FILE COPY

JUL 23 2018

DAVID Y. IGE
GOVERNOR OF
HAWAII

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

ROBERT K. MASUDA
FIRST DEPUTY

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR:OCCL:SH

Kaanapali Beach Restoration and Berm Enhancement Project

RECEIVED
'18 JUL -3 P1:00
OFC. OF ENVIRONMENTAL QUALITY CONTROL

Scott Glenn, Acting Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania St., Rm. 702
Honolulu, HI 96813

SUBJECT: **ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN) THE PROPOSED** Kaanapali Beach Restoration and Berm Enhancement Project
Wahiawā District, Island of Oahu
*Fronting TMK(s) (2) 4-4-013:007, (2) 4-4-013:006, (2) 4-4-013:008, (2) 4-4-013:013, (2) 4-4-013:002, (2) 4-4-013:001, (2) 4-4-008:022, (2) 4-4-008:019, (2) 4-4-008:001, (2) 4-4-008:002, (2) 4-4-008:003, and (2) 4-4-008:005*

Dear Mr. Glenn,

Under the provisions of Act 172 (12), the Department of Land and Natural Resources, Office of Conservation and Coastal Lands has determined at the outset that an environmental impact statement is required for the Kaanapali Beach Restoration and Berm Enhancement project situated makai of TMKs *(2) 4-4-013:007, (2) 4-4-013:006, (2) 4-4-013:008, (2) 4-4-013:013, (2) 4-4-013:002, (2) 4-4-013:001, (2) 4-4-008:022, (2) 4-4-008:019, (2) 4-4-008:001, (2) 4-4-008:002, (2) 4-4-008:003, and (2) 4-4-008:005*, in the Lahaina District on the island of Maui. A completed Bulletin Publication Form and a summary of the proposed action are enclosed (with a copy of the same sent via electronic mail to oeqc@doh.hawaii.gov).

Pursuant to the requirements of Section 11-200-3, Hawaii Administrative Rules, and Section 11-200-15, Hawaii Administrative Rules, we request publication of this statutory determination in the next available periodic bulletin (Environmental Notice) for the public to submit comments to the DLNR-OCCL during a thirty-day public comment period.

Should you have any questions on the matter, please feel free to contact Shellie Habel, Hawaii Sea Grant Extension Agent in the DLNR Office of Conservation and Coastal Lands at (808) 587-0049 or via email at Shellie.L.Habel@Hawaii.gov.

19-006

Sincerely,

SUZANNE D. CASE, CHAIRPERSON
DEPARTMENT OF LAND AND NATURAL RESOURCES

*CC:* *Land Division – Maui District Office*
*Sea Engineering Inc., Attn: Chris Conger*

*Attachments:* *OEQC Publication form (1 hard copy)*
*EISPN (1 hard copy)*
*1 CD/R w/ three (3) electronic copies of PDF of EISPN and MSWord Document of OEQC Publication Form*

# AGENCY
## PUBLICATION FORM

| | |
|---|---|
| Project Name: | Kaanapali Beach Restoration and Berm Enhancement |
| Project Short Name: | Kaanapali Beach Restoration |
| HRS §343-5 Trigger(s): | Use of state lands – Section 343-5(a)(1), HRS<br>Use of conservation district – Section 343-5(a)(2), HRS |
| Island(s): | Maui |
| Judicial District(s): | Lahaina |
| TMK(s): | Seaward of (2) 4-4-013:007, (2) 4-4-013:006, (2) 4-4-013:008, (2) 4-4-013:013, (2) 4-4-013:002, (2) 4-4-013:001, (2) 4-4-008:022, (2) 4-4-008:019, (2) 4-4-008:001, (2) 4-4-008:002, (2) 4-4-008:003, (2) 4-4-008:005 |
| Permit(s)/Approval(s): | Conservation District Use Permit<br>Clean Water Act Section 401 Water Quality Certification<br>Coastal Zone Management Act Consistency Determination<br>Department of the Army Permit (Section 10 and Section 404)<br>SMA |
| Proposing/Determining Agency: | Department of Land and Natural Resources<br>Office of Conservation and Coastal Lands |
| *Contact Name, Email, Telephone, Address* | Samuel Lemmo, Administrator<br>sam.j.lemmo@hawaii.gov<br>(808) 587 – 0377<br>1151 Punchbowl St., Room 131<br>Honolulu, HI 96813 |
| Accepting Authority: | Governor, State of Hawaii |
| *Contact Name, Email, Telephone, Address* | The Honorable David Y. Ige, Governor<br>(808) 586 – 0034<br>http://governor.hawaii.gov/contact-us/contact-the-governor/<br>Executive Chambers<br>State Capitol<br>415 South Beretania St.<br>Honolulu, Hawaii 96813 |
| Consultant: | Sea Engineering, Inc. |
| *Contact Name, Email, Telephone, Address* | Christopher Conger, Coastal Scientist<br>cconger@seaengineering.com<br>(808) 259 – 7966 ext. 26<br>41-305 Kalanianaole Highway<br>Waimanalo, HI 96795 |

| **Status (select one)** | **Submittal Requirements** |
|---|---|
| ____ DEA-AFNSI | Submit 1) the proposing 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 proposing 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 proposing 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. |
| __x__ Act 172-12 EISPN ("Direct to EIS") | Submit 1) the proposing 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 accepting authority, 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 accepting authority, 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 accepting authority simultaneously transmits to both the OEQC and the proposing agency 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. |
| ____ FEIS Statutory Acceptance | Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions. |
| ____ Supplemental EIS Determination | The accepting authority simultaneously transmits its notice to both the proposing agency 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.

Kaanapali Beach has been negatively impacted by chronic and extreme seasonal erosion over the previous four decades. Beach restoration to the approximate condition of the 1988 shoreline is proposed for the section of Kaanapali Beach between Hanakaoo Beach Park and Hanakaoo Point. Beach berm enhancement, which would raise the elevation of the dry beach by 3.5 feet, is proposed for the section between Hanakaoo Point and Puu Kekaa. The approximately 75,000 cubic yards of sand needed for the proposed project would be recovered from an 8.5-acre sand deposit, located approximately 150 feet offshore of Puu Kekaa in 28 to 56 feet water depth. The proposed sand recovery method consists of a moored crane barge equipped with an clamshell bucket. Deck barges would be rotating between the sand deposit and two off-loading sites, where the deck barges would be moored to an elevated trestle or floating bridge to shore. The sand would be transferred to shore along the trestle or bridge system. Land-based equipment would then transfer the sand from the shoreline to the placement area where crews would spread sand along the shore to create the design beach and berm enhancement plan and sections.

# Environmental Impact Statement Preparation Notice

# Kāʻanapali Beach Restoration and Berm Enhancement

*June 2018*

***Prepared for:***
Department of Land and Natural Resources
Office of Conservation and Coastal Lands
1151 Punchbowl Street, Suite 131
Honolulu, Hawaii 96813

***Prepared by:***
Sea Engineering, Inc.
Makai Research Pier
41-305 Kalanianaole Hwy
Waimanalo, HI 96795

*Job No. 25457*

# TABLE OF CONTENTS

**1. PROJECT OVERVIEW ..... 1**

1.1 INTRODUCTION ..... 1
1.2 PROPERTY LOCATION, EXISTING USE, AND LAND OWNERSHIP ..... 1
1.3 NEED FOR BEACH RESTORATION AND BERM ENHANCEMENT ..... 5
1.4 PROPOSED ACTION ..... 7
*1.4.1 Beach Restoration of Hanakaʻōʻō Littoral Cell ..... 8*
*1.4.2 Beach Berm Enhancement of the Kāʻanapali Littoral Cell ..... 9*
*1.4.3 Sand Source - Puʻu Kekaʻa Sand Area ..... 9*
*1.4.4 Expected Project Lifespan ..... 10*
1.5 CONSTRUCTION METHODOLOGY ..... 21
*1.5.1 Construction Schedule ..... 21*
*1.5.2 Construction Costs ..... 22*
1.6 REGULATORY CONTEXT ..... 28
*1.6.1 Chapter 343, Hawaii Revised Statutes Requirements ..... 28*
*1.6.2 Special Management Area (SMA) ..... 28*
*1.6.3 State Conservation District ..... 28*
*1.6.4 Governor's Executive Order No. 4230 ..... 28*
*1.6.5 State Water Quality Certification ..... 28*
*1.6.6 National Pollutant Discharge Elimination System ..... 29*
*1.6.7 State Coastal Zone Management Consistency ..... 29*
*1.6.8 Department of the Army, Section 10 and Section 404 ..... 29*

**2. DESCRIPTION OF THE EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES ..... 31**

2.1 PHYSICAL ENVIRONMENT ..... 31
*2.1.1 Surrounding Land Use ..... 31*
*2.1.2 Climate ..... 31*
*2.1.3 Topography ..... 32*
*2.1.4 Sand Characteristics ..... 33*
*2.1.5 Flood and Tsunami Hazard ..... 40*
*2.1.6 Flora and Fauna ..... 41*
*2.1.7 Marine Biology ..... 41*
*2.1.8 Protected Species ..... 42*
*2.1.9 Air Quality ..... 43*
*2.1.10 Water Quality ..... 44*
*2.1.11 Noise ..... 47*
*2.1.12 Streams ..... 48*
*2.1.13 Coastal Processes ..... 49*
*2.1.14 Archaeological Resources ..... 50*
*2.1.15 Cultural Impact Assessment ..... 52*
*2.1.16 Scenic and Open Space Resources ..... 53*
2.2 SOCIO-ECONOMIC ENVIRONMENT ..... 54
*2.2.1 Community Character ..... 54*
*2.2.2 Beach Access ..... 54*
*2.2.3 Coastal and Nearshore Recreation ..... 55*

*2.2.4 Economy and Labor Force ... 57*
*2.2.5 Population ... 58*
*2.2.6 Housing ... 58*
2.3 PUBLIC SERVICES ... 58
*2.3.1 Solid Waste Disposal ... 58*
*2.3.2 Medical Facilities ... 58*
*2.3.3 Police and Fire Protection ... 59*
*2.3.4 Schools ... 59*
*2.3.5 Recreational Facilities ... 60*
2.4 INFRASTRUCTURE ... 60
*2.4.1 Roadways ... 60*
*2.4.2 Water System ... 60*
*2.4.3 Wastewater System ... 61*
*2.4.4 Drainage System ... 61*
*2.4.5 Electrical, Telephone, and Cable Television Services ... 61*
2.5 CUMULATIVE AND SECONDARY IMPACTS ... 61

**3. RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS ... 63**

3.1 STATE LAND USE DISTRICTS ... 63
3.2 CHAPTER 226, HAWAII STATE PLAN ... 63
3.3 STATE FUNCTIONAL PLANS ... 63
3.4 MAUI COUNTY GENERAL PLAN ... 63
*3.4.1 Countywide Policy Plan ... 63*
*3.4.2 Maui Island Plan ... 63*
3.5 WEST MAUI COMMUNITY PLAN ... 63
3.6 MAUI COUNTY ZONING ... 63

**4. ALTERNATIVES TO THE PROPOSED ACTION ... 64**

4.1 FORMULATION OF THE PREFERRED ALTERNATIVE ... 64
4.2 NO-ACTION ALTERNATIVE AND DEFERRAL OF ACTION ALTERNATIVE ... 64
4.3 OTHER ALTERNATIVES ... 65
*4.3.1 Alternative Sand Sources ... 65*
*4.3.2 Temporary Shore Protection ... 67*
*4.3.3 Permanent Shore Protection ... 67*
*4.3.4 Adaptation ... 68*

