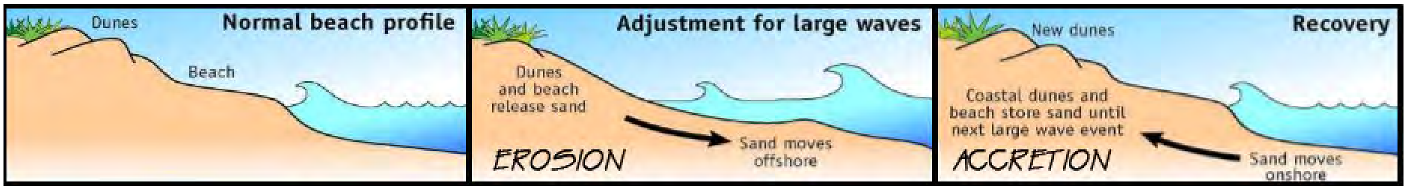
Historical and Modern Aerial Photos



WINTER NORTHWEST SWELL CONDITIONS



SUMMER NORTHEAST TRADEWIND CONDITIONS



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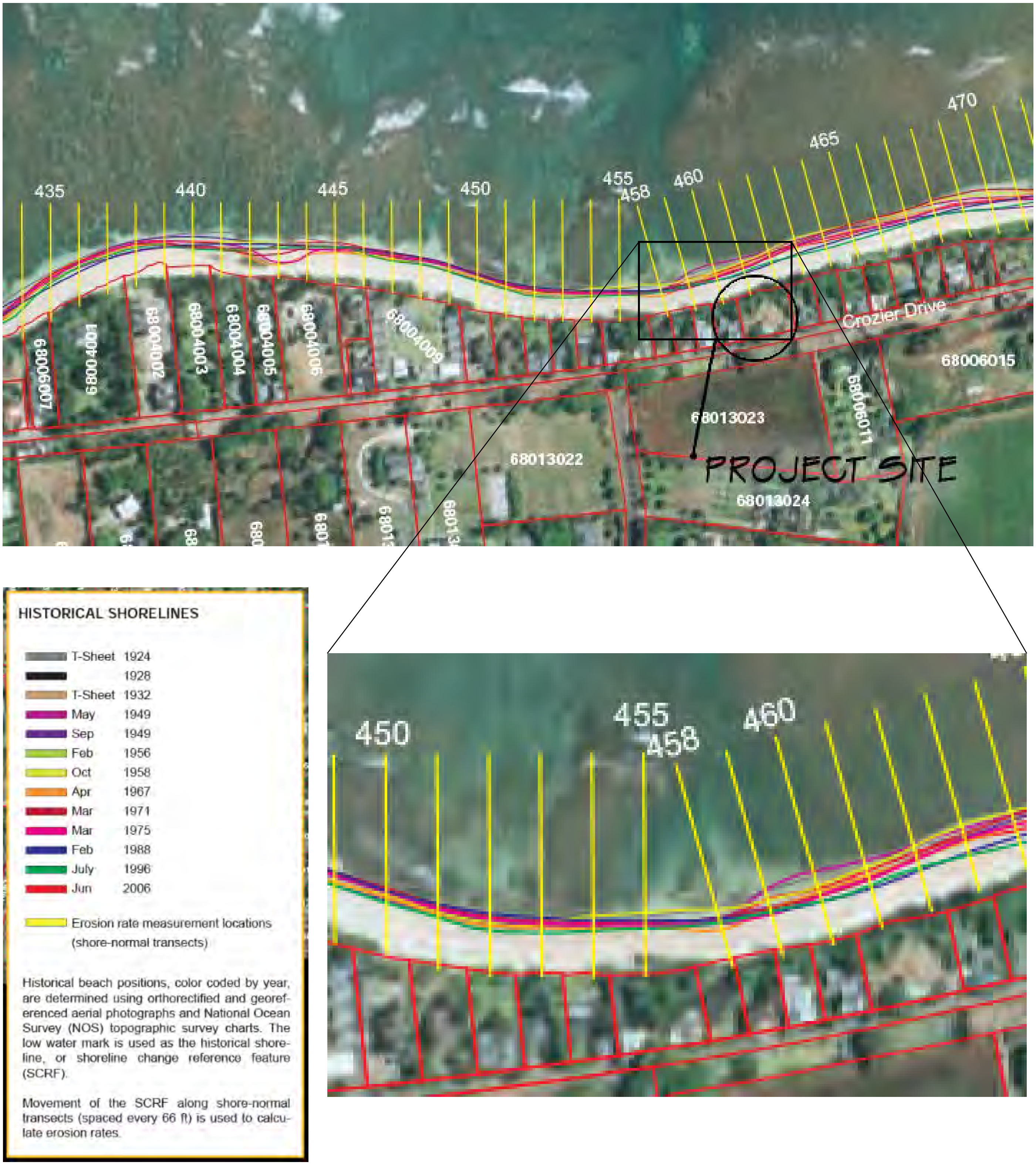
DESIGN & CONSTRUCTION
BC - 32542

Figure 6
SAND TRANSPORT FIGURES
For Project Site and Surrounding Area



Historical beach positions, color coded by year, are determined using orthorectified and georeferenced aerial photographs and National Ocean Survey (NOS) topographic survey charts. The low water mark is used as the historical shoreline, or shoreline change reference feature (SCRF).

Movement of the SCRF along shore-normal transects (spaced every 66 ft) is used to calculate erosion rates.

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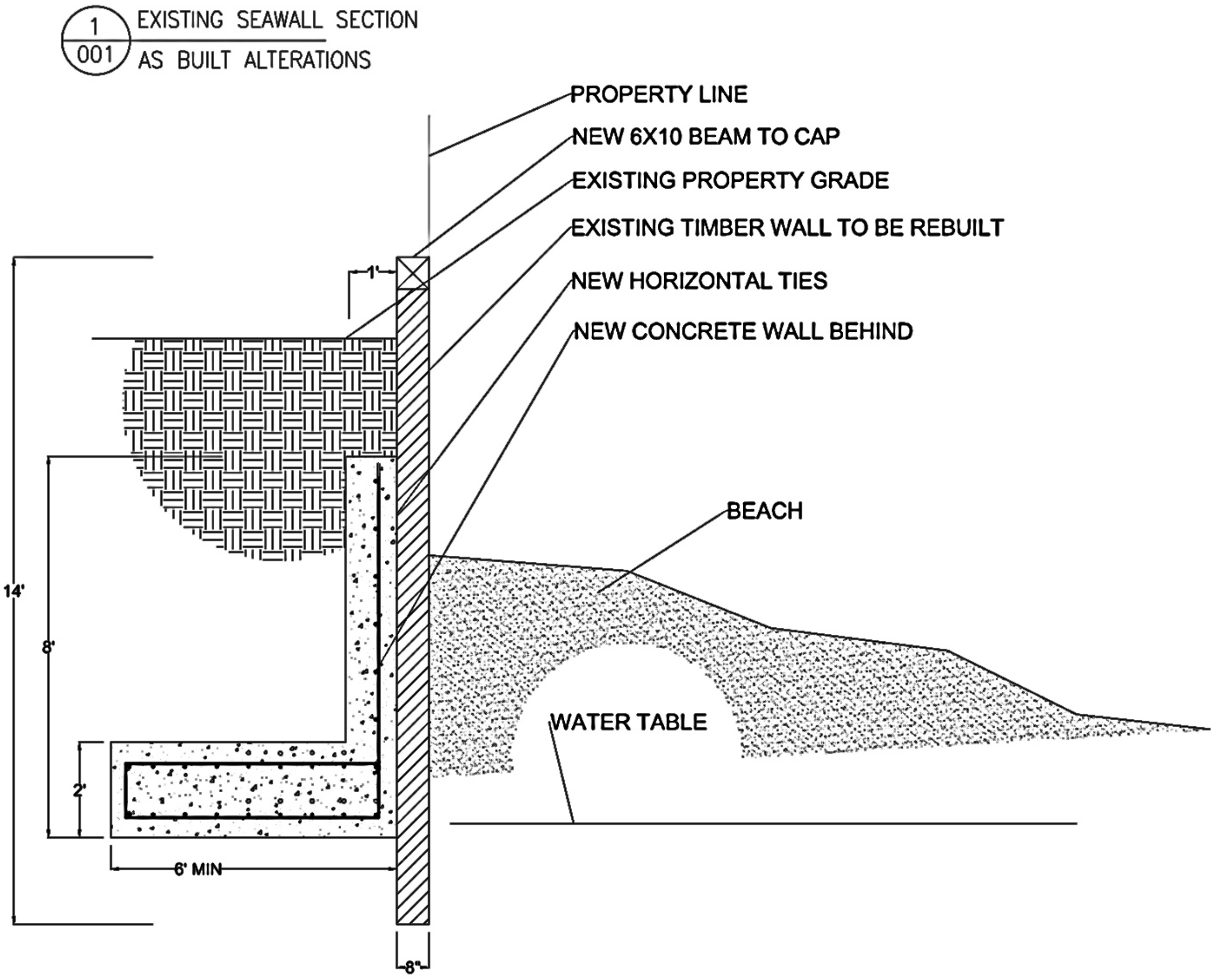
WORKS LLC
DESIGN & CONSTRUCTION
BC - 32542

Figure 7

BEACH LOSS – Historical Aerial Graphic

Source: Oahu Shoreline Study: *Fletcher, Romine, Barbee, Dyer*



NEW CONCRETE WALL TO HAVE MMFX REBAR
#4 @ 12" O.C. EACH WAY BEHIND TIMBER WALL AND
#5 @ 8" O.C. ON BOTH THE TOP AND BOTTOM ROW OF FOUNDATION
WALL TO BE 12" IN WIDTH, 8' IN HEIGHT AND STRETCH THE LENGTH OF THE OCEAN FRONT

GUNDAKER WORKS LLC
DESIGN & CONSTRUCTION
BC - 32542

Figure 8

Seawall Detail – As Built

Existing & Modified Structure

Appendix A

Property Tax Record Building Permits

TMK: 6-8-004:018
68-505 Crozier Dr.
Waialua, Oahu, Hawaii 96791

TMK: 6-8-004:031
68-511 Crozier Dr.
Waialua, Oahu, Hawaii 96791

ACCEPTING AUTHORITY:

City and County of Honolulu
Department of Planning and Permitting

PREPARED BY:

Gundaker Works, LLC

February 2018

hawaii

WAII, LTD.

AN KITAPCI

D5

R-4

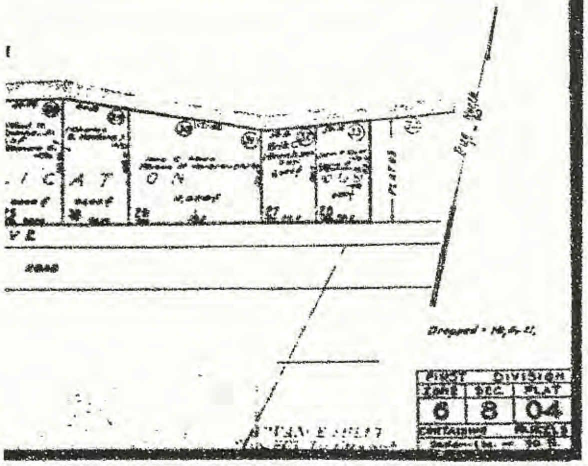
CTER
8-4-86

As Noted Martyn 8/27/86

TRICT R-4 6-8-4-18

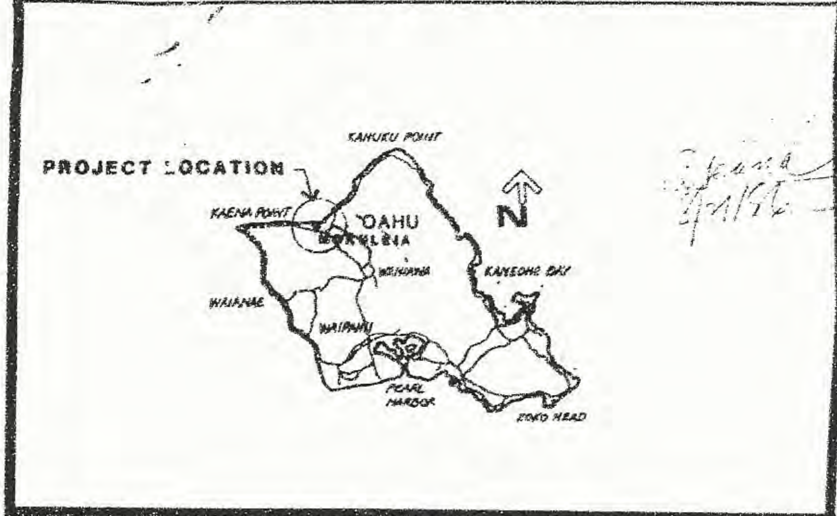
228998

ING DEPARTMENT
FILE COPY

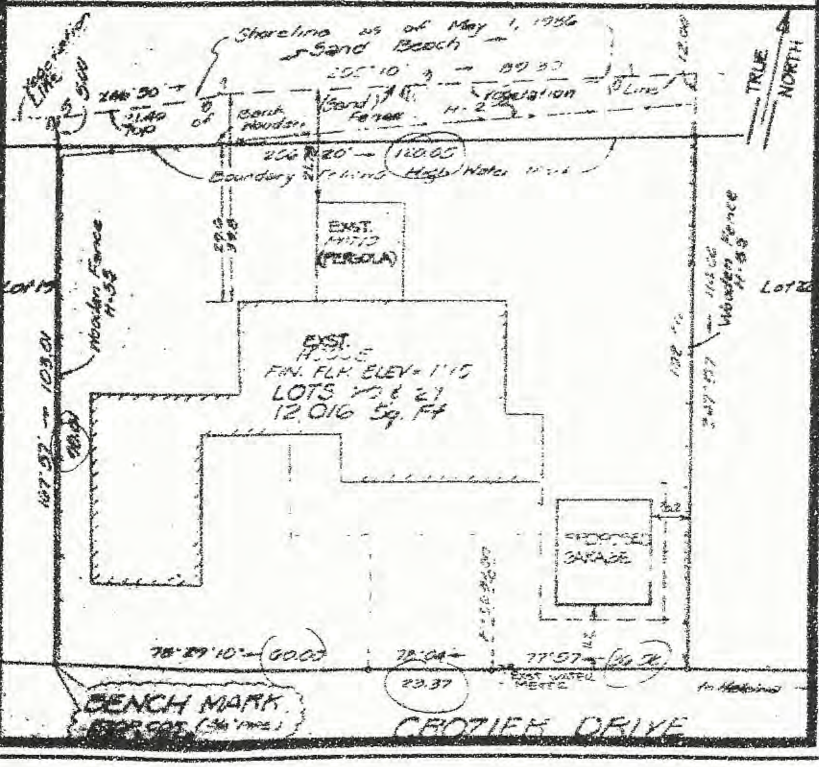


S-1 STRUCTURAL DETAILS

VICINITY MAP



PLOT PLAN 1"=20'-0"



PROJECT
MARTYN RESIDENC
ADDITION AND REMODELING

SHEET CON
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LOCATION
TAX MAP

DATE

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REVISIONS

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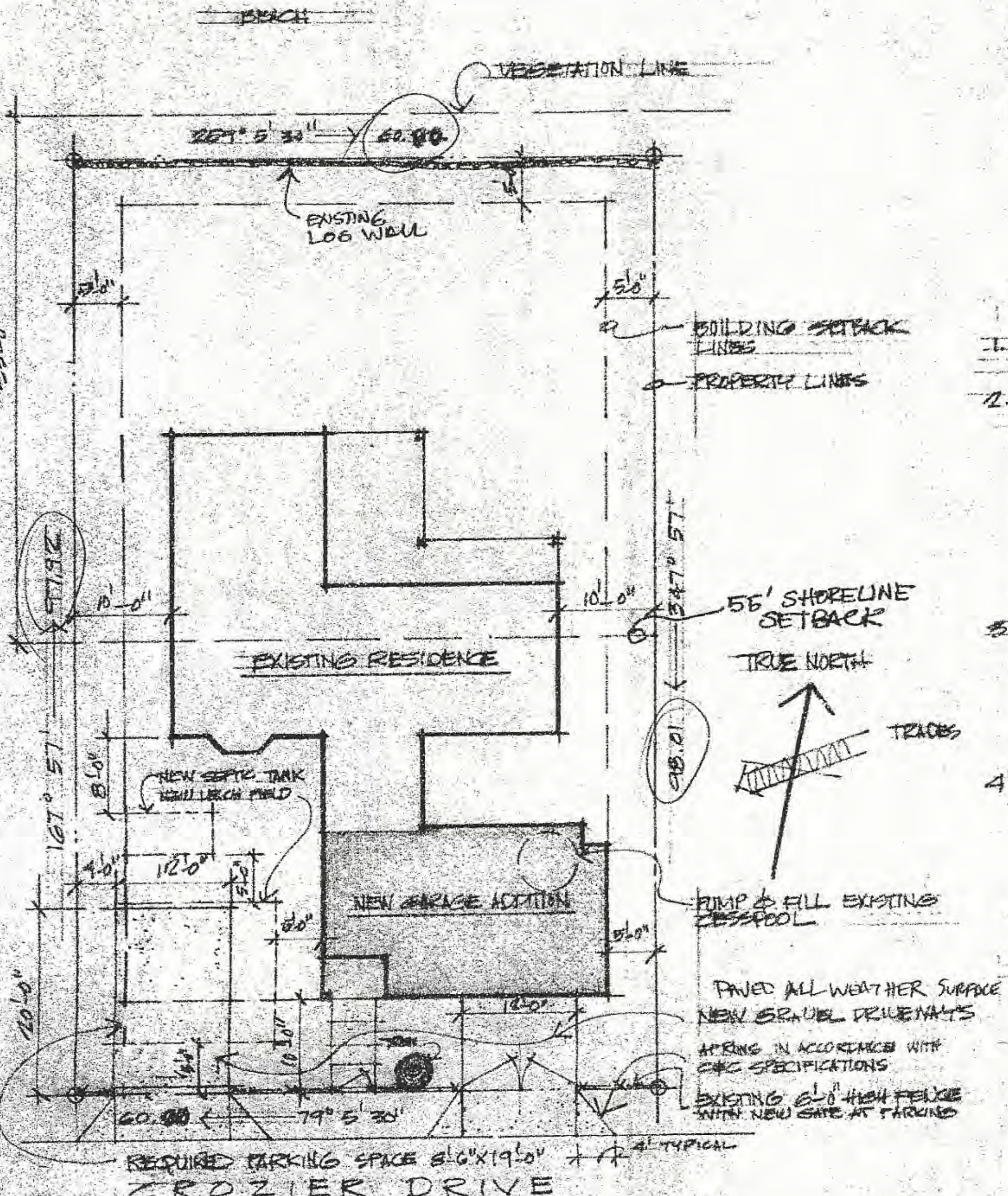
SHT 1 OF 10



SITE PLAN

1" = 10'-0"

TMK: 1-6-8-4131

AREA T

EXISTING
COVERED
TOTAL EX
NEW GARAGE

GENER

1. CONTRACTOR
BEFORE P

2. NEW FRA
STRAPPING,
DIAPHRAGM
OPENINGS
ACHIEVE A
RESISTANT
WITH CHAP
OF THE UN
DETAILS
CHAPTER

3. TERMITE
PRESSURE
LUMBER,
SIDING,
ROOF DIAPH
ETC.
MEMBERS

4. TERMITE
TERMITE
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(DOUGLAS F
STRUCTUR
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6x6 POST
LIGHT FRA
CONSTRUCT
STUDS, PL

LUMBE

CONCEALE
EXPOSED
BEAMS,
FASCIA &

DEPARTMENT OF HEALTH
- The wastewater plans have been reviewed and approved by the Department of Health.
- Final construction inspection of the wastewater system is required by the design engineer prior to backfilling of the wastewater system.
- Written approval from the Department of Health is required prior to use of the wastewater system.
(Chapter 11-62, HAR)

Reviewed by: ______ Date: 6/20/9
New/Existing CP/ST #: 3075

DEPARTMENT OF LAND UTILIZATION
City and County of Honolulu
Checked by:
Date: 6/23/97
for shoreline only

BUILDING DEPARTMENT
FILE COPY BP# 241665 (06/23/1997)

Appendix B

2011 Report, Oahu Shoreline Study
Data on Beach Changes Excerpt

TMK: 6-8-004:018
68-505 Crozier Dr.
Waialua, Oahu, Hawaii 96791

TMK: 6-8-004:031
68-511 Crozier Dr.
Waialua, Oahu, Hawaii 96791

ACCEPTING AUTHORITY:

City and County of Honolulu
Department of Planning and Permitting

PREPARED BY:

Gundaker Works, LLC

February 2018

MOKULEIA - AREA DESCRIPTION

This map shows a central portion of Mokuleia Beach (transects 274 – 411), including Mokuleia Polo Field and Makaleha Beach Park. This shoreline is a portion of a continuous 7-mile-long beach on Oahu's north shore. The shoreline is composed of carbonate sand and limestone, and the area is exposed to north and west swells in winter months and persistent easterly tradewind waves year-round.

The western half of the beach has experienced chronic erosion since 1924 with the highest erosion rates centered at transects 284 (more than -1.5 ft/yr) and 328 (more than -1.0 ft/yr). Beach profile surveys have shown that little or no beach remains at high tide in front of much of Camp Mokuleia (transect 285). The shoreline near the end of Crozier Drive (transect 409) has also eroded over -0.5 ft/yr. The remainder of the shoreline has been relatively stable with erosion rates less than -0.5 ft/yr.

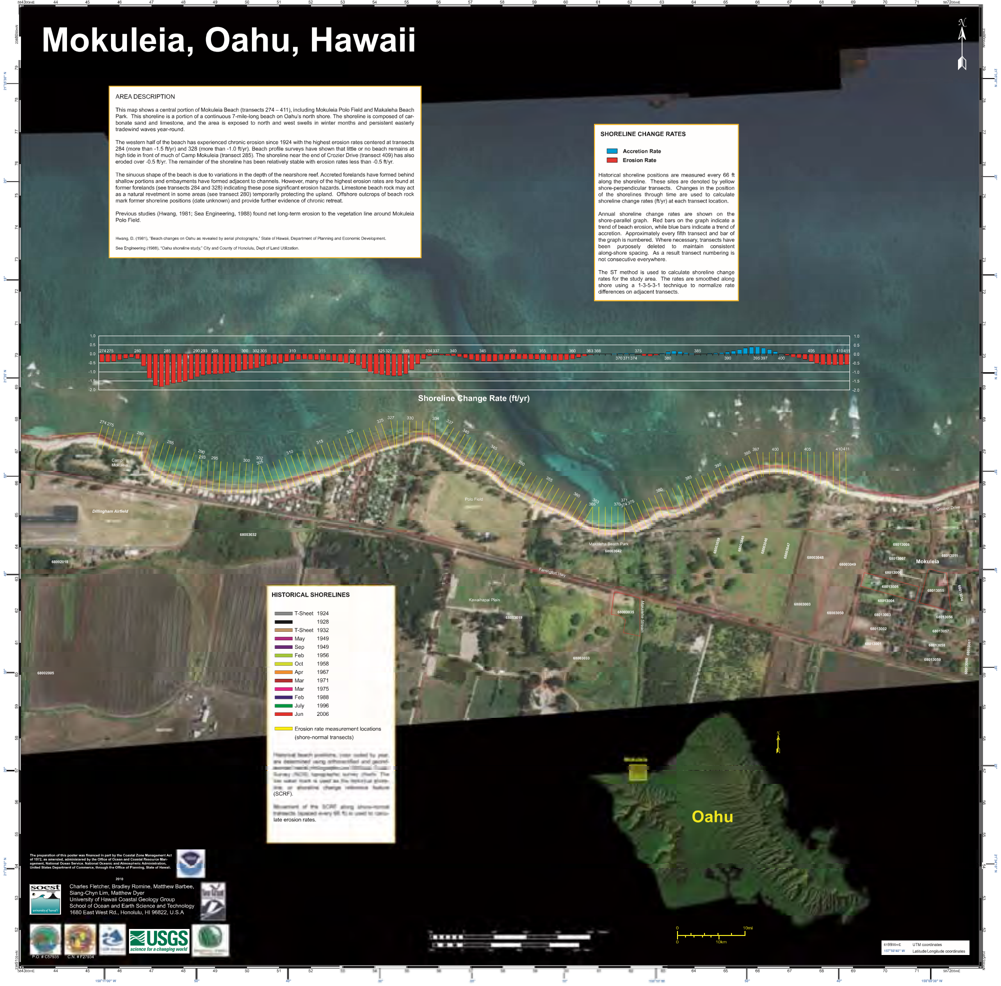
The sinuous shape of the beach is due to variations in the depth of the nearshore reef. Accreted forelands have formed behind shallow portions and embayments have formed adjacent to channels. However, many of the highest erosion rates are found at former forelands (see transects 284 and 328) indicating these pose significant erosion hazards. Limestone beach rock may act as a natural revetment in some areas (see transect 280) temporarily protecting the upland. Offshore outcrops of beach rock mark former shoreline positions (date unknown) and provide further evidence of chronic retreat.

Previous studies (Hwang, 1981; Sea Engineering, 1988) found net long-term erosion to the vegetation line around Mokuleia Polo Field.

Hwang, D. (1981), "Beach changes on Oahu as revealed by aerial photographs," State of Hawaii, Department of Planning and Economic Development.

Sea Engineering (1988), "Oahu shoreline study," City and County of Honolulu, Dept of Land Utilization.

Mokuleia, Oahu, Hawaii



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SHORELINE CHANGE RATES

🟦	**Accretion Rate**
🟥	**Erosion Rate**

Historical shoreline positions are measured every 66 ft along the shoreline. These sites are denoted by yellow shore-perpendicular transects. Changes in the position of the shorelines through time are used to calculate shoreline change rates (ft/yr) at each transect location.

Annual shoreline change rates are shown on the shore-parallel graph. Red bars on the graph indicate a trend of beach erosion, while blue bars indicate a trend of accretion. Approximately every fifth transect and bar of the graph is numbered. Where necessary, transects have been purposely deleted to maintain consistent along-shore spacing. As a result transect numbering is not consecutive everywhere.

The ST method is used to calculate shoreline change rates for the study area. The rates are smoothed along shore using a 1-3-5-3-1 technique to normalize rate differences on adjacent transects.

HISTORICAL SHORELINES

▬	T-Sheet	1924
▬		1928
▬	T-Sheet	1932
▬	May	1949
▬	Sep	1949
▬	Feb	1956
▬	Oct	1958
▬	Apr	1967
▬	Mar	1971
▬	Mar	1975
▬	Feb	1988
▬	July	1996
▬	Jun	2006
▬	Erosion rate measurement locations (shore-normal transects)	

Historical beach positions, color coded by year, are determined using orthorectified and georeferenced aerial photographs and National Ocean Survey (NOS) topographic survey charts. The low water mark is used as the historical shoreline, or shoreline change reference feature (SCRF).

Movement of the SCRF along shore-normal transects (spaced every 66 ft) is used to calculate erosion rates.

The preparation of this poster was financed in part by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, United States Department of Commerce, through the Office of Planning, State of Hawaii.

