



GIS Applications in Regional Sediment Management Southeast O'ahu

DISDI 2006 Pacific Workshop
Honolulu, HI
28 February 2006



Topics



- 1) Overview of the Corps of Engineers Southeast O'ahu Regional Sediment Management (SEORSM) initiative
- 2) SEORSM geospatial data storage and structure
- 3) The use of geospatial data in SEORSM modeling
- 4) SEORSM's web-based GIS interface



Southeast O'ahu Regional Sediment Management Overview



GIS Rocks!



RSM Overview

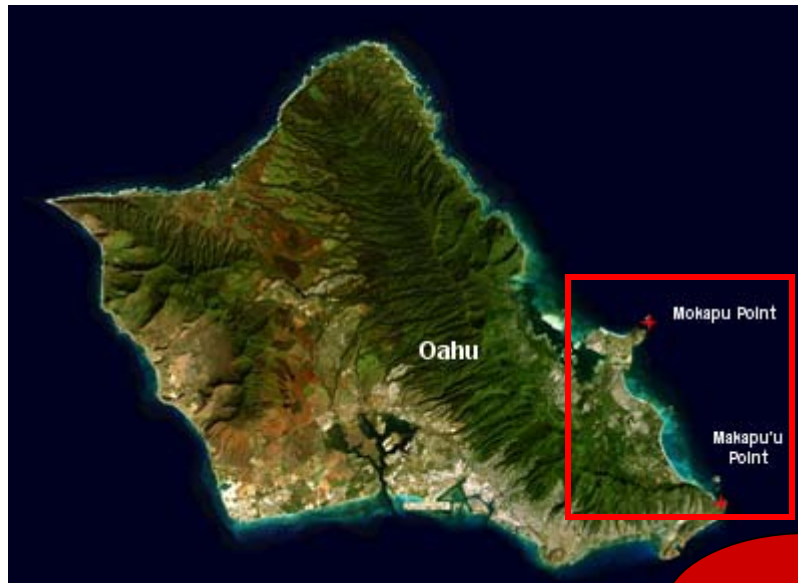


Managing sediment to benefit a region potentially saves money, allows use of natural processes to solve engineering problems, and improves the environment. As a management method, RSM

- Includes the entire environment, from the watershed to the sea;
- Accounts for the effect of human activities on sediment erosion as well as its transport in streams, lakes, bays, and oceans; and
- Protects and enhances the nation's natural resources while balancing national security and economic needs.



Southeast O'ahu RSM Study Area



- 2 distinct headlands
- 12 miles of shoreline



RSM Potential Demonstration Projects



- The success of RSM in Hawaii depends upon demonstration projects.
- Demonstration projects allow the U.S. Army Corps of Engineers and the Department of Land & Natural Resources to understand sediment management in a regional setting.
- Sand transport from “mauka” to “makai”



Potential Demonstration Projects



- 1) Kaupo & Kaiona Beaches
- 2) Bellows Air Force Station
- 3) Lanikai Beach
- 4) Ka'elepulu Stream



1) Kaupo & Kaiona Beaches

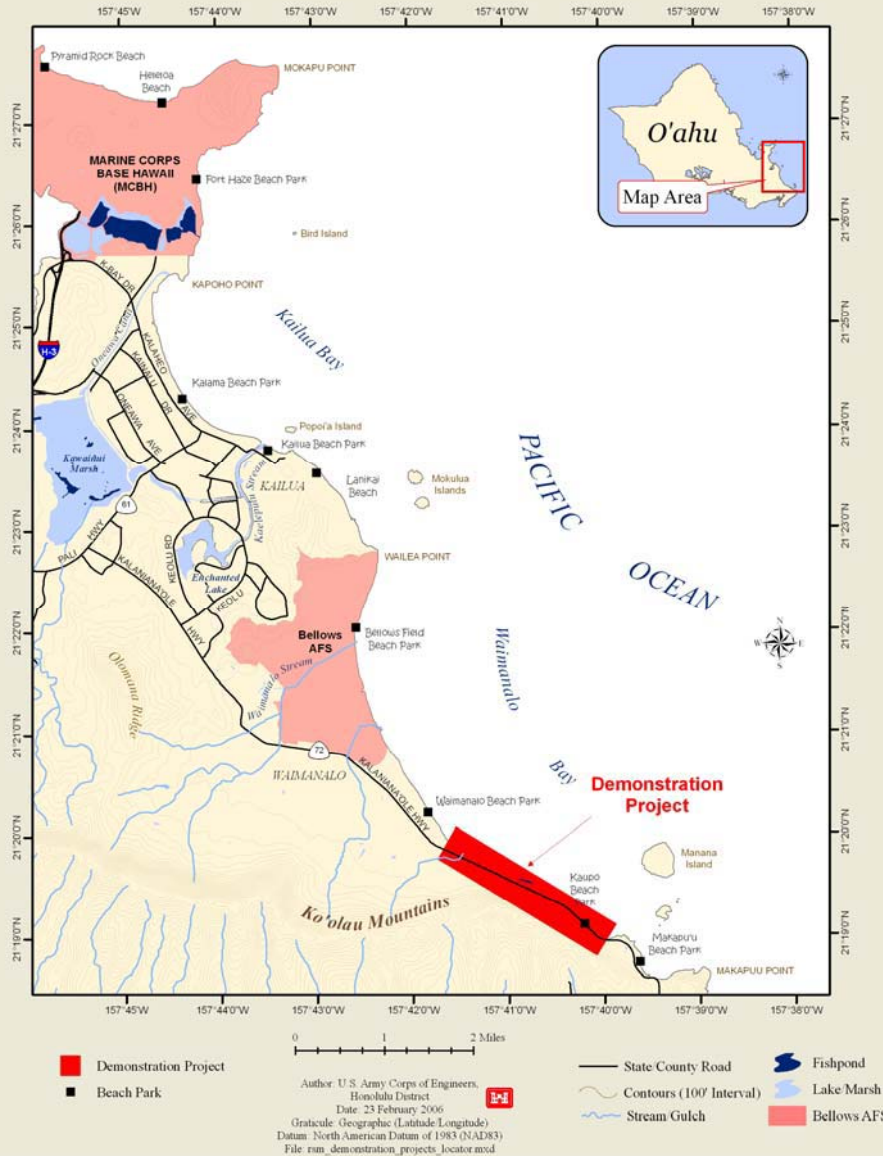


Problem Statement:

- Erosion is threatening Kalanianaʻole Highway along Kaupo and Kaiona beaches.
- The beaches are narrow with unstable backshore slopes.
- Erosion is undermining the highway in a number of locations.



SOUTHEAST OAHU REGIONAL SEDIMENT MANAGEMENT
KAUPO & KAIONA BEACHES DEMONSTRATION PROJECT



Kaupo & Kaiona Beach Location



Road erosion at Kaupo Beach



Undermining at Kaiona Beach



2) Bellows Air Force Station



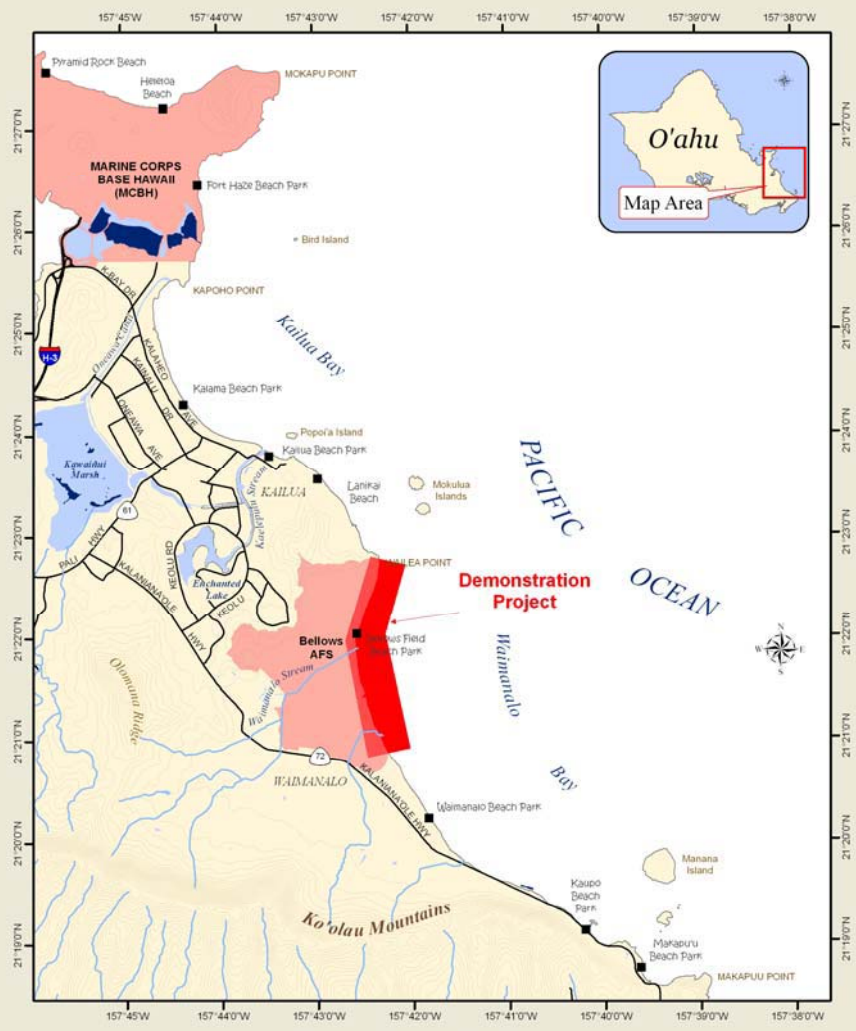
Problem Statement:

- Erosion is threatening the vacation cottages.
- The existing coastal armoring is tying up the sand supply for the littoral zone.