**5. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED ... 70**

**6. LIST OF PERMITS AND APPROVALS ... 71**

**7. EARLY CONSULTATION WITH AGENCIES AND ORGANIZATIONS IN THE PREPARATION OF THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE ... 72**

**8. AGENCIES AND ORGANIZATIONS TO BE CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT ... 73**

**9. REFERENCES ... 75**

## LIST OF FIGURES

FIGURE 1-1. KĀʻANAPALI BEACH LOCATION ON MAUI ..... 3
FIGURE 1-2. KĀʻANAPALI BEACH OVERVIEW ..... 4
FIGURE 1-3. KĀʻANAPALI BEACH A) 1988 AERIAL PHOTOGRAPH (UH COASTAL GEOLOGY GROUP) AND B) 2013 AERIAL PHOTOGRAPH (GOOGLE EARTH) ..... 11
FIGURE 1-4. HANAKAʻŌʻŌ LITTORAL CELL BEACH RESTORATION AREA – PLAN VIEW ..... 12
FIGURE 1-5.HANAKAʻŌʻŌ LITTORAL CELL BEACH RESTORATION – PROFILE VIEWS (SOUTH PROFILES) ..... 13
FIGURE 1-6. HANAKAʻŌʻŌ LITTORAL CELL BEACH RESTORATION – PROFILE VIEWS (NORTH PROFILES) ..... 14
FIGURE 1-7. HANAKAʻŌʻŌ POINT BERM ENHANCEMENT AREA – PLAN VIEW ..... 15
FIGURE 1-8. HANAKAʻŌʻŌ POINT BERM ENHANCEMENT – PROFILE VIEWS ..... 16
FIGURE 1-9. PUʻU KEKAʻA BERM ENHANCEMENT AREA – PLAN VIEW ..... 17
FIGURE 1-10. PUʻU KEKAʻA BERM ENHANCEMENT – PROFILE VIEWS ..... 18
FIGURE 1-11. PUʻU KEKAʻA SAND AREA ..... 19
FIGURE 1-12. PREDICTED COASTAL EROSION AT KĀʻANAPALI BEACH (FROM HAWAII SEA LEVEL RISE VIEWER) ..... 20
FIGURE 1-13. ANCHOR SPREAD AROUND THE PUʻU KEKAʻA SAND AREA ..... 24
FIGURE 1-14. APPROXIMATE BARGE ROUTES TO OFFLOADING LOCATIONS ..... 25
FIGURE 1-15. NEARSHORE ANCHOR SPREAD FOR THE NORTH OFFLOADING LOCATION ..... 26
FIGURE 1-16. NEARSHORE ANCHOR SPREAD FOR THE SOUTH OFFLOADING LOCATION ..... 27
FIGURE 2-1. SAND GRAIN DISTRIBUTION, KĀʻANAPALI BEACH SAMPLES ..... 35
FIGURE 2-2. 2016 PUʻU KEKAʻA SAND AREA AVERAGE WITH HLC AVERAGE AND ±20% LIMITS (DASHED) ..... 39
FIGURE 2-3. 2016 PUʻU KEKAʻA SAND AREA AVERAGE WITH KLC AND ±20% LIMITS (DASHED) 39
FIGURE 2-4. DRY COLOR COMPARISON BETWEEN NATIVE BEACH SAND (TOP ROW) AND OFFSHORE SAND (BOTTOM TWO ROWS) ..... 40

## LIST OF TABLES

TABLE 1-1. KĀʻANAPALI BEACH SHORELINE HISTORY ..... 7
TABLE 1-2. PRELIMINARY PROJECT CONSTRUCTION TIMELINE ..... 22
TABLE 1-3. PROJECT CONSTRUCTION COST ESTIMATE ..... 23
TABLE 2-1. SORTING VALUE DESCRIPTIONS ..... 34
TABLE 2-2. SEDIMENT SIZE CHARACTERISTICS, KĀʻANAPALI BEACH SAMPLES ..... 35
TABLE 2-3 MAXIMUM PERMISSIBLE SOUND LEVELS IN DBA ..... 48
TABLE 2-4. WEST MAUI SCHOOLS AND EDUCATIONAL FACILITIES ..... 59

## LIST OF ACRONYMS

| | |
|---|---|
| AMAP | Applicable Monitoring and Assessment Plan |
| BMP | Best Management Practices |
| BMPP | Best Management Practices Plan |
| CGG | (University of Hawaii) Coastal Geology Group |
| CWA | Clean Water Act |
| CZM | Coastal Zone Management |
| DA | Department of the Army |
| DAR | Department of Aquatic Resrouces |
| DEIS | Draft Environmental Impact Statement |
| DLNR | Department of Land and Natural Resources |
| DOBOR | Department of Boating and Ocean Recreation |
| DOH-CWB | Department of Health – Clean Water Branch |
| EISPN | Environmental Impact Statement Preparation Notice |
| EPA | U.S. Environmental Protection Agency |
| FEIS | Final Environmental Impact Statement |
| FIRM | Flood Insurance Rate Map |
| HAR | Hawaii Administrative Rules |
| HLC | Hanakaʻōʻō Littoral Cell |
| HRS | Hawaii Revised Statutes |
| KLC | Kāʻanapali Littoral Cell |
| KOA | Kāʻanapali Operators Association |
| MLLW | Mean Lower Low Water |
| NPDES | National Pollutant Discharge Elimination System |
| OCCL | Office of Conservation and Coastal Lands |
| OEQC | Office of Environmental Quality Control |
| SEI | Sea Engineering, Inc. |
| SMA | Special Management Area |
| TMK | Tax Map Key |
| USACE | United States Army Corps of Engineers |

# EXECUTIVE SUMMARY

**Project:** Kāʻanapali Beach Restoration and Berm Enhancement

**Approving Authority:** Department of Land and Natural Resources

**Proposing Organization:**
Department of Land and Natural Resources
State of Hawaii
1151 Punchbowl Street, Room 131
Honolulu, Hawaii 96813
Contact: Sam Lemmo
Phone: (808) 587 – 0377
Fax: (808) 587 – 0322
E-mail: sam.j.lemmo@hawaii.gov

**Consultant:**
Sea Engineering, Inc.
Makai Research Pier
41-305 Kalanianaole Highway
Waimanalo, HI 96744
Contact: Christopher Conger, Coastal Scientist
Phone (808) 259 – 7966, ext. 26
E-mail: cconger@seaengineering.com

**Location** Kāʻanapali Beach, Maui, Hawaii

**Tax Map Keys:** Fronting (2) 4-4-013:007, (2) 4-4-013:006, (2) 4-4-013:008, (2) 4-4-013:013, (2) 4-4-013:002, (2) 4-4-013:001, (2) 4-4-008:022, (2) 4-4-008:019, (2) 4-4-008:001, (2) 4-4-008:002, (2) 4-4-008:003, (2) 4-4-008:005

**State Land Use District:** Conservation (Resource Subzone)

**Maui County Zoning:** H-2 (Hotel)

**Project Summary:** Kāʻanapali Beach has been negatively impacted by chronic erosion and extreme seasonal erosion over the previous four decades. The cumulative effect on the shoreline, the beach resource, and the sandy nearshore ecosystem has been negative. The State of Hawaii and the Kāʻanapali Operators Association have developed a plan to ensure the long-term viability of this sandy coastal resource that includes both beach restoration and berm enhancement. Beach restoration is proposed for the section of beach between Hanakaʻōʻō Beach Park and Hanakaʻōʻō Point ("Hanakaʻōʻō Littoral Cell"), and beach berm enhancement is proposed for the section of beach between Hanakaʻōʻō Point and Puʻu Kekaʻa ("Kāʻanapali Littoral Cell").

The Hanakaʻōʻō Littoral Cell is suffering from chronic and episodic erosion, which has resulted in beach narrowing, beach migration, and damage to backshore infrastructure including the Kāʻanapali Beachwalk. The beach in this littoral cell is less seasonally dynamic than the beach in the Kāʻanapali Littoral Cell to the north. The presently narrow beach, chronic erosion, and limited seasonal sand transport make this section of shoreline suitable for beach restoration. The proposed project would use 50,000 cubic yards of sand to restore the beach to the approximate position shown in the 1988 aerial photograph. This would widen the dry beach by between 41 and 78 feet.

The Kāʻanapali Littoral Cell experiences significant seasonal sediment transport between Hanakaʻōʻō Point and Puʻu Kekaʻa. Berm enhancement, or raising the elevation of the beach berm, would create a stockpile of sand along the backshore to augment the current sediment system with additional volume. This would provide a buffer during extreme erosion events by increasing beach sand volume. The proposed project would use 25,000 cubic yards of sand to raise the beach berm elevation by 3.5 feet within the Kāʻanapali Littoral Cell.

The approximately 75,000 cubic yards of sand needed for the proposed beach restoration and berm enhancement project would be recovered from an 8.5-acre sand deposit, located approximately 150 feet offshore of Puʻu Kekaʻa in 28 to 56 feet water depth. The proposed sand recovery method consists of a moored crane barge equipped with an environmental clamshell bucket. The crane barge would lift sand from the seafloor and place it onto two 1,500 cubic yard capacity deck barges.

The deck barges would be rotating between the sand deposit and the off-loading sites. Once a deck barge is filled at the sand deposit, it would be towed to the off-loading site, where it would be moored to an elevated trestle or floating bridge to shore. The sand would be transferred to shore along the bridge/trestle system. Land-based equipment would then transfer the sand from the shoreline to the placement area, and bulldozers and crews would spread sand along the shore to create the design beach plan and section or berm enhancement plan and section.

**Required Permits & Approvals:**

- Environmental Impact Statement (Chapter 343, HRS and §11-200, HAR)
- Department of the Army Permit (Section 10 and Section 404)

- Clean Water Act Section 401 Water Quality Certification
- Coastal Zone Management Act Consistency Determination
- Conservation District Use Permit
- County of Maui Special Management Area Permit

**Actions Requiring Environmental Impact Statement:** Work within the State Conservation District

**Estimated Cost:** $9,275,000

**Time Frame:** Construction will begin when the necessary permits and approvals are obtained and a construction contract is awarded, currently estimated for Fall 2019. The construction period is estimated to be 63 days.

# 1. PROJECT OVERVIEW

## 1.1 Introduction

Kāʻanapali Beach is located in West Maui (Figure 1-1) within the census-designated place of Kāʻanapali. South Kāʻanapali Beach is nearly 1.5 miles of golden sand beaches, extending from Hanakaʻōʻō Beach Park at the south end to Puʻu Kekaʻa (a rocky promontory that is commonly referred to as "Black Rock") at the north end. Kāʻanapali Beach experiences both chronic and episodic erosion that has caused shoreline recession, beach narrowing, reduction in coastal access, and occasional severe damage to shoreline infrastructure and amenities. Portions of the shoreline are also seasonally dynamic, meaning the shape of the shoreline changes in response to changing swell direction from winter to summer. Erosion and beach narrowing can be exacerbated if an erosion event occurs during a seasonal extreme water level or wave event.

The Kāʻanapali Beach Resort is located mauka of Kāʻanapali Beach, and contains five hotels and seven condominiums and vacation clubs on 1,200 acres of land. The resort is managed by the Kāʻanapali Operations Association (KOA). The resort is located alongside both Kāʻanapali Beach and Kahekili Beach to the north. The resort has constructed and maintains for public use long spans of the Kāʻanapali Beachwalk, which provides coastal lateral access for the region. Kāʻanapali Beach and Resort draw approximately 500,000 visitors annually.