2010

Charles Fletcher, Bradley Romine, Matthew Barbee,
Siang-Chyn Lim, Matthew Dyer
University of Hawaii Coastal Geology Group
School of Ocean and Earth Science and Technology
1680 East West Rd., Honolulu, HI 96822, U.S.A

P.O. # C57935
C.N. # F27934

Mokuleia - Smoothed ST Rates

Positive Rate = Accretion
Negative Rate = Erosion

TMK**	Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
68002001	274	-0.4	0.3
68002001	275	-0.4	0.3
68002001	276	-0.4	0.2
68002001	277	-0.3	0.2
68002001	278	-0.3	0.2
68003008	279	-0.2	0.2
68003008	280	-0.3	0.3
68003008	281	-0.7	0.5
68003008	282	-1.3	0.7
68003008	283	-1.8	0.6
68003008	284	-1.8	0.5
68003008	285	-1.7	0.5
68003008	286	-1.6	0.4
68003008	287	-1.6	0.4
68003008	288	-1.5	0.4
68003008	289	-1.4	0.3
68010030	290	-1.3	0.3
68010028	293	-1.2	0.2
68010027	294	-1.1	0.2
68010026	295	-1.1	0.2
68010025	296	-1.1	0.2
68010024	297	-1.1	0.2
68010023	298	-1.0	0.2
68010022	299	-0.9	0.2
68010021	300	-0.9	0.2
68010020	301	-0.8	0.2
68010019	302	-0.8	0.2
68010015	305	-0.7	0.2
68010014	306	-0.6	0.3
68010013	307	-0.5	0.3
68010011	308	-0.5	0.3
68010010	309	-0.4	0.2
68010009	310	-0.3	0.2
68010008	311	-0.3	0.2
68010008	312	-0.3	0.2
68010008	313	-0.3	0.2
68010008	314	-0.3	0.2
68010008	315	-0.3	0.2
68009020	316	-0.4	0.2
68009020	317	-0.4	0.2
68009020	318	-0.4	0.2
68009013	319	-0.5	0.2
68009012	320	-0.5	0.2
68009011	321	-0.6	0.3
68009010	322	-0.8	0.3
68009010	323	-1.0	0.2

* Beach was lost to erosion. Rates are calculated up to and including first shoreline with no beach.

** Only the nearest TMK is listed for each transect. Other TMK's / transects may apply. See shoreline change map and TMK map for verification.

Mokuleia - Smoothed ST Rates

Positive Rate = Accretion
Negative Rate = Erosion

TMK**	Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
68009001	324	-1.1	0.2
68009001	325	-1.1	0.2
68009001	327	-1.2	0.2
68009001	328	-1.2	0.3
68009001	329	-1.2	0.4
68009001	330	-1.1	0.4
68003018	331	-0.9	0.4
68003018	332	-0.6	0.4
68003018	333	-0.3	0.3
68003017	334	-0.1	0.3
68003017	337	-0.1	0.3
68003017	338	-0.1	0.3
68003017	339	-0.1	0.3
68003017	340	-0.1	0.3
68003017	341	-0.1	0.3
68003017	342	-0.2	0.3
68003017	343	-0.3	0.3
68003017	344	-0.4	0.2
68003017	345	-0.4	0.2
68003017	346	-0.4	0.2
68003017	347	-0.4	0.2
68003017	348	-0.3	0.2
68003017	349	-0.3	0.2
68003017	350	-0.3	0.2
68003017	351	-0.3	0.2
68003017	352	-0.3	0.3
68003017	353	-0.3	0.3
68003017	354	-0.3	0.2
68003042	355	-0.3	0.2
68003042	356	-0.3	0.2
68003042	357	-0.3	0.2
68003042	358	-0.3	0.3
68003042	359	-0.3	0.3
68003042	360	-0.3	0.3
68003042	361	-0.2	0.3
68003042	362	-0.1	0.3
68003042	363	0.0	0.3
68003042	366	0.0	0.4
68003042	367	0.0	0.5
68003042	368	0.0	0.5
68003042	369	0.0	0.5
68003042	370	0.0	0.4
68003042	371	0.0	0.3
68003042	374	0.0	0.3
68003042	375	0.0	0.3
68003042	376	-0.1	0.4

* Beach was lost to erosion. Rates are calculated up to and including first shoreline with no beach.

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Mokuleia - Smoothed ST Rates

Positive Rate = Accretion
Negative Rate = Erosion

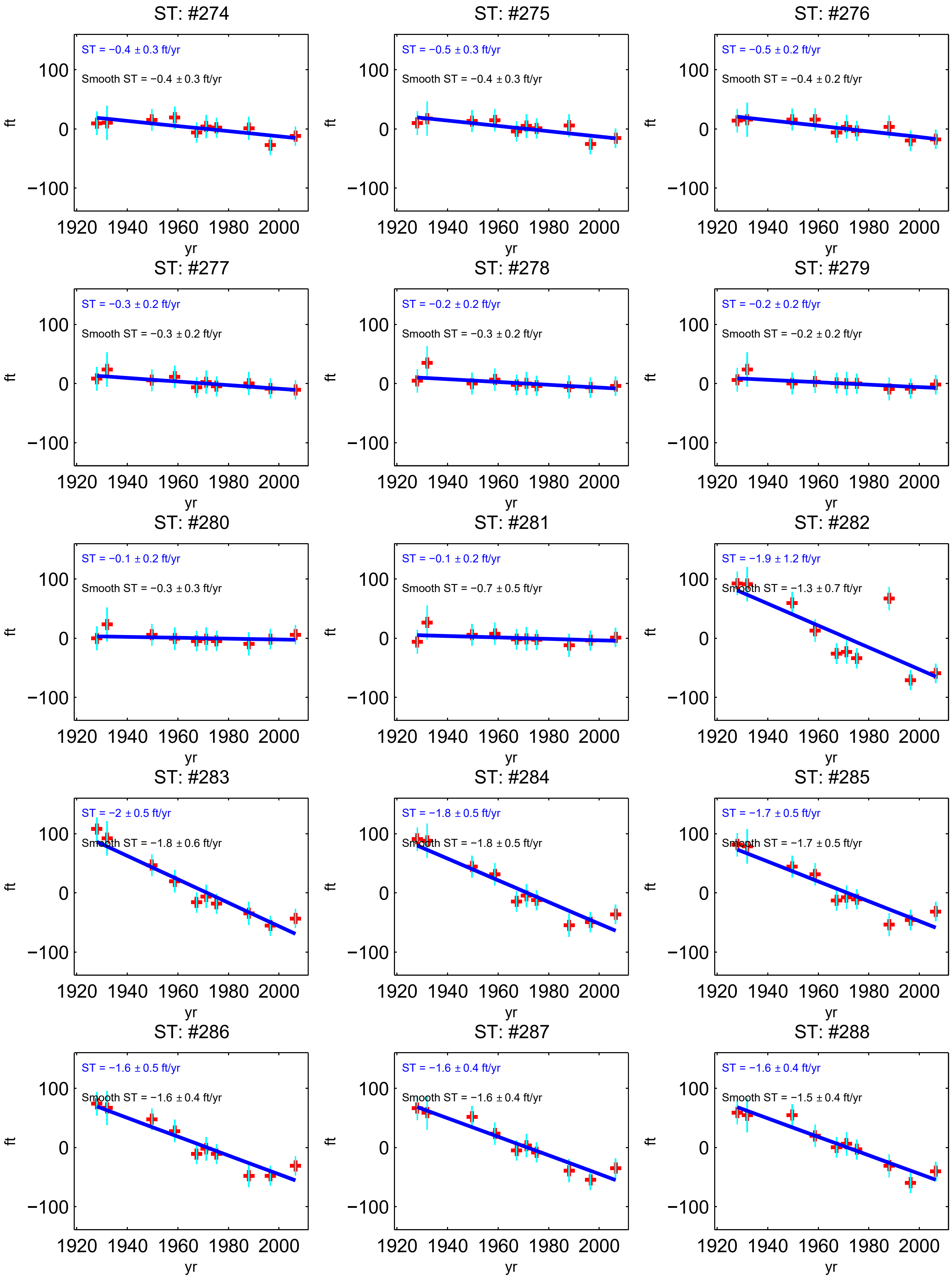
TMK**	Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
68003042	377	-0.1	0.4
68003042	378	0.0	0.5
68003042	379	0.1	0.4
68003042	380	0.2	0.4
68003042	381	0.2	0.4
68003042	382	0.2	0.4
68003042	383	0.1	0.4
68003042	384	0.0	0.3
68003042	385	0.0	0.3
68003042	386	0.1	0.3
68003042	387	0.1	0.3
68003042	388	0.2	0.3
68003039	389	0.2	0.3
68003039	390	0.2	0.3
68003039	391	0.2	0.3
68003039	392	0.3	0.3
68003045	393	0.3	0.3
68003045	394	0.4	0.4
68003045	395	0.4	0.4
68003045	397	0.3	0.3
68003045	398	0.2	0.4
68003045	399	0.1	0.4
68003046	400	0.0	0.4
68003046	401	-0.1	0.4
68003046	402	-0.2	0.3
68003046	403	-0.2	0.3
68003047	404	-0.3	0.3
68003047	405	-0.4	0.3
68003047	406	-0.5	0.4
68003001	407	-0.6	0.4
68003001	408	-0.6	0.4
68003001	409	-0.6	0.4
68003001	410	-0.6	0.4
68003001	411	-0.6	0.3

* Beach was lost to erosion. Rates are calculated up to and including first shoreline with no beach.

** Only the nearest TMK is listed for each transect. Other TMK's / transects may apply. See shoreline change map and TMK map for verification.

Mokuleia - Smoothed Shoreline Change Rates

Positive Rate = Accretion
Negative Rate = Erosion



*Hardened shorelines with no beach are shown with a blue square. The analysis stops at the first hardened shoreline.

Mokuleia - Smoothed Shoreline Change Rates

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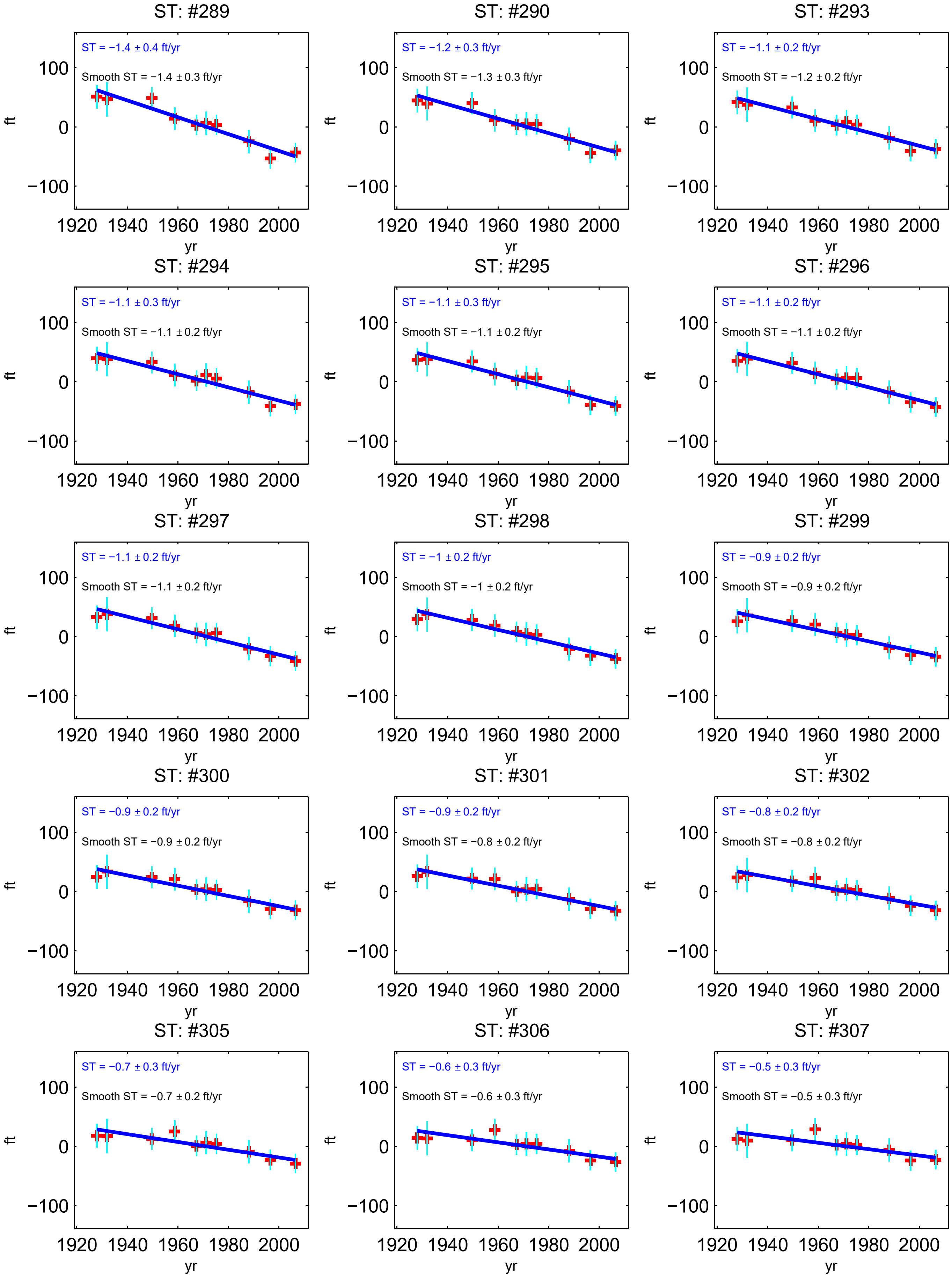
Negative Rate = Erosion



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Positive Rate = Accretion
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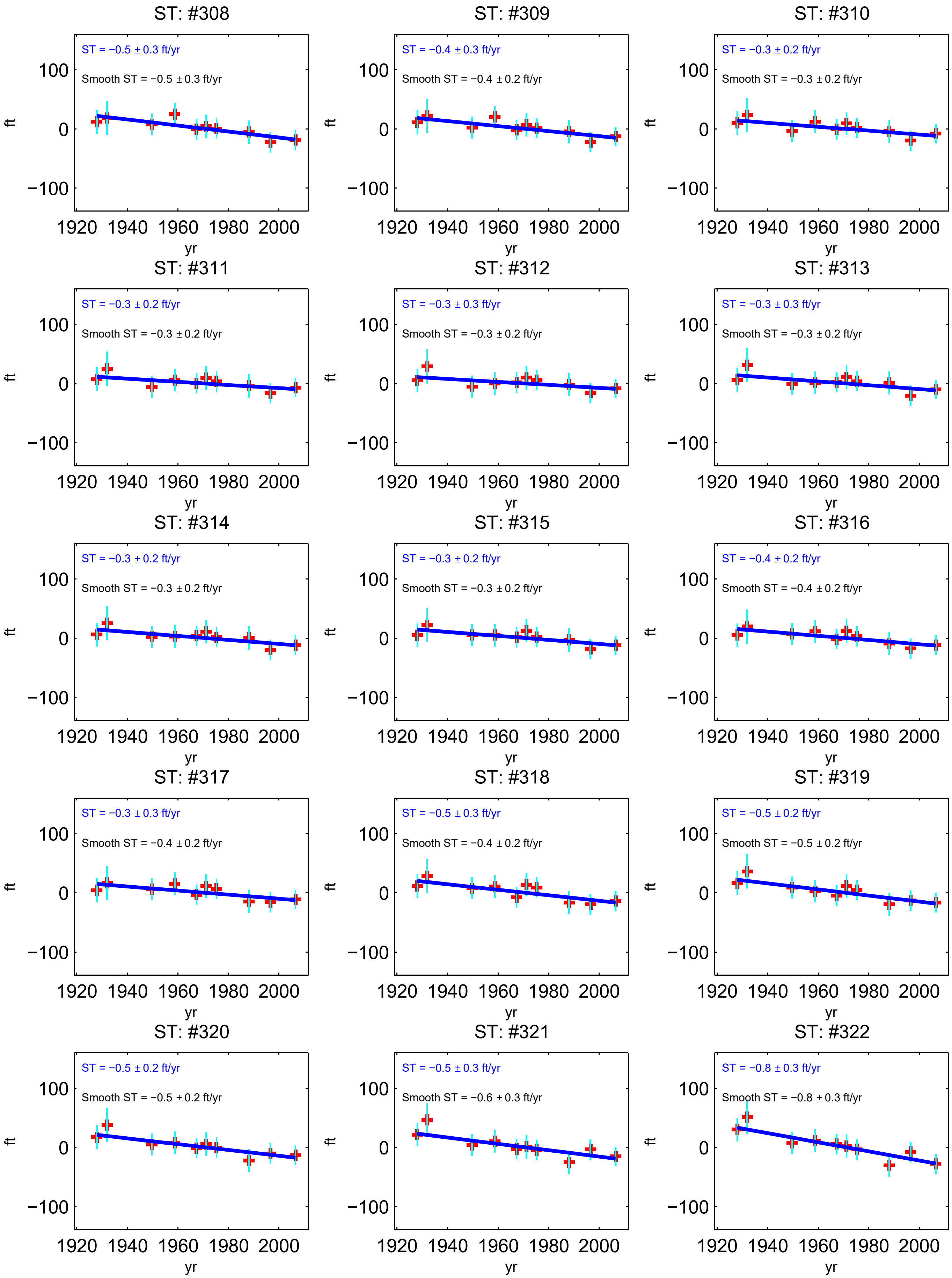

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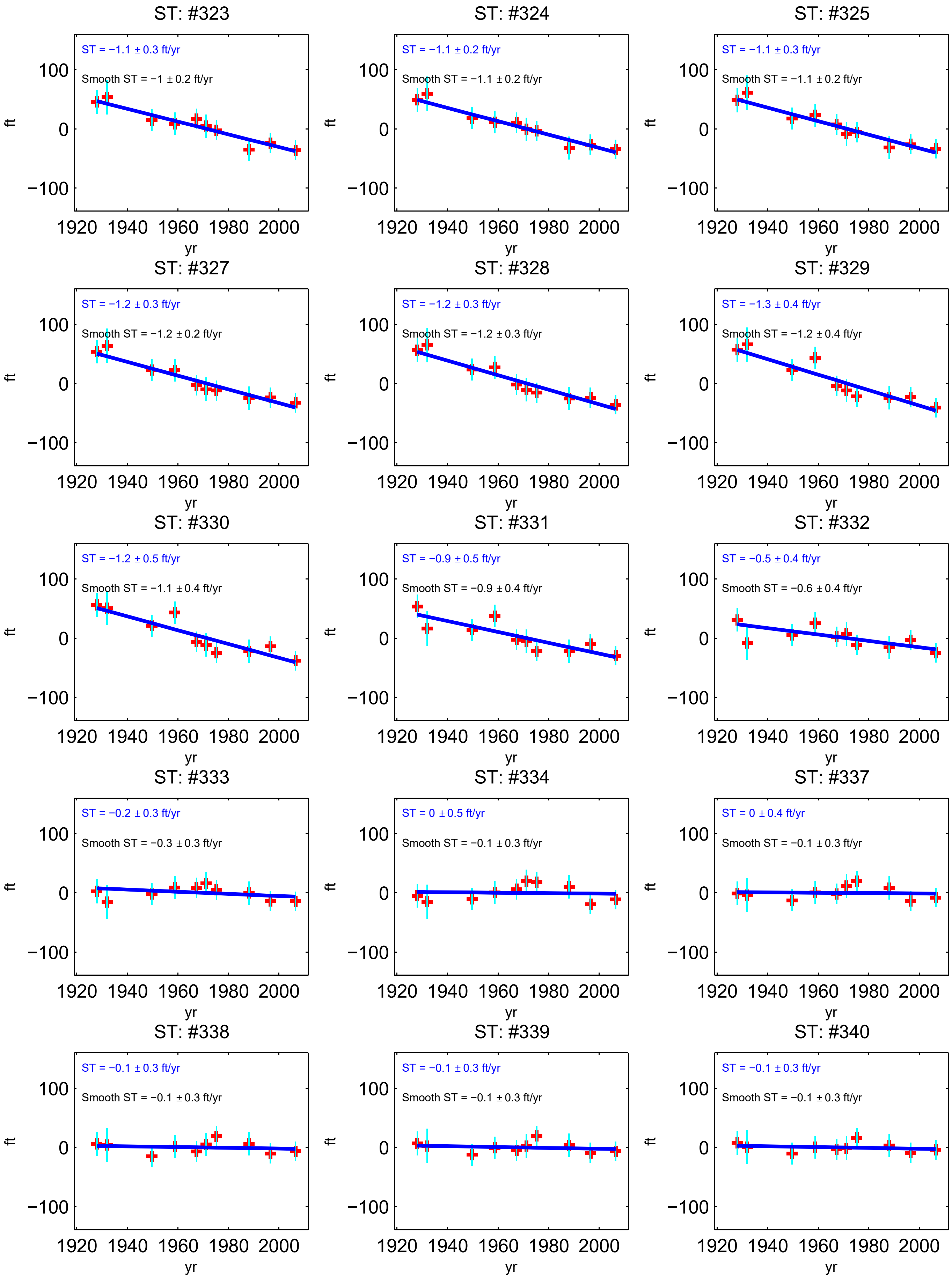
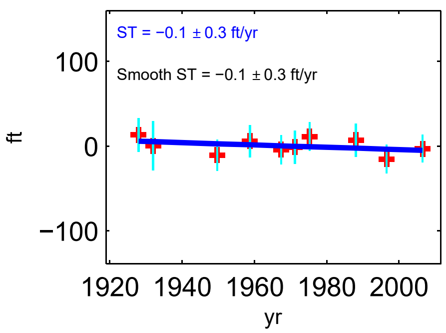


*Hardened shorelines with no beach are shown with a blue square. The analysis stops at the first hardened shoreline.

Positive Rate = Accretion
Negative Rate = Erosion

Mokuleia - Smoothed Shoreline Change Rates

ST: #341



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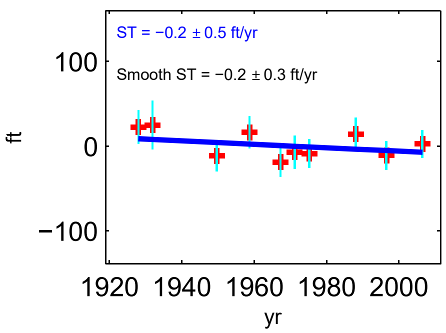

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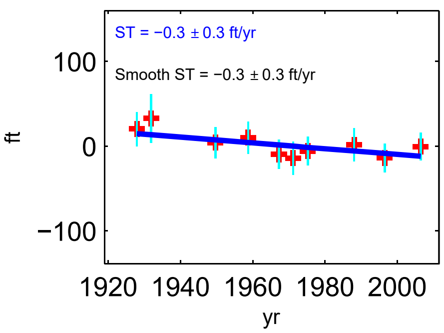

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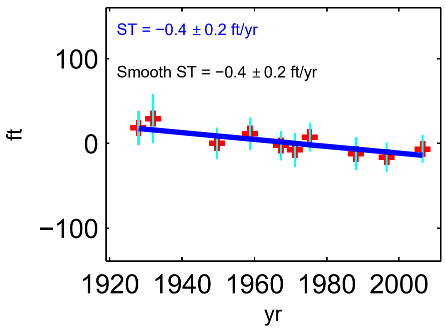

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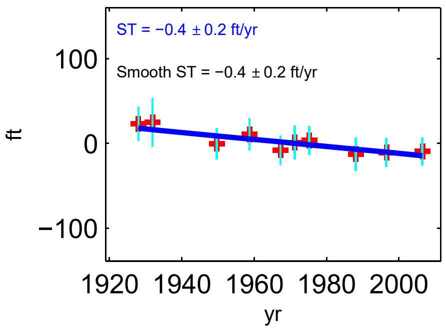

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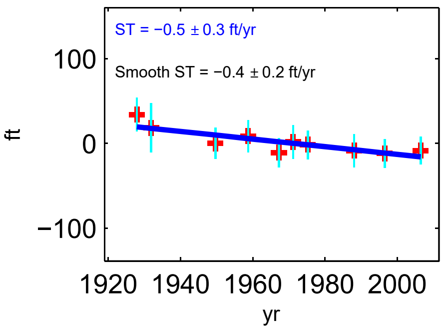

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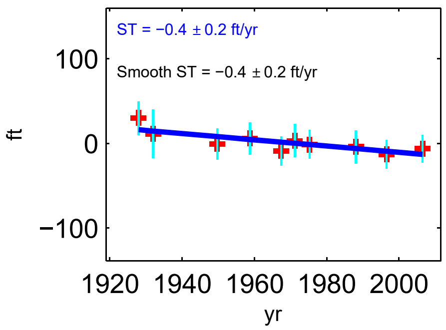

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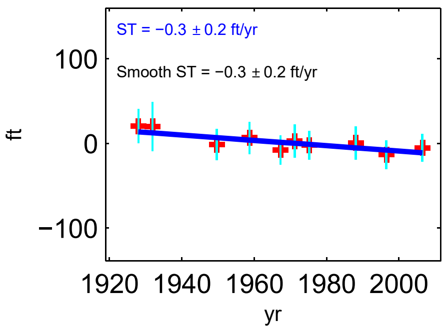

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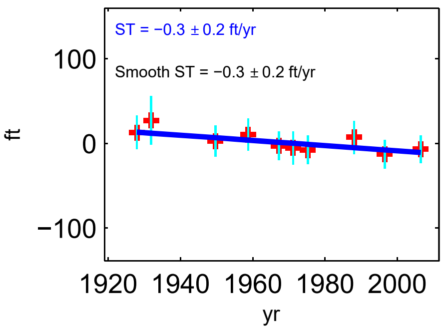

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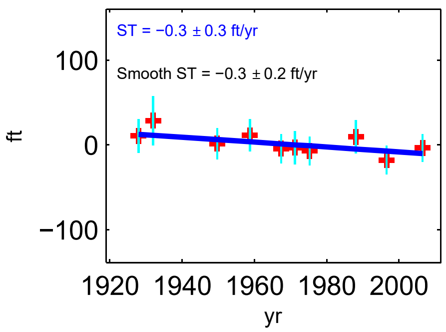

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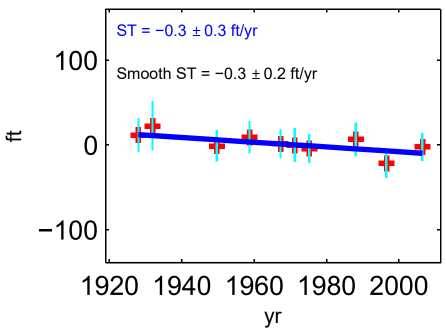

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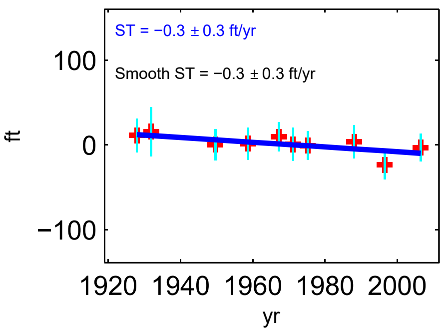