SOUTHEAST OAHU REGIONAL SEDIMENT MANAGEMENT BELLOWS AIR FORCE STATION DEMONSTRATION PROJECT



Bellows Air Force Station Location

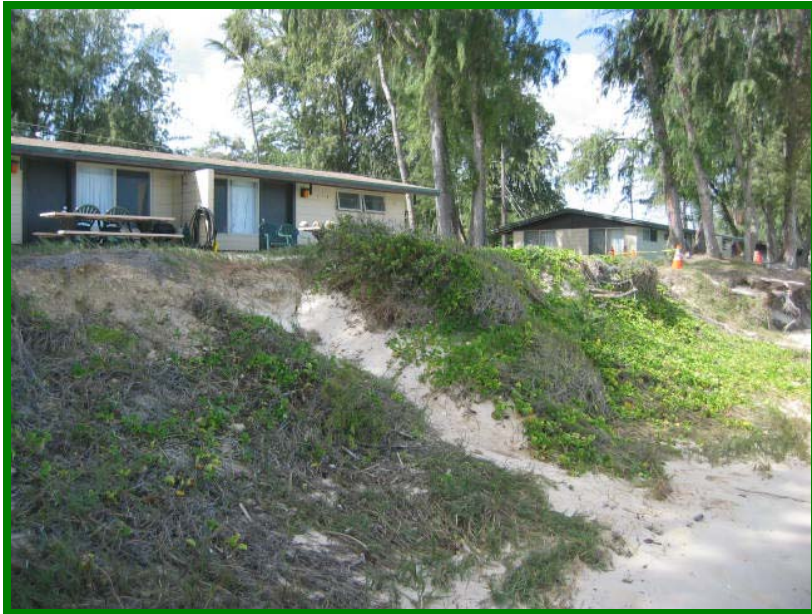


- Demonstration Project
- Beach Park
- State County Road
- Contours (100' Interval)
- Stream Gulch
- Fishpond
- Lake Marsh
- Bellows AFS

Author: U.S. Army Corps of Engineers,
Hawaii District
Date: 23 February 2006
Graticule: Geographic (Latitude-Longitude)
Datum: North American Datum of 1983 (NAD83)
File: run_demonstration_projects_locator.mxd



Bellows Air Force Station



Erosion threatening cottages

Existing armoring



GIS Rocks!



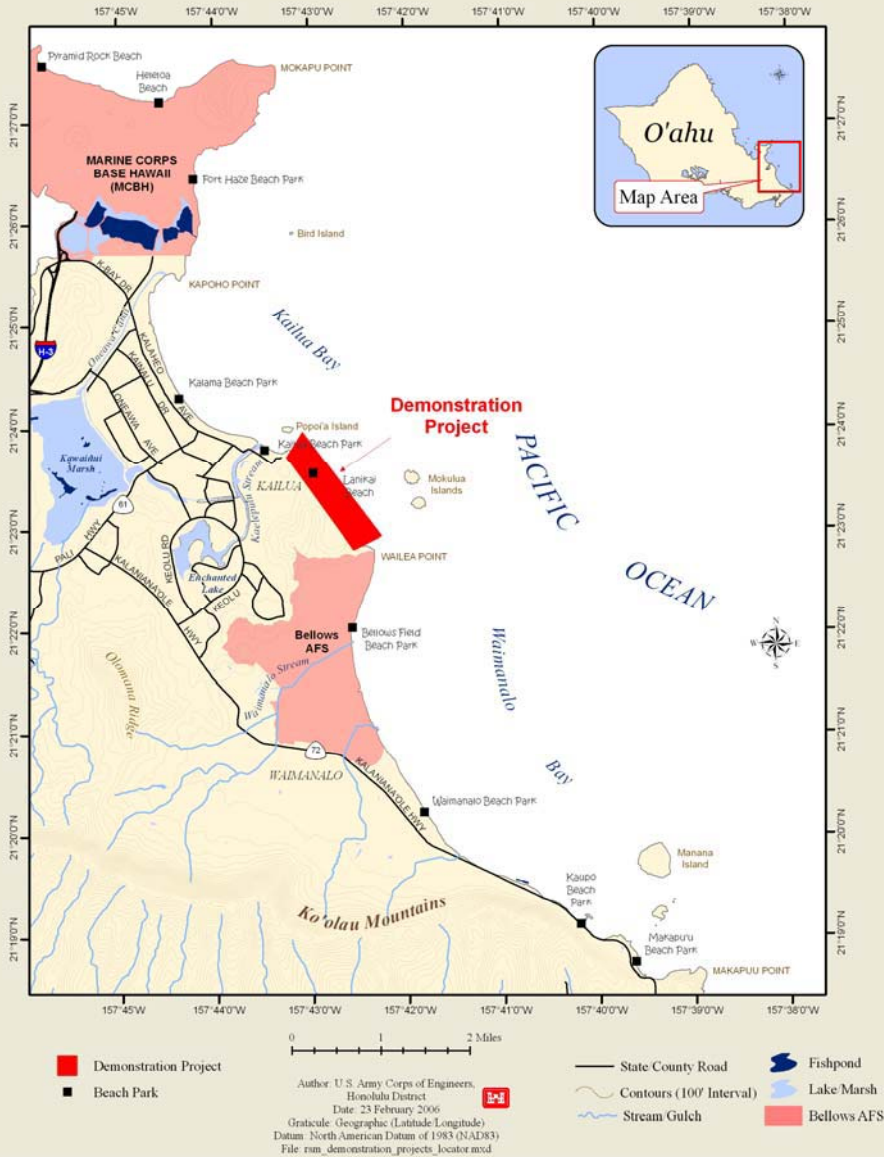
Lanikai Beach



Problem Statement:

- There is no dry beach along the southern portion of the Lanikai shoreline.
- The majority of the Lanikai shoreline has been hardened.

SOUTHEAST OAHU REGIONAL SEDIMENT MANAGEMENT
LANIKAI DEMONSTRATION PROJECT



Lanikai Beach Location



Lanikai Beach
Looking North



Lanikai Beach
Looking South



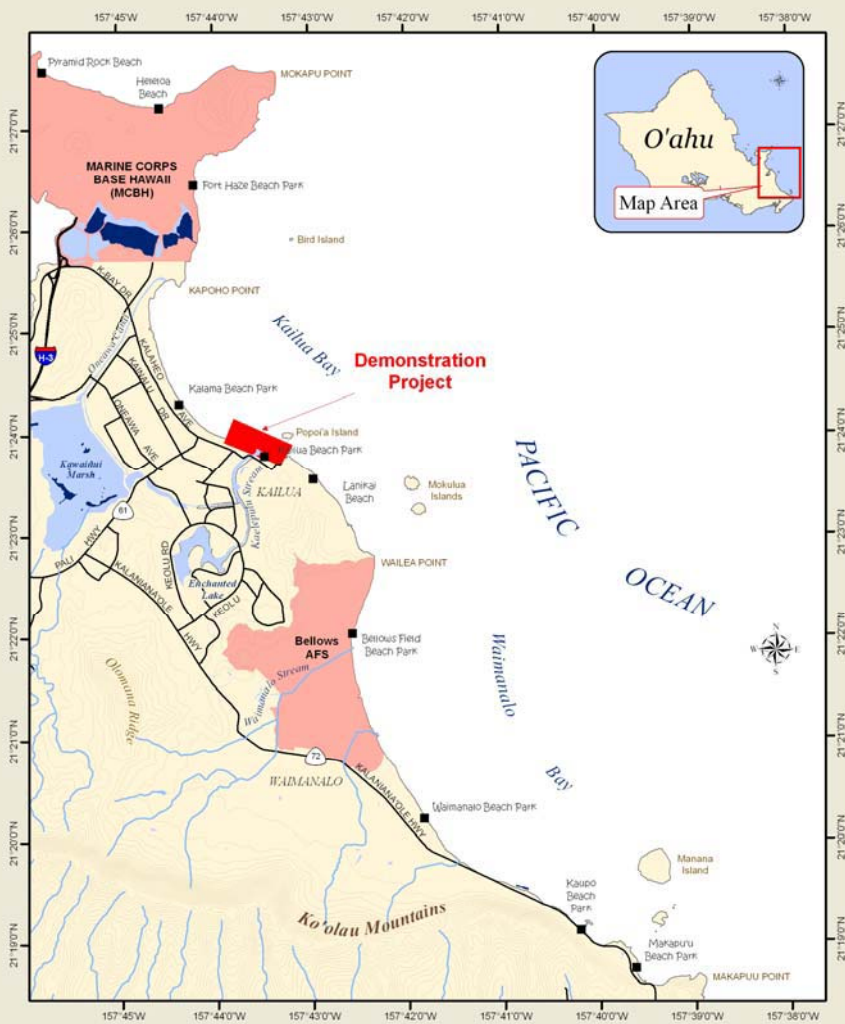
Ka'elepulu Stream



Problem Statement:

- Sand is being removed from littoral system through maintenance of the stream mouth.
- Sand is being stockpiled along the stream banks.
- A portion of the sand is blown inland by the trade winds & lost to littoral system.

SOUTHEAST OAHU REGIONAL SEDIMENT MANAGEMENT
KA'ELEPULU STREAM DEMONSTRATION PROJECT



- Demonstration Project
- Beach Park
- State County Road
- Contours (100' Interval)
- Stream Gulch
- Fishpond
- Lake Marsh
- Bellows AFS

Author: U.S. Army Corps of Engineers,
Honolulu District
Date: 23 February 2006
Graticule: Geographic (Latitude Longitude)
Datum: North American Datum of 1983 (NAD83)
File: run_demonstration_projects_locator.mxd

Ka'elepulu Stream Location



Ka'elepulu Stream looking inland



Ka'elepulu Stream looking towards
ocean



SEORSM

Geospatial Data Storage & Structure



GIS Rocks!

GIS & RSM



- RSM GIS is a “decision” tool that uses geospatial information to analyze all regional sediment management processes from makua (mountains) to makai (ocean).
- It is the primary platform for all stakeholders to interactively participate in this project and learn about regional sediment management and change in Hawaii.