KOA, which is deeply interested in the health of Kāʻanapali Beach, has been pro-active in initiating a work program to evaluate methods to mitigate the shoreline erosion and beach narrowing problem. In 2006, Sea Engineering, Inc. (SEI) was contracted by KOA to evaluate the feasibility of restoring Kāʻanapali Beach.

The first step in designing the beach restoration project was finding sufficient sand to augment the existing sand system's volume. Sand surveys offshore of Kāʻanapali began in 2007 and indicated the presence of sufficient quantities of suitable sand for potential use in restoring the beach. In March of 2010, SEI submitted a detailed proposal to use offshore sand to restore the southern portion of the beach, between Hanakaʻōʻō Point and Hanakaʻōʻō Beach Park. In 2014, the Department of Land and Natural Resources (DLNR) entered into a Memorandum of Understanding (MOU) with KOA to fund a beach restoration project at Kāʻanapali Beach, and in 2015 a contract was issued to SEI to conduct research, develop a concept plan, draft an Environmental Impact Statement (EIS), and pursue permits for a regional beach restoration effort at Kāʻanapali Beach.

## 1.2 Property Location, Existing Use, and Land Ownership

Kāʻanapali Beach is located on the west shore of the island of Maui, extending south from Puʻu Kekaʻa around Hanakaʻōʻō Point to Hanakaʻōʻō Beach Park, a distance of approximately 7,450 feet. Figure 1-2 shows an overview of the project shoreline. Within Kāʻanapali Beach are the Kāʻanapali Littoral Cell (KLC), located between Puʻu Kekaʻa and Hanakaʻōʻō Point, and the Hanakaʻōʻō Littoral Cell (HLC), located between Hanakaʻōʻō Point and Hanakaʻōʻō Beach Park. A littoral cell is a segment of coast that is more or less isolated sedimentologically from adjacent coastal segments.

Hanakaʻōʻō Beach Park is the southern boundary of the proposed beach restoration site. This public beach park includes parking and amenities including picnic tables and restrooms. The beach park is a popular spot for visitors and local residents alike. Multiple canoe clubs maintain a canoe hale at the north end of the beach park. Landward of the beach park is the Hanakaʻōʻō Cemetery, an historical burial ground that contains graves from plantation-era West Maui. South of the beach park, the shoreline becomes rocky with intermittent sandy stretches. The town of Lāhainā begins approximately one mile to the south of Hanakaʻōʻō Beach Park.

The Kāʻanapali Beachwalk begins at the north end of Hanakaʻōʻō Beach Park. The Beachwalk is a public amenity that is privately owned and maintained. The Beachwalk extends continuously for nearly 1.2 miles from the Hyatt Regency Maui, abutting Hanakaʻōʻō Beach Park, to north of Puʻu Kekaʻa, continuous across eight shorefront properties. The Beachwalk is the only ADA-compliant thoroughfare along the beach and has been identified as having great importance to the region. Many resort representatives view the Beachwalk as the main pedestrian artery that makes Kāʻanapali a community. Many travel organizations, including Frommer's, TripAdvisor, and Fodor's Travel, refer to the value of the Beachwalk as an amenity. Moreover, the Beachwalk is freely available to any member of the public visiting Kāʻanapali.

Hanakaʻōʻō Beach Park marks the southern boundary of the HLC, which comprises approximately 3,600 feet of southwest-facing shoreline. The beach within the HLC has progressively eroded landward during the last four decades. To the south of the park, towards Lāhainā, the beach has disappeared along nearly 700 feet of coastline. To the north of the park, the backshore is densely developed with hotel and condominium buildings as well as resort amenities including the Beachwalk, which provides lateral access along the entire HLC. The Hyatt Regency Maui Resort is located backshore of the southern half of the HLC. The shoreline fronting the Hyatt has experienced several significant erosional and beach narrowing events since 2011. Many of these events have also threatened the Beachwalk and other hotel amenities. The Marriott Maui Ocean Club is located backshore of the northern half of the HLC, and previous erosion events in this area have resulted in narrowing of the beach and relocation of the Beachwalk as well.

Hanakaʻōʻō Point is the boundary between the Hanakaʻōʻō Littoral Cell and the Kāʻanapali Littoral Cell. It is the also is the northern boundary of the proposed beach restoration. The proposed berm enhancement begins to the north of Hanakaʻōʻō Point. The point accretes (grows) into a wide sandy beach throughout each winter swell season.

The KLC is a west-facing shoreline that begins at Hanakaʻōʻō Point and extends approximately 3,850 feet north to Puʻu Kekaʻa. Similar to the HLC, the backshore of the KLC is densely developed with hotel buildings, resort amenities, and a shopping center. Puʻu Kekaʻa is a distinct rock promontory that creates a well-defined boundary between the KLC and the Honokowai Littoral Cell to the north. Puʻu Kekaʻa is also the northern boundary of the proposed berm enhancement. The Beachwalk provides lateral access to the entire KLC.

**Figure 1-1. Kāʻanapali Beach location on Maui**

**Figure 1-2. Kāʻanapali Beach overview**

## 1.3 Need for Beach Restoration and Berm Enhancement

Before Kāʻanapali became a tourist destination, the West Maui economy was largely based on agriculture, including sugar cane and pineapple. In the early 20th century, immigrant workers lived in plantation camps that dotted the landscape. Evidence of West Maui's plantation history is still visible today at the Kekaʻa Landing Pier on the north side of Puʻu Kekaʻa, the Hanakaʻōʻō Cemetery behind Hanakaʻōʻō Beach Park, and the Lāhainā, Kāʻanapali and Pacific Railroad (the "Sugar Cane Train") located inland of the Kāʻanapali Resort.

Post-war Maui saw a sharp decline in population due to the decline of the sugar and pineapple industries and the bourgeoning Oʻahu and mainland US economies. Maui lost 24 percent of its population from 1940 to 1960 as the younger generation left in search of employment. In 1959, the *Report of Land Use for the Island of Maui*, prepared by Community Planning Inc., identified tourism as a potential solution to reversing the downward population trend on the island. Later in 1959, Amfac, Inc. (formerly American Factors) began developing the Kāʻanapali shoreline into a master-planned resort destination area, the first of its kind in Hawaii. Over the next 50 years, extensive construction took place along Kāʻanapali Beach, and the backshore is now fully developed with resort hotels and condominiums.

The beach within the KLC is seasonally dynamic, meaning the seasonal swell direction determines the beach shape. During most years, a shift in beach sand between the north and south ends of the KLC results in beach narrowing at the updrift end of the beach. During some particularly energetic seasons, however, the beach narrowing can be so severe as to cause damage to backshore infrastructure at the updrift end. Periodic extreme erosion events have resulted in loss of beach width and vegetated landscape, and caused damage to the Kāʻanapali Beachwalk. A list of events that impacted the KLC is presented in Table 1-1.

In the strong El Niño winter of 1997-1998, persistent North Pacific swell severely impacted the north end of the KLC. This event resulted in the undermining and failure of a section of Beachwalk fronting the Sheraton, as well as threatening a pool facility.

An erosion event in 2003 at Hanakaʻōʻō Point, the south end of the littoral cell, resulted in loss of up to 30 feet of vegetated land and numerous trees. Over 70,000 sandbags were emplaced and steel plates installed in efforts to protect the shoreline, at a cost of several hundred thousand dollars. Following this event, the Kāʻanapali Aliʻi condominium prepared an emergency response plan with the assistance of the State of Hawaii DLNR to allow rapid deployment of temporary shore protection during future erosion events. This plan identified action triggers and outlined a 2-week implementation schedule.

The initial response to the 2003 event was a difficult lesson for all involved. Placing sandbags involved intensive labor with modest results. The sandbags broke down within a few weeks due to exposure to the sun, and many of them floated offshore and became an environmental nuisance. The best and final protective measure used by Kāʻanapali Aliʻi in desperation was the placement of steel road plates. These plates appeared to work well; however, they were not exposed for long before the anticipated seasonal reversal of the sand transport direction occurred, the beach widened, and the plates were able to be removed. Having the giant steel places in place for an

extended period of time is not desirable for the State, the public, or a beach resort, as they are unsightly and potentially dangerous.

In response to this series of erosion events, SEI was contracted by KOA in 2006 to begin evaluating the feasibility of nourishing Kāʻanapali Beach. The first phase of work, completed in August 2006, provided an overview of sand sources and costs, and permit and environmental requirements. The second phase of work, completed in November 2007, consisted of an offshore survey of potential sand sources using sidescan sonar and hand coring. The third phase of work, completed in September 2008 included a more extensive sand survey conducted offshore of Kāʻanapali and Kahekili Beach. The focus of the 2008 survey was to more extensively map the sand deposits offshore of these beaches and to attempt to determine the deposit thickness. The work included a sub-bottom profiler survey and vibracoring.

While long term beach management plans were being developed, erosion events at Kāʻanapali continued. In December 2008, a severe Kona storm caused rapid beach loss, land erosion, and damage to the Beachwalk at Hanakaʻōʻō Point. The damage occurred quickly, with no time to implement an emergency response, further highlighting the Kāʻanapali shoreline's vulnerability to extreme wave events.

Meanwhile, the shoreline within the Hanakaʻōʻō Littoral Cell has been undergoing both chronic and episodic erosion at a rate that has been accelerating during the last several decades. Southern swell during the summer of 2013 caused severe erosion that undermined the Beachwalk in the middle of the littoral cell. Vegetation that had collapsed into the ocean and several sections of the Beachwalk were removed. In response, 400 coir (natural fiber) sandbags were installed under the remaining portion of the Beachwalk to prevent further undermining and collapse. In 2015, this area once again experienced an erosion event that threatened the Beachwalk. In response, the Hyatt deployed an Emergency Erosion Protection Skirt along 200 feet of the eroded shoreline. The geotextile skirt is a temporary solution, but has been effective in slowing erosion of the area. The geotextile skirt, which was not designed for long-term deployment, was removed and replaced in November of 2016. It was also extended 100 feet to the south to mitigate continuing erosion and impacts to the Beachwalk.

Despite ongoing erosion events, beach narrowing, and threats to backshore infrastructure, it is notable that the shoreline at Kāʻanapali has undergone no previous long-term improvements to the sand beach or berm. Temporary erosion mitigation has been deployed, including sandbags, road plates, and erosion skirts, though none have been emplaced as permanent shoreline armoring of the Kāʻanapali shoreline.