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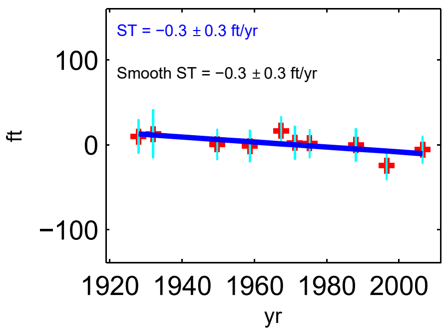
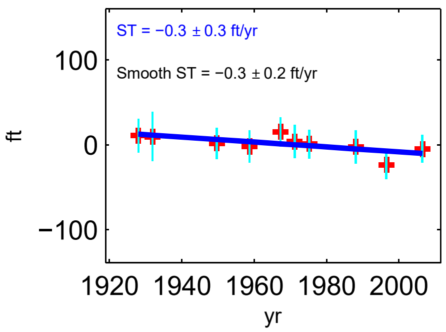
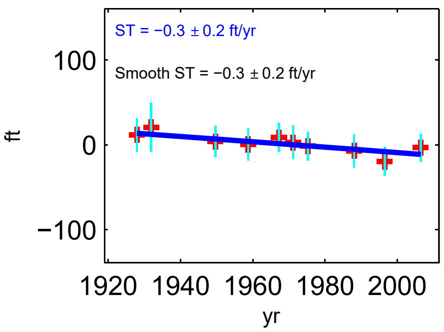


ST: #354



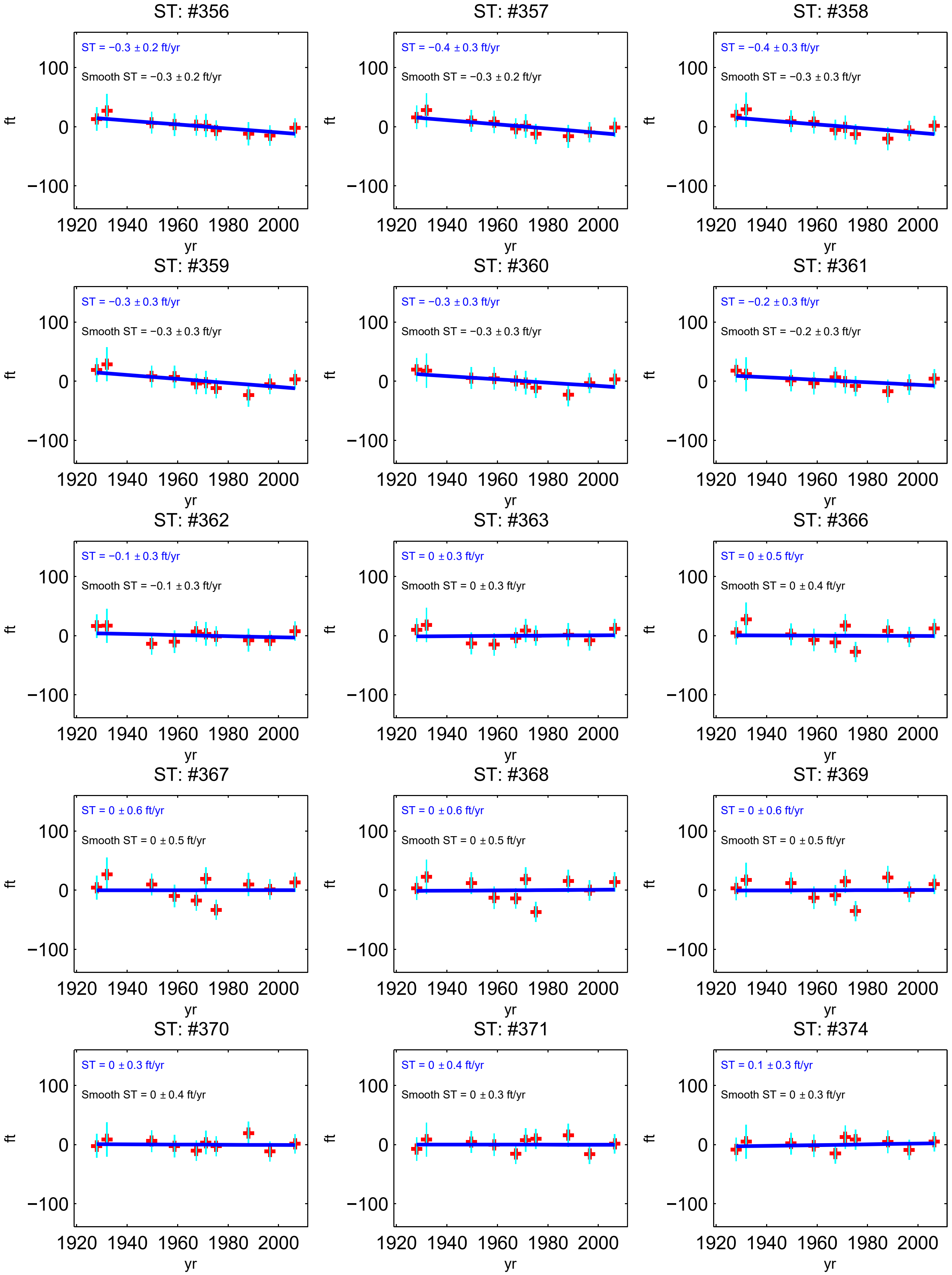
ST: #355



*Hardened shorelines with no beach are shown with a blue square. The analysis stops at the first hardened shoreline.

Mokuleia - Smoothed Shoreline Change Rates

Positive Rate = Accretion
Negative Rate = Erosion



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Mokuleia - Smoothed Shoreline Change Rates

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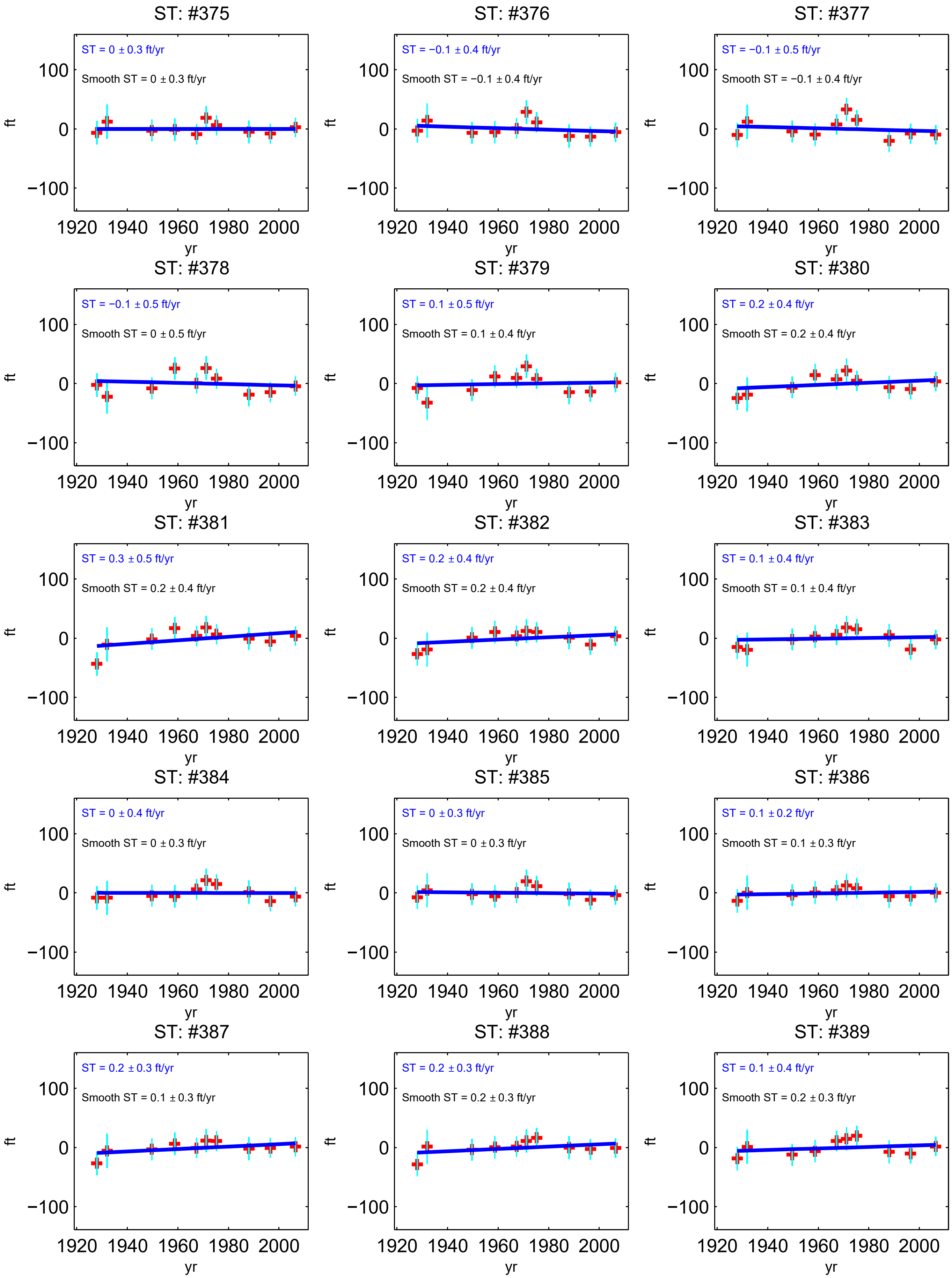

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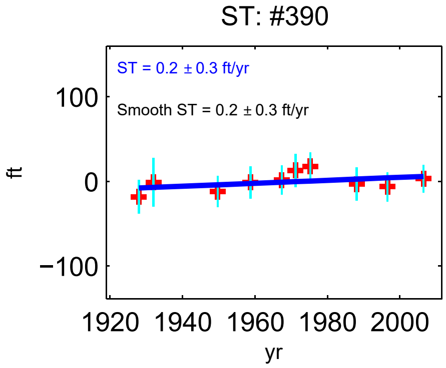

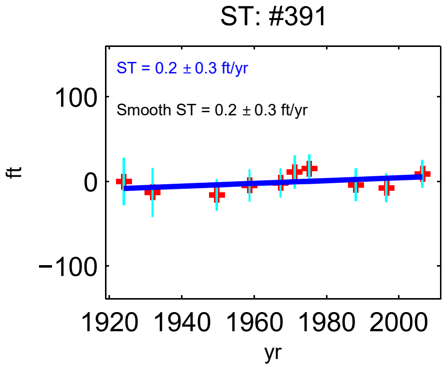

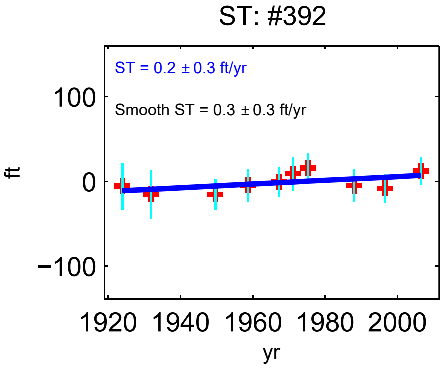

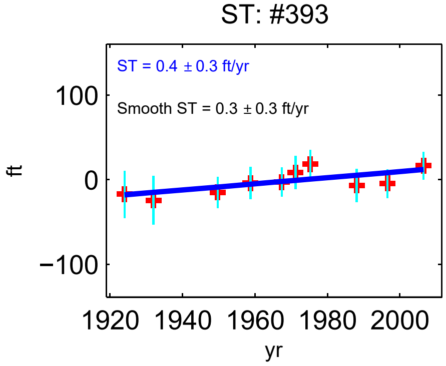

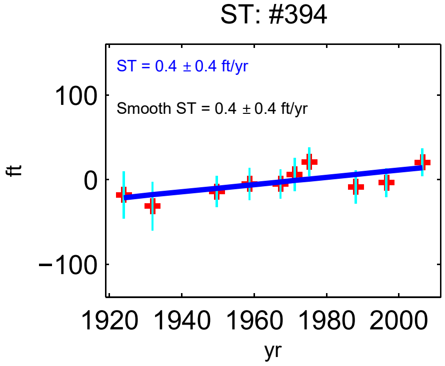

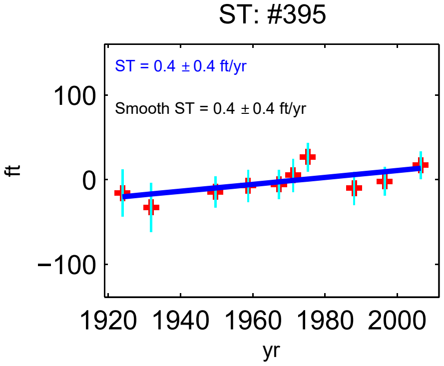

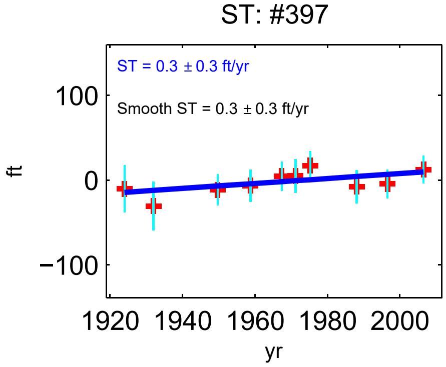

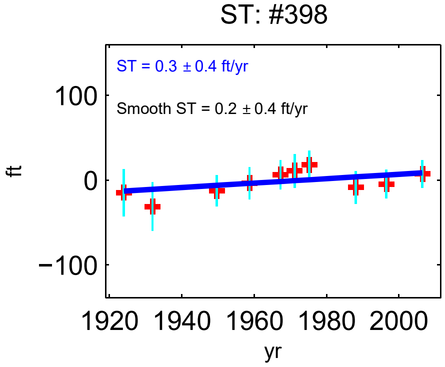

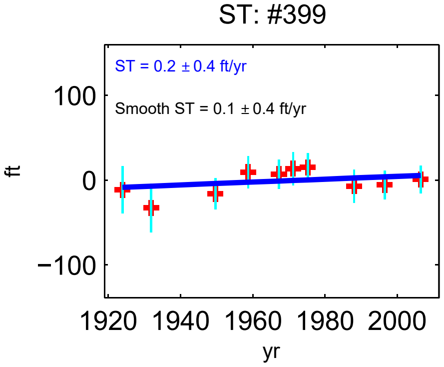

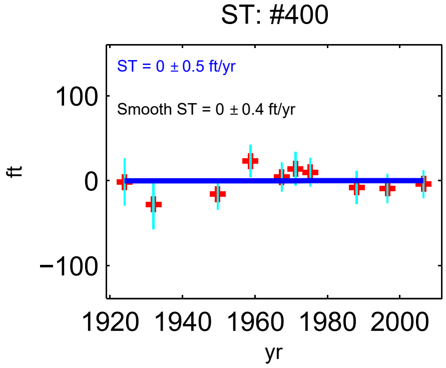

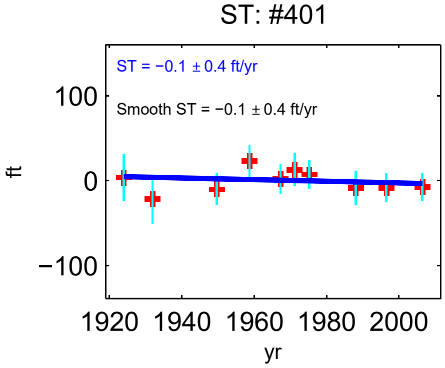

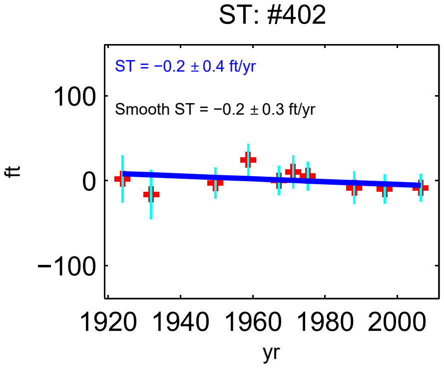

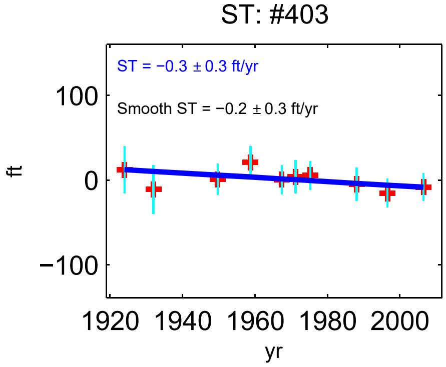

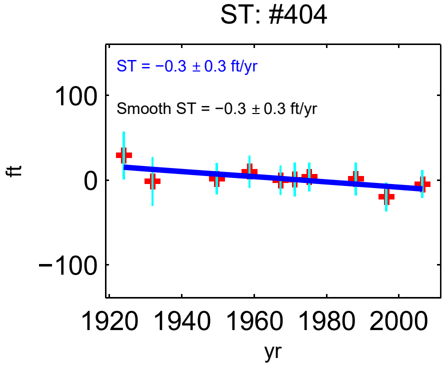

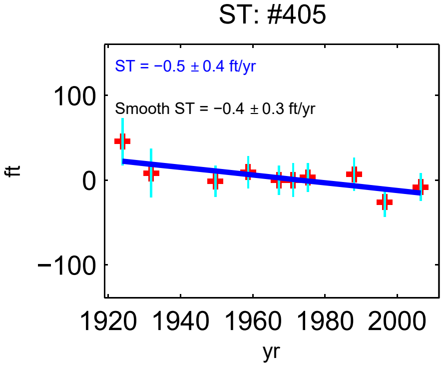

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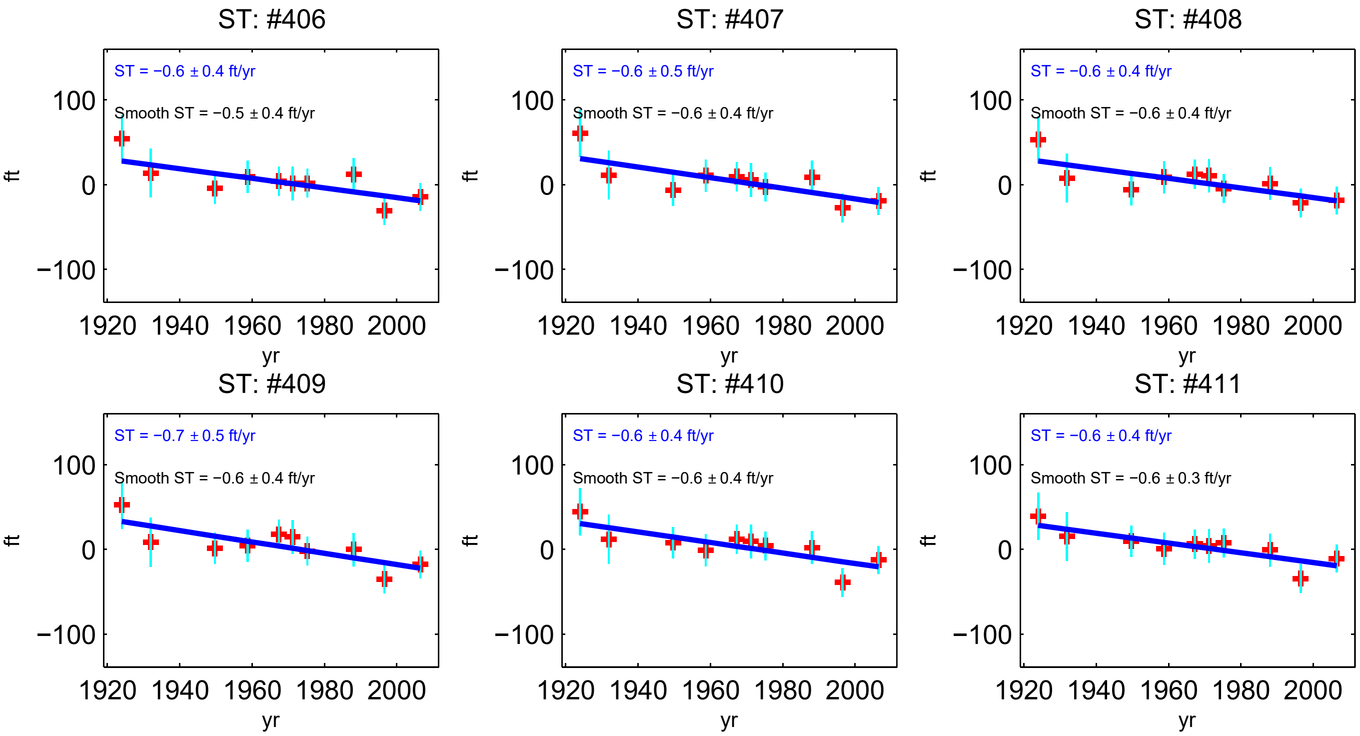
Mokuleia - Smoothed Shoreline Change Rates

Positive Rate = Accretion
Negative Rate = Erosion



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CROZIER DRIVE - AREA DESCRIPTION

This map shows a central portion of Mokuleia Beach (transects 412 – 548), including much of the residential area along Crozier Drive. This shoreline is a portion of a continuous 7-mile-long beach on Oahu’s north shore. The shoreline is composed of carbonate sand and limestone, and the area is exposed to north and west swells in winter months and persistent easterly tradewind waves year-round.

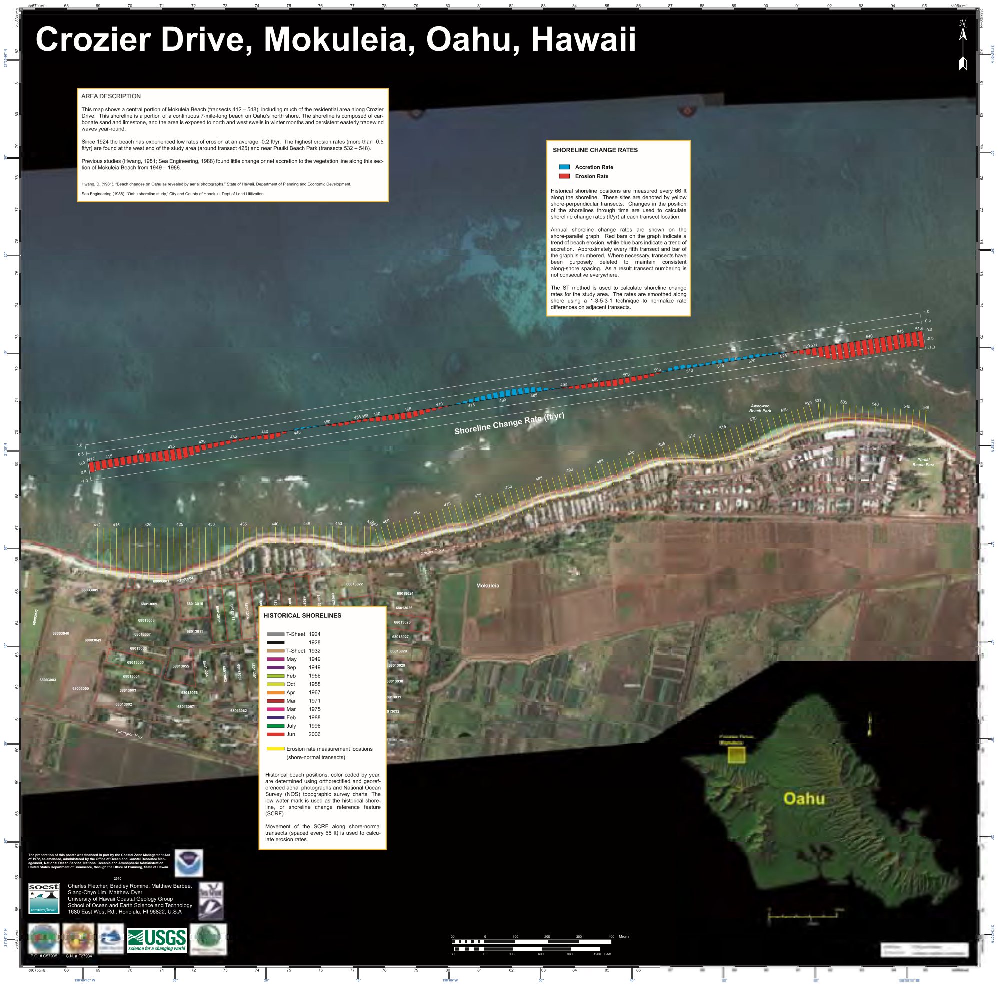
Since 1924 the beach has experienced low rates of erosion at an average -0.2 ft/yr. The highest erosion rates (more than -0.5 ft/yr) are found at the west end of the study area (around transect 425) and near Puuiki Beach Park (transects 532 – 548).

Previous studies (Hwang, 1981; Sea Engineering, 1988) found little change or net accretion to the vegetation line along this section of Mokuleia Beach from 1949 – 1988.

Hwang, D. (1981), “Beach changes on Oahu as revealed by aerial photographs,” State of Hawaii, Department of Planning and Economic Development.

Sea Engineering (1988), “Oahu shoreline study,” City and County of Honolulu, Dept of Land Utilization.

Crozier Drive, Mokuleia, Oahu, Hawaii



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SHORELINE CHANGE RATES

🟦 **Accretion Rate**
🟥 **Erosion Rate**

Historical shoreline positions are measured every 66 ft along the shoreline. These sites are denoted by yellow shore-perpendicular transects. Changes in the position of the shorelines through time are used to calculate shoreline change rates (ft/yr) at each transect location.

Annual shoreline change rates are shown on the shore-parallel graph. Red bars on the graph indicate a trend of beach erosion, while blue bars indicate a trend of accretion. Approximately every fifth transect and bar of the graph is numbered. Where necessary, transects have been purposely deleted to maintain consistent along-shore spacing. As a result transect numbering is not consecutive everywhere.

The ST method is used to calculate shoreline change rates for the study area. The rates are smoothed along shore using a 1-3-5-3-1 technique to normalize rate differences on adjacent transects.

HISTORICAL SHORELINES

▬	T-Sheet	1924
▬		1928
▬	T-Sheet	1932
▬	May	1949
▬	Sep	1949
▬	Feb	1956
▬	Oct	1958
▬	Apr	1967
▬	Mar	1971
▬	Mar	1975
▬	Feb	1988
▬	July	1996
▬	Jun	2006

▬ Erosion rate measurement locations (shore-normal transects)

Historical beach positions, color coded by year, are determined using orthorectified and georeferenced aerial photographs and National Ocean Survey (NOS) topographic survey charts. The low water mark is used as the historical shoreline, or shoreline change reference feature (SCRF).

Movement of the SCRF along shore-normal transects (spaced every 66 ft) is used to calculate erosion rates.

The preparation of this poster was financed in part by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, United States Department of Commerce, through the Office of Planning, State of Hawaii.

2010

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Siang-Chyn Lim, Matthew Dyer
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P.O. # C57935
C.N. # F27934

Crozier Drive - Smoothed ST Rates

Positive Rate = Accretion
Negative Rate = Erosion

TMK**	Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
68003001	412	-0.5	0.2
68003001	413	-0.5	0.2
68003001	414	-0.5	0.2
68003001	415	-0.5	0.3
68003001	416	-0.5	0.3
68003001	417	-0.5	0.3
68006002	418	-0.4	0.3
68006018	419	-0.4	0.4
68006019	420	-0.5	0.4
68006003	421	-0.5	0.5
68006003	422	-0.6	0.5
68006003	423	-0.6	0.5
68006004	424	-0.7	0.5
68006004	425	-0.7	0.5
68006004	426	-0.7	0.4
68006004	427	-0.6	0.4
68006005	428	-0.5	0.4
68006012	429	-0.4	0.3
68006013	430	-0.3	0.3
68006006	431	-0.2	0.3
68006020	432	-0.2	0.4
68006031	433	-0.1	0.4
68006031	434	-0.1	0.4
68006007	435	-0.1	0.3
68004001	436	-0.1	0.3
68004001	437	-0.1	0.3
68004002	438	-0.1	0.3
68004002	439	-0.1	0.3
68004003	440	-0.2	0.3
68004004	441	-0.2	0.3
68004005	442	-0.2	0.5
68004006	443	-0.1	0.5
68004006	444	0.1	0.4
68004006	445	0.1	0.3
68004029	446	0.1	0.2
68004009	447	0.1	0.2
68004009	448	0.0	0.2
68004009	449	0.0	0.2
68004011	450	-0.1	0.2
68004012	451	-0.2	0.2
68004013	452	-0.2	0.3
68004014	453	-0.2	0.2
68004015	454	-0.2	0.2
68004016	455	-0.1	0.2
68004030	458	-0.2	0.3
68004032	459	-0.2	0.3

* Beach was lost to erosion. Rates are calculated up to and including first shoreline with no beach.