Geospatial Data Standards



Data being derived and stored in the SEORSM follows certain standards, such as:

- Spatial Data Standards for Facilities, Infrastructure, & Environment (SDSFIE)
- Federal Geographic Data Committee (FGDC) metadata
- USACE's eCoastal standards
- Marine Data Model



Geospatial Standards according to SDSFIE





Geospatial Standards according to FGDC

Contents | Preview | Metadata

shoreline

Personal GeoDatabase Feature Class

Description

Spatial

Attributes

Keywords

Theme: beach, shoreline, hydrography, sand, sediment, status

Place: O'ahu, Kailua, Waimanalo, Lanikai, MCBH, Marine Corps Base Hawaii, Bellows AFS

Stratum: RSM, Regional Sediment Management, Tom Smith

Temporal: 2005

Description

Abstract

This file contains the shoreline from Mokapu Point to Mokapu'u Point on O'ahu. The file was collected between 19-30 September 2005 for the Regional Sediment Management (RSM) shoreline inventory. The file was walked for the most part at the wet/dry line, with exceptions deemed necessary by USACE Coastal Engineers.

Purpose

The file was created for EC-T's Regional Sediment Management (RSM) Demonstration Project.

Supplementary Information

The file was collected with a Trimble GeoXT GPS Receiver. Gaps in the shoreline are present because no shoreline exists and has been replaced with floodwalls and/or revetments. These gaps can be found in the respective floodwall and/or revetment files.



RSM GIS Data Layers

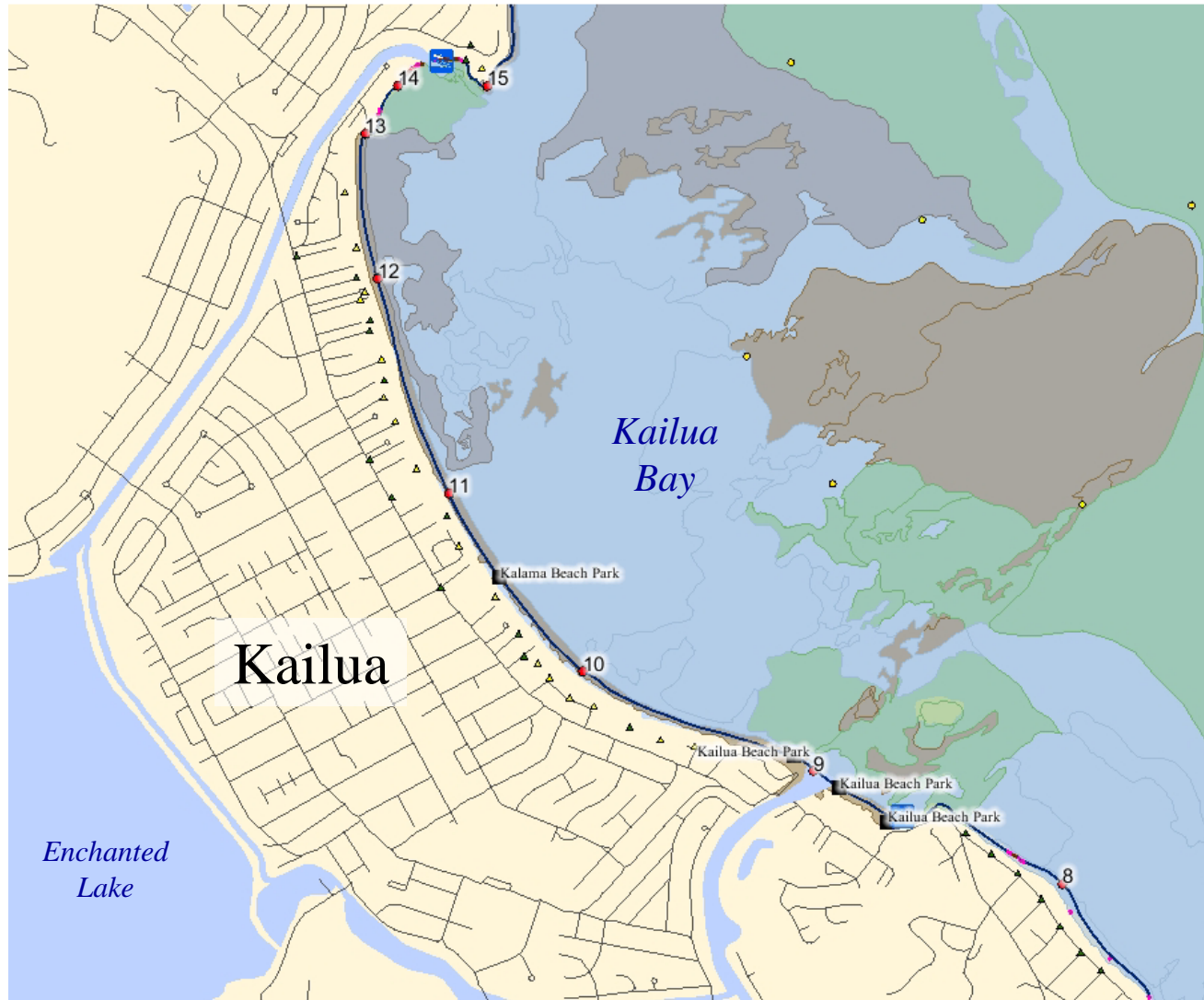


Layers will include:

- satellite imagery
- land parcels
- watershed boundaries
- roads
- shoreline profiles
- coastal habitat & reefs
- sediment deposit information
- hydrography
- historical shoreline change
- soil types
- wetlands
- shoreline structures
- revetments
- bathymetry
- wave gages
- nautical charts
- and much more!

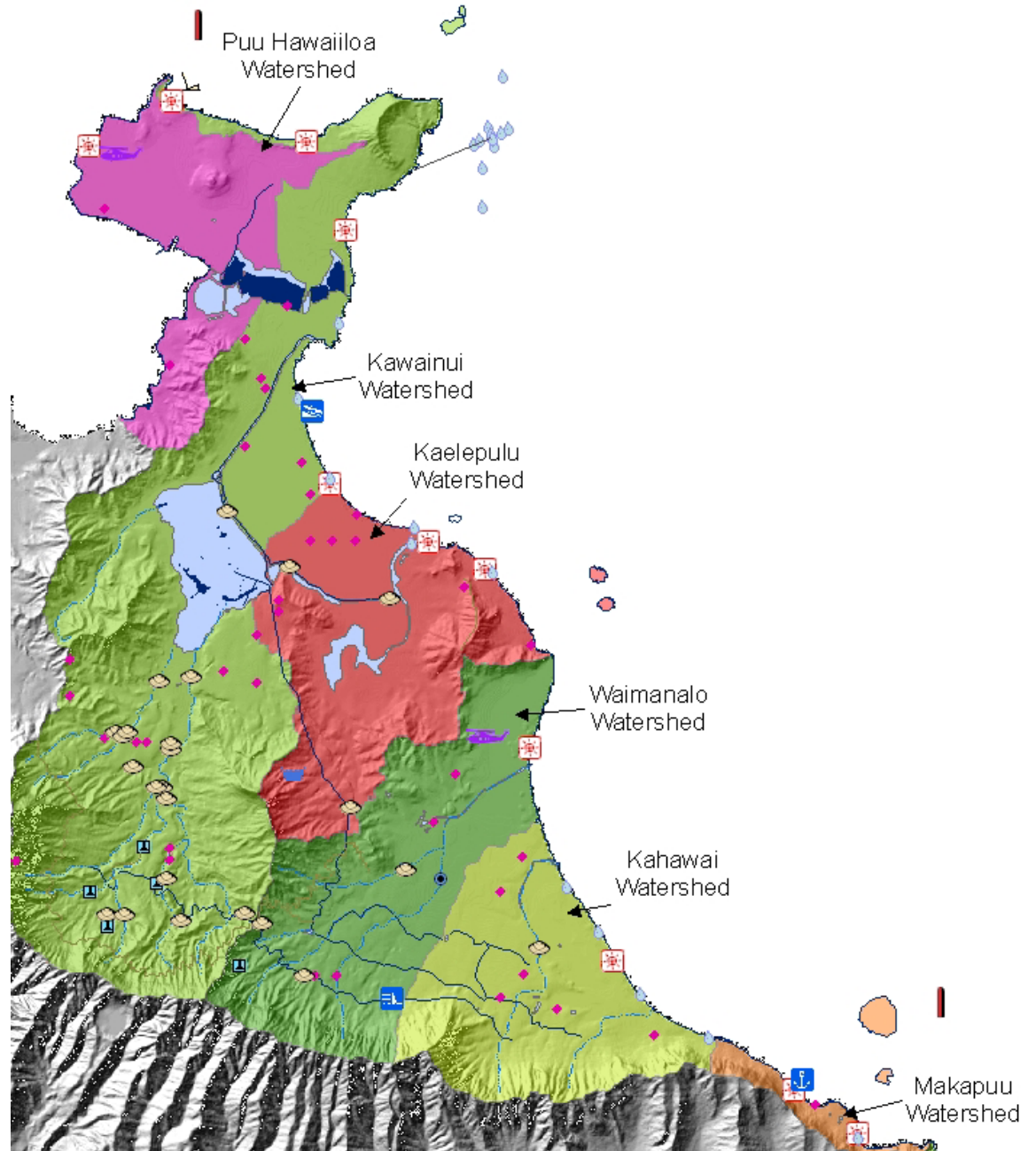


Example of RSM Geospatial Data Layers





Example of RSM Geospatial Data Layers





Example of RSM Geospatial Data Layers



	Reach	Type	Status	
▶	27	Rocky/Sand/Coral/Bas	Non-critical	Marine Corps Base Hawaii
	28	Basalt/Coral	Potentially Critical	Marine Corps Base Hawaii
	28	Basalt/Coral	Non-critical	Marine Corps Base Hawaii
	21	Sandy Beach	Potentially Critical	
	21	Sandy Beach	Non-critical	
	21	Sandy Beach	Potentially Critical	
	22	Sandy Beach	Critical	
	23	Sandy Beach	Non-critical	
	22	Basalt Boulder	Non-critical	
	14	Cemented Dune	Potentially Critical	sea wall, 435
	14	Sandy Beach	Potentially Critical	beach rock present
	14	Sandy Beach	Non-critical	
	14	Sandy Beach	Potentially Critical	
	16	Sandy Beach	Non-critical	
	16	Sandy Beach	Critical	
	17	Dumped Rocks	Critical	dumped rocks
	17	Dumped Rocks	Potentially Critical	dumped rocks
	18	Sandy Beach	Potentially Critical	
	18	Sandy Beach	Non-critical	
	18	Sandy Beach	Potentially Critical	
	01	Sandy Beach	Non-critical	
	04	Sandy Beach	Non-critical	
	06	Basalt/Sand	Non-critical	
	07	Sandy Beach	Potentially Critical	Cockroach Bay
	07	Sandy Beach	Critical	
	09	Sandy Beach	Non-critical	Makai Pier
	10	Cemented Dune	Non-critical	coarse sand present
	11	Basalt/Sand	Potentially Critical	dumped rock being used as erosion protection

GIS Rocks!