**Table 1-1. Kāʻanapali Beach shoreline history**

| Year | Event |
|---|---|
| Early 1900s | Kekaʻa Landing Pier built to the north of Puʻu Kekaʻa as the primary loading spot for shipping processed sugar from the island and bringing in supplies for the plantation camps in West Maui |
| 1950s | Post-war population of Maui sharply declines; plantation operations in West Maui fall from their peak |
| 1959 | *Report of Land Use for the Island of Maui* identifies tourism as a potential solution to reversing the downward population trend of the island |
| 1959 | Amfac, Inc. begins developing Kāʻanapali Beach Resort |
| 1998 | Beachwalk near Puʻu Kekaʻa, providing lateral access along the shoreline, was undermined and collapsed after a prolonged period of North Pacific swell; road plates were driven into the sand to protect a pool facility at the Sheraton |
| 2003 | Loss of vegetated landscape and damage to the Beachwalk at Hanakaʻōʻō Point, near the Kāʻanapali Aliʻi, after extended periods of high surf and water levels; road plates driven into the sand to protect the Beachwalk |
| 2006 | KOA begins looking into beach nourishment as a long-term shoreline management plan for Kāʻanapali Beach Resort |
| 2007 | Initial sand source reconnaissance offshore of Kāʻanapali Beach, including sidescan sonar surveys and sand sample collection |
| 2008 | A severe Kona storm resulted in rapid beach loss, land erosion, and damage to the Beachwalk at Hanakaʻōʻō Point |
| 2008 | Sub-bottom surveys and vibracore operations confirm presence of suitable sand source offshore of Puʻu Kekaʻa |
| 2013 | Severe erosion undermined the Beachwalk in the middle of HLC, makai of the Hyatt Regency Maui, requiring removal of vegetation and hardscape; 400 coir (natural fiber) sandbags installed to prevent further damage to the Beachwalk |
| 2015 | Continued erosion in the middle of the HLC requires installation of an Emergency Erosion Protection Skirt along 200 feet of shoreline |
| 2016 | Continued erosion pressure at the Beachwalk, in the middle of the HLC, requires replacement of existing Emergency Erosion Protection Skirt and extension to the southeast by approximately 100 feet. |

## 1.4 Proposed Action

Several beach management plans have been written that encompass beaches of the Hawaiian Islands in general, the island of Maui, and specifically Kāʻanapali. The plans have the same general emphasis, outlining the problems and giving overviews of possible management alternatives. These plans, and any resulting actions generated from the plans, typically address key management issues identified for the region. The regulatory environment, coastal processes, shoreline history, and local and agency interests in the area produced the following key management considerations:

- DLNR prefers beach restoration over coastal armoring. Coastal armoring can potentially affect physical, biological, and ecological characteristics of a shoreline. Community considerations could also be negatively affected by coastal armoring.

- Severe storms, such as the Kona storms of December 2007 and 2008, can cause rapid erosion damage along the entire coast.
- The KLC is highly dynamic and experiences large seasonal fluctuations in beach width at the ends of the cell. Transport of approximately 70,000 cubic yards of sand in a 2-month period and maximum average daily rates of 800 cubic yards were measured following the 1998 erosion event. Following the 2003 erosion event, approximately 19,000 cy of sand accreted in front of the Kāʻanapali Aliʻi within one to two weeks at an estimated rate of 1,350 to 2,700 cy/day. Occasional extreme seasonal events, such as those that occurred in 1998 and 2003, can result in rapid, significant shoreline erosion, beach narrowing, and damage to property.
- The HLC is less seasonally dynamic; however, it is experiencing chronic erosion and is also subject to severe storm damage. The beach is narrow, and dry beach may be non-existent at high tide.
- Inland dune sand is not available at this time and is not a good match for the beach sand in either the Hanakaʻōʻō or Kāʻanapali littoral cells.
- No other sources of compatible carbonate sand are presently available on island.

Given these considerations, SEI has developed a proposed action that satisfies the following beach management tasks:

- Restoration of the HLC, through placement of additional beach sand. This is a technique that is supported by the DLNR and County of Maui Planning Department.
- Adding sand to the dry berm area ("berm enhancement") in the KLC. This would augment the existing sand volume, providing greater capacity for the littoral cell to respond to and recover from episodic events.
- Harvesting nearshore beach compatible sand from offshore of Kāʻanapali Beach. This would provide a local sand source that is a good match for both littoral cells.

### *1.4.1 Beach Restoration of Hanakaʻōʻō Littoral Cell*

Beach restoration involves placing quantities of sand on a beach to maintain or widen the beach to a previous condition. Beach restoration is promoted, and in some cases supported, by the State of Hawaii as an alternative to hard shore protection structures (seawalls and revetments) as a means of erosion control, as an environmental restoration activity, and as an investment in improving the public beach resource. The HLC, which experiences minimal seasonal transport and more severe chronic erosion, is a feasible location for a beach restoration project. There are local examples where beach restoration and maintenance has been successful, such as at Sugar Cove and Stable Road on Maui's north shore.

The proposed project includes restoring the HLC beach to the approximate position shown in the 1988 aerial photograph (Figure 1-3). This requires 50,000 cubic yards of sand and would widen the dry beach by between 41 and 78 feet. A plan view of the proposed beach restoration is shown in Figure 1-4. Profile views of the proposed beach restoration is shown in Figure 1-5 and Figure 1-6.

### *1.4.2 Beach Berm Enhancement of the Kāʻanapali Littoral Cell*

The proposed project includes beach berm enhancement, or raising the elevation of the beach berm, within the KLC. The purpose of berm enhancement is to create a stockpile of sand along the backshore to augment the current sediment system with additional volume. This would provide a buffer during extreme erosion events by increasing back beach sand volume. Beach berm enhancement would be accomplished by adding a layer of sand atop the existing dry beach, or the area between the beach crest and the vegetation line, at the northern and southern ends of the KLC.

Raising the elevation of the beach berm by 3.5 feet at the southern portion of the KLC, fronting Whaler's Village, the Westin, the Kāʻanapali Aliʻi, and the Marriott, would require approximately 13,000 cubic yards of sand. This portion of the berm enhancement is referred to herein as the Hanakaʻōʻō Point Berm Enhancement. A plan view of the Hanakaʻōʻō Point Berm Enhancement is shown in Figure 1-7. Profile views of the berm enhancement are shown in Figure 1-8.

Raising the elevation of the beach berm by 3.5 feet at the northern portion of the KLC, fronting the Sheraton and the Kāʻanapali Beach Hotel, would require approximately 12,000 cubic yards of sand. This portion of the berm enhancement is referred to herein as the Puʻu Kekaʻa Berm Enhancement. A plan view of the Puʻu Kekaʻa Berm Enhancement is shown in Figure 1-9. Profile views of the berm enhancement are shown in Figure 1-10.

Typical seasonal sediment transport within the KLC is between 20,000 and 30,000 cubic yards. The cumulative berm enhancement volume, 25,000 cubic yards of placed sand in the KLC, is equivalent to the volume of sand moved during a typical season.

### *1.4.3 Sand Source - Puʻu Kekaʻa Sand Area*

A key component to the success of the proposed beach restoration and berm enhancement is the availability of suitable sand for placement. Placed sand should closely match the grain size distribution, color, composition, and density of the native beach sand. Deviation from any of these characteristics could result in unpredictable behavior of the beach restoration project. Multiple sources of sand were carefully evaluated in terms of quality, quantity, recovery cost, and general feasibility. Initial investigations for this project concluded that there was no readily available, inexpensive terrestrial source of sand and that local offshore sand resources should be evaluated.

Offshore investigations for this project located a suitable sand deposit near Puʻu Kekaʻa. The deposit (referred to herein as the Puʻu Kekaʻa Sand Area) is located in 28 to 56 feet of water depth and approximately 150 feet offshore of Puʻu Kekaʻa. Offshore reconnaissance of the sand deposit included side scan sonar imaging, towed video transects, hand coring, compressed air probing, vibracoring, and subbottom profiling. Laboratory tests on the vibracore samples included graded sieve analysis, fine content analysis, calcium carbonate analysis, and wet/dry color comparison. Sand sample analysis revealed the sand in the Puʻu Kekaʻa Sand Area to be suitable for placement on Kāʻanapali Beach. Subbottom and side scan sonar investigations revealed the Puʻu Kekaʻa Sand Area to be approximately 11 acres in area with a varying thickness between 7 and 26 feet. This corresponds to a total estimated volume of 358,000 cubic yards of sand.

The proposed project includes removing 75,000 cubic yards of sand from 8.5 acres of the Puʻu Kekaʻa Sand Area for use in restoring the beach in the HLC and enhancing the beach berm in the KLC. This would require a submarine excavation pit that is approximately 6 feet deep and covers the dredging extents shown in Figure 1-11. The sand recovery method is discussed in Section 1.5.

There is the potential for sand from the adjacent seafloor to naturally fill in the pit. However, the sand deposit is well offshore of the depth of closure of the beach toe, which has been measured to be near the 12-foot contour and it is unlikely that this would result in erosion of the adjacent shorelines.

### *1.4.4 Expected Project Lifespan*

According to the State of Hawaii Sea Level Rise Report (Hawaii Climate Change Mitigation and Adaptation Commission, 2017), Kāʻanapali is anticipated to undergo significant erosion as sea levels rise (Figure 1-12). Beach restoration and berm enhancement would help to extend the life of Kāʻanapali Beach in its current form. The HLC beach restoration would return the beach toe to approximate location in 1988, reversing over 30 years of erosion. However, the project lifespan is anticipated to be less than 30 years because the rate of erosion along Kāʻanapali Beach has been observed to increase as sea levels have risen (Sea Engineering, 2017).

Using recent erosion rates to extrapolate into the future can be a reasonable approach to estimate the upper limit of the project lifespan. The Univeristy of Hawaii Coastal Geology Group (CGG) produced erosion maps for the Kāʻanapali area; however, the erosion rates are based on shorelines dating back to 1912, and are likely not applicable for the present day sea level. To estimate a reasonable lifespan of the proposed project, the most recent statistically significant erosion rates must be used. SEI updated the CGG study by removing chronological outliers to show that the present day erosion rate is on average 2 feet per year within the Hanakaʻōʻō Littoral Cell (Sea Engineering, 2017). The proposed beach restoration would move the beach toe 41 feet seaward on average; therefore, the upper limit on the project lifespan would be 20 years.

Unpredictable extreme events such as hurricanes and tsunamis could significantly affect the project lifespan.

**a)** **b)**

**Figure 1-3. Kāʻanapali Beach a) 1988 aerial photograph (UH Coastal Geology Group) and b) 2013 aerial photograph (Google Earth)**