** Only the nearest TMK is listed for each transect. Other TMK's / transects may apply. See shoreline change map and TMK map for verification.

Crozier Drive - Smoothed ST Rates

Positive Rate = Accretion
Negative Rate = Erosion

TMK**	Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
68004031	460	-0.3	0.3
68004018	461	-0.3	0.3
68004018	462	-0.3	0.4
68004019	463	-0.4	0.4
68004020	464	-0.4	0.4
68004021	465	-0.4	0.4
68004022	466	-0.4	0.4
68004023	467	-0.3	0.4
68004025	468	-0.3	0.4
68004033	469	-0.3	0.4
68004026	470	-0.2	0.4
68004026	471	-0.2	0.4
68004027	472	-0.1	0.3
68004028	473	-0.1	0.4
68005002	474	0.0	0.4
68005003	475	0.1	0.4
68005004	476	0.1	0.4
68005004	477	0.1	0.4
68005005	478	0.2	0.4
68005006	479	0.2	0.4
68005007	480	0.2	0.4
68005008	481	0.2	0.4
68005009	482	0.3	0.4
68005010	483	0.3	0.4
68005011	484	0.3	0.4
68005012	485	0.3	0.4
68005013	486	0.2	0.4
68005047	487	0.1	0.4
68005045	488	0.1	0.4
68005014	489	0.0	0.4
68005015	490	0.0	0.4
68005048	491	-0.1	0.4
68005016	492	-0.2	0.4
68005018	493	-0.2	0.4
68005020	494	-0.2	0.4
68005021	495	-0.3	0.4
68005022	496	-0.3	0.4
68005023	497	-0.3	0.4
68005024	498	-0.3	0.4
68005026	499	-0.3	0.4
68005027	500	-0.3	0.4
68005029	501	-0.2	0.4
68005030	502	-0.2	0.4
68005031	503	-0.2	0.4
68005032	504	-0.1	0.4
68005032	505	0.0	0.4

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Crozier Drive - Smoothed ST Rates

Positive Rate = Accretion
Negative Rate = Erosion

TMK**	Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
68012040	506	0.1	0.4
68012041	507	0.2	0.3
68012042	508	0.2	0.3
68012043	509	0.2	0.3
68012044	510	0.2	0.3
68012045	511	0.2	0.2
68012046	512	0.2	0.2
68012047	513	0.2	0.2
68012048	514	0.2	0.2
68012049	515	0.2	0.2
68012050	516	0.2	0.2
68012051	517	0.2	0.2
68012052	518	0.2	0.2
68012053	519	0.2	0.2
68012053	520	0.2	0.3
68012053	521	0.2	0.3
68012053	522	0.1	0.3
68012053	523	0.1	0.3
68012053	524	0.1	0.4
68011039	525	0.0	0.4
68011040	526	0.0	0.4
68011041	527	-0.1	0.4
68011041	528	-0.2	0.4
68011075	529	-0.3	0.4
68011042	531	-0.4	0.4
68011042	532	-0.6	0.4
68011042	533	-0.7	0.4
68011042	534	-0.8	0.4
68011042	535	-0.9	0.4
68011042	536	-0.9	0.4
68011042	537	-0.9	0.4
68011044	538	-0.8	0.4
68011046	539	-0.8	0.4
68011046	540	-0.9	0.4
68011046	541	-0.9	0.4
68011046	542	-0.9	0.5
68011046	543	-0.8	0.5
68011048	544	-0.8	0.5
68011049	545	-0.8	0.4
67013007	546	-0.8	0.4
67013007	547	-0.8	0.4
67013007	548	-0.9	0.4

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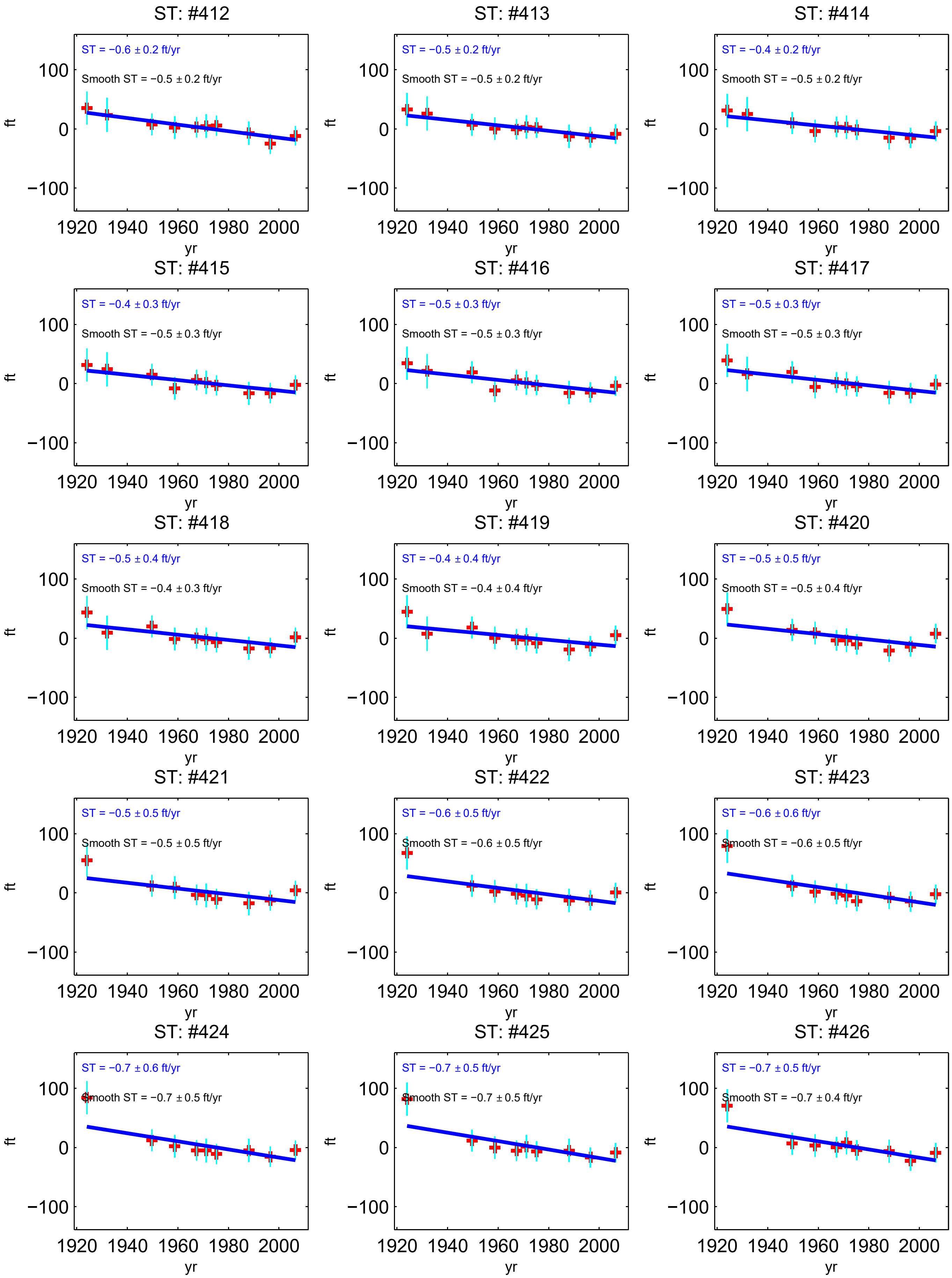
Crozier Drive - Smoothed Shoreline Change Rates

Positive Rate = Accretion
Negative Rate = Erosion



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Crozier Drive - Smoothed Shoreline Change Rates

Positive Rate = Accretion
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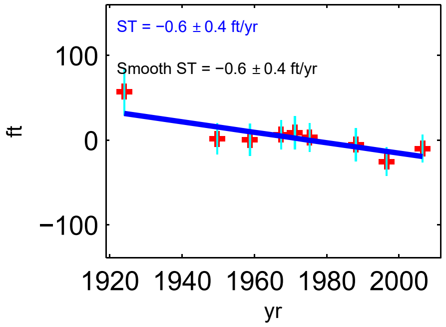
ST: #427



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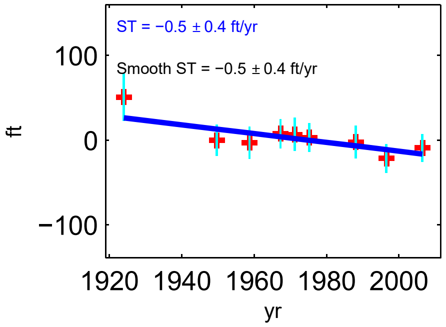

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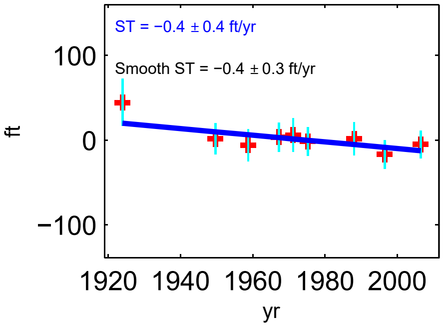

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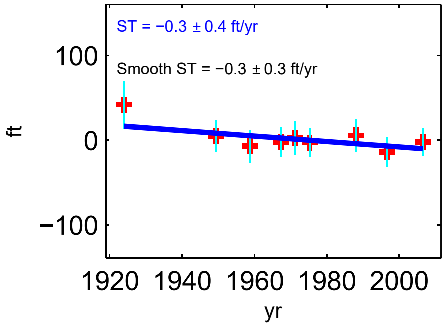

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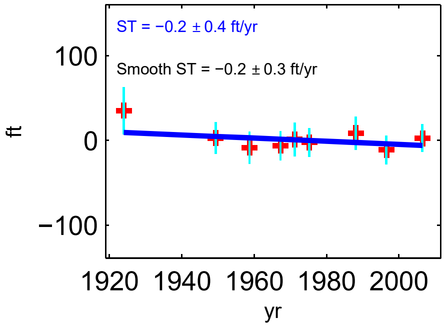

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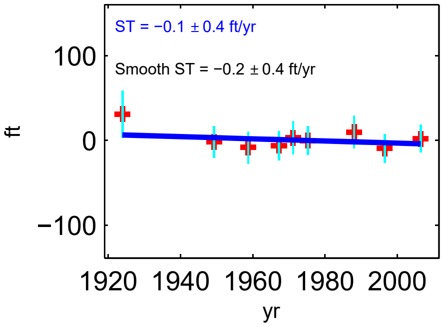

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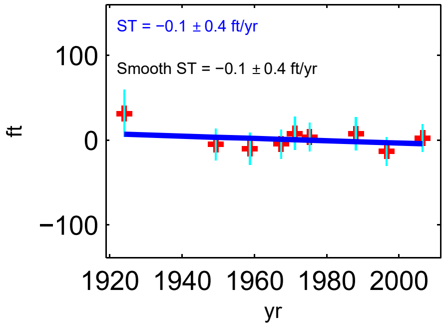

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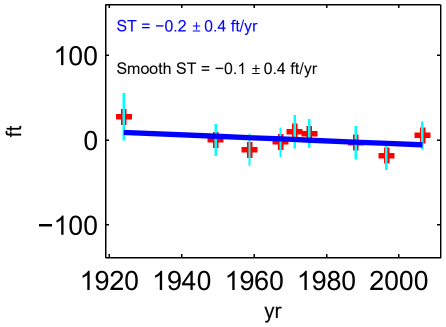

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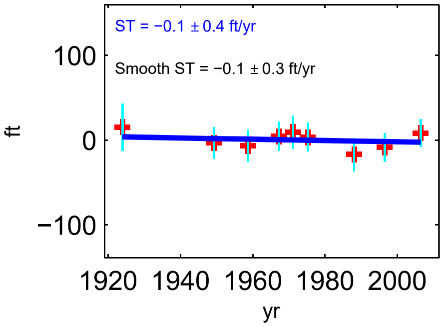

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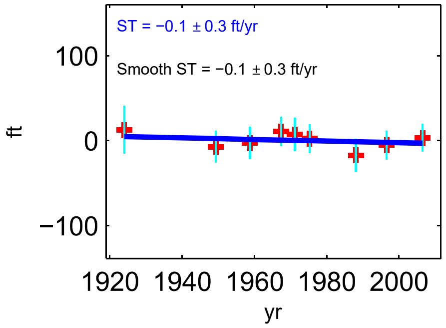

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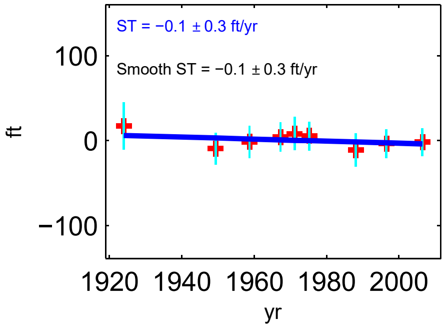

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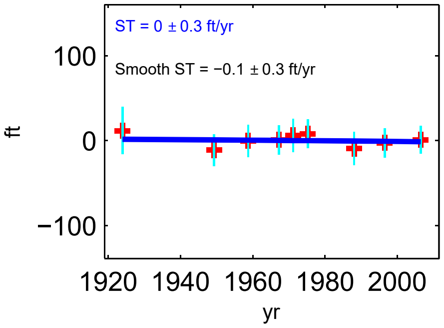

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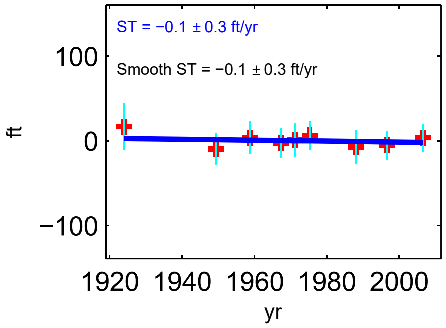

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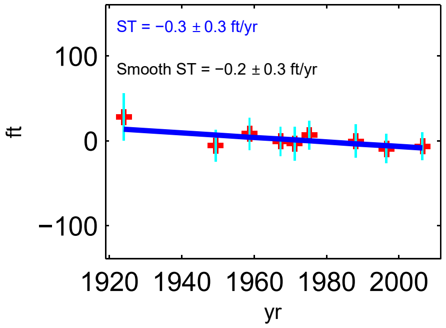

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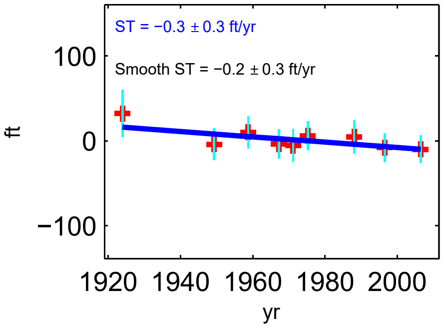

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Crozier Drive - Smoothed Shoreline Change Rates

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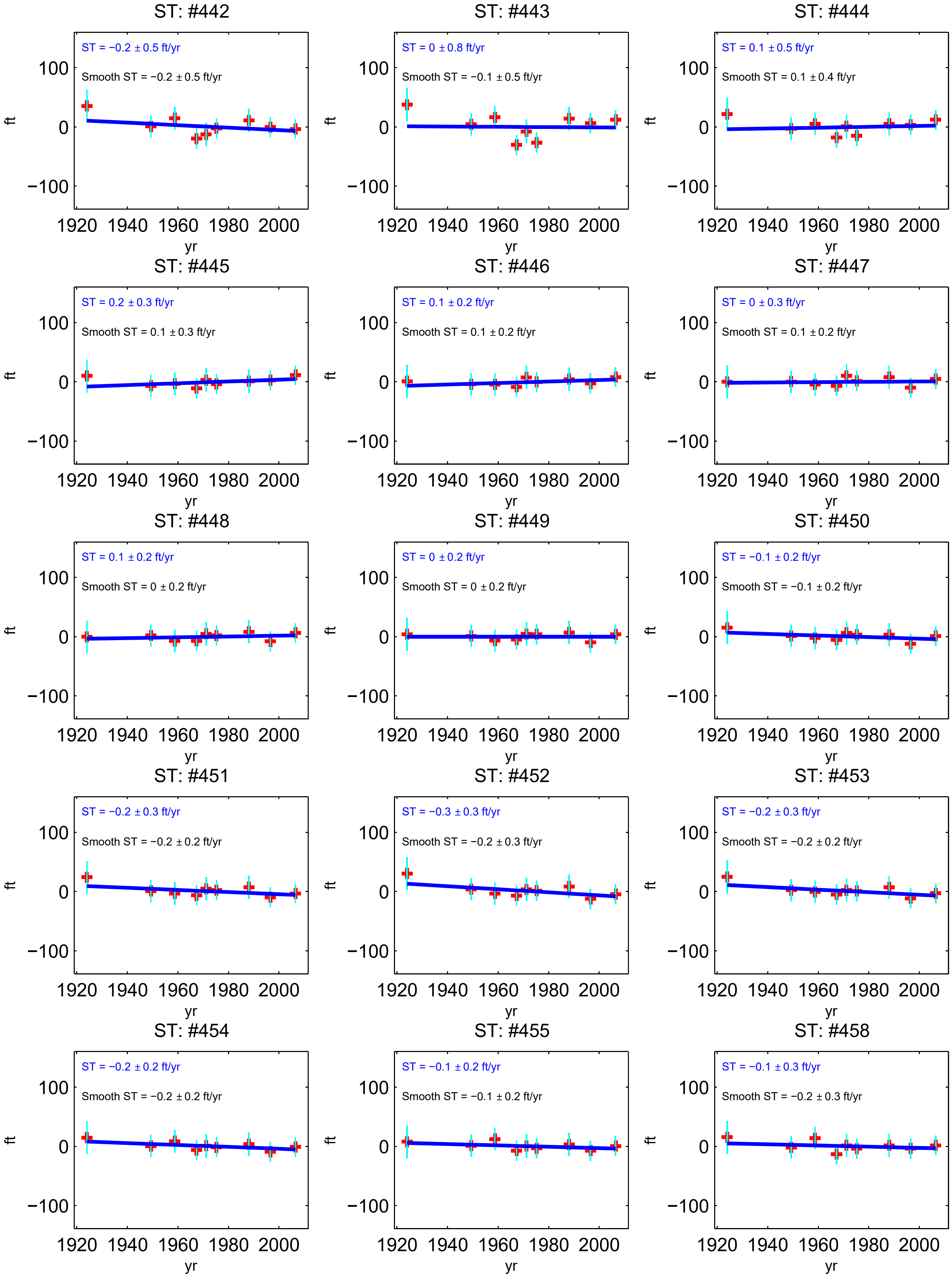
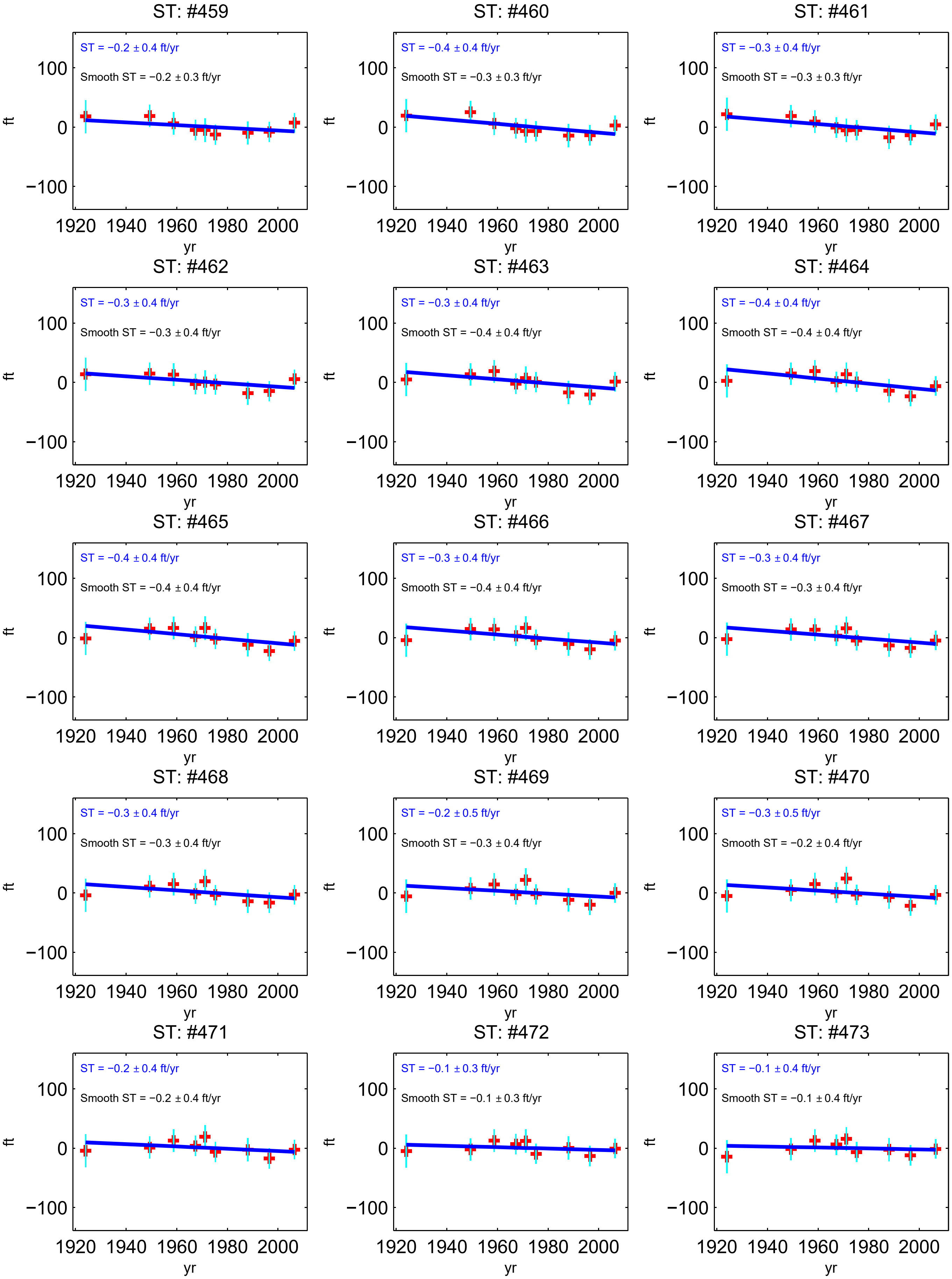
Negative Rate = Erosion



*Hardened shorelines with no beach are shown with a blue square. The analysis stops at the first hardened shoreline.

Crozier Drive - Smoothed Shoreline Change Rates

Positive Rate = Accretion
Negative Rate = Erosion



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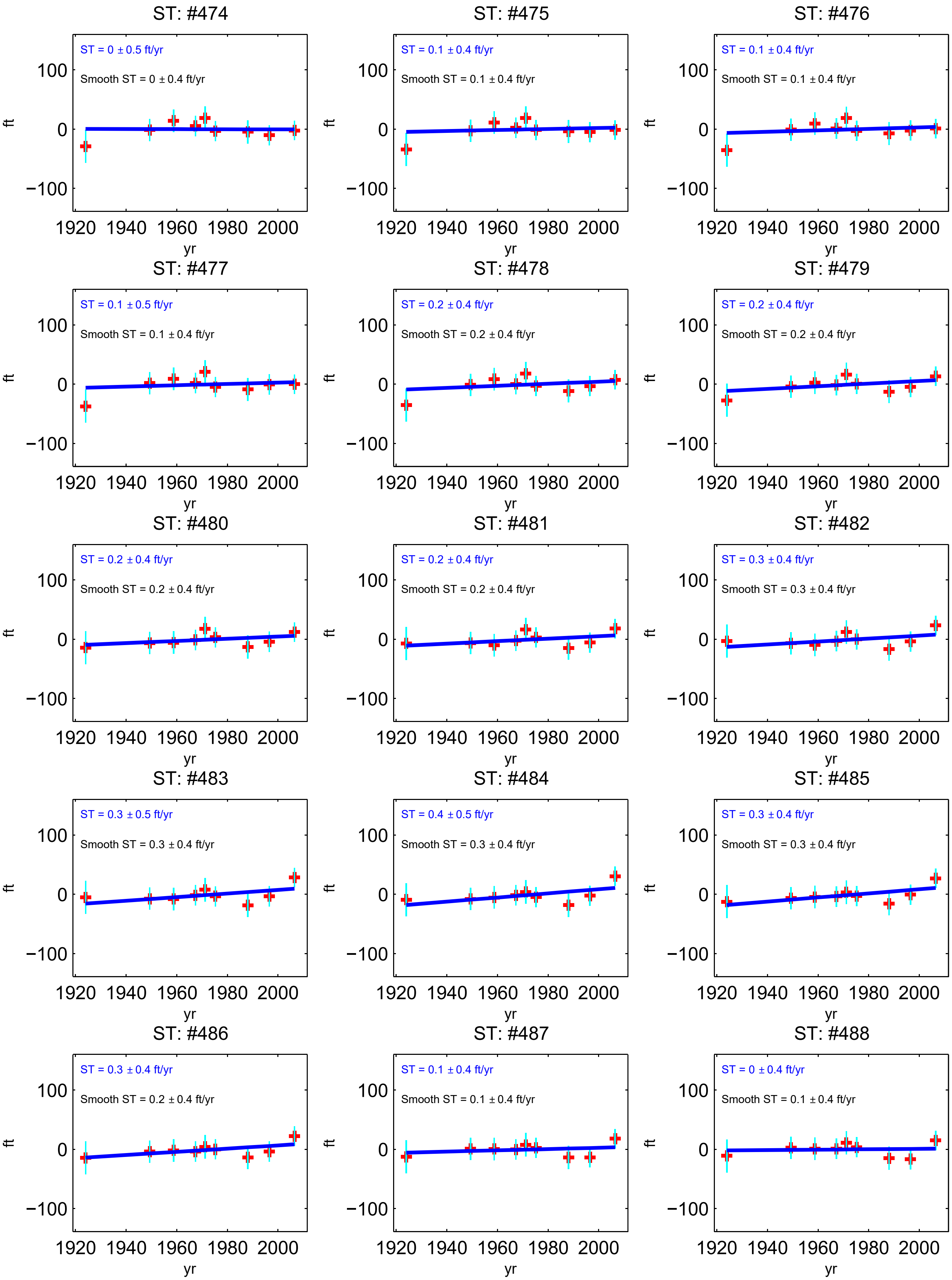
Crozier Drive - Smoothed Shoreline Change Rates

Positive Rate = Accretion
Negative Rate = Erosion



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Crozier Drive - Smoothed Shoreline Change Rates