The Use of Geospatial Technology in SEORSM Modeling



GIS Rocks!



Modeling Status

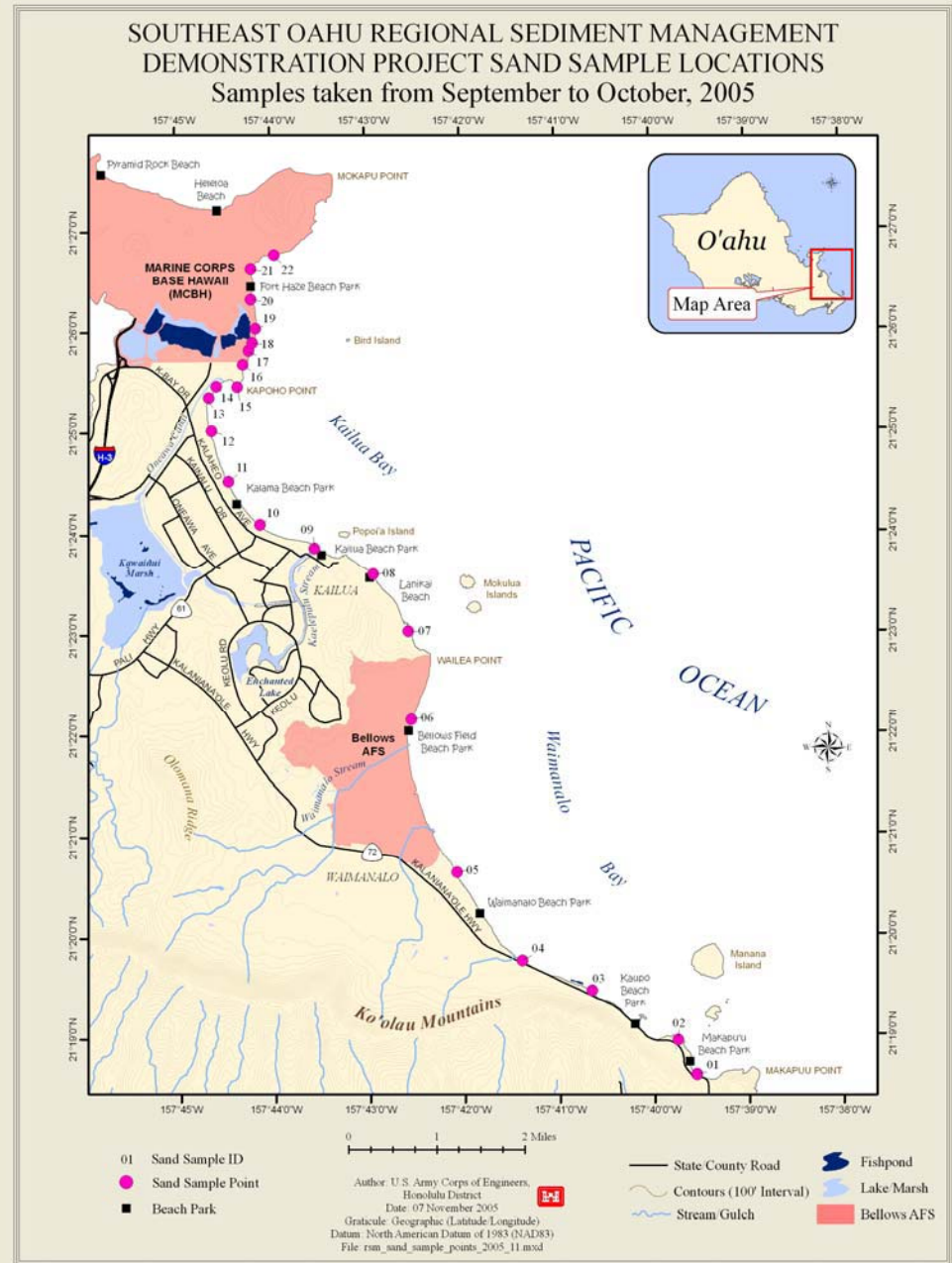


- This is an on-going portion of the project.
- Now that we have the geospatial data, we are running coastal and hydrographic models to determine:
 - sand transport, thickness, composition, etc
 - wave heights, direction, & refraction
 - inland water runoff
 - historical shoreline change



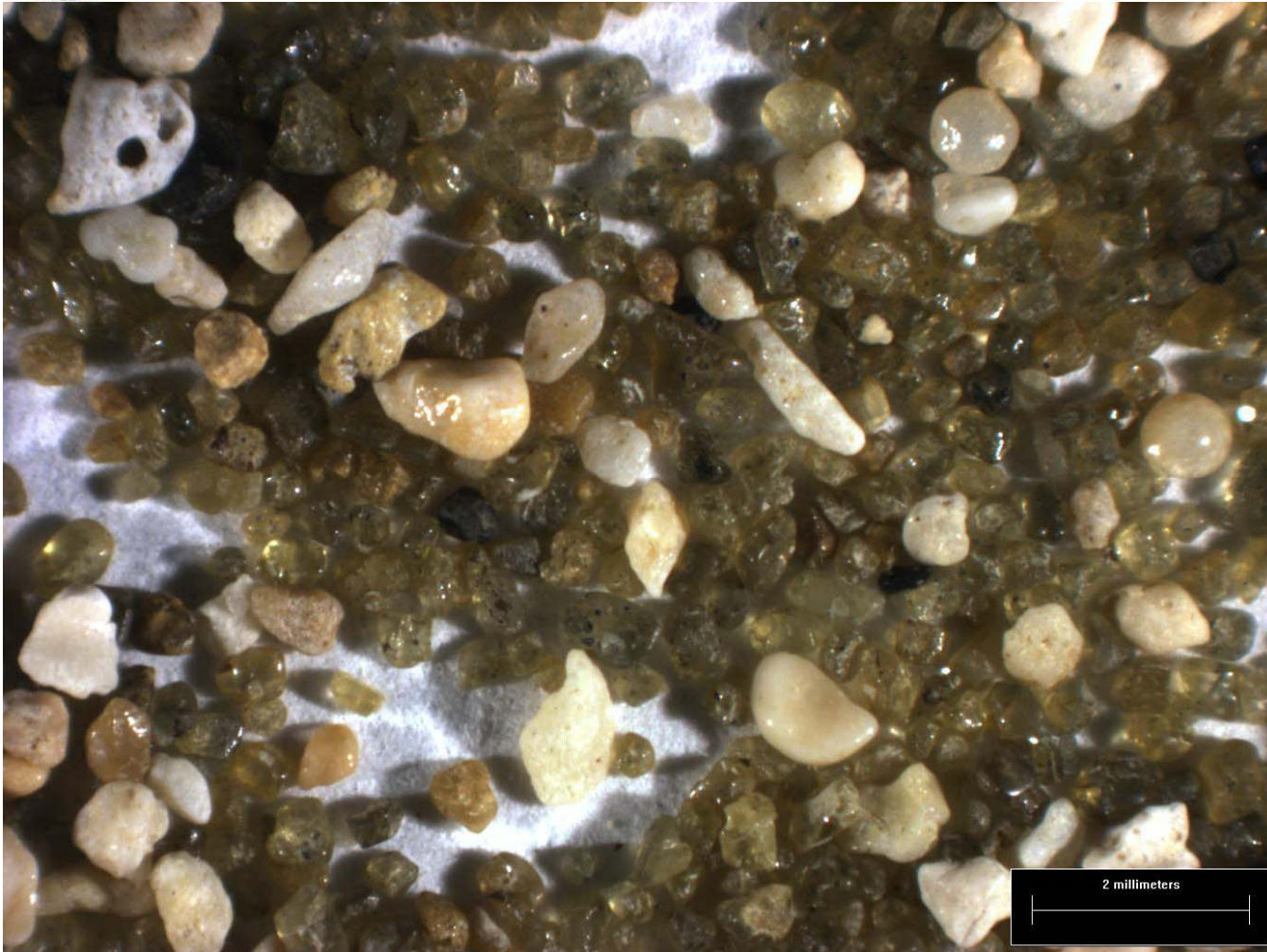
Sand Sampling

Using GPS and GIS, we were able to collect, map, and archive numerous sand sample locations within Southeast O'ahu.