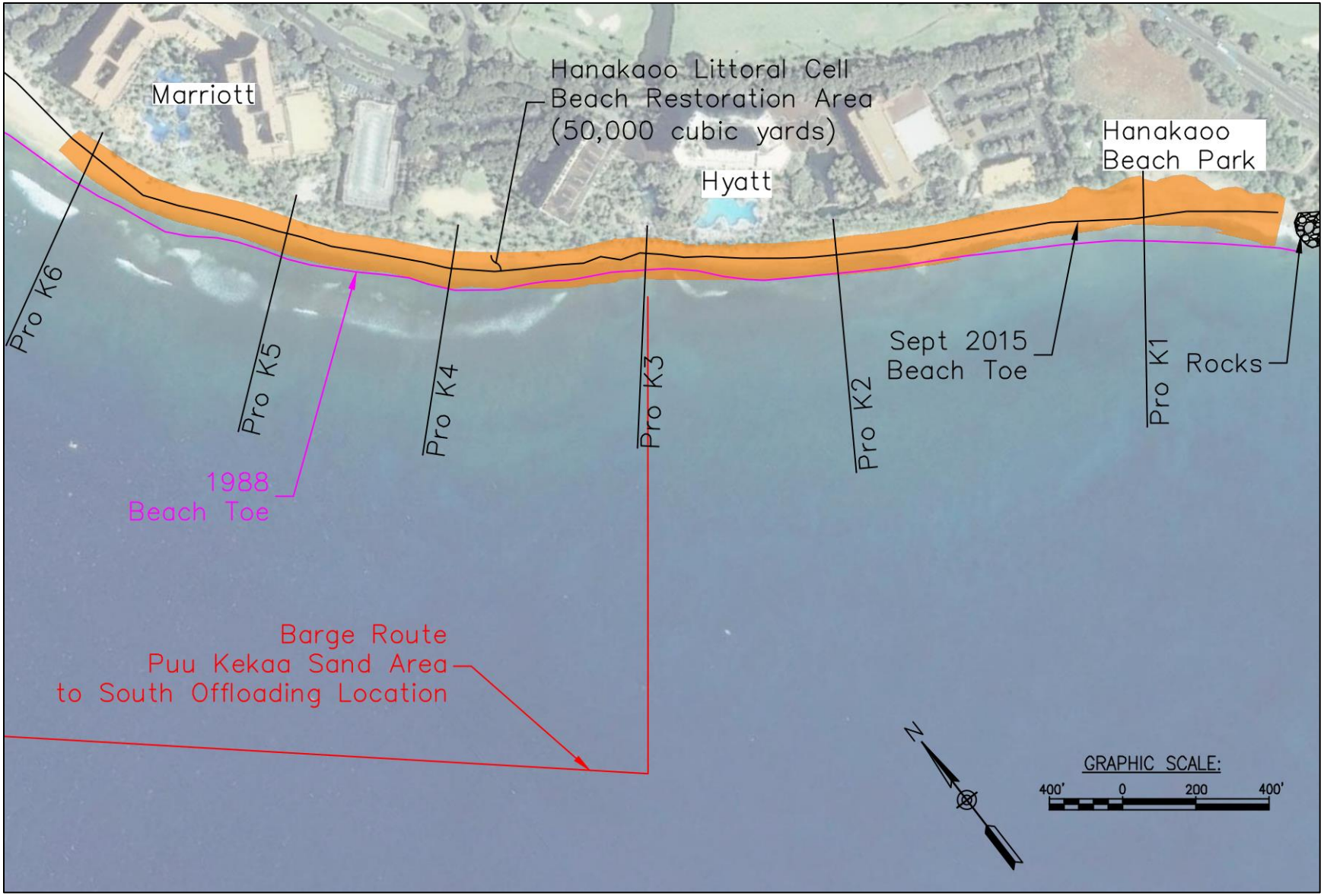


**Figure 1-4. Hanakaʻōʻō Littoral Cell Beach Restoration area – Plan View**

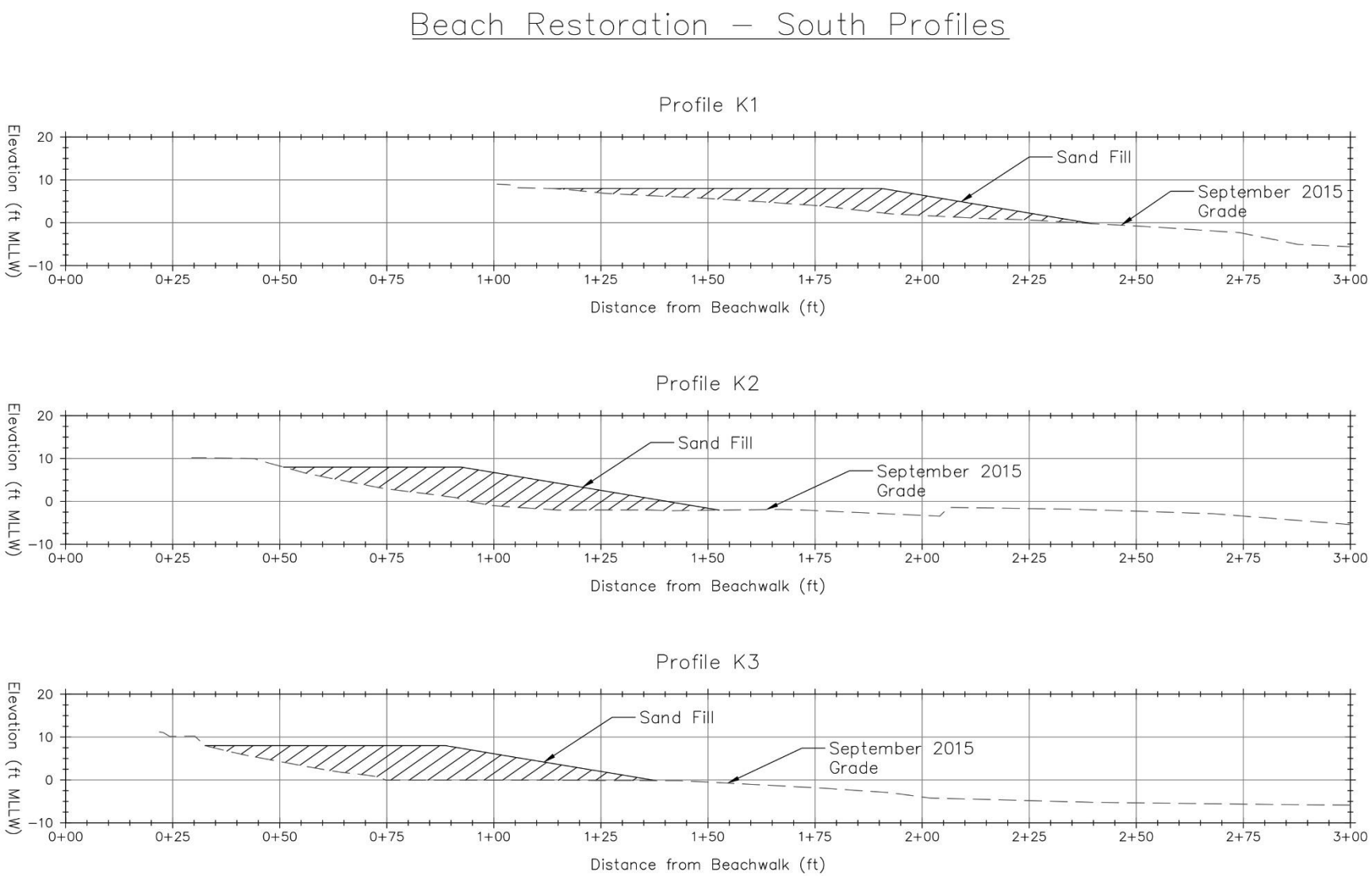


**Figure 1-5.Hanakaʻōʻō Littoral Cell Beach Restoration – Profile Views (South Profiles)**

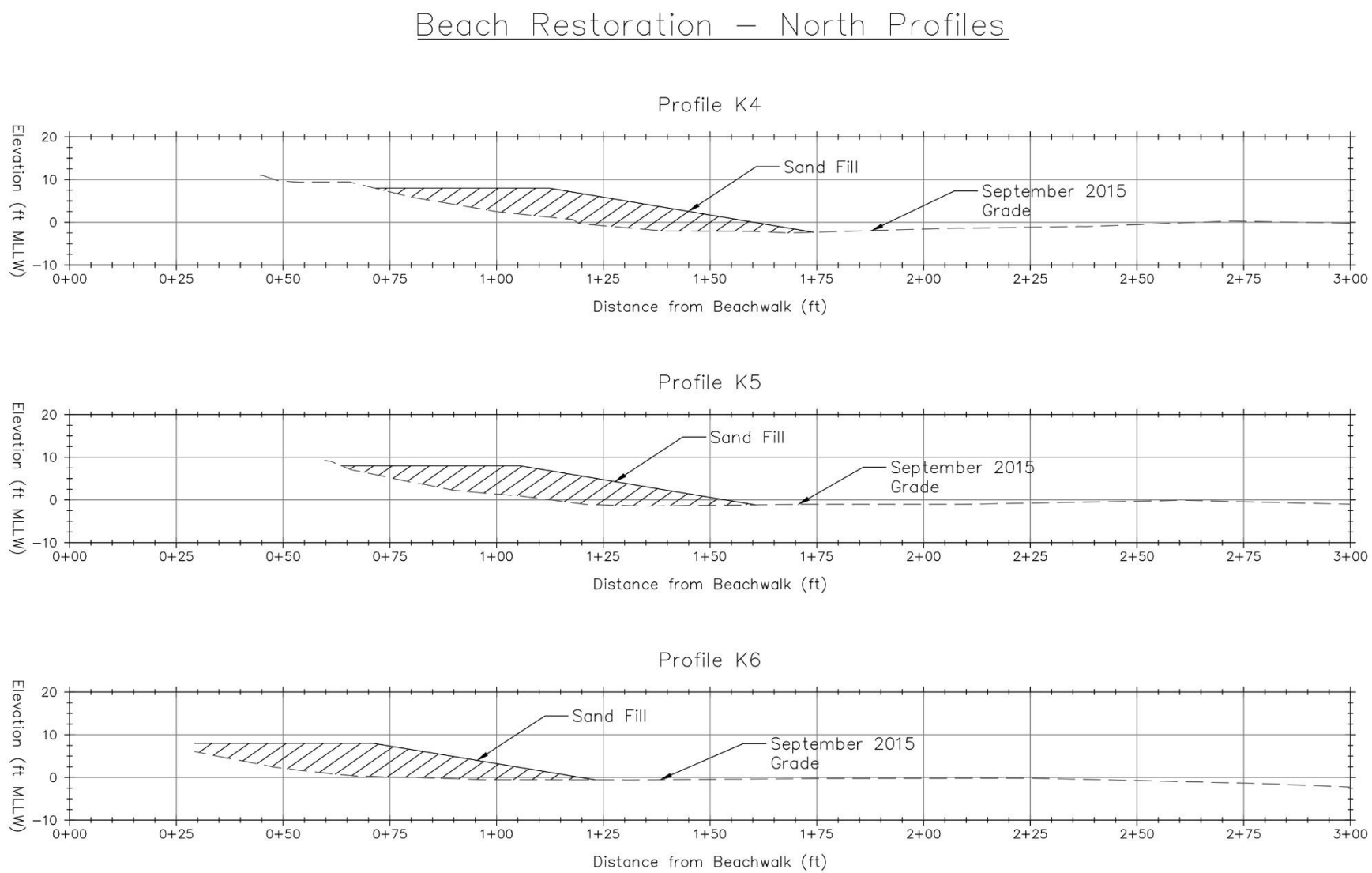


**Figure 1-6. Hanakaʻōʻō Littoral Cell Beach Restoration – Profile Views (North Profiles)**

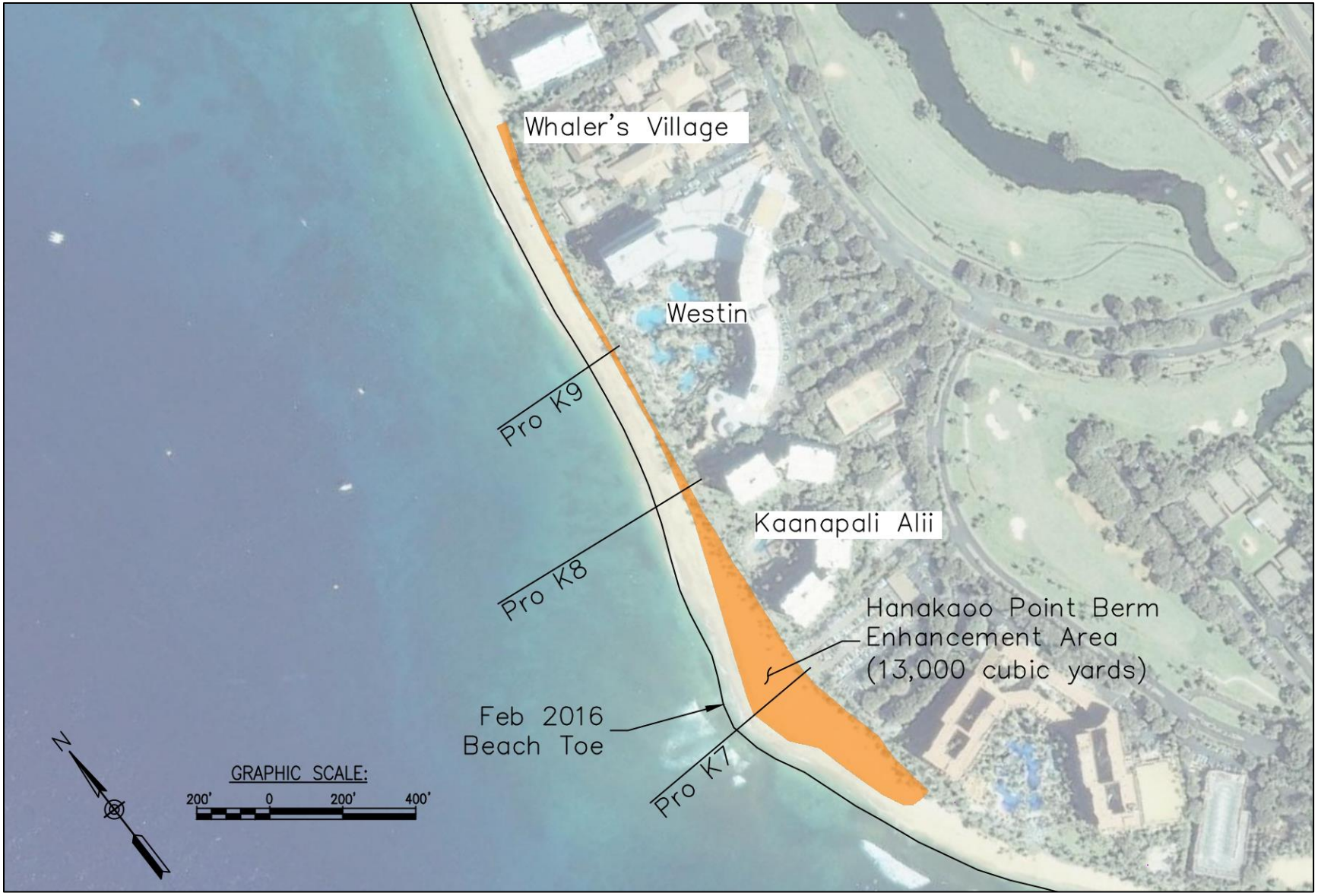


**Figure 1-7. Hanakaʻōʻō Point Berm Enhancement area – Plan View**

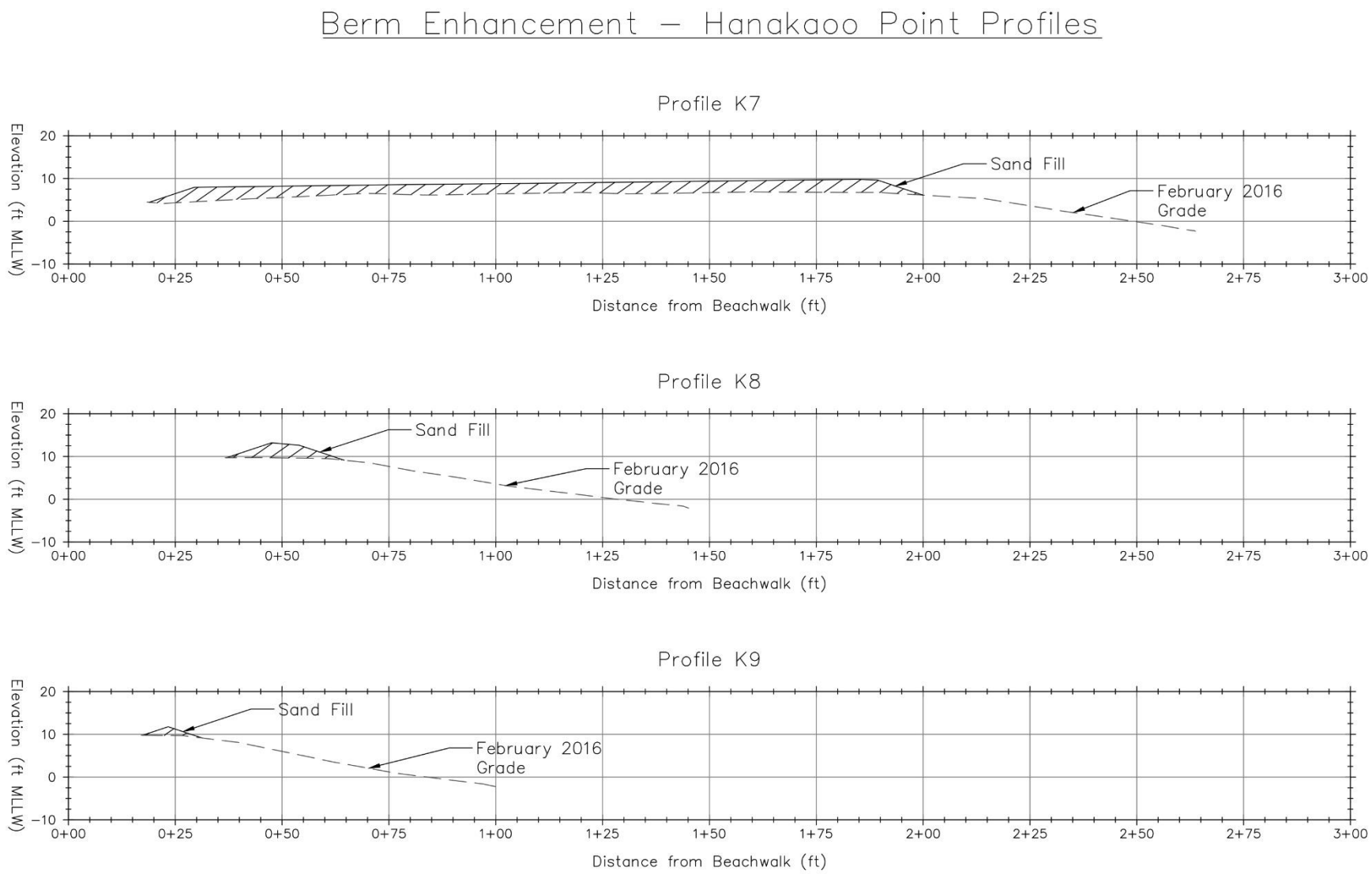


**Figure 1-8. Hanakaʻōʻō Point Berm Enhancement – Profile Views**

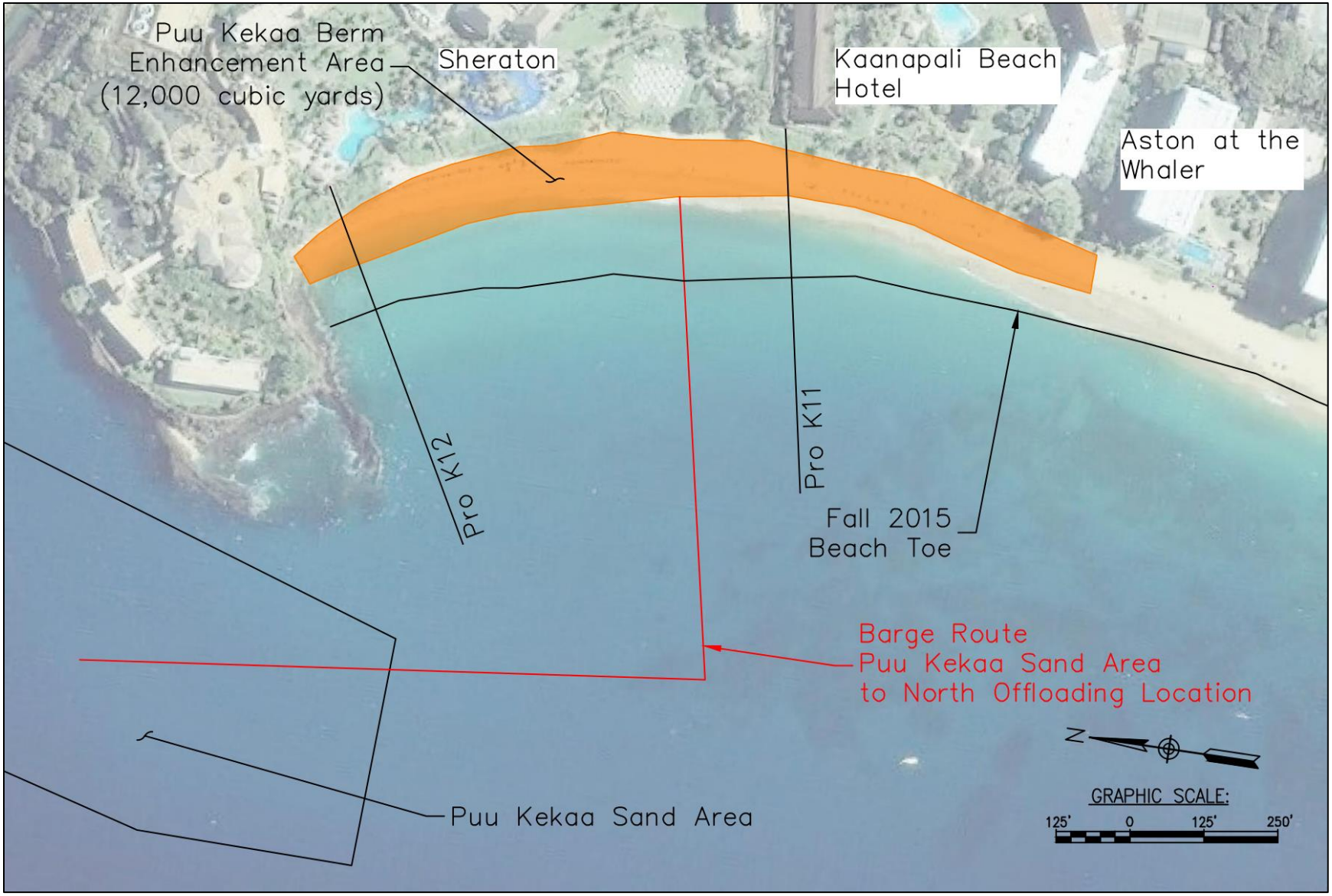


**Figure 1-9. Puʻu Kekaʻa Berm Enhancement area – Plan View**

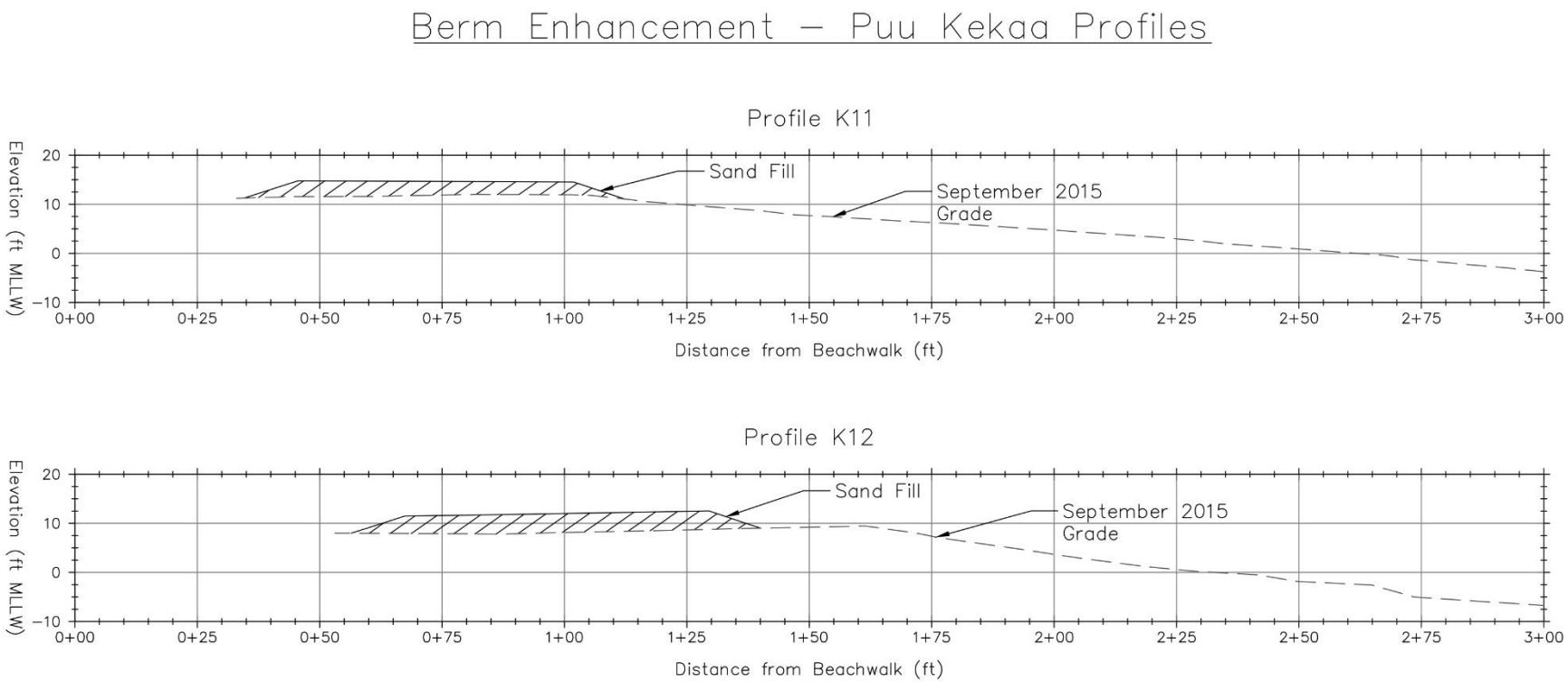


**Figure 1-10. Puʻu Kekaʻa Berm Enhancement – Profile Views**

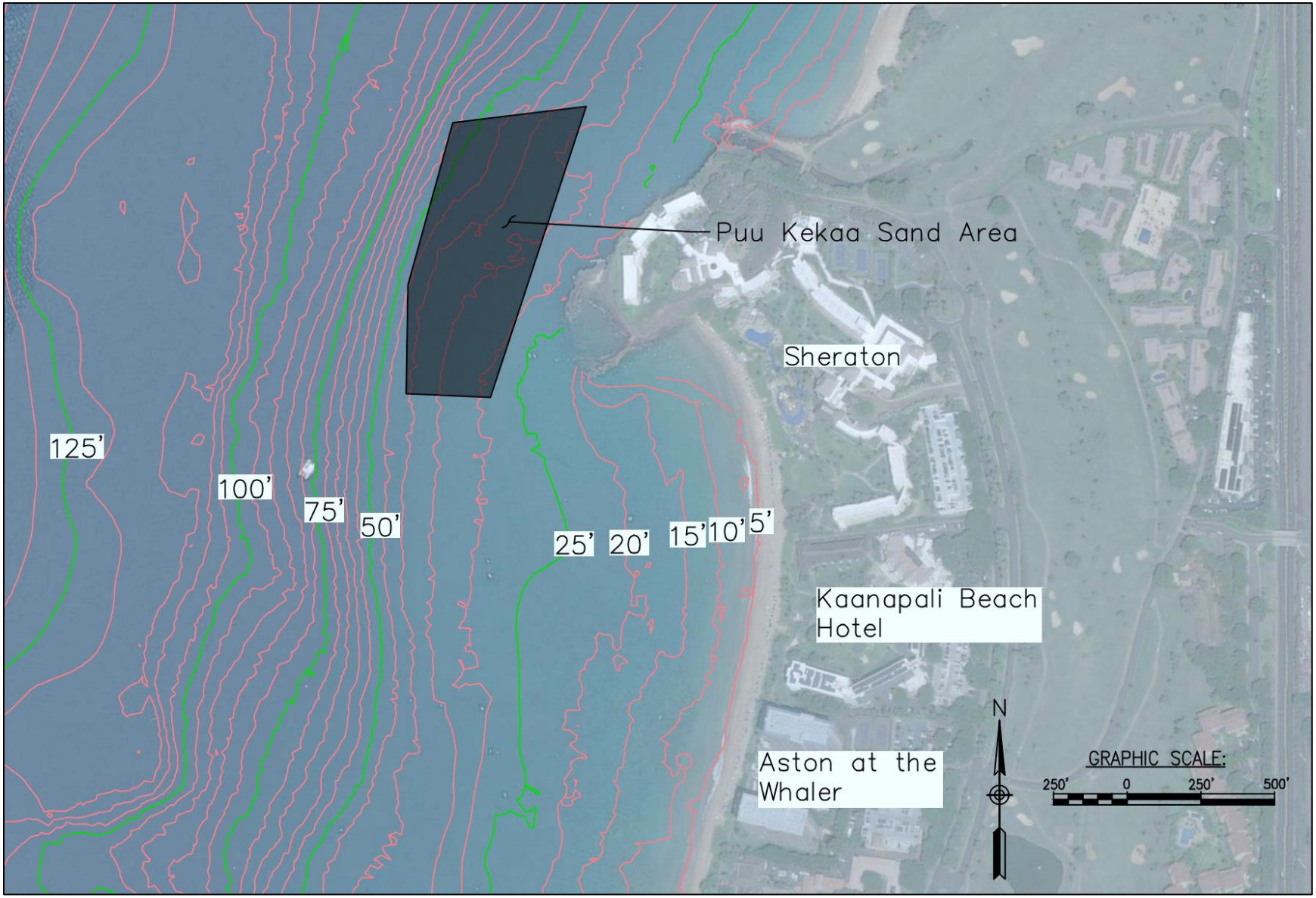


**Figure 1-11. Puʻu Kekaʻa Sand Area**

**Figure 1-12. Predicted coastal erosion at Kāʻanapali Beach (from Hawaii Sea Level Rise Viewer)**

## 1.5 Construction Methodology

Approximately 75,000 cubic yards of sand would be recovered from an 8.5-acre area within the Puʻu Kekaʻa Sand Area, located approximately 150 feet offshore of Puʻu Kekaʻa in 28 to 56 feet water depth. The proposed sand recovery method consists of a moored crane barge equipped with an environmental clamshell bucket. The mooring configuration for the crane barge is shown in Figure 1-13. The crane barge would lift sand from the seafloor and place it onto two 1,500 cubic yard capacity deck barges or scows. The deck barges would be equipped with concrete wear decks and containment fences.

The deck barges would rotate between the Puʻu Kekaʻa Sand Area and the off-loading sites so dredging and offloading operations could be performed simultaneously. Once a deck barge was filled at the Puʻu Kekaʻa Sand Area, it would be towed to one of two off-loading sites, where it would be moored to an elevated trestle or floating bridge to shore. Approximate barge routes are shown in Figure 1-14. Barges would stay well offshore of surf and snorkeling sites during transit between the offshore sand deposit and the offloading locations.