Positive Rate = Accretion
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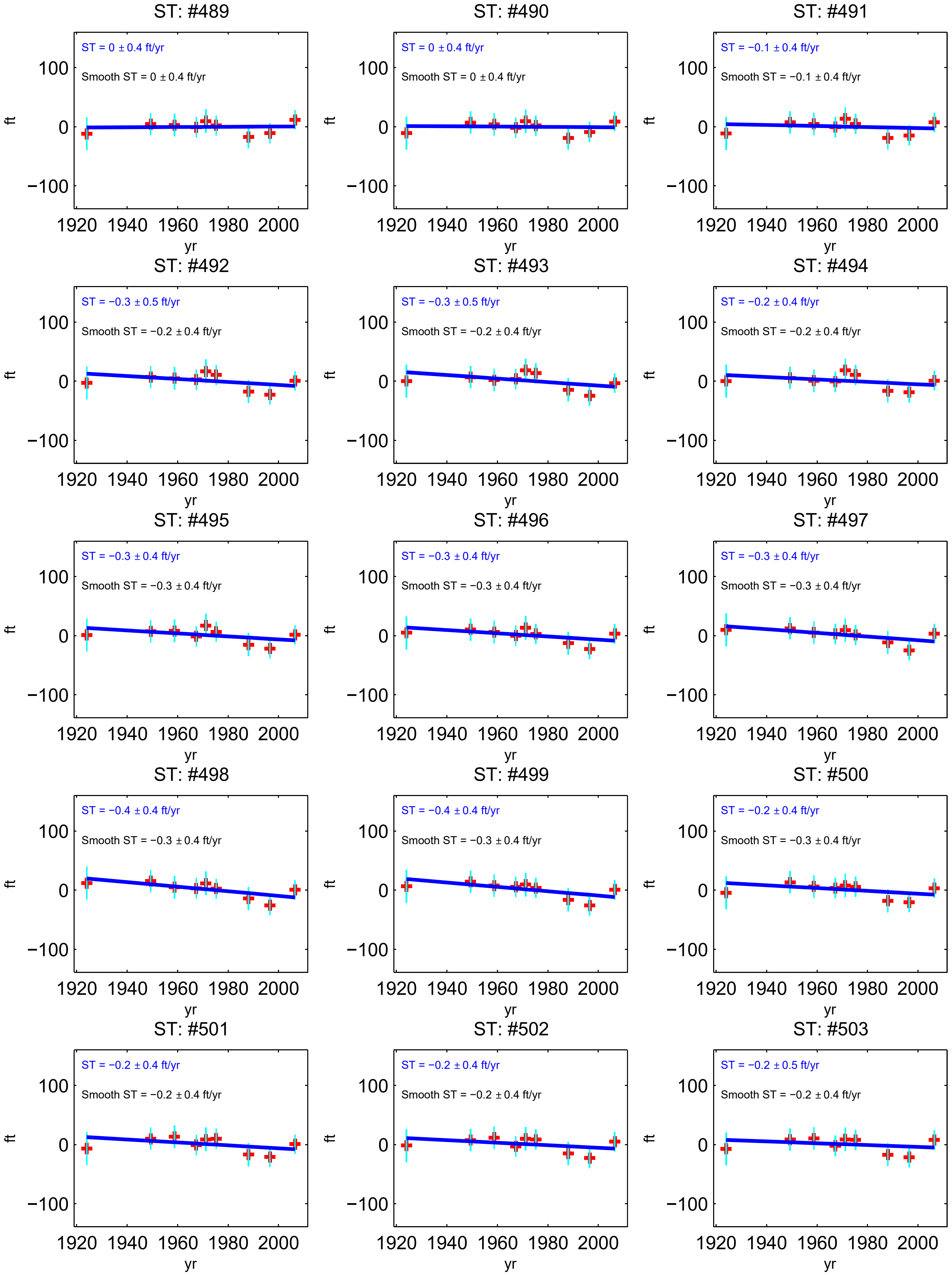

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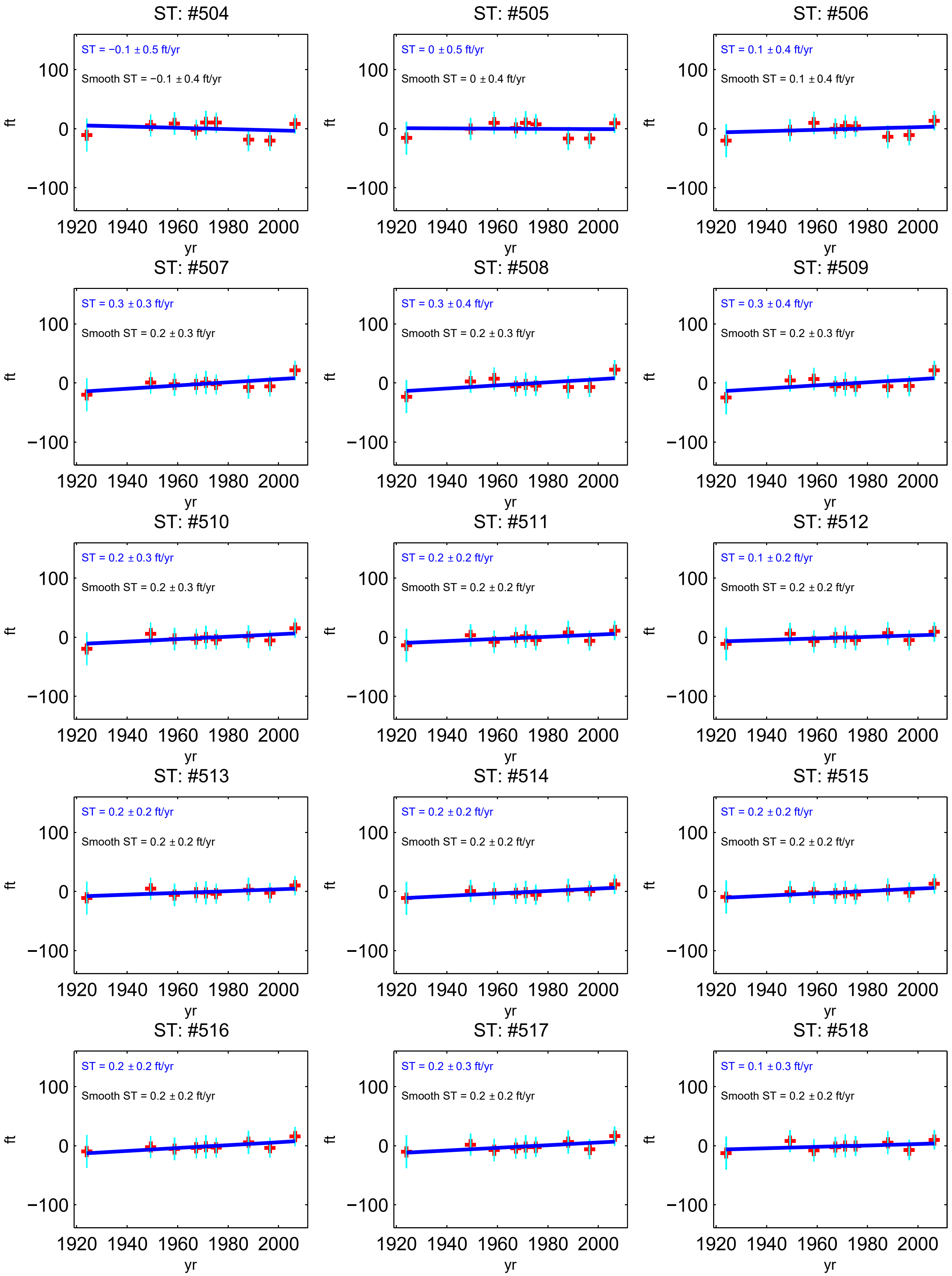

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Crozier Drive - Smoothed Shoreline Change Rates

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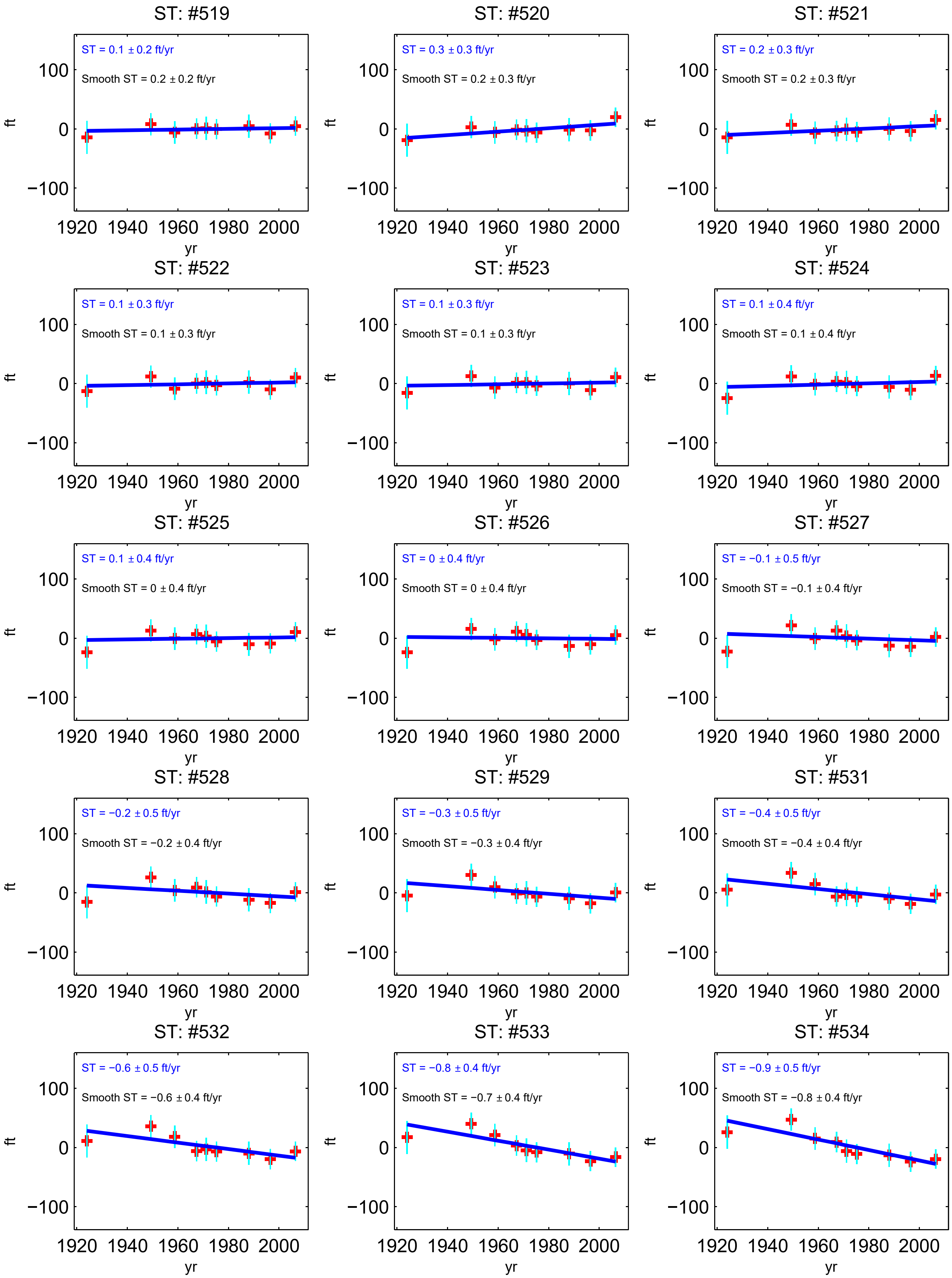

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Crozier Drive - Smoothed Shoreline Change Rates

Positive Rate = Accretion
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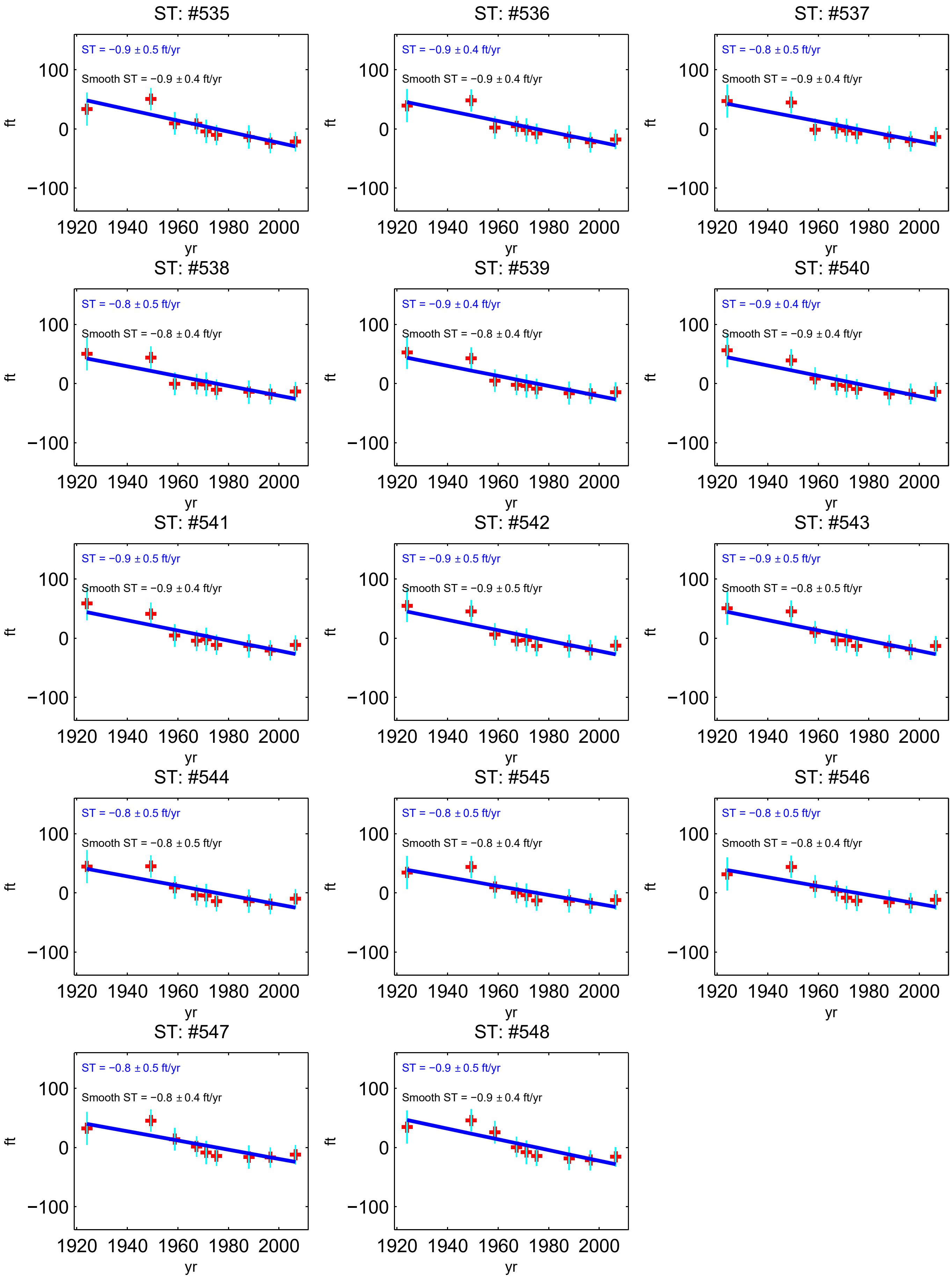

*Hardened shorelines with no beach are shown with a blue square. The analysis stops at the first hardened shoreline.

Appendix C

2018 Coastal Engineering Assessment
Little Environments, PLLC

TMK: 6-8-004:018
68-505 Crozier Dr.
Waialua, Oahu, Hawaii 96791

TMK: 6-8-004:031
68-511 Crozier Dr.
Waialua, Oahu, Hawaii 96791

ACCEPTING AUTHORITY:

City and County of Honolulu
Department of Planning and Permitting

PREPARED BY:

Gundaker Works, LLC

February 2018

Coastal Engineering Assessment of Existing Seawalls at the properties of 68-505 Crozier Dr, Waialua Hi 96791 TMK 6-8-004:018 & 68-511 Crozier Dr. Waialua, HI 96791 TMK6-8-004:031 and Implications of Refurbishment for Extended Life

Prepared for:

Gundaker Works LLC
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Prepared by:

Little Environments PLLC
PO Box 6388
Raleigh, NC 27628
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JOSEPH M. LITTLE
28-Mar-18
No. PE-16050

22 March 2018
18 pages

Introduction

Little Environments PLLC has been engaged by Gundaker Works LLC to provide a coastal engineering report in regards to the Sea Wall improvements/amendments at the properties of (A)68-505 Crozier Dr, Waialua Hi 96791 [TMK 6-8-004:018] & 68-511 Crozier Dr. Waialua, HI 96791[TMK6-8-004:031]. Currently both properties have effectively contiguous existing timber seawalls. Both properties have had existing seawalls. Adjacent or proximate properties in the area to the east and west have also had seawalls or revetment structures. This report has been prepared in support of upgrading the existing seawalls for the purpose of extended life and maintaining coastal equilibrium. Data and hydraulic assessment of the area also along with previous studies identify that the site is at relative coastal equilibrium. Maintaining this equilibrium into the future is in the interest of the protection of public property and amenity and the safety of the community. Ultimately the rebuild or upgrade of the seawalls is recommended. The figures below show the wooden topped seawall nearing end of serviceable life and also the vicinity of the two properties in reference to Mokuleia and the north shore.

Figure A. Site Location/Vicinity Inset Map

Problem Identification

The two residences located at 68-505 Crozier Dr, Waialua Hi 96791 (TMK 6-8-004:018) & 68-511 Crozier Dr. Waialua, HI 96791(TMK6-8-004:031) both have sea walls. The properties were built in 1940 and 1926 respectively. Since the original construction both properties in the area have experienced erosion. No direct definitive of quantifiable cause of the erosion can be proven deterministically, however the probability of a discrete or other abnormal event to occur is reasonably probable in the foreseeable future. The current seawall materials are nearing the end of their serviceable life. Many proximate and adjacent homes in the area have seawalls and the current coastal system is generally at equilibrium with such structures in place. In the interest of maintaining coastal equilibrium the seawalls should be rebuilt in the interest of protecting people and property. Along shore accesses for the public will be maintained as a result of this project. This report outlines the background for the project and identifies the variables required for a shoreline setback variance. Ultimately the reestablishment of the structures for another 20-year design period is recommended with further recommendation for maintenance into perpetuity.

The Affected Shoreline

The project will not substantially affect or impair the shoreline nor is it expected to alter or impede any natural existing coastal processes. Other reports prepared by other engineering-consulting firms draw similar conclusions through analysis and similar engineering considerations put forward in this report. The sea wall refurbishment will not change or affect the shoreline in any unnatural means.

Beach Profile/Foreshore and Backshore Areas

The beach profile in the area is rather constant and varies with slopes between 10% and 30% depending on the status of the littoral system. Where the normal water level intersects the beach profile and seaward of this line, there is the foreshore. The foreshore has about 4 feet in elevation change resulting in about 8-12 feet of lateral distance into the water. The bottom at the toe of the foreshore is crushed coral and is at about the same elevation as reported in previous geotechnical investigations in the yard that terminate at this depth. The following photos demonstrate the normal beach profile at the two properties. The backshore upto the existing sea wall is sand with deposits of vegetation and driftwood that have washed up. This area is consistent with the highest reach of the waves as modeled using combine STWAVE source calculations as well as the USACE method for estimating run up on smooth impermeable slopes such as the near shore reef. The foreshore and backshore are both comprised of the uniformly graded calcium carbonate sand. For more details on the sand composition reference the previous geotechnical investigation. The historical photos below are undisputable evidence that the beach profile has not changed over 51 years.

Figure B. 2017 and 2018 Aerial Photograph Comparison

(Photos are generally to the same scale +/-2%)

Figure C. Photo of Shoreline – Backshore

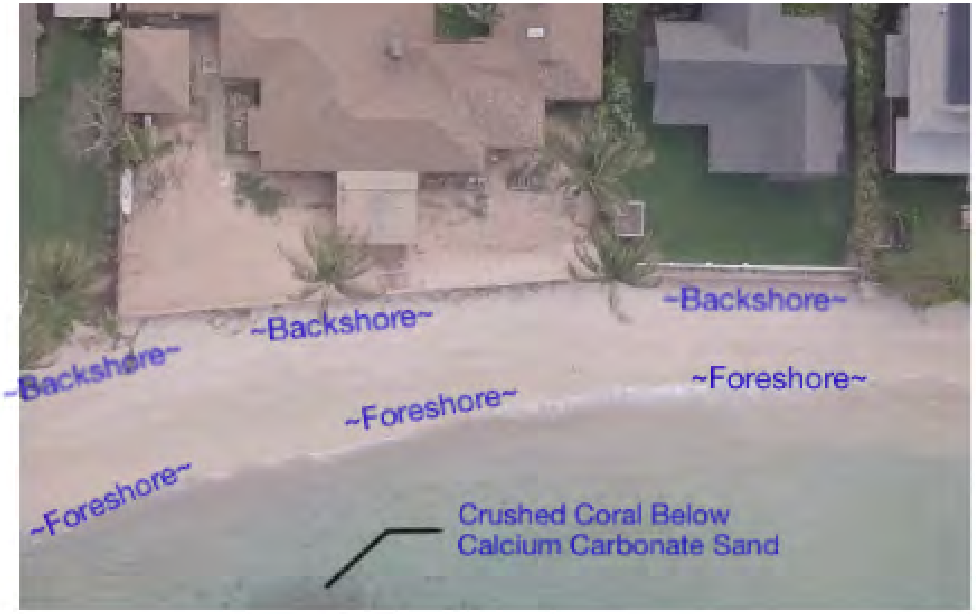


Figure D. Foreshore and Backshore Denoted on Aerial Photograph

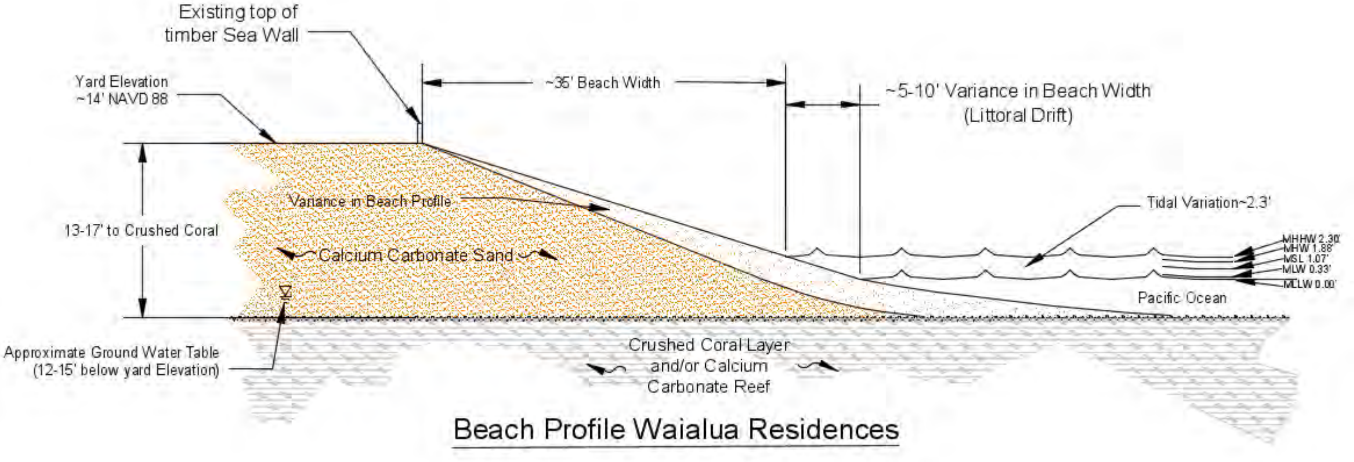


Figure E. Beach Profile

Offshore Depths

The bathymetry of just off shore and further offshore is shown in the following figures from the USGS and NOAA/Navy. To the west the Waho shelf protects the inner bay of Mokeluia and Haleiwa from weather and waves from the south. The geography to the northeast upto Kahuku Point protects the subject properties from wave events and prevailing ocean swell from the northeast around to the west. Swell that arrives from the window of NE counter clockwise to the west has little to no impact on this site. During event of this type, wind generated waves may push sand back and forth along littoral currents. Going offshore from the sites of consideration north-northwest, one encounters the most exposed direction of prevailing swell to affect the property. Immediately offshore(near shore) for about 1000 feet width the property is protected by shallow reefs with depths about 6 to 15 feet in depth averaging around 8 feet of depth. Outside of this reef, water depths drop quickly at about a 1:1 slope dropping down to the Ka’ena slump, about 8 miles offshore and at about 6000 feet of depth. Going further north an additional 8 miles the depth of the ocean drops to about 4500 meters depth or 14000 feet depth. The nearshore reef provides critical energy dissipation of waves approaching from the WNW to the NE.

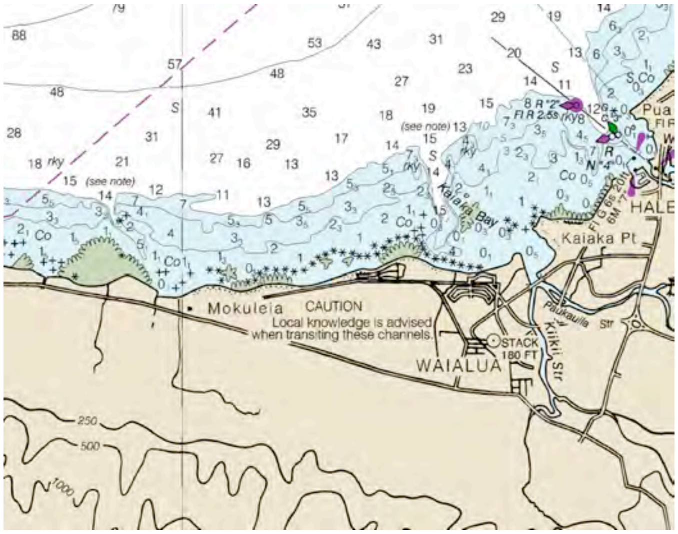


Figure F. NOAA and Navy navigation Map 2018

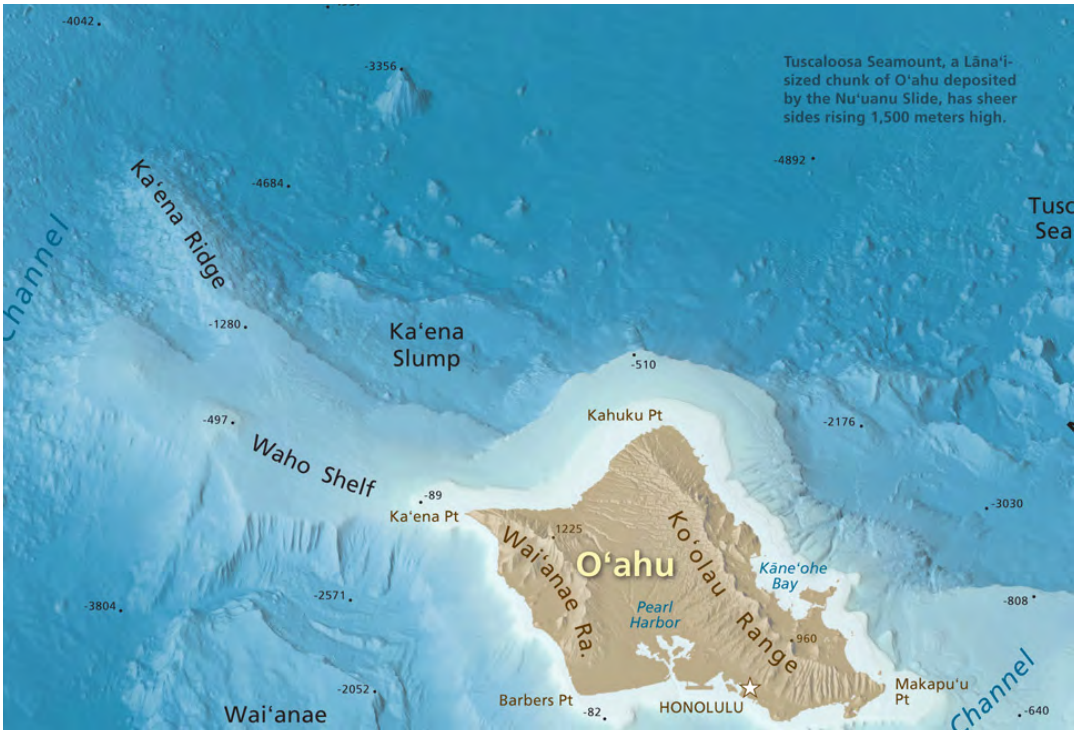


Figure G. USGS Data 2003

Littoral Transport/ Sand Sources

Littoral transport driven primarily by swell and wind waves dominates the coastal sand transport processes in the area offshore and affronting the properties of consideration. The reef structures also play a role in the balance of the sand transport. Given the primary direction of swell from the north west, waves are set-up and split by the reefs in random patters. The withdrawal of the waves through submerged trenches and propagation of waves over these trenches creates a stirring and mixing effect that allows sand to be taken from the shoreline and also redeposited along the shoreline. The figure below outlines the littoral transport as well as the conveyance of sand from offshore and along the reef. Given the minimal to no net change of the shoreline since 1967 it is reasonable to assume the system is at littoral equilibrium and while cyclical erosion may occur of the sectional area identified in the beach profile, (figure e)further erosion is not anticipated except during discrete events. These discrete events are rare and improbable. that are not reasonably probable. The maintenance of the front face of the sea wall and backing seawall is therefore dually recommended without exception.