Sand Composition

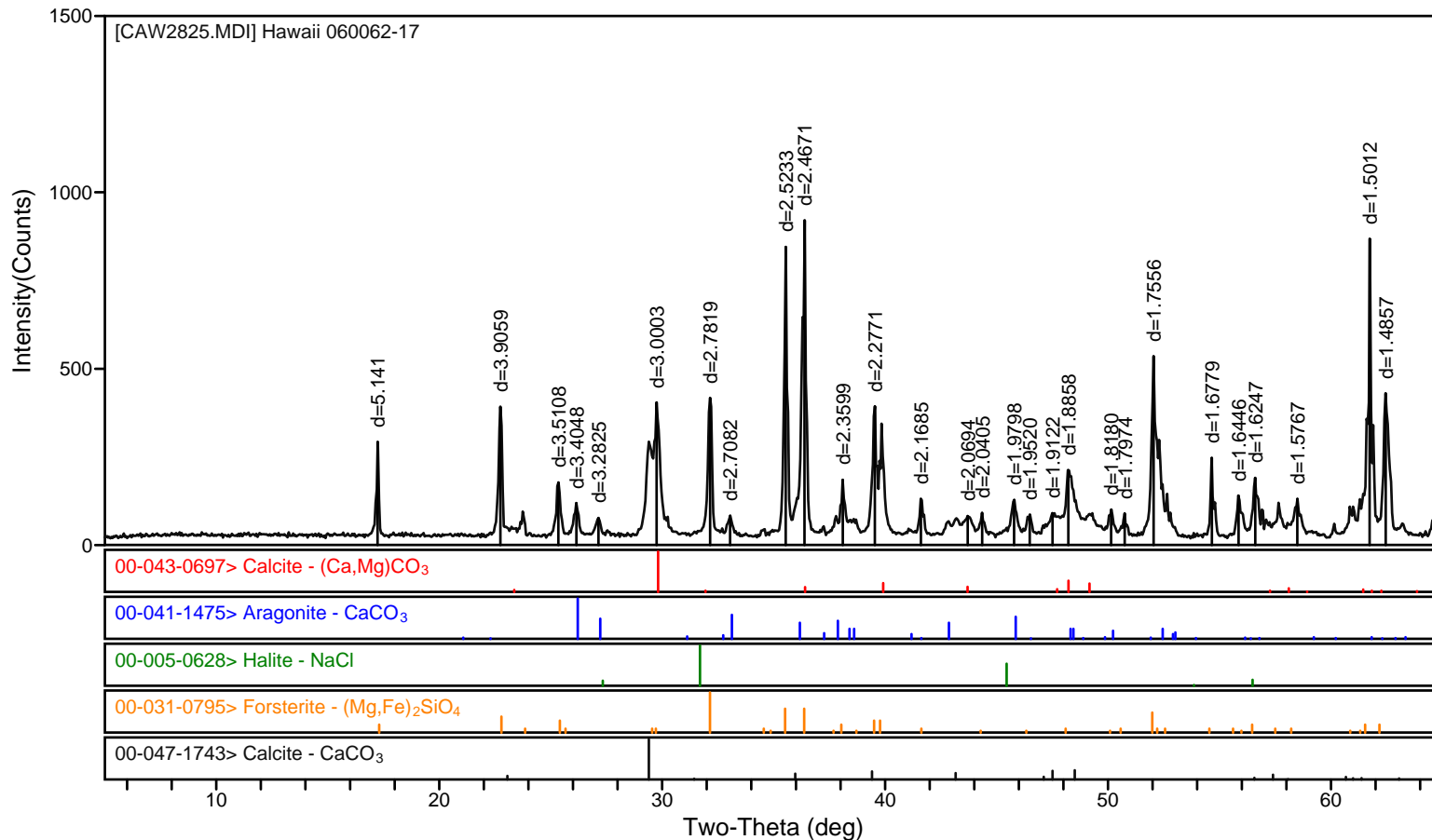


Sand
Sample
#17

GIS Rocks!



Sand Sample Results



GIS Rocks!

Computed by the Corps of Engineers, Environmental Research & Development Center, Geotechnical and Structures Laboratory



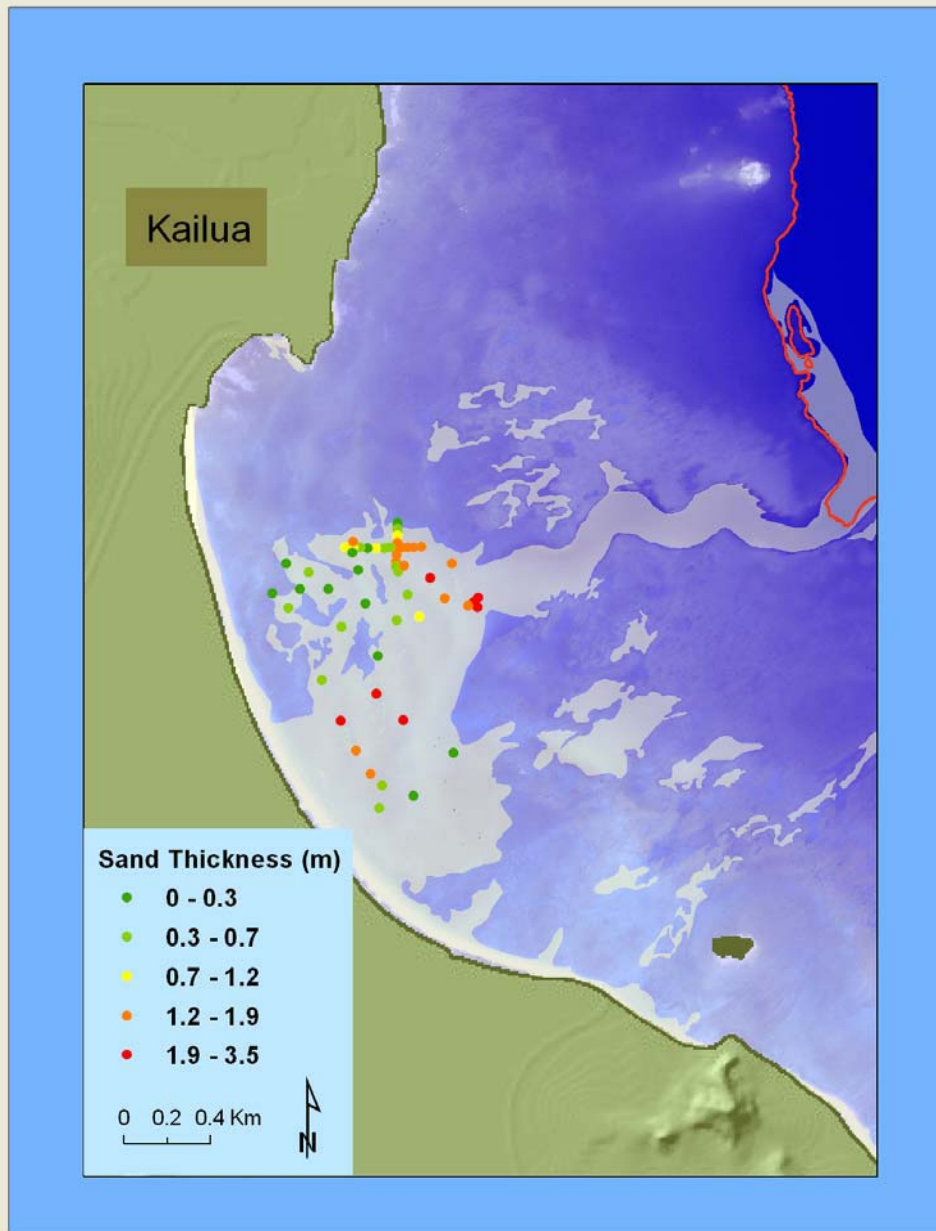
Sand Sample Conclusions



- Major Minerals
 - High-Mg calcite (Ca, MgCO_3)
 - Aragonite - CaCO_3
 - Forsterite (**Olivine**), “**Green Sand**” - $(\text{Mg,Fe})_2\text{SiO}_4$
 - Low-Mg Calcite - CaCO_3
- 3 groups
 - A) Samples low in low-Mg Calcite, high in high-Mg Calcite
 - B) Samples high in low-Mg Calcite , high in high-Mg Calcite
 - C) Samples high in **Olivine**, low in Aragonite, low in high-Mg Calcite

Jet Probing

We have also been using jet probing models to measure sand thickness.