The North Offloading Location would be located makai of the Sheraton (Figure 1-15) and would supply sand to the Puʻu Kekaʻa Berm Enhancement area. The South Offloading Location would be located makai of the Hyatt (Figure 1-16) and would supply sand to the Hanakaʻōʻō Littoral Cell Beach Restoration area and the Hanakaʻōʻō Point Berm Enhancement area. Offloading locations were chosen based on their proximity to the placement areas and nearshore bathymetry and geomorphology. The seafloor offshore of the KLC is sand with no coral or reef, therefore the north offloading location is simply placed in the middle of the Puʻu Kekaʻa Berm Enhancement Area. In contrast, the fringing reef in the HLC limits the potential locations for offloading. The South Offloading Location is located over a paleo stream channel that forms a gap in the reef.

Each offloading location would require an anchoring system for the barges as well as a bridge structure and machinery for transporting sand to shore. The deck barges would be moored in approximately 15 feet of water depth, where they would hold position adjacent to the bridge structure. Bridge structures may be temporary floating bridges, trestles, or similar structures.

The sand would be transferred to shore along the bridge/trestle system. Land-based equipment would then transfer the sand from the offloading location to the placement area. Sand placement would start at the offloading locations and progress down the beach in each direction. Bulldozers and crews would spread sand along the shore to create the design beach plan and section or berm plan and section.

### *1.5.1 Construction Schedule*

Construction of the proposed project would take place during the fall and winter months. The Federal resource agencies, including the National Marine Fisheries Service and the U.S. Fish and Wildlife Service both suggest that beach nourishment projects not be conducted during peak coral spawning and marine animal nesting and birthing season (spring and early summer). The proposed project is anticipated to have negligible impact on coral spawning or marine animal nesting/birthing.

The current schedule includes permitting activities from late 2018 through early 2019 and construction contracting through summer 2019. This would allow construction to take place during the fall and early winter of 2019, with the possibility of individual tasks being completed in 2020. Should there be delays in permitting, contracting would occur around late 2019 to the middle of 2020, with construction taking place during the fall and winter of 2020, and into 2021.