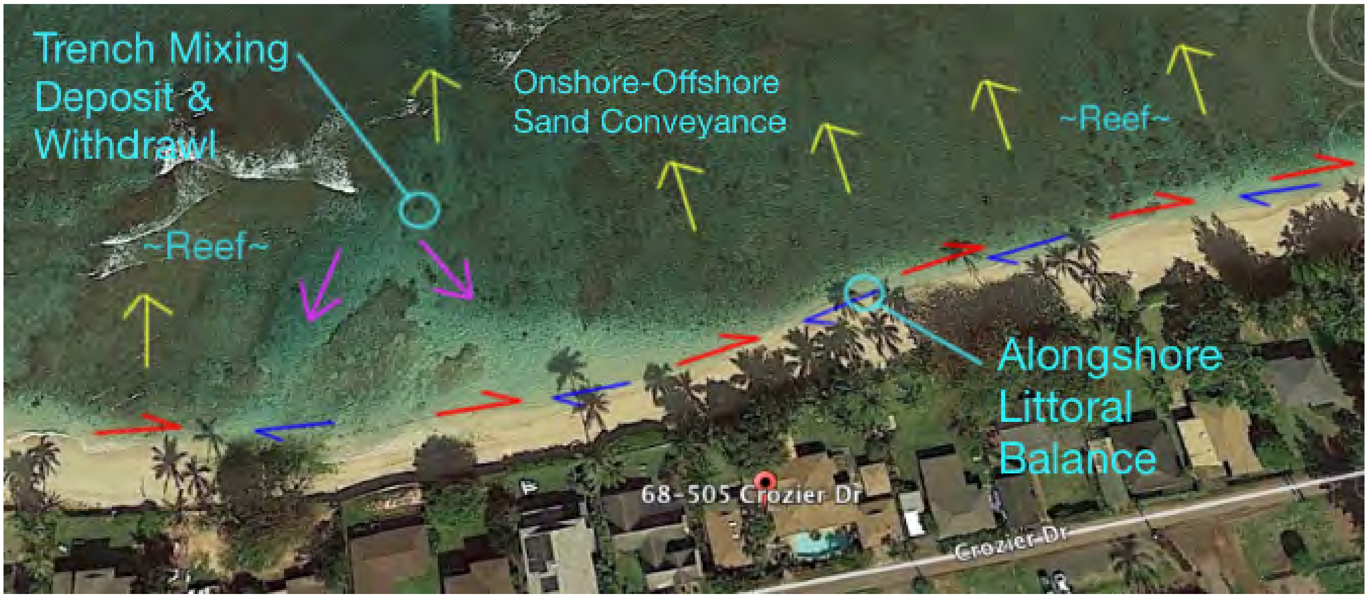


Figure H. Littoral Sand Transport in Harmony/Equilibrium

Cyclical Changes in Beach Form

Cyclical changes in beach form in this area are minimal. The minor cyclical shifts that do occur are the result of a balance in sand shifting in the fore shore as a result of wind driven waves balancing out the net sand movement that results for north east winter swell. Some reports in this vicinity identify that the area is eroding to various extents. The most quantitatively informed study or estimation was carried out using an army corps of engineers ST Wave model. While the ST wave model is a good model for making estimations and sizing structures for longevity, the assumptions that are incorporated into the model such as neglecting to incorporate impacts from waves reflected from steep bottom features, wind waves being limited by the duration of the winds, assuming constant currents throughout a water column and also incorporating bottom friction (Smith, J et. Al .2001) make the STWAVE model non 100% deterministic. In the past the beach here has not varied significantly in height. Historical photographs do show erosion over time, but data is limited in regards to identifying the direct cause of the erosion due to developments that have also occurred in the area over time that were done so without establishing a baseline for monitoring. Significant erosion of the fore shore at the properties of concern is not reasonable anticipatable in the near future and hence the improved design of the wall will assume a reasonable continuous level of foreshore for which to protect the base of the seawall. Given the seawall frontage will not vary from the current seawall frontage, no impact to the natural cyclical changes will occur.

Abnormal Changes in Beach Form

No abnormal changes in beach form will result from the installation or upgrade of the sea wall or seawall amendments. The installation of the sea wall before catastrophic failure of the existing sea wall will ensure that the current equilibrium of the system is not disrupted in a one off event. The loss of the sea wall amongst the other applied coastal protection strategies along the Mokeluia shoreline would result in significant disruption of the system's littoral sand drift potentially discharging large amounts of sand out to sea that could not be reclaimed or easily reclaimed. The proactive planning and refurbishment/upgrading/ updating of the seawall will ensure that lateral access to the beach is maintained for the public. Aerial photos of the sites from the past back to 1967 have shown erosion of the sites. It is reported that sand mining used to take place in the area. With shoreline setback rules implemented in 1971, and significant erosion being traceable more form the 1960's to the 1980's it is discernable that the equilibrium of the coastal processes was disturbed during this time period and that erosion rates have abated or stabilized as regulatory processes governing development have been applied. Additional potential sources of changes may be associated with alternate weather patterns, sea level rise, and increased human foot traffic on the beach. Given the area's stability and resilience to maintain littoral equilibrium during large swell events and that the sea walls were present back to the original construction of the properties in 1940 and 1926, maintaining a face at or about the current location of the face of the sea wall is recommended without exception to prevent abnormal changes to the beach form.

Changes in Water Level

Changes in water level in the area are a function of the tidal variations along with storm surge or "wave setup" and propagating waves. Storm water runoff in the area does not have a substantial impact on the water level in the bay just offshore. Sea Level rise associated with climate change and/or melting ice caps has been a common concern of the public. The figure below shows mean sea levels along with confidence intervals. Over the design life of the structure for the next 20 years, if a direct positive trend of 1.2mm rise per annum is continued, this would result in about a 1 inch rise in mean sea level rise. Given the location of the property relative to the reef, this would have negligible effects on the wave run-up and anticipating no change in the distribution of wave from various directions would have no significant effect on the current balance of the littoral drift.

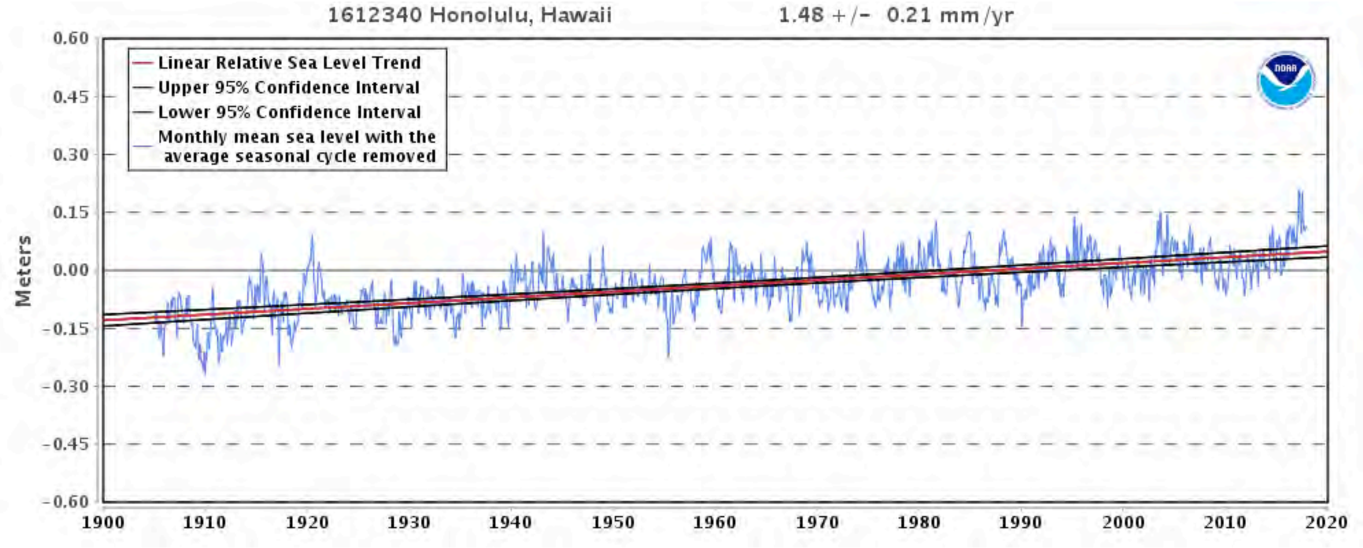
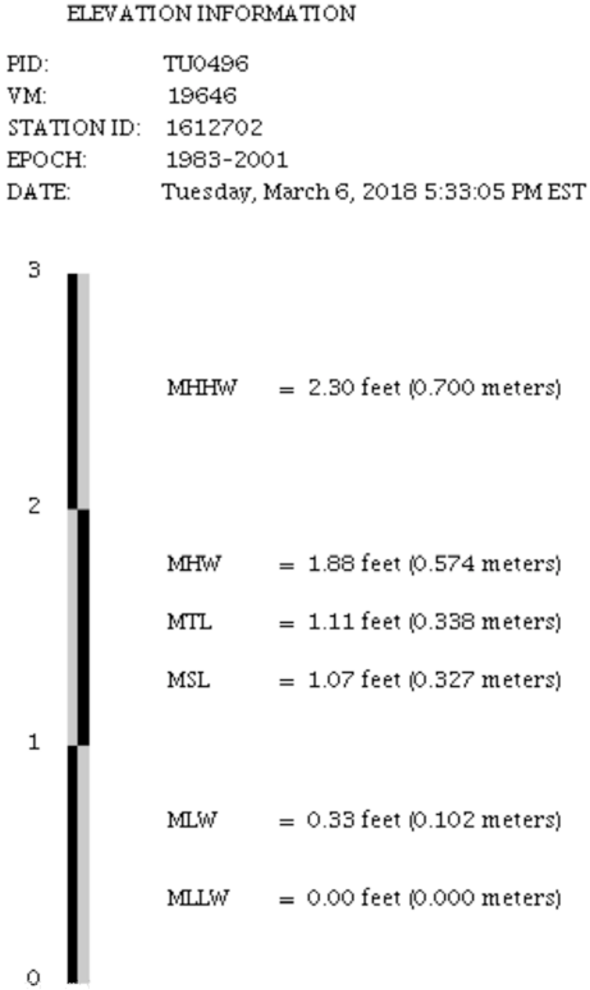


Figure I. Sea Level Rise Extrapolation



ELEVATION INFORMATION

PID: TU0496
VM: 19646
STATION ID: 1612702
EPOCH: 1983-2001
DATE: Tuesday, March 6, 2018 5:33:05 PM EST

MHHW = 2.30 feet (0.700 meters)

MHW = 1.88 feet (0.574 meters)

MTL = 1.11 feet (0.338 meters)

MSL = 1.07 feet (0.327 meters)

MLW = 0.33 feet (0.102 meters)

MLLW = 0.00 feet (0.000 meters)

Figure J. Tidal Datum Variances (National Geodetic Survey)

Wave Run up

Wave Run-up in the area normally does not exceed or go past the current toe of the existing seawall. A wave run-up analysis was carried out using the USACE method for estimating irregular wave run up on smooth, impermeable slopes (S. Hughes 2003). The model was executed considering the reef as the primary wave breaking point given that after waves either break or pass over the outer fringes of the offshore reef at depths of about 3 -5 fathoms. The wave height is then depth controlled atop the reef resulting in a maximum wave carry over height of no more than 65% of the water depth atop the reef. Given the size of the reef and the and the maximum wave height that can expected atop the reef in normal conditions of about 7 feet above MHHW and also considering that the wave that is running up the beach is depth limited, the length of run-up, up the slope of the beach face would be about 20-25 feet. This corresponds with the current face of the seawall being about the maximum reach of waves in the most intense normal events. Wave with large periods such as 20 seconds and above but not necessarily at large wave heights have the potential to result in large wave setup or surge atop the reef and may push the run up of the wave to the higher extents of the backshore. Wave Run-up will not substantially affect this structure unless the foreshore is eroded in ultra rare improbable instances.

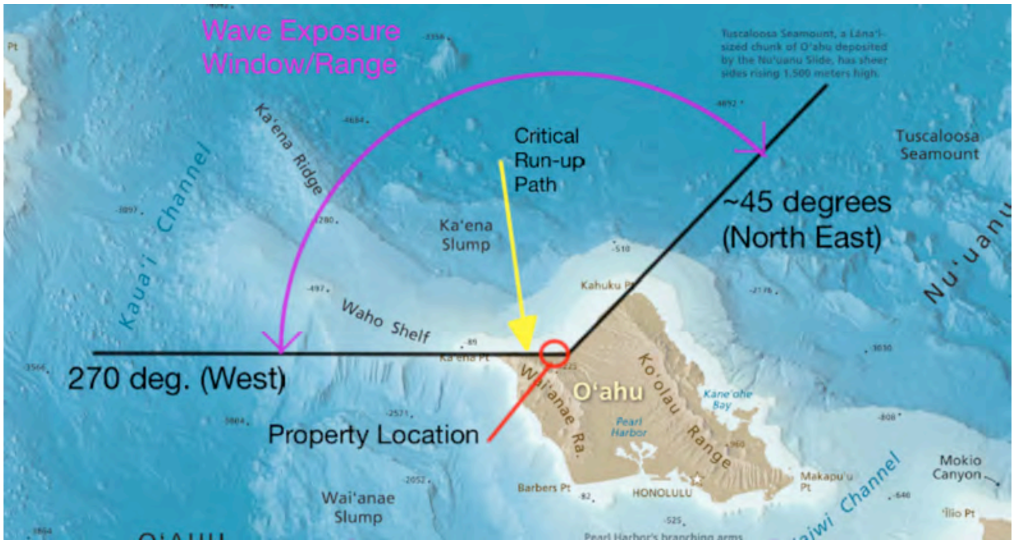


Figure K. Figure Showing Critical Run up Path

Structure Description

The front face of the seawall will not change in position in order to maintain the current coastal equilibrium of the area. Moving the front face of the wall mauka or makai would disrupt the current coastal equilibrium and create risk of large erosion events that will affect the community, adjacent and proximate land owners, and the presence of the beach profile. The seawall improvements will effectively be the same as the current structure but with more robust materials that account for structure degradation due to corrosion.

Functionality and Structural Stability

The functionality of the structure will remain the same but will not require as much maintenance as to afford the home owner peace in their dwelling. The structural stability of the current wall is insufficient as the wood and other materials are at the end of or do not have much more serviceable life. The current wall would be structurally compromised should a large erosive event occur. Currently a large erosive event is not anticipated but such event cannot be completely eliminated from consideration. The current debate and probable evidence of sea level rise along with continued development associated with tourism make the chance of an erosive event that could undermine the current wall potential. Applying engineering theory to establish a design life requires that deterministic principles be considered and thus accounting for potential erosion of the foreshore in a discrete event is necessary. For this reason the base of the seawall amendments will continue down to the coral bedding at approximately 0’ elevation. The effective wall structure will have a center of gravity behind the current face of the wall such that should there ever be catastrophic or multiple discrete events that result un settlement of the wall, the settlement will not result in significant or abrupt failure.

Structural Life Expectancy

The sea wall upgrade will have a 20 year service life. The wall will be limited in performance by corrosion or the deleterious effects of the materials to withstand salt degradation. An example figure is provided below for a sea wall that has met its final life by means of corrosion failure. The life of the sea wall may be extended in the future by means of additional maintenance.

Figure L. Example End of Service Life of Sea Wall Due to Rebar Corrosion

Toe Protection

The coral bedding present at about 16 feet below the yard elevation or about -2 feet from the datum will be the base of the sea wall. Due to the structures center of gravity design location significantly behind the face of the current wall for the purpose of uniform settlement, not toe protection is provided. Should the walls’ toe or footing become exposed within the design life of the wall(20 years), the wall will settle uniformly. The probability of the toe becoming exposed given the current knowledge at this time is extremely unlikely.

Foundation

Geotechnical reports of the site identify refusal at about 16’ below the back yard surface elevation. This refusal is most probably associated with a fragmented coral deposits. No specific details as to the cause of the refusal are made in the geotechnical report. The coral deposits interlock very well and serve as an excellent foundation for the sea wall. Should alternate condition be encountered when excavating or constructing, the contractor should consult with the engineer for alternate foundation preparation methods.

Flank Protection

Both properties currently include flank protection. While these current wall returns provide protection, they are ultimately there in contingency should an adjacent seawall fail. Given the continuous nature of this shoreline as well as the minimal variance in littoral sand drift/onshore-offshore sand exchange, flank protection is unnecessary. The offshore reef also provides significant protection from flanking as the wave travel distance along approach angles near to parallel to the shore resulting in hydraulic resistance and dissipation capability such that wave energy is almost completely abated. Upgrades to the sea wall will not include returns as the wall will be designed to settle should and event of such occur. This relies on the fact that flanking by waves around the sea wall would only occur in the event the beach was completely eroded. Given this has not occurred in 50 years, the event is not reasonable or cost justified to account for.

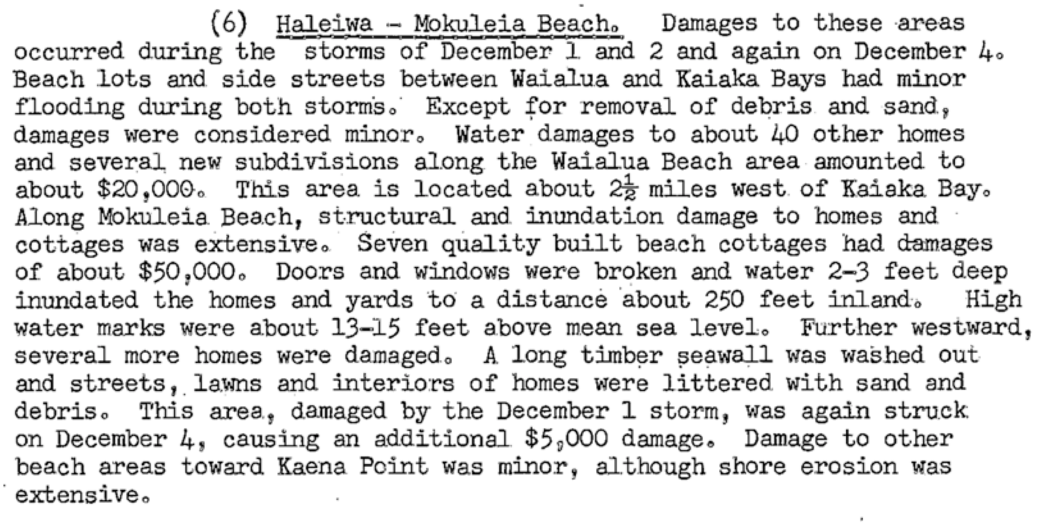
Figure M. Current Seawall Returns

Stone Underlayment and Filters

The current installation as well as any refurbishments or seawall improvements will allow ground water to flow freely below the wall in both directions. The Calcium carbonate sand has excellent hydraulic conveyance properties and there is no significant source of other soils that could clog the natural groundwater flow through and below the seawall.

Wave Run-up/Impact

Appendix A of this report contains wave-modeling calculations based on appropriate USACE calculation methods. Applying USACE wave models directly would be extraneous, as the assumptions of the STWAVE model do not apply in this location for a long run over a hard bottom reef where serious reef friction applies. The calculation reef run-up was determined at the exterior of the reef associated with the significant slope just offshore of the reef. The resulting maximum height or period wave as a result of the run-up was then applied as an assumption for the basis of modeling a depth limited wave that carried over the reef. Calculations were corroborated with witness events of similar size. The force of the wave run-up will not deteriorate the current or future seawall, however the wall is subject to materials degradation over time. There is an extremely rare possibility that the beachfront that has been at equilibrium for 50 years could erode and this be compounded with a large wave events. In the interest of granting the homeowner peace in their residence, the wall has been sized to survive such a combined event. Further corroborating the model is the report from the 1970’s big wave swell event. The description of the event is described below. Note the height of the current seawall matches the surge inundation from the report except below.



(6) Haleiwa – Mokuleia Beach. Damages to these areas occurred during the storms of December 1 and 2 and again on December 4. Beach lots and side streets between Waialua and Kaiaka Bays had minor flooding during both storms. Except for removal of debris and sand, damages were considered minor. Water damages to about 40 other homes and several new subdivisions along the Waialua Beach area amounted to about $20,000. This area is located about 2½ miles west of Kaiaka Bay. Along Mokuleia Beach, structural and inundation damage to homes and cottages was extensive. Seven quality built beach cottages had damages of about $50,000. Doors and windows were broken and water 2-3 feet deep inundated the homes and yards to a distance about 250 feet inland. High water marks were about 13-15 feet above mean sea level. Further westward, several more homes were damaged. A long timber seawall was washed out and streets, lawns and interiors of homes were littered with sand and debris. This area, damaged by the December 1 storm, was again struck on December 4, causing an additional $5,000 damage. Damage to other beach areas toward Kaena Point was minor, although shore erosion was extensive.

Figure N. Excerpt from 1969 Big Wave - Department of Commerce Report

Potential for design to have Effects on Shoreline

The findings of this engineering study, both quantitative and qualitative support the conclusion that the refurbishment and upgrade of the existing seawall be carried out with out exception in order to maintain coastal equilibrium in the interest of the protection of property and safety and in the interest of the public and adjacent property owners. Based on current and past property conditions internal to the properties of consideration and adjacent and proximate it is recommended that the seawall be re-built for the purpose of existence into perpetuity. Should other permitting constrains exist, it is recommended that the seawall be maintained to the maximum extent possible to safeguard against the disruption of the current coastal equilibrium.

From the Director

It is a pleasure to carry out this study. Little Environments enjoys working with people and the environment, as people are a critical component of the environment. Please do not hesitate to contact me for clarification or additional questions.

Best Regards,

Joseph Little PE
(919) 916 9061
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JOSEPH M. LITTLE
28-Mar-18
No. PE-16050

References

NOAA/Navy Navigational Charts

USGS Oceanographic Survey

USACE Steady-State Spectral Wave Model STWAVE Users manual Version 3.0

ERDC/CHL CHETN-III-68 S. Huges “UASCE-Estimating Irregualar Wave Runup on Smooth, Impermeable Slopes”

National Geodetic Survey

Department of Commerce Report on Big Wave Event 1970

APPENIX A - Wave Run Up Calculations- Property Specific Model

Max Runnup at Reef face Offshore
[Theoretical Assumption]

Lp	Wave Length	1200	ft
H	Significnat wave height	28	ft
h	water depth at toe of slope	10000	ft
T	wave period-spectral peak	22	s
g	gravity	32.2	ft/s^2
tanalpha	structure slope	0.3	

Relative Depth Calc
0.641650839

Relative Wave height
0.0028

Coeff A0
4.29975E-06
Coeff A1
1.792394963
NONDimensional wave momentum flux parameter
9.52445E-06

Determine which runnup forumula to use
0.023333333

Test slope fall in eq 11 applicability
3.333333333 must be between 1.5 and 4

Nondimensional relative 2 percent runnup
0.006528159

Dimensional 2 percent runnup
65.28159461 ft

Resultant wave Hight Assuming Wave slope of 20%
13.05631892 feet face height

Depth limited calculation of propagated wave atop Reef
(Root STWAVE Assumption)

Lp	Wave Length	1200	ft
H	Significnat wave height	18	ft
h	water depth at toe of slope	8	ft
T	wave period-spectral peak	22	s
g	gravity	32.2	ft/s^2
tanalpha	structure slope	0.3	

4.8 ft (Wave Height atop Reef)

Max runnup at Beach Face from Offshore Dissipated Wave

Lp	Wave Length	100	ft
H	Significnat wave height	7	ft
h	water depth at toe of slope	4	ft
T	wave period-spectral peak	22	s
g	gravity	32.2	ft/s^2
tanalpha	structure slope	0.3	

Relative Depth Calc
0.00025666

Relative Wave height
1.75

Coeff A0
1.985619114
Coeff A1
0.144625418
NONDimensional wave momentum flux parameter
6.564383367

Determine which runnup forumula to use
0.07

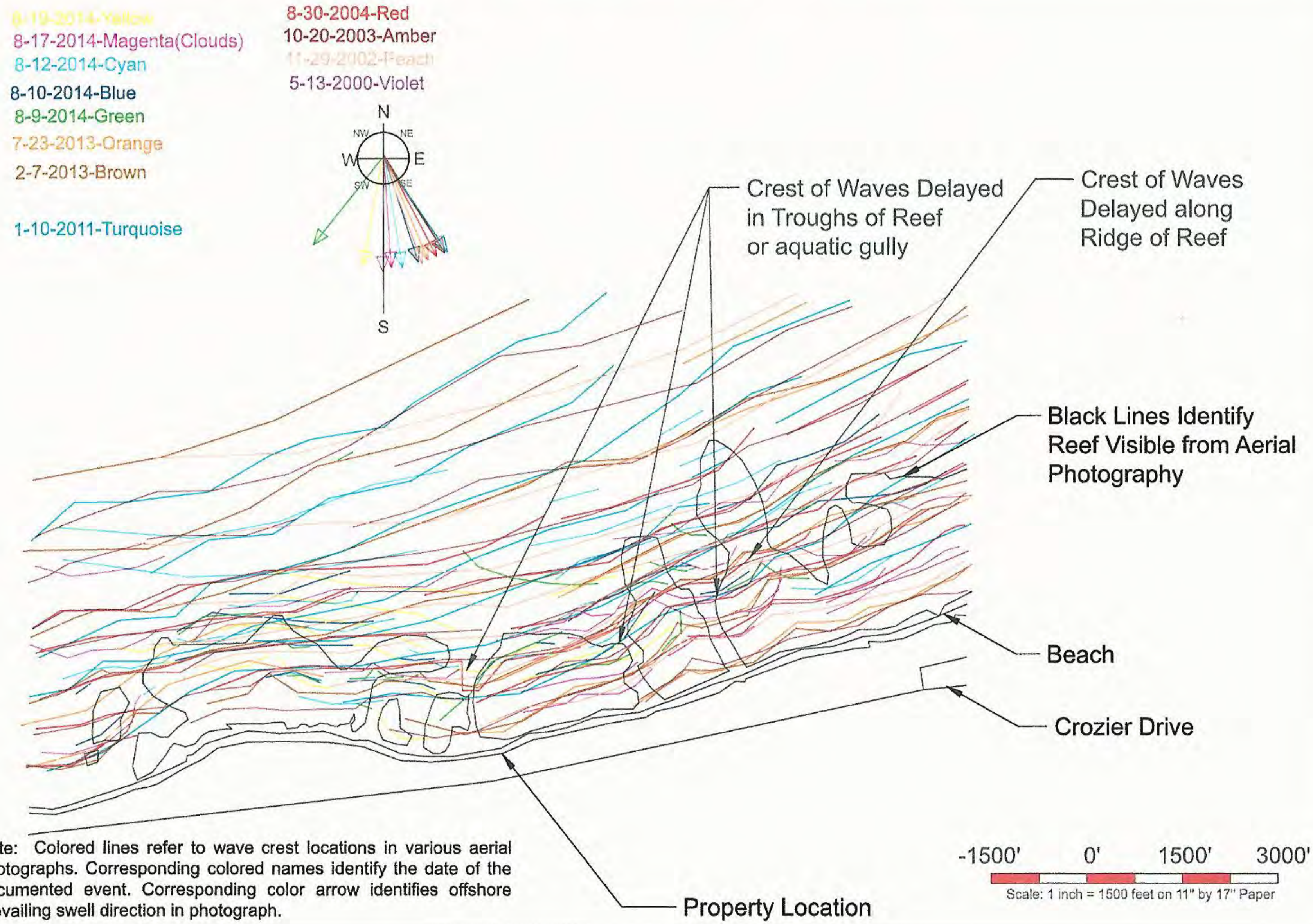
Test slope fall in eq 11 applicability
3.333333333 must be between 1.5 and 4

Nondimensional relative 2 percent runnup
5.419607656

Dimensional 2 percent runnup
21.67843062 ft

APPENIX B - Wave Crest Analysis

(See Accompanying Document 17 x11” drawing)



Note: Colored lines refer to wave crest locations in various aerial photographs. Corresponding colored names identify the date of the documented event. Corresponding color arrow identifies offshore prevailing swell direction in photograph.