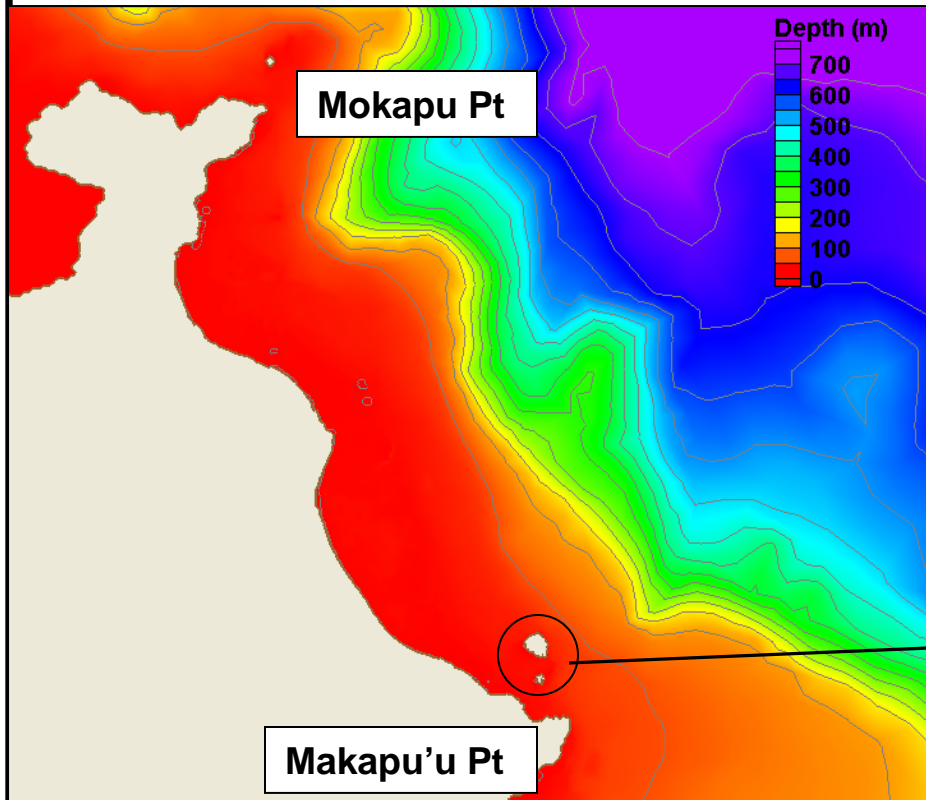




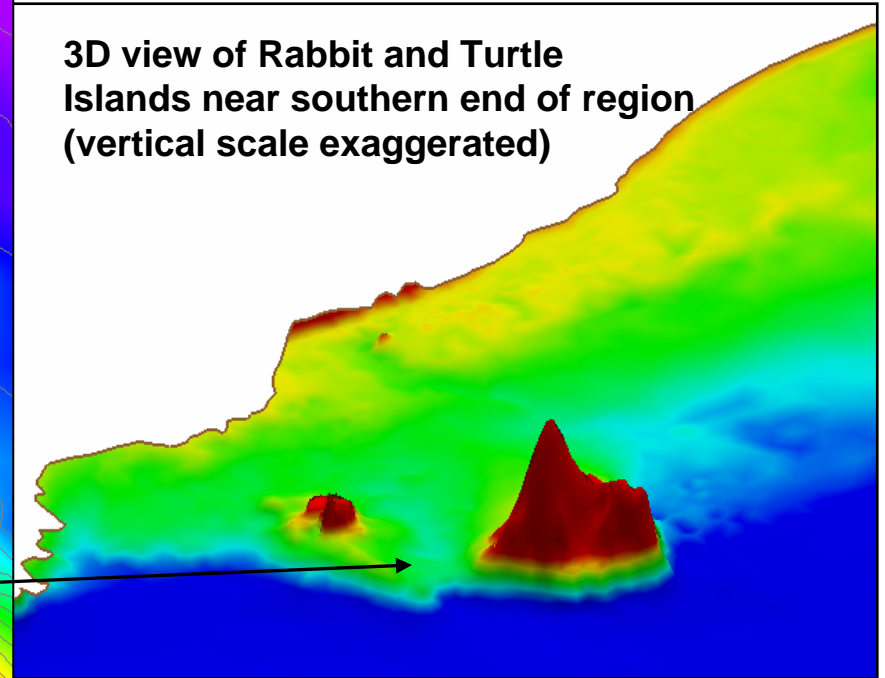
Wave Circulation & Depth



Bathymetry data is interpolated onto ADCIRC mesh and hand-edited to ensure accuracy

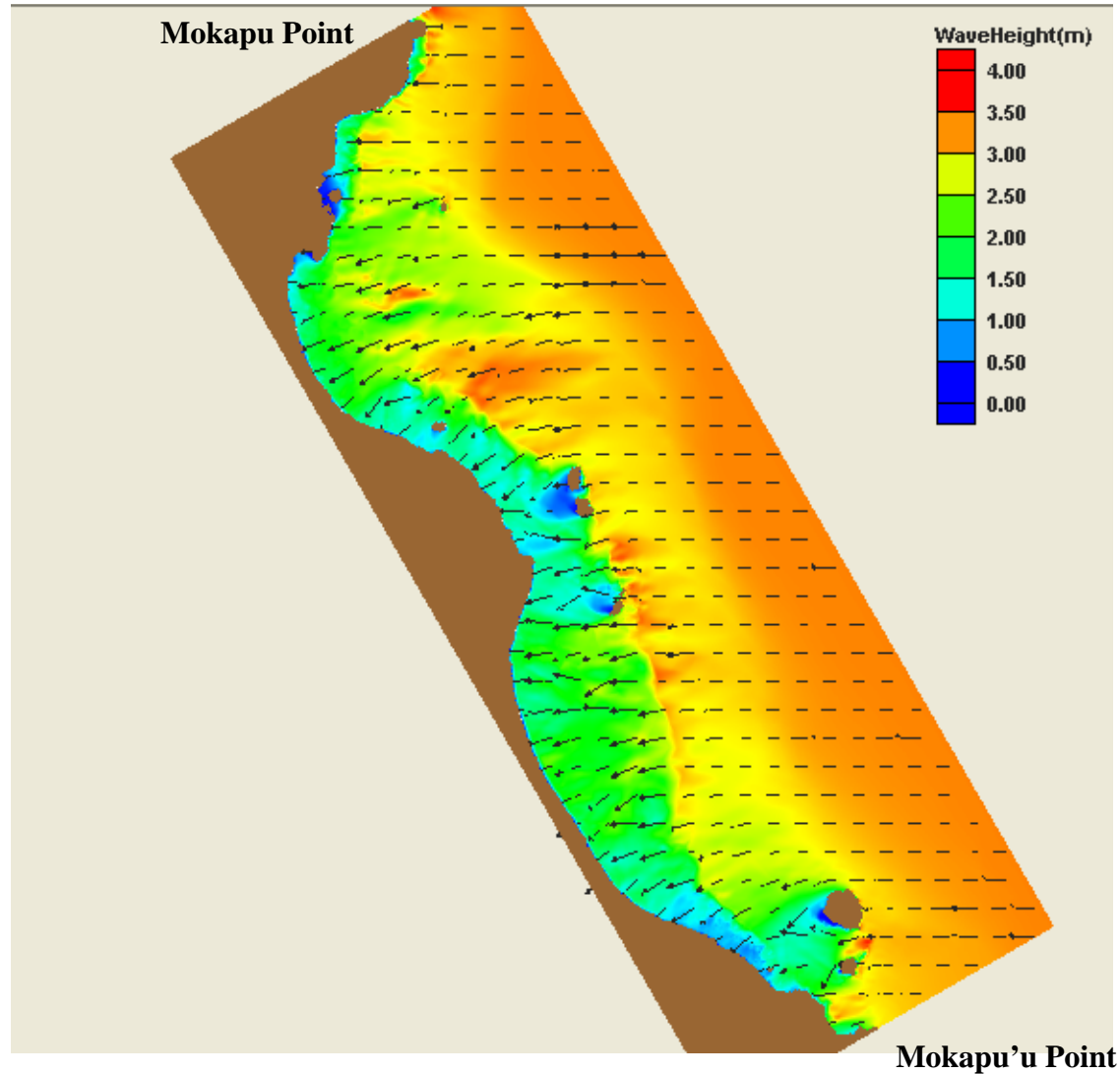


3D view of Rabbit and Turtle Islands near southern end of region (vertical scale exaggerated)





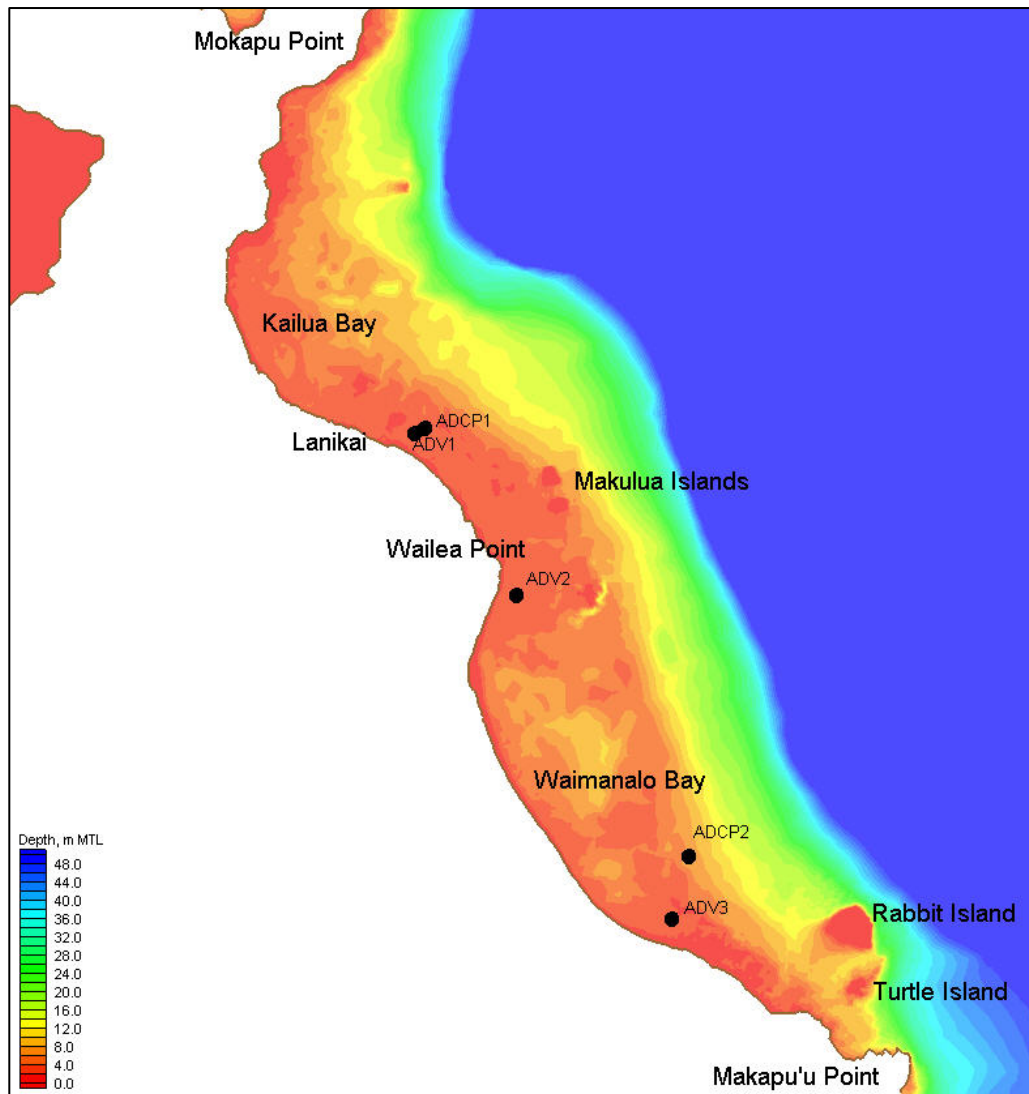
Wave Heights



GIS Rocks!



Water Depth Calculations



GIS Rocks!