Table 1-2 shows a preliminary project construction timeline. Work is expected to proceed 7 days per week and 12 hours per day. The anticipated construction duration for placing 75,000 cubic yards of sand, including time for site mobilization and demobilization, is approximately 63 calendar days. This is based on an estimated rate of dredging and delivery to the beach of 2,000 cubic yards per day. Operational weather windows have been maximized by using multiple barges for the sand recovery and delivery system. Having one barge anchored over the recovery site, and separate barges used explicitly for sand delivery allows more flexibility with both beach restoration and berm enhancement.

**Table 1-2. Preliminary project construction timeline**

| Activity | Duration |
|---|---|
| Mobilization | 5 days |
| Move and place sand | 38 days |
| Weather delays | 5 days |
| Safety factor | 10 days |
| Demobilization | 5 days |
| **Total** | 63 days |

### *1.5.2 Construction Costs*

The cost of mobilization and demobilization is estimated to be $2,200,000. Mobilization includes transporting equipment (barges, tugs, cranes, earthmoving equipment, etc.) to site, setting mooring anchors around the borrow area and offloading locations, and constructing floating bridges or trestles at the offloading locations. Demobilization includes removing all equipment and anchors from the site. The fixed cost of mobilization and demobilization is a significant percentage of the total project cost because dredging equipment is very specialized and is not readily available on Maui, therefore nearly all equipment must be shipped from Oʻahu or further.

The construction cost estimate is based on a per cubic yard cost of $85 for dredging and placement. The estimated cost for beach berm enhancement in the KLC is $2,125,000. The estimated cost for beach restoration of the HLC is $4,250,000. The preliminary estimated construction cost for the Kāʻanapali Beach Restoration and Berm Enhancement project including mobilization, demobilization, and best management practices is $9,275,000. The construction cost estimate is broken down in Table 1-3.