Drawn by: J. Little PE **Date:** March 20 2018 **Revision:** Analysis **Revision #:** 1

Little Environments PLLC
PO Box 6388
Raleigh, NC 27628, USA NCBELS P-1292

Project: Crozier Drive Seawall - TMK: 6-8-004:018 & 6-8-004:031
Drawing Description: Directional Wave Crest Patterns- Waialua HI, USA

Project #: HI-KD-1001 Sheet:1 of 1

Appendix D

Soil Sampling,
Geotechnical Investigation

TMK: 6-8-004:018
68-505 Crozier Dr.
Waialua, Oahu, Hawaii 96791

ACCEPTING AUTHORITY:

City and County of Honolulu
Department of Planning and Permitting

PREPARED BY:

Gundaker Works, LLC

February 2018

REPORT
GEOTECHNICAL INVESTIGATION

PROPOSED SEAWALL AND FUTURE ADDITION TO RESIDENCE
68-505 CROZIER DRIVE
WAIALUA, OAHU, HAWAII
TMK: (1) 6-8-004: 018

for

MARK BUTTON

Project No. 15-0120
September 24, 2015

SHINSATO ENGINEERING, INC.
98-747 KUAHAO PLACE, #E
PEARL CITY, HI 96782

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September 24, 2015
Project No. 15-0120

Mr. Mark Button
68-505 Crozier Drive
Waialua, Hawaii 96791

Subject: **Geotechnical Investigation Report**
Proposed Seawall and Future Addition to Residence
68-505 Crozier Drive
Waialua, Hawaii 96791
TMK: (1) 6-8-004: 018

Dear Mr. Button:

This report presents the results of a geotechnical investigation for the subject project.

1.0 INTRODUCTION

This investigation was made for the purpose of obtaining information on the subsurface conditions from which to base recommendations for foundation design for the proposed seawall and future addition to your residence at 68-505 Crozier Drive in Waialua, Oahu, Hawaii. The location of the site, relative to the existing streets and landmarks, is shown on the Vicinity Map, Plate 1.

2.0 SCOPE OF WORK

The services included drilling 4 test borings to the depths of 11.5 to 20.6 feet below grade, obtaining samples of the underlying soils, performing laboratory tests to determine pertinent engineering properties of the representative soil samples, and performing an engineering analysis to determine foundation design parameters. The following information is provided for use by the Architect and/or Engineer:

a) General subsurface conditions, as disclosed by the test borings.
b) Physical characteristics of the soils encountered.
c) Recommendations for foundation design, including allowable soil bearing values, embedment depth and estimated settlement.
d) Recommendations for placement of fill and backfill.
e) Special design considerations.

3.0 PLANNED DEVELOPMENT

From the information provided, the project will consist of demolishing the existing seawall and constructing a new seawall on the property. Future additions to the existing residence are also being considered.

4.0 FIELD INVESTIGATION

4.1 General

The field investigation consisted of performing explorations at the locations shown on the Plot Plan, Plate 2. The borings were advanced with a Badger drill rig. Material removed from the borings were visually inspected and a continuous log of the boring was kept.

Probing was done to determine soil consistency at deeper depths. The probe consists of a 2-inch diameter steel tip that is attached to AW drilling rods. The probe is driven into the underlying material with a 140-pound hammer falling from a height of 30-inches. Blow counts are recorded at 12-inch intervals and are shown on the boring logs.

4.2 Soil Sampling

Relatively undisturbed samples of the underlying soils were obtained from the borings by driving a sampling tube into the subsurface material using a 140-pound safety hammer falling from a height of 30 inches. Ring samples were obtained using a 3-inch outside diameter, 2.5 inch inside diameter steel sampling tube with an interior lining of one-inch long, thin brass rings. The tube is driven approximately 18 inches into the soil and a section of the central portion is placed in a close fitting waterproof container in order to retain field conditions until completion of the laboratory tests. The number of blows required to drive the sampler into the ground is recorded at 6-inch intervals. The blow count for the last 12-inches is shown on the boring logs.

Samples were then packed in moisture proof containers and transported to the laboratory for testing.

5.0 SITE CONDITIONS

5.1 Surface

The property, designated by Tax Map Key Number: (1) 6-8-004:018, is located in the north-western quadrant of the island of Oahu. The lot is on the ocean side of Crozier Drive, approximately 330-feet east of Olohio Street.

At the time of the field investigation, the lot was occupied by an existing residence. At the back of the property, there is an existing wooden seawall.

5.2 Subsurface

The subsurface conditions at the site were explored by drilling 4 test borings to depths of 11.5 to 20.6 feet below grade. The locations of the test borings are shown on the Plot Plan, Plate 2. Detailed logs of the test borings are presented on Plates 3 through 6.

In general, the borings encountered medium dense to loose, brown-tan silty SAND to depths of 3 to 5 feet followed by loose, tan SAND to depths of 6 to 10 feet below grade. Below the loose SAND layer, the tan SAND graded medium dense to very dense to the final depths of the borings.

Groundwater was encountered in the borings, however the depth could not be determined due to collapsing of the bore hole. It is estimated that the depth to groundwater varies from approximately 5 to 10 feet below existing grade across the property.

From the USDA Soil Conservation Service "Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii," the site is located in an area designated as Jaucas sand, 0 to 15 percent slopes (JaC). This series consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean on all islands. These soils developed in wind- and water-deposited sand from coral and seashells. On this soil, permeability is rapid. Runoff is very slow to slow, and the hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed.

6.0 LABORATORY TESTING

6.1 General

Laboratory tests are performed on various soil samples to determine their engineering properties. Descriptions of the various tests are listed below.

6.2 Unit Weight and Moisture Content

The in-place moisture content and unit weight of the samples are used to correlate similar soils at various depths. The sample is weighed, the volume determined, and a portion of the sample is placed in the oven. After oven-drying, the sample is again weighed to determine the moisture loss. The data is used to determine the wet-density, dry-density and in-place moisture content.

6.3 Direct Shear

Direct shear tests are performed to determine the strength characteristics of the representative soil samples. The test consists of placing the sample into a shear box, applying a normal load and then shearing the sample at a constant rate of strain. The shearing resistance is recorded at various rates of strain. By varying the normal load, the angle of internal friction and cohesion can be determined.

6.4 Classification Tests

The terms and symbols used to describe the soil materials are based on the Unified Soil Classification System which provides a basis for classifying soils using either visual methods or laboratory test results.

Coarse grained soils are described as follows:

Boulder:	Material retained on a 12-inch square sieve
Cobble:	Material passing a 12-inch sieve but retained on a 3-inch sieve
Gravel:	Material passing a 3-inch sieve but retained on a #4 sieve
Sand:	Material passing a #4 sieve but retained on a #200 sieve

Fine-grained materials are silts and clays.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 General

Special permitting and shoreline certification may be required to rebuild the seawall. This is beyond the scope of our work and expertise. We recommend consulting with other professional who are versed in this process.

A summary of our geotechnical recommendations is as follows:

a) The new seawall should be constructed with a foundation system that bears on the underlying medium dense to very dense SAND.

b) According to the City and County of Honolulu FEMA Flood Insurance Rate Map (FIRM), the subject property is located in “Zone AE.” Additional footing embedment depth may be required to minimize the adverse effects from scouring of the soil adjacent to and beneath the footings.

c) The underlying soils are susceptible to caving especially near groundwater level. Proper safety precautions should be used when excavating into the underlying soils.

d) Compaction of fill and backfill material should be done with care due to the close proximity of the neighboring structures.

7.2 Foundations

a) Allowable Soil Bearing Pressure

For footings that bear on either firm on-site soil or properly compacted fill and are embedded a minimum of 24-inches below the lowest adjacent grade, an allowable bearing value of 2,000 pounds per square foot may be used to design the footings.

The bearing value may be increased by 500 psf for each additional foot of embedment below 24-inches to a maximum of 4,000 psf.

The bearing value is for dead plus live loads and may be increased by one-third (1/3) for momentary loads due to wind or seismic forces. If any footing is eccentrically loaded, the maximum edge pressure shall not exceed the bearing pressure for permanent or for momentary loads.

Where the bottom of the footing is below the groundwater level, the above bearing values shall be reduced by one-third.

b) Footing Embedment Depth

The minimum footing embedment depth shall be as follows:

- For footings constructed on relatively level ground, the minimum embedment shall be 24 inches below the lowest adjacent finished grade (measured to the bottom of the footing).
- For footings located adjacent to utility trenches, the bottom of the footing shall be deepened below a 1 horizontal to 1 vertical plane projected upwards from the edge of the utility trench.
- For footings located on or adjacent to slopes, the footing shall be deepened such that there is a minimum horizontal distance of 5 feet from the edge of the footing to the slope face.
- Where footings are to be located adjacent to retaining walls or other structural elements which are not designed for surcharge loading, the new footing shall be deepened below a 45-degree plane projected upwards from the adjacent structure.

All loose and disturbed soil at the bottom of footing excavations shall be removed to firm soil or the disturbed soil shall be compacted prior to laying of steel or pouring of concrete.

Additional footing embedment depth may be required due to the potential for scouring of soil from beneath footings during floods. The estimated depth of scouring is based on the distance from the shoreline, the height of flood water above the ground surface, and the type of soil at the site. The recommended soil description for use in designing the additional embedment depth is “Loose Sand” for this site.

TABLE 1.0 - ESTIMATED MINIMUM SCOUR

	Distance from Shoreline	
Soil Description	Up to 300 Feet [1]	Greater than 300 Feet [2]
Loose Sand	80% h	60% h
Dense Sand	50% h	35% h
Soft Silt	50% h	25% h
Stiff Silt	25% h	15% h
Soft Clay	25% h	15% h
Stiff Clay	10% h	5% h

[1] Values may be reduced by 40% if a substantial dune or berm higher than the regulatory flood elevation protects the building site.

[2] Values may be reduced 50% if the entire region is essentially flat.

[3] The estimated minimum depth of soil scour below existing grade as a percentage of the depth (h) of water at the location.

[4] Shallow foundation types are not permitted unless the natural supporting soils are protected on all sides against scour by a shore protection structure, preferably a bulkhead. Shallow foundations may be permitted beyond 300 feet from the shoreline provided they are founded on natural soil and at least two feet below the anticipated depth of scour and provided not more than 3 feet of scour is expected at the structure.

Reference: Revised Ordinances of Honolulu, Sec. 16-7.5.

7.3 Seismic Design Parameters (2006 IBC)

In accordance with the 2006 International Building Code, the soil profile type may be assumed as D (stiff soil).

The occupancy category for this project was assumed to be Category I. The final determination of the appropriate occupancy category shall be determined by the designated project structural engineer. The seismic site parameters pertaining to an occupancy Category I are as follows:

Mapped spectral acceleration parameters	
Ss (0.2 second spectral response acceleration)	0.574 g
S_1 (1.0 second spectral response acceleration)	0.156 g
Site coefficients	
Fa (short period)	1.341
Fv (1-second period)	2.175

Adjusted maximum considered earthquake spectral response acceleration parameters	
S_{MS} (short periods) = Fa x Ss	0.769 g
S_{M1} (1-second periods) = Fv x S_1	0.340 g
Design spectral response acceleration parameters	
S_{DS} (short periods) = S_{MS} x 2/3	0.513 g
S_{D1} (1-second periods) = S_{M1} x 2/3	0.226 g
Seismic design category*	C
Peak ground acceleration = S_{DS} / 2.5	0.205 g

* The seismic design category has been determined by Table 1613.5.6 (1) and 1613.5.6 (2) of the City and County of Honolulu Ordinance 12-34, Bill 35 (2012), CD2.

7.4 Settlement

Under the fully applied recommended bearing pressure, it is estimated that the total settlement of footings up to 5 feet square or 3 feet continuous that bear on properly compacted fill or the firm on-site soil will be less than 1 inch.

Differential settlement between footings will vary according to the size and bearing pressure of the footing.

7.5 Lateral Earth Pressure Coefficients

The lateral earth pressure coefficients, frictional resistance, and unit weights may be assumed as follows:

Material Type	Passive Earth Coefficient (Kp)	Active Earth Coefficient (Ka)	At-Rest Earth Coefficient (Ko)	Frictional Coefficient (x D.L.)	Unit Weight (pcf)	
					Above GWS	Below GWS
on-site silty SAND and SAND	3.0	0.30	0.45	0.5	95	42
Imported Structural Fill	3.5	0.27	0.42	0.7	140	90

GWS: groundwater surface
DL: dead load

NOTES:

1) The passive, active and at-rest earth pressures are determined by multiplying the respective earth coefficient by the unit weight.
2) The allowable passive earth resistance values may be used for structural elements in direct contact with undisturbed material. Where the ground surface adjacent to the resisting element is exposed to the weather, the top 12 inches shall be neglected in calculating the passive earth resistance. This is to allow for soil shrinkage and/or erosion.
3) Lateral resistance and friction may be combined.

4) The above active earth coefficients do not include surcharge loads such as footings located within a 45-degree plane projected upwards from the heel of the footing, sloping ground and/or from hydrostatic pressures. If such conditions occur, the active earth pressures shall be increased accordingly.
5) The active earth pressure coefficient is for unrestrained conditions. Unrestrained walls are defined as walls that are allowed to rotate between 0.005 and 0.01 times the wall height. The rotation of the wall develops the "active earth pressure." If the wall is not allowed to move as in the case of basement walls or walls that are restrained at the top, the soil pressure that will develop is known as an "at-rest" pressure. For restrained walls, the above “at-rest” earth pressures shall be used to design the structure.
6) The active earth pressure coefficient for imported structural fill may be used to design retaining walls where the imported structural fill is placed within a 1H:2V plane projected upward and outward from the heel of the wall footing. Where this cannot be accomplished, the active earth pressure for the on-site soil shall be used to design the wall.
7) Drainage for the retaining wall backfill shall be accomplished by providing 4-inch diameter weepholes spaced 8-feet on-center or by using a minimum 4-inch diameter perforated PVC footing drain pipe. A 2-foot thick layer of crushed gravel (ASTM No. 67), which is wrapped with geotextile filter fabric, shall be placed above the pipe; the crushed gravel shall be continuous from weephole to weephole, or in the case of a footing drain pipe, laid throughout the full length of the pipe. Geotextile fabric shall be MIRAFI 140N or similar.
8) The backfill material for retaining walls shall be properly compacted in accordance with the Site Preparation and Grading section to this report. Also, surface drainage shall be designed to minimize surface water runoff from entering the backfill area. In non-pavement areas, the top 12 inches of backfill material shall be fine-grained, cohesive soil.

7.6 Slab-on-Grade

No expansive type soils were observed on the site or encountered in the explorations. Conventional slab-on-grade construction may be used. However, during construction should expansive CLAY soils be found under slab areas, the expansive CLAY shall be removed and if necessary to achieve finished subgrade elevation, shall be replaced with properly compacted structural fill.

It is recommended that concrete floor slabs that have moisture sensitive floor covering be constructed using a vapor retarder and a capillary moisture barrier of 4-inches of clean gravel cushion material such as #3-fine gravel (ASTM Designation No. 67).

For design of slabs, a modulus of subgrade reaction of 100 pci may be used for the on-site soil or properly compacted structural fill.

Preparation of the subgrade shall be in accordance with the Site Preparation and Grading section to this report.

7.7 Slopes

Cut and fill slopes shall not exceed 2 horizontal to 1 vertical. Exposed slopes shall be covered as soon as practical after construction to minimize erosion.

Fill slopes shall be constructed by either overfilling and cutting back to compacted soil, or the slope shall be track-rolled.

7.8 Site Preparation and Grading

It is recommended that the site be prepared in the following manner:

a) Clearing and Grubbing:
In all areas to receive fill and in structural areas, all vegetation, weeds, brush, roots, stumps, rubbish, debris, soft soil and other deleterious material shall be removed and disposed of off-site.

b) Preparation of Ground to Receive Fill:
The exposed surface shall then be scarified to a depth of 6 inches, moisture conditioned to near optimum moisture (ASTM D1557-00) and then compacted to the degree of compaction specified below. If soft or loose spots are encountered, the loose/soft areas shall be removed to firm material and the resulting depression shall be filled with properly compacted fill.

c) Types of Fill and Backfill Material:
Structural fill and backfill shall be described as material placed beneath buildings and extending a horizontal distance of 3 feet beyond the edge of the building line. Non-structural fill shall be described as material placed beyond 3 feet from the building line.

d) Material Quality:
Fill and backfill material shall consist of soil which is free of organics and debris. The maximum size particle for fill and backfill material shall be as follows:

Structural Fill	
Top 2 feet below finished subgrade (FSG)	3"
Below 2 feet from FSG	6"
Non-structural fill and Pavement areas	
Top 2 feet from FSG	3"
2 to 6 feet from FSG	6"
Below 6 feet from FSG	*

(FSG = Finished Subgrade Elevation)
*Generally minus 12-inch size material is preferred. However, larger rock or boulders (up to 24 inches in diameter) may be used in deep fills provided they are well embedded and geotextile filter fabric is placed over the "boulder" fill. If utility lines are to be installed within fill areas, the maximum particle size shall be reduced to minimize obstruction of trenching work.

Structural fill shall have a Unified Soil Classification of either GW, GM, SW, or SM. The plasticity index of the fine portion as determined by the ASTM D4318-84 test shall be less than 15.

e) Placement of Fill and Backfill:
Each layer of fill and backfill material shall be placed in lifts not exceeding the following (loose thickness):

Structural Fill (including pavement areas)	
Top 2 feet below finished subgrade (FSG)	8"
Below 2 feet from FSG	12"
Non-structural fill	
Top 6 feet from FSG	12"
Below 6 feet from FSG	*

*The loose thickness of this layer shall not exceed 1.5 times the largest size particle; this is predicated upon proper compaction of each lift.

Prior to placing of fill and backfill material, the material shall be aerated or moistened to near optimum moisture content (ASTM D1557-00 test procedure).

Where fill is placed on existing ground that is steeper than 5 horizontal to 1 vertical, the existing ground surface shall be benched into firm soil as the fill is placed.

f) Degree of Compaction:
Each layer of fill and backfill shall be thoroughly compacted from edge to edge using conventional compaction equipment designed for the purpose. The minimum degree of compaction for each layer (as determined by the ASTM D1557-00 test procedure) shall be as follows:

Structural Fill (under and 3 feet beyond the edge of buildings)	95 %
Non-structural fill	*90 %

*Where compaction tests are not practical due to the size of the material, each layer shall be compacted by track rolling until it does not weave or creep under the weight of the track rolling equipment (D-8 dozer or larger).

It is particularly important to see that all fill and backfill soils are properly compacted in order for the design parameters to remain applicable.

g) Preparation of Footing Excavations:
Footing excavations shall be cleaned of loose material and soils disturbed by the excavation prior to placing of steel or pouring of concrete. Any soft soil encountered at the bottom of the footing excavation shall be removed to firm material. The resulting depression shall then be backfilled with properly compacted structural fill.

h) Site Drainage:
During construction, drainage shall be provided to minimize ponding of water adjacent to or on foundation and pavement areas. Ponded areas shall be drained immediately. Any subgrade soil that has become soft due to ponding shall be removed to firm material and replaced with compacted structural fill.

8.0 INSPECTION

During the progress of construction, so as to evaluate compliance with the design concepts, specifications and recommendations contained in this report, qualified engineering personnel should be present to observe the following operations:

a) Site preparation.
b) Placement of fill and backfill.
c) Footing excavations.

9.0 REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the test boring locations. If conditions are encountered during construction which appear to differ from those disclosed by the explorations, this office shall be notified so as to consider the need for modifications.

This report has been prepared for the exclusive use of Mr. Mark Button and his respective design consultants. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed relative to possible changed conditions.

Samples obtained in this investigation will deteriorate with time and will be unsuitable for further laboratory tests within one (1) month from the date of this report. Unless otherwise advised, the samples will be discarded at that time.

The following are included and complete this report:

Vicinity Map
Plot Plan
Log of Test Borings
Results of Laboratory Tests

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary for the project. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization. No other warranty is either expressed or given.

Respectfully submitted,

SHINSATO ENGINEERING, INC.

Lawrence S Shinsato

Lawrence S. Shinsato, P.E.
President

No. 4169-C

LSS:ks

This work was prepared by me
or under my supervision.
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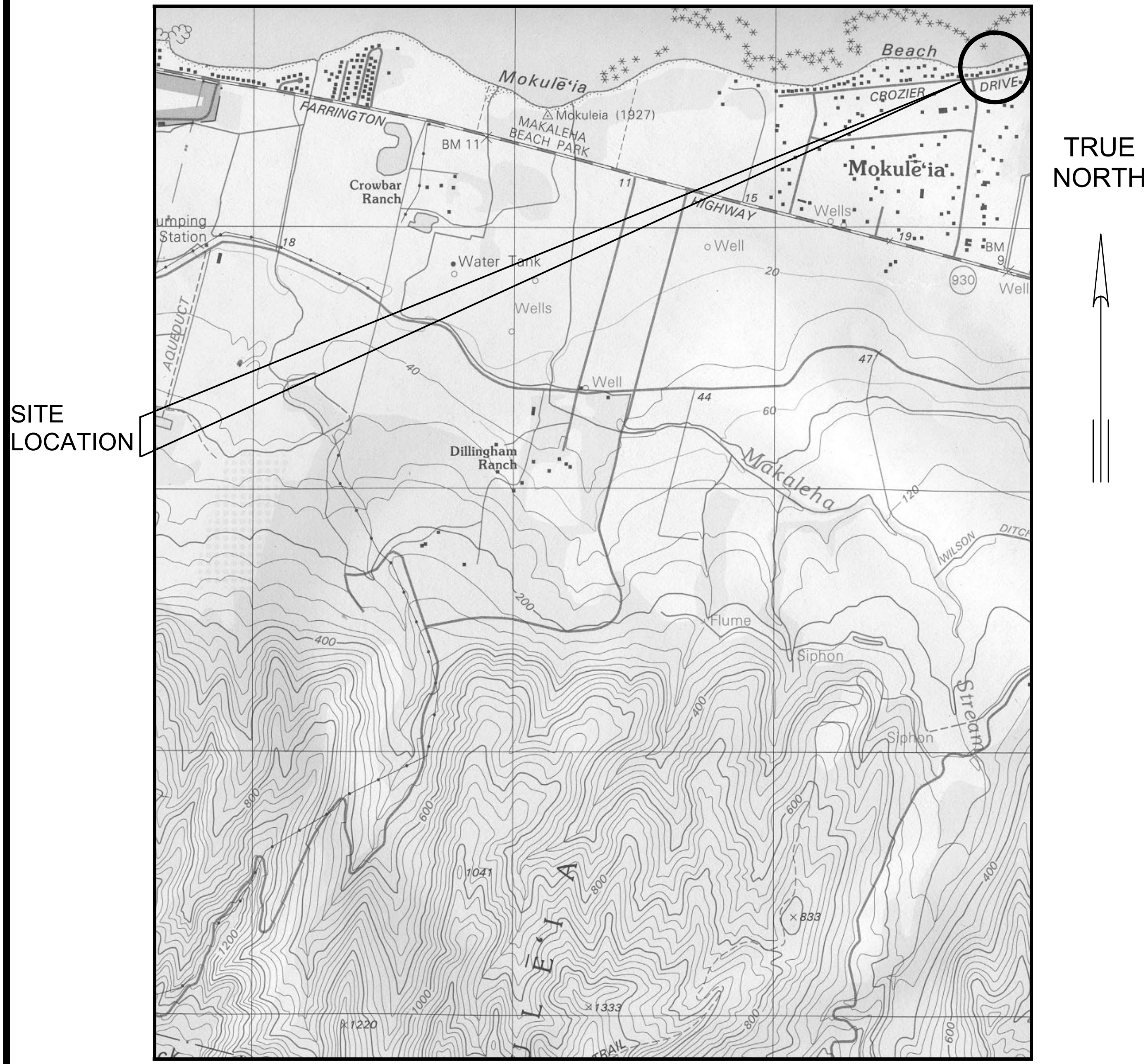
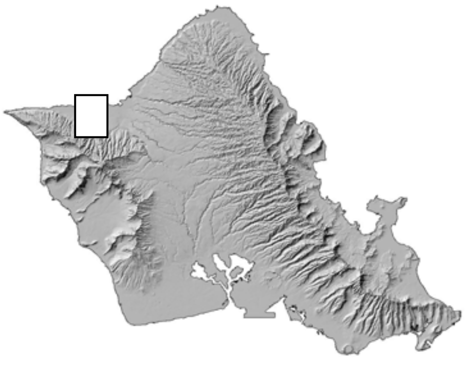
VICINITY MAP



REFERENCE:
USGS TOPOGRAPHIC MAP
KAENA QUADRANGLE
DATED 1998
SCALE: 1"=2000'