Southeast O'ahu Regional Sediment Management Web-Based GIS



GIS Rocks!



RSM Web-Based GIS



Regional Sediment Management



[HOT NEWS: MAP GALLERY ACTIVE](#)

U.S. ARMY ENGINEER DISTRICT, HONOLULU
AMERICA'S ENGINEERS IN THE PACIFIC

[Program Overview](#)

[RSM in Hawaii](#)

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Various Photos of the Southeast O'ahu Demonstration Project

<http://gis.poh.usace.army.mil/rsm/pages/index.htm>



RSM Web-Based GIS



Map Room Services - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites

Address <http://gis.poh.usace.army.mil/MapRoom/MapRoom.asp?Customer=POH>


On-Line Map Room

Southeast Oahu Regional Sediment Management

[Open Map](#) [Top](#) [Data Dictionary](#)

Availability: Online

In January 2004, the U.S. Army Engineer District, Honolulu (POH), initiated the USACE Southeast Oahu Regional Sediment Management Demonstration Program. The goal of the demonstration program is to change the paradigm of project specific management to focusing on a regional approach in which USACE as well as state and local agencies stop managing projects and begin "managing the sand." The product of the RSM demonstration program is a Regional Sediment Management Plan consisting of a calibrated regional sediment budget, a calibrated numerical regional prediction system, and a regional data management and Geographic Information System.



OPJ Map Room - Microsoft Internet Explorer

Benthic Habitat	5/24/2002	Available	Vector	Analytical Laboratories of Hawaii
Boat Ramps	9/30/2005	Available	Vector	USACE
Coral Reefs	12/1/2002	Available	Vector	NOAA
Elevation Contours (100-ft)	1/1/1983	Available	Vector	USGS
Fishponds	9/30/2005	Available	Vector	USACE
Flood Zones	1/1/2003	Available	Vector	FEMA
Historic Tsunami Wave Heights	10/1/1999	Available	Vector	State of Hawaii
...

Done Trusted sites



RSM Web-Based GIS



Online GIS Maps

home map room

[Display Settings](#)

Active Layer: Sand Sample

Zoom to Scale

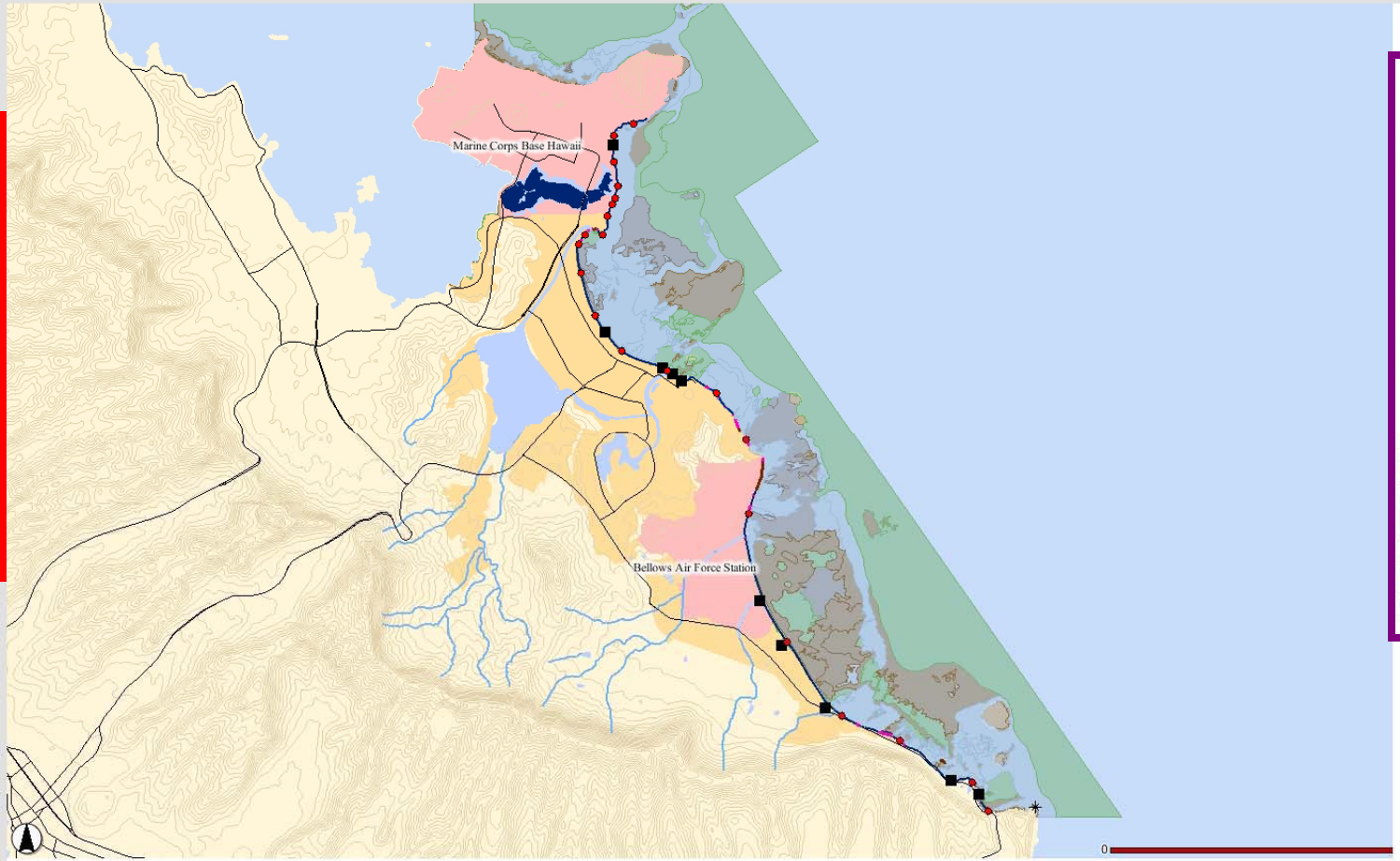
1=81647

Change Active Layer

Controls Layers Legend

[FEMA Flood Zone Info](#)

[Locate Coordinate](#)



Tool Help



Zoom In

Width of map:30200 METERS

Map Datum: UTM Zone 4 Meters NAD83

GIS Rocks!



RSM Web-Based GIS



Online GIS Maps

home map room

[Display Settings](#)

Active Layer: Sand Sample

Zoom to Scale

1=10941

Change Active Layer

Controls Layers Legend

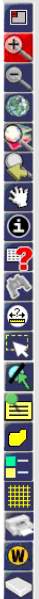
Refresh

Visible Active Label Layer

<input checked="" type="checkbox"/>	<input type="checkbox"/>	Beach Access Point
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Beach Park
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Benthic Habitat
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boat Ramp
<input type="checkbox"/>	<input type="checkbox"/>	Coral Reef
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Elevation (100-ft)
<input type="checkbox"/>	<input type="checkbox"/>	Fishpond
<input type="checkbox"/>	<input type="checkbox"/>	Flood Zone (FEMA)
<input type="checkbox"/>	<input type="checkbox"/>	Historic Tsunami Wave Heights
<input type="checkbox"/>	<input type="checkbox"/>	Island
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Jetty
<input type="checkbox"/>	<input type="checkbox"/>	Lake/Marsh
<input type="checkbox"/>	<input type="checkbox"/>	Land Parcels (TMK)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Lighthouse
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Major Roads
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Military Installation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Minor Roads
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Ocean
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Pier
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Revetment
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Sand Sample
<input type="checkbox"/>	<input type="checkbox"/>	Satellite Imagery
<input type="checkbox"/>	<input type="checkbox"/>	Sea Bed Characteristics
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sea Wall
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Shoreline (2005)
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Streams
<input type="checkbox"/>	<input type="checkbox"/>	Topo Map
<input type="checkbox"/>	<input type="checkbox"/>	Tsunami



Tool Help



Zoom In

Width of map:4046 METERS

Map Datum: UTM Zone 4 Meters NAD83

GIS Rocks!



RSM Web-Based GIS



Online GIS Maps

home map room

Display Settings

Active Layer: Revetment

Zoom to Scale

1=10941

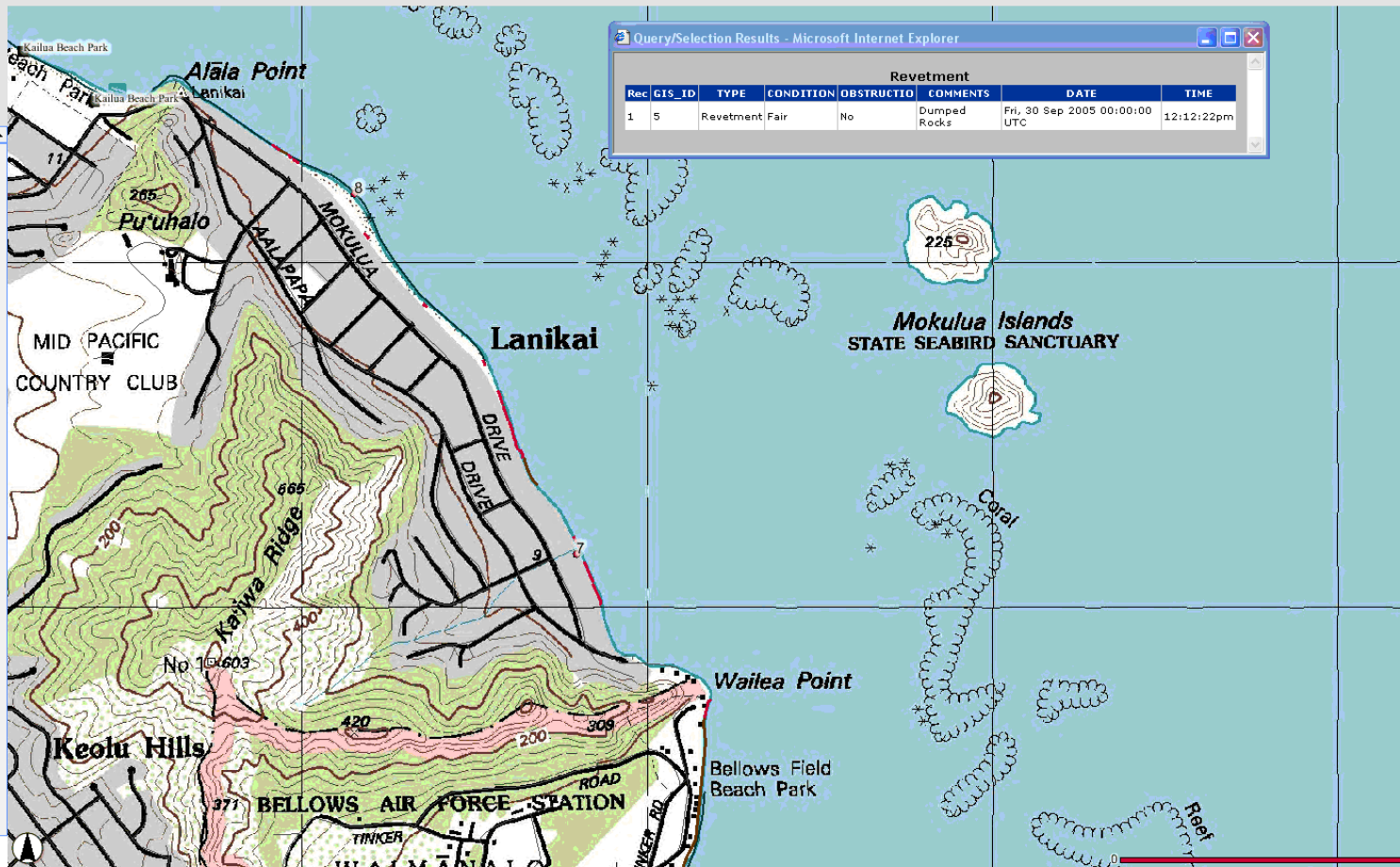
Change Active Layer

Controls Layers Legend

Refresh

Visible Active Label Layer

- Beach Access Point
- Beach Park
- Benthic Habitat
- Boat Ramp
- Coral Reef
- Elevation (100-ft)
- Fishpond
- Flood Zone (FEMA)
- Historic Tsunami Wave Heights
- Island
- Jetty
- Lake/Marsh
- Land Parcels (TMK)
- Lighthouse
- Major Roads
- Military Installation
- Minor Roads
- Ocean
- Pier
- Revetment
- Sand Sample
- Satellite Imagery
- Sea Bed Characteristics
- Sea Wall
- Shoreline (2005)
- Streams
- Topo Map
- Tsunami



Query/Selection Results - Microsoft Internet Explorer

Revetment							
Rec	GIS_ID	TYPE	CONDITION	OBSTRUCTIO	COMMENTS	DATE	TIME
1	5	Revetment	Fair	No	Dumped Rocks	Fri, 30 Sep 2005 00:00:00 UTC	12:12:22pm

Tool Help



Width of map: 4046 METERS

Map Datum: UTM Zone 4 Meters NAD83

GIS Rocks!



RSM Web-Based GIS



Online GIS Maps

home map room

[Display Settings](#)

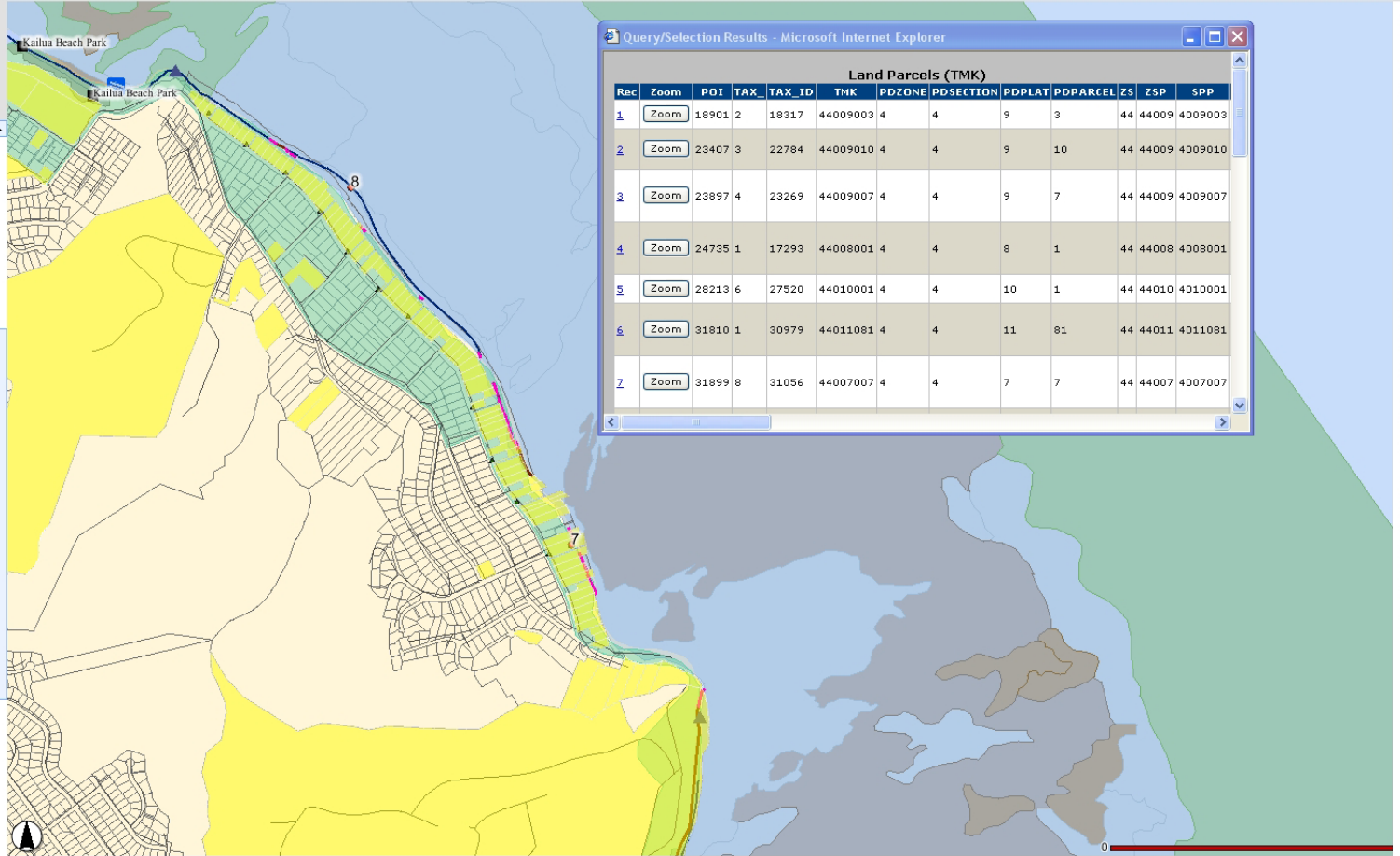
Active Layer: Land Parcels (TMK)

Zoom to Scale

1=10941

Change Active Layer

- Map Legend**
- Sand Sample
 - ▲ Beach Access Point
 - ▲ Private Beach Access
 - ▲ Public Beach Access
 - ▲ Historic Tsunami Wave Heights
 - ✳ Lighthouse
 - ⚓ Boat Ramp
 - ⚓ Jetty
 - ⚓ Pier
 - ⚓ Beach Park
 - ⚓ Sea Wall
 - ⚓ Revetment
 - ⚓ Shoreline (2005)
 - Sea Bed Characteristics**
 - Coral Sea Bed
 - Coral and Sand Sea Bed
 - Mud Sea Bed
 - Mud and Clay Sea Bed
 - Mud and Rock Sea Bed
 - Rock Sea Bed
 - Sand Sea Bed
 - Sand and Coral Sea Bed
 - Sand and Pebble Sea Bed
 - Sand and Shell Sea Bed
 - Shell Sea Bed
 - Rocky Sea Bed
 - ⚓ Minor Roads
 - ⚓ Fishpond
 - ⚓ Coral Reef
 - ⚓ Tsunami Evacuation Area
 - ⚓ Flood Zone (FEMA)
 - 100-yr Flood Zone
 - 500-yr Flood Zone
 - Lake/Marsh
 - ⚓ Streams
 - Land Parcels (TMK)
 - Topo Map
 - Satellite Imagery
 - Benthic Habitat
 - Coral Reef and Hard Bottom
 - Submerged Vegetation

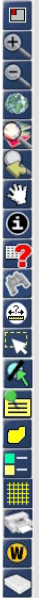


Query/Selection Results - Microsoft Internet Explorer

Land Parcels (TMK)

Rec	Zoom	POI	TAX_ID	TAX_ID	TMK	PDZONE	PDSECTION	PDPLAT	PDPARCEL	ZS	ZSP	SPP
1	Zoom	18901	2	18317	44009003	4	4	9	3	44	44009	4009003
2	Zoom	23407	3	22784	44009010	4	4	9	10	44	44009	4009010
3	Zoom	23897	4	23269	44009007	4	4	9	7	44	44009	4009007
4	Zoom	24735	1	17293	44008001	4	4	8	1	44	44008	4008001
5	Zoom	28213	6	27520	44010001	4	4	10	1	44	44010	4010001
6	Zoom	31810	1	30979	44011081	4	4	11	81	44	44011	4011081
7	Zoom	31899	8	31056	44007007	4	4	7	7	44	44007	4007007

Tool Help



Width of map:4046 METERS

Map Datum: UTM Zone 4 Meters NAD83

GIS Rocks!



RSM Web-Based GIS



Still To Come:

- historical shoreline information
- more NOAA nautical charts
- improved GIS layer functionality & organization
- hyperlinked sand photos
- wave height, depth, and circulation model outputs
- sand borrow areas
- downloadable RSM GIS maps – including detailed shoreline inventory map book
- sediment budget
- 20-year sediment management plan



Questions



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