Project:	PROPOSED SEAWALL 68-505 CROZIER DRIVE
Project No.:	15-0120

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PLATE
1

LEGEND:

⌖ BORING LOCATION

PLOT PLAN
SCALE: 1" = 30'

0 15' 30' 60'

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PLATE
2

LOG OF BORING NO. 1

DRILLING METHOD: **Badger Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **Unknown**
DEPTH OF BORING (FT.): **16.5**
DEPTH TO GROUNDWATER (FT.): **Unknown**
DATE DRILLED: **August 18, 2015**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**SM**	silty SAND;			brown tan	moist	loose				
										11.7		
2					11					2.0		
4					12				106.5	11.0		
		SP	SAND;			tan						
6					9					5.2		
8												
10			--coarse grain					medium dense				
12					19					22.8		
14												
			--moderately cemented					dense				
16					34					24.2		
			END OF BORING									
18												
20												
22												
24												
26												
28												
30												

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PLATE
3

LOG OF BORING NO. 2

DRILLING METHOD: **Badger Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **Unknown**
DEPTH OF BORING (FT.): **20.583**
DEPTH TO GROUNDWATER (FT.): **Unknown**
DATE DRILLED: **August 18, 2015**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**SM**	silty SAND; with roots			brown tan	moist	loose				
2				■	13				75.1	14.8		
4				■	14					4.5		
		SP	SAND; trace roots			tan						
6				■	13					8.0		
			--probe at 6.5'		16			medium dense				
8					18							
					19							
10					18							
					19							
12					23							
					34			dense				
14					29			medium dense				
					21							
16					19							
					17							
18					14							
					14							
20					38			dense				
			END OF BORING		15/1"			very dense				
22												
24												
26												
28												
30												

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PLATE
4

LOG OF BORING NO. 3

DRILLING METHOD: **Badger Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **Unknown**
DEPTH OF BORING (FT.): **15**
DEPTH TO GROUNDWATER (FT.): **Unknown**
DATE DRILLED: **August 18, 2015**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**SM**	silty SAND; some gravel			brown tan	moist	loose				
				■						5.2		
2					16							
		SP	SAND; some fines			tan						
4				■	12					5.3		
6				■	9					8.1		
			--probe at 6.5'		9							
8					12			medium dense				
					15							
10					14							
					25							
12					31			dense				
					26			medium dense				
14					27							
					16/6"			dense				
			END OF BORING									
16												
18												
20												
22												
24												
26												
28												
30												

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PLATE
5

LOG OF BORING NO. 4

DRILLING METHOD: **Badger Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **Unknown**
DEPTH OF BORING (FT.): **11.5**
DEPTH TO GROUNDWATER (FT.): **Unknown**
DATE DRILLED: **August 18, 2015**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**SM**	silty SAND;			brown tan	moist	medium dense				
2				■	28				74.9	5.1		
		SP	SAND;			tan						
4				■	17				80.6	6.9		
								loose				
6				■	9					7.5		
8												
10								medium dense				
				■	27					16.9		
12			END OF BORING									
14												
16												
18												
20												
22												
24												
26												
28												
30												

Project: PROPOSED SEAWALL
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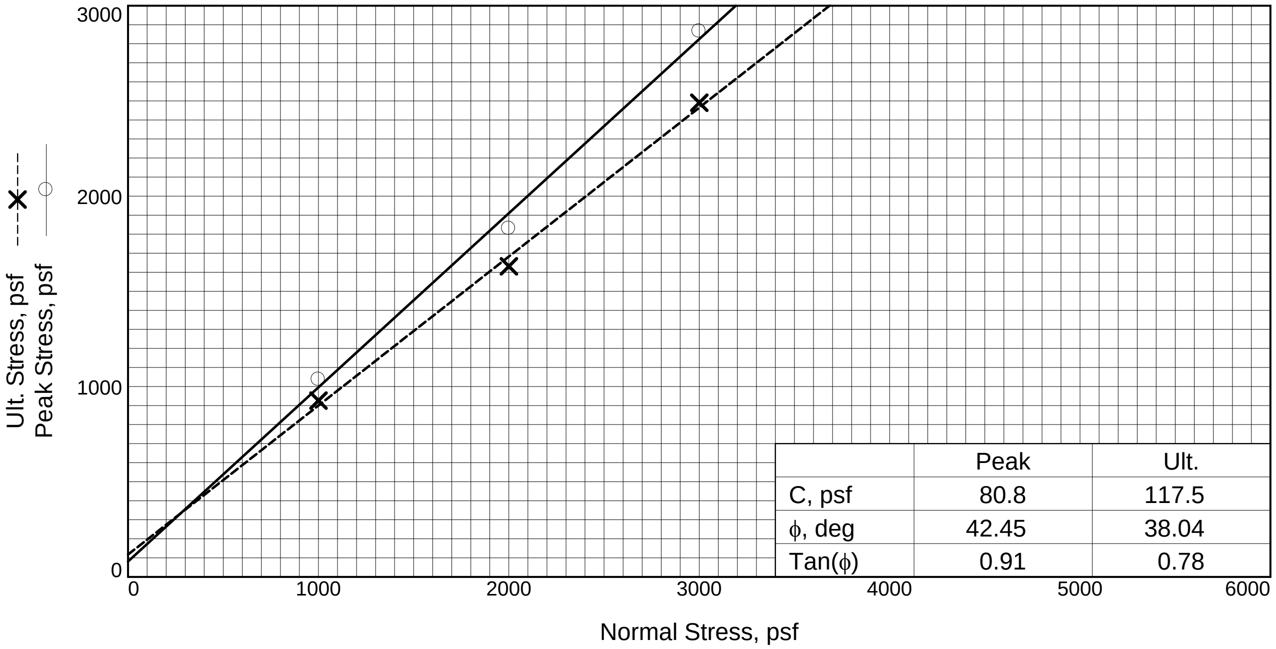
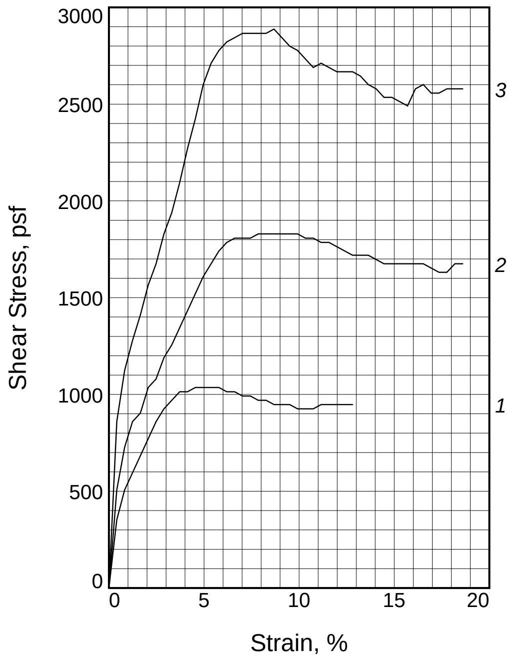
98-747 KUAHAO PL. #E, PEARL CITY, HI 96782

PLATE
6



	Peak	Ult.
C, psf	80.8	117.5
ϕ, deg	42.45	38.04
Tan(ϕ)	0.91	0.78



	Sample No.	1	2	3
Initial	Water Content, %	N/A	N/A	N/A
	Dry Density, pcf	N/A	N/A	N/A
	Saturation, %	N/A	N/A	N/A
	Void Ratio	N/A	N/A	N/A
	Diameter, in.	2.420	2.420	2.420
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	N/A	N/A	N/A
	Dry Density, pcf			
	Saturation, %			
	Void Ratio			
	Diameter, in.			
	Height, in.			
	Normal Stress, psf	1000.0	2000.0	3000.0
	Peak Stress, psf	1035.9	1829.3	2865.2
	Strain, %	4.5	7.9	7.0
	Ult. Stress, psf	925.7	1631.0	2490.5
	Strain, %	10.3	17.4	15.7
	Strain rate, in./min.	N/A	N/A	N/A

Sample Type: SP

Description: SAND

Specific Gravity=

Remarks:

Figure 7

Client:

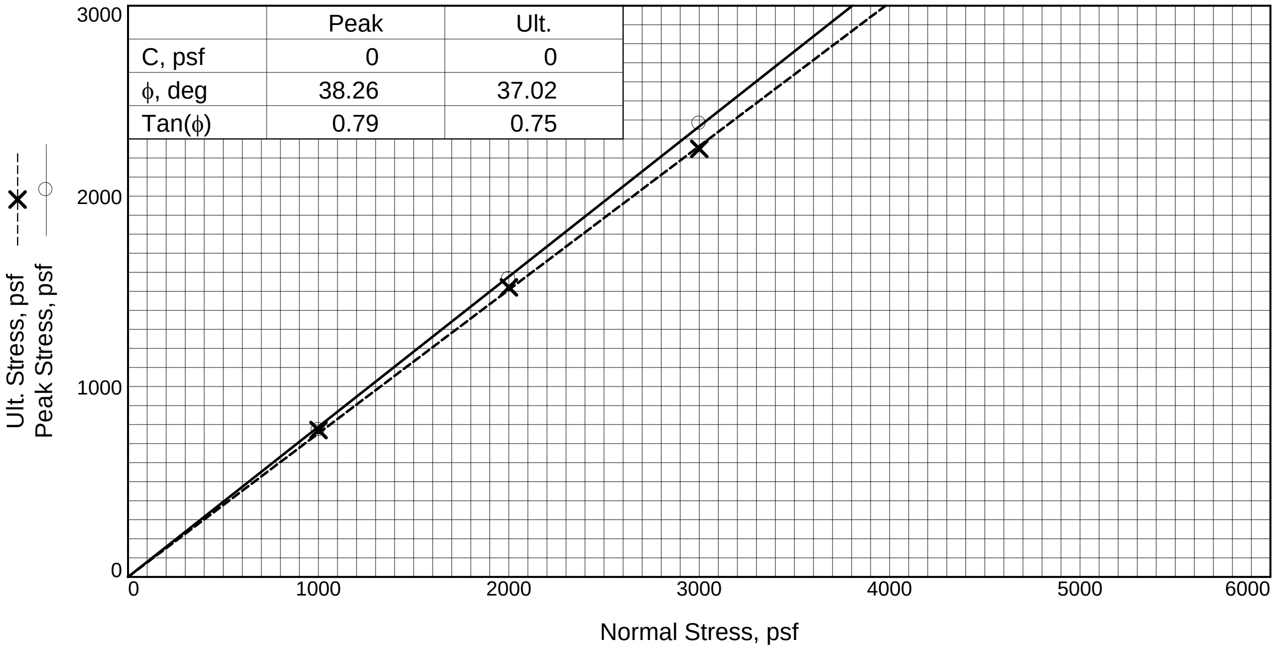
Project: PROPOSED SEAWALL
68-505 CROZIER DRIVE

Source of Sample: 1 **Depth:** 11.5

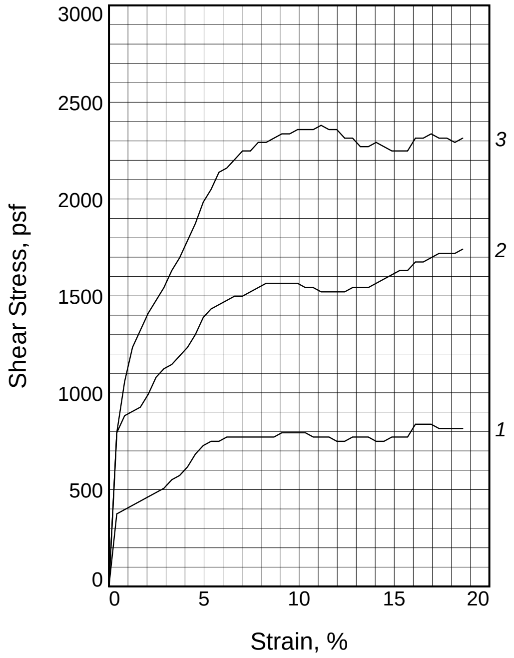
Sample Number: 5

Proj. No.: 15-0120 **Date Sampled:**

DIRECT SHEAR TEST REPORT
SHINSATO ENGINEERING, INC.
Pearl City, HI



	Peak	Ult.
C, psf	0	0
ϕ, deg	38.26	37.02
Tan(ϕ)	0.79	0.75



	Sample No.	1	2	3
Initial	Water Content, %	N/A	N/A	N/A
	Dry Density, pcf	N/A	N/A	N/A
	Saturation, %	N/A	N/A	N/A
	Void Ratio	N/A	N/A	N/A
	Diameter, in.	2.420	2.420	2.420
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	N/A	N/A	N/A
	Dry Density, pcf			
	Saturation, %			
	Void Ratio			
	Diameter, in.			
	Height, in.			
	Normal Stress, psf	1000.0	2000.0	3000.0
	Peak Stress, psf	771.4	1564.9	2380.3
	Strain, %	6.2	8.3	11.2
	Ult. Stress, psf	771.4	1520.8	2248.1
	Strain, %	6.2	11.2	14.9
	Strain rate, in./min.	N/A	N/A	N/A

Sample Type: SP

Description: SAND

Specific Gravity=

Remarks:

Figure 8

Client:

Project: PROPOSED SEAWALL
68-505 CROZIER DRIVE

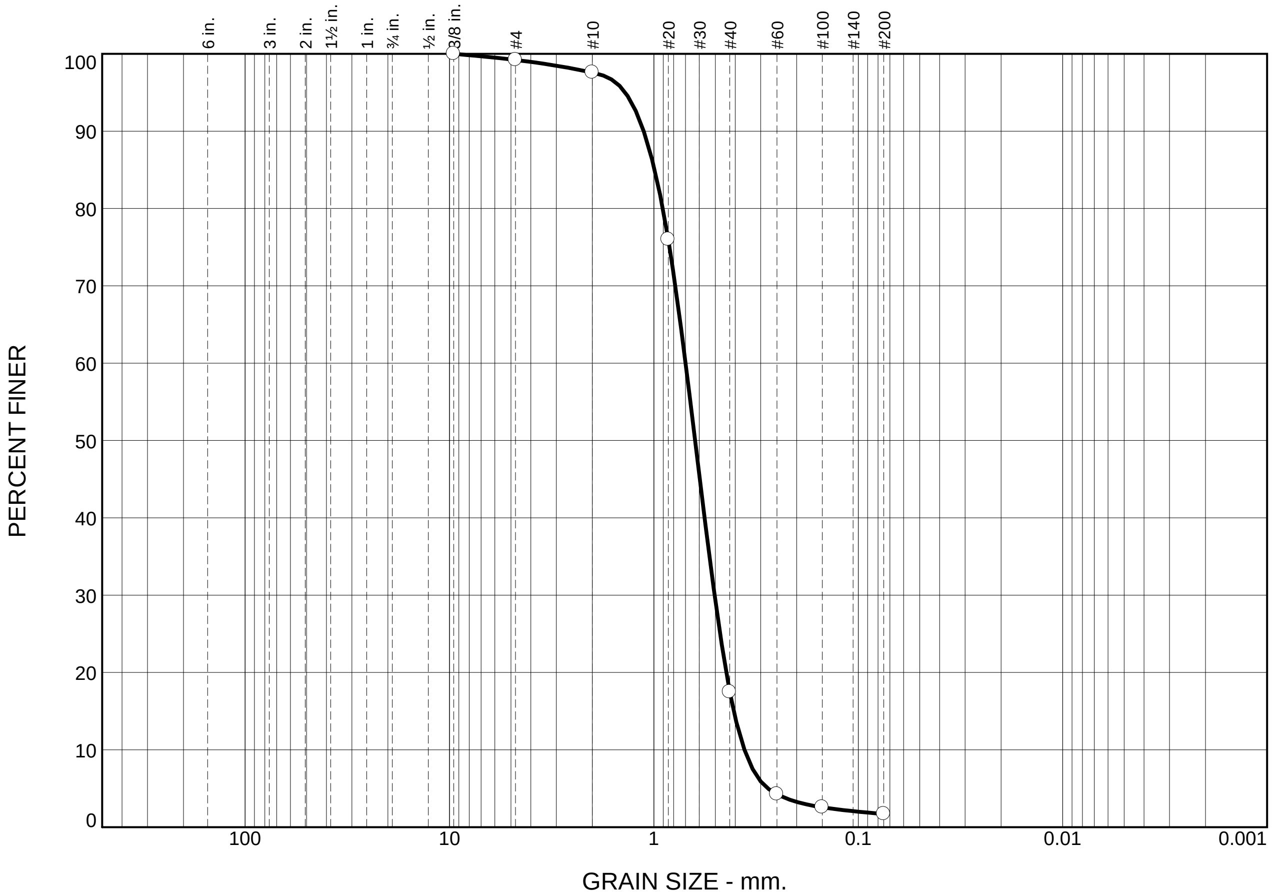
Source of Sample: 3 **Depth:** 4

Sample Number: 2

Proj. No.: 15-0120 **Date Sampled:**

DIRECT SHEAR TEST REPORT
SHINSATO ENGINEERING, INC.
Pearl City, HI

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	1	1	81	15	2	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	4	2	4	SAND	SP

SHINSATO ENGINEERING, INC.

Pearl City, HI

Client:

Project: PROPOSED SEAWALL
68-505 CROZIER DRIVE

Project No.: 15-0120 **Figure** 9

Appendix E

Shoreline Certification Maps

TMK: 6-8-004:018
68-505 Crozier Dr.
Waialua, Oahu, Hawaii 96791

TMK: 6-8-004:031
68-511 Crozier Dr.
Waialua, Oahu, Hawaii 96791

ACCEPTING AUTHORITY:

City and County of Honolulu
Department of Planning and Permitting

PREPARED BY:

Gundaker Works, LLC

February 2018

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE
MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 24, 2016

File No.: OA-1712

Leaps & Boundaries, Inc.
2016 Waterhouse Street, Suite 101
Honolulu, Hawaii 96819

Dear Applicant:

Subject: Transmittal of Signed Shoreline Certification Maps
Owner(s): Mark & Diane Button
Tax Map Key: (1) 6-8-004:018

Enclosed please find three (3) copies of the certified shoreline survey maps for the subject property.

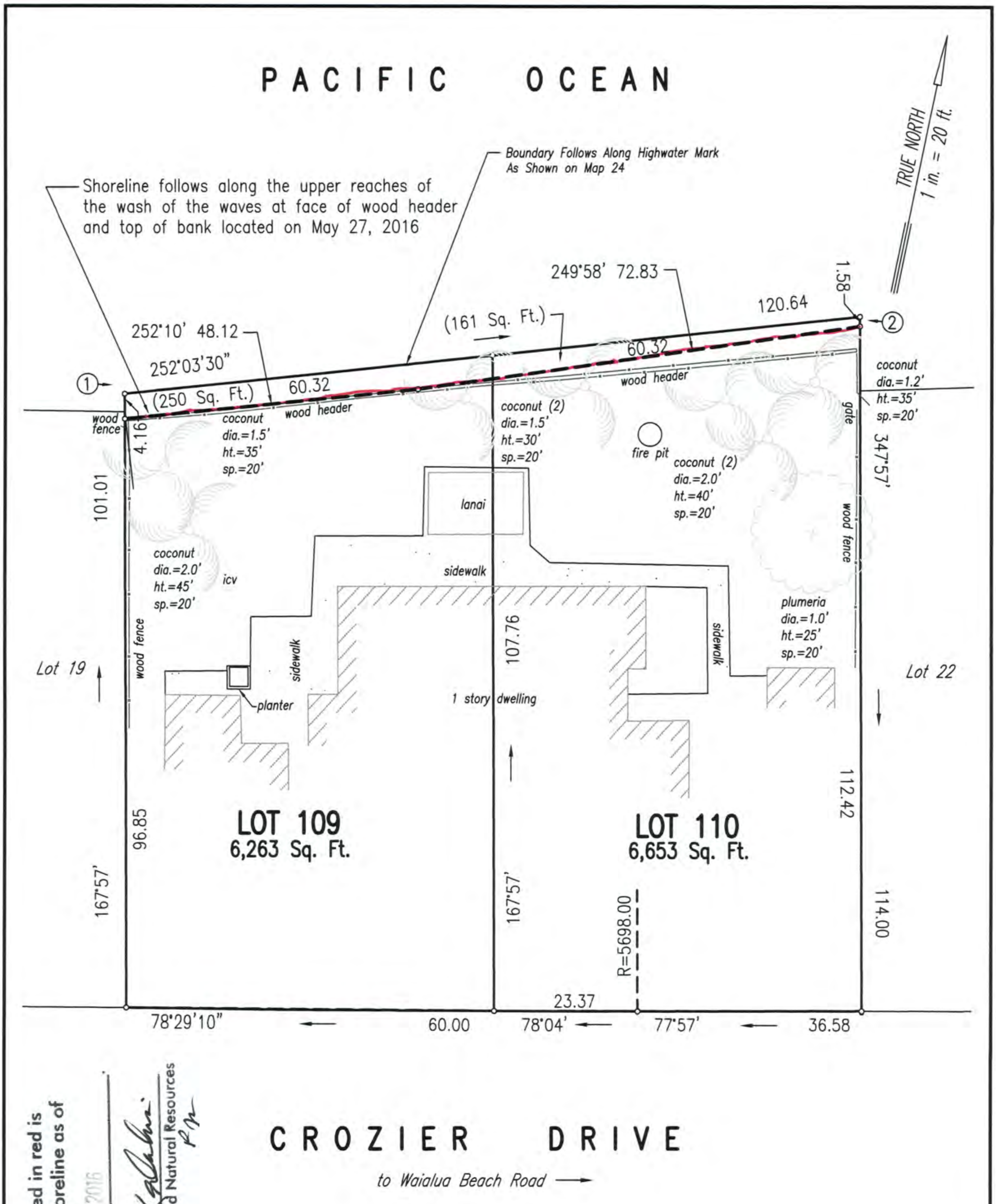
If you have any questions, please feel free to call us at (808) 587-0420. Thank you.

Sincerely,

Ian Hirokawa
Special Projects Coordinator

Enclosures

cc: DAGS



The shoreline as delineated in red is hereby certified as the shoreline as of OCT 2 0 2016

Chairperson, Board of Land and Natural Resources

SHORELINE SURVEY
LOTS 109 & 110 (Map 24)
Land Court Application 609

At Mokuleia, Waialua, Oahu, Hawaii
Date: May 27, 2016
Tax Map Key (1) 6-8-004: 018
Scale: 1 in. = 20 ft.

ARDEN J. TORCUATO
LICENSED PROFESSIONAL LAND SURVEYOR No. 10257
HAWAII, U.S.A.

This map was prepared by me or under my direct supervision

A. J. Torcuato

LICENSED PROFESSIONAL LAND SURVEYOR
CERTIFICATE NUMBER 10257
Exp. 4/30/2018

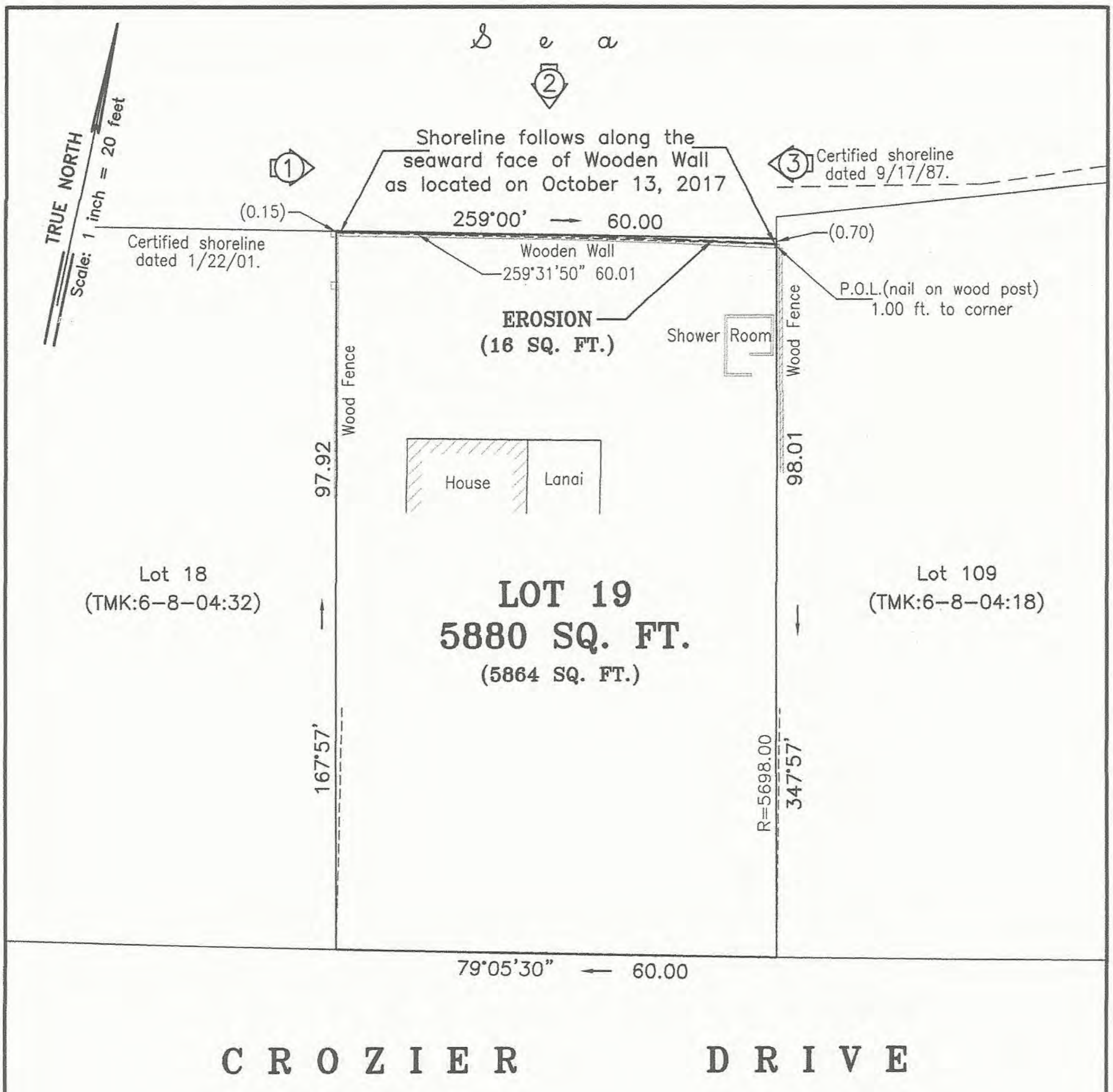
Owner: Button

Note: ③→ Picture Number & Direction

68-505 Crozier Drive, Waialua
F.B. 75:46

LEAPS & BOUNDARIES, INC.
2016 WATERHOUSE ST., STE. 101 PH. (808) 484-5701
HONOLULU, HI 96819 FAX (888) 542-2097

8 ½" x 14"



JAIME F. ALIMBOYOGUEN
LICENSED PROFESSIONAL LAND SURVEYOR
No. 8216

SHORELINE SURVEY MAP
LOT 19
as shown on Map 1
of Land Court Application 609

Waialua, Oahu, Hawaii
Tax Map Key: 6-8-04:31
Scale: 1 inch = 20 feet
Date: October 16, 2017

This work was prepared by me
or under my direct supervision.

NOTES:
1. Only improvements shown were located.
2. [◇] Denotes number and direction of photographs.

Owner: Heidi Snow Trust
Address: 68-511 Crozier Drive,
Waialua, Hawaii 96791