**Table 1-3. Project construction cost estimate**

| Description | Amount |
|---|---|
| Mobilization/Demobilization | $2,200,000 |
| Berm Enhancement Dredging and Placement (25,000 cubic yards at $85 per cubic yard) | $2,125,000 |
| Beach Restoration Dredging and Placement (50,000 cubic yards at $85 per cubic yard) | $4,250,000 |
| Best Management Practices | $700,000 |
| **Total** | $9,275,000 |

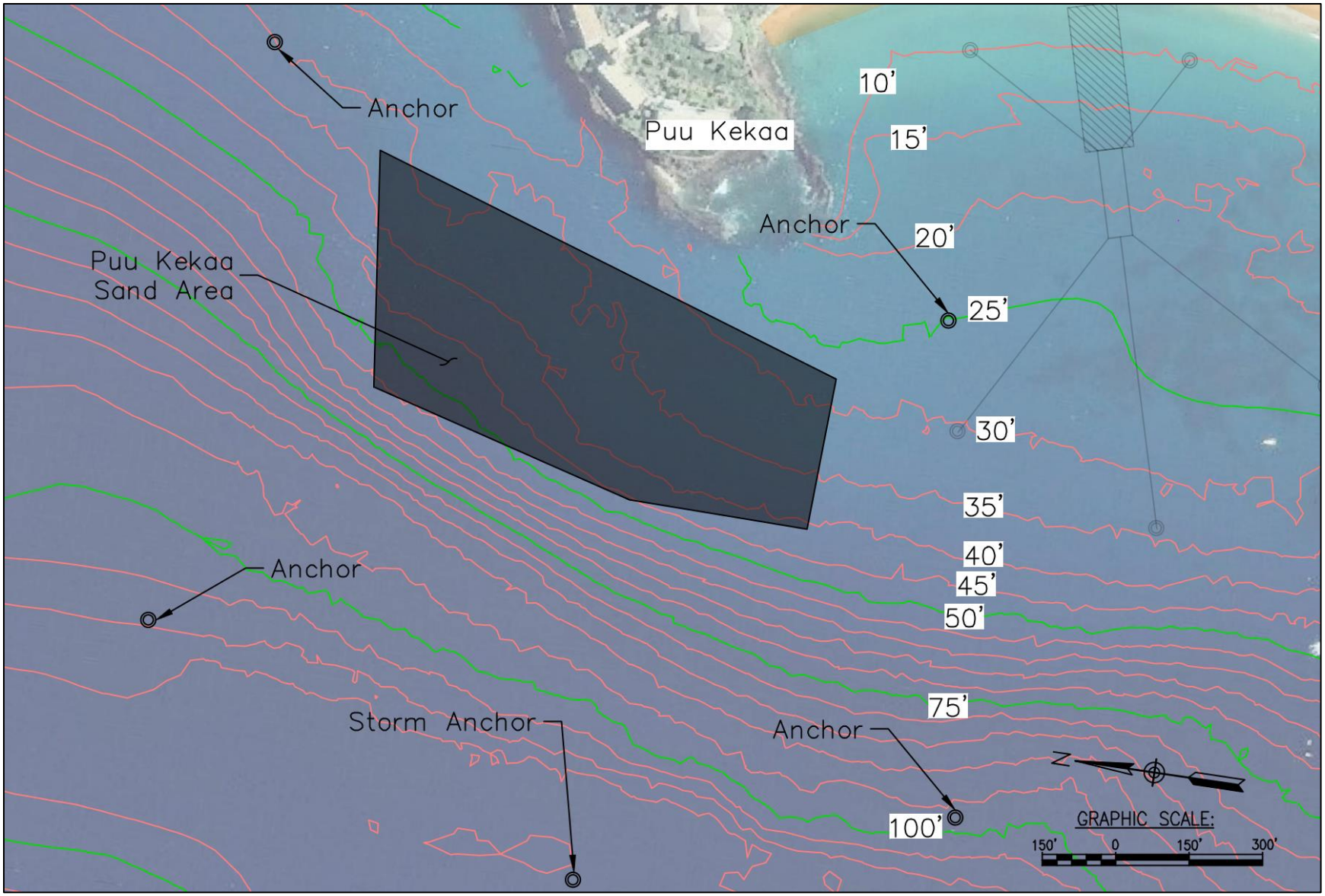


**Figure 1-13. Anchor spread around the Puʻu Kekaʻa Sand Area**

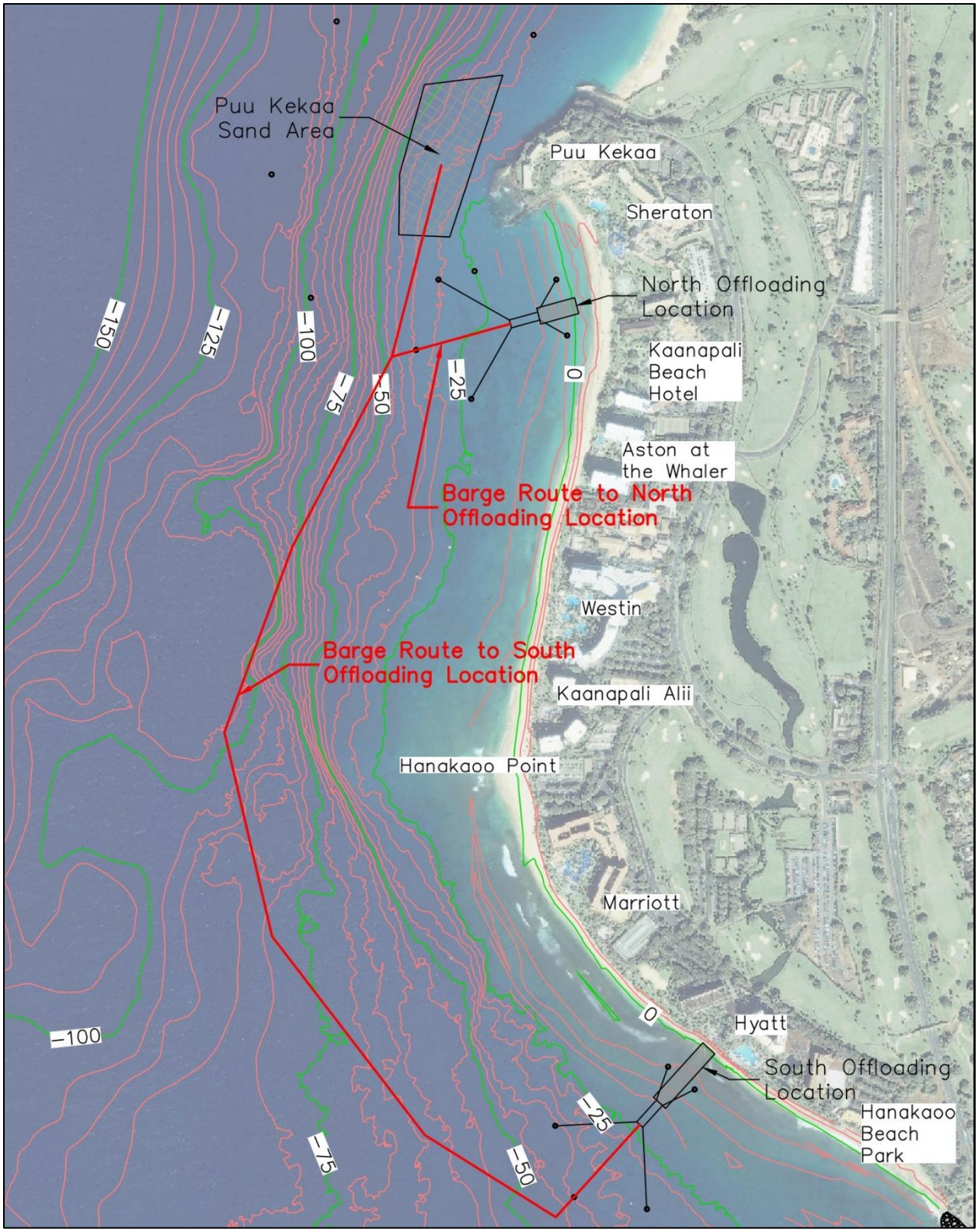


**Figure 1-14. Approximate barge routes to offloading locations**

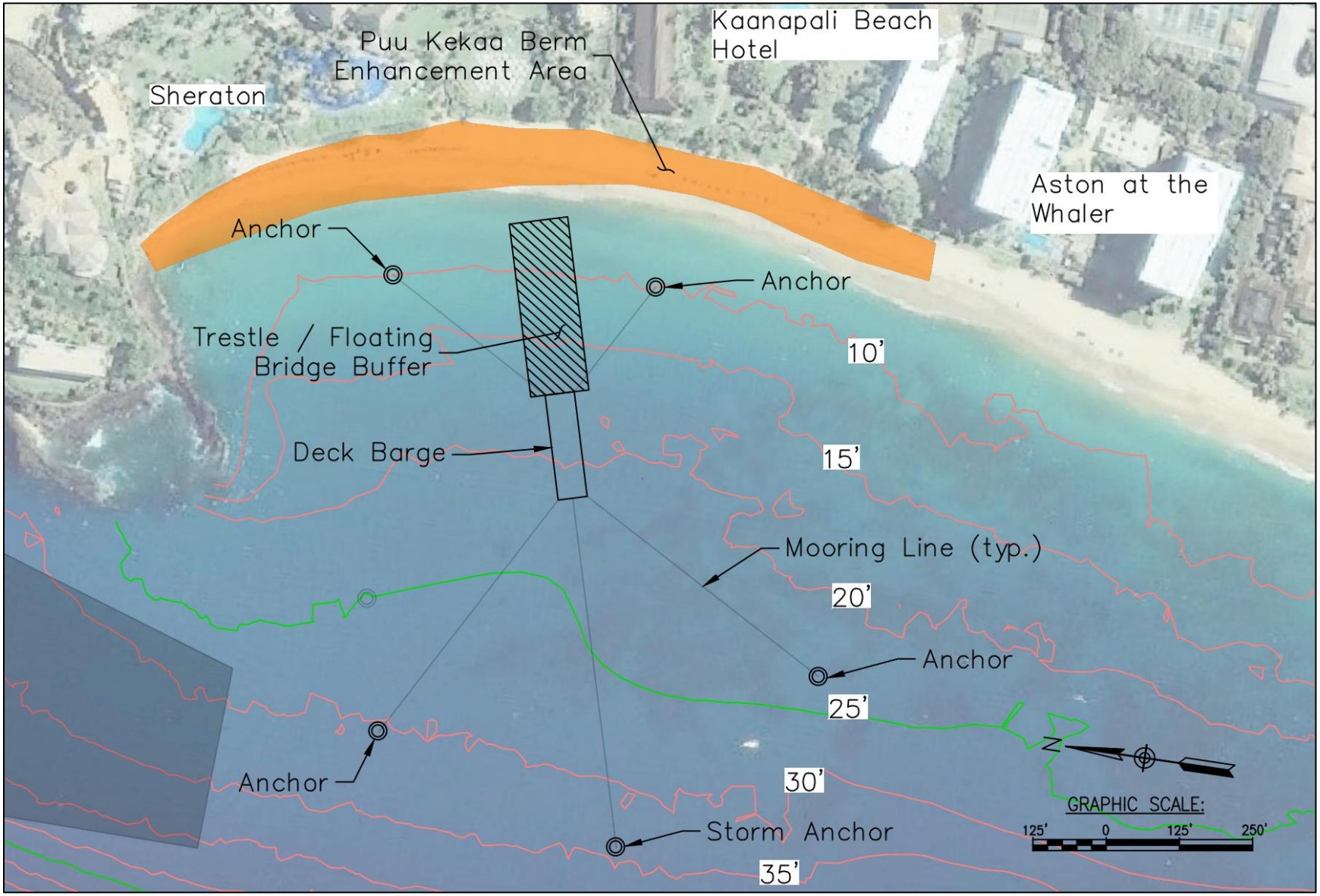


**Figure 1-15. Nearshore anchor spread for the North Offloading Location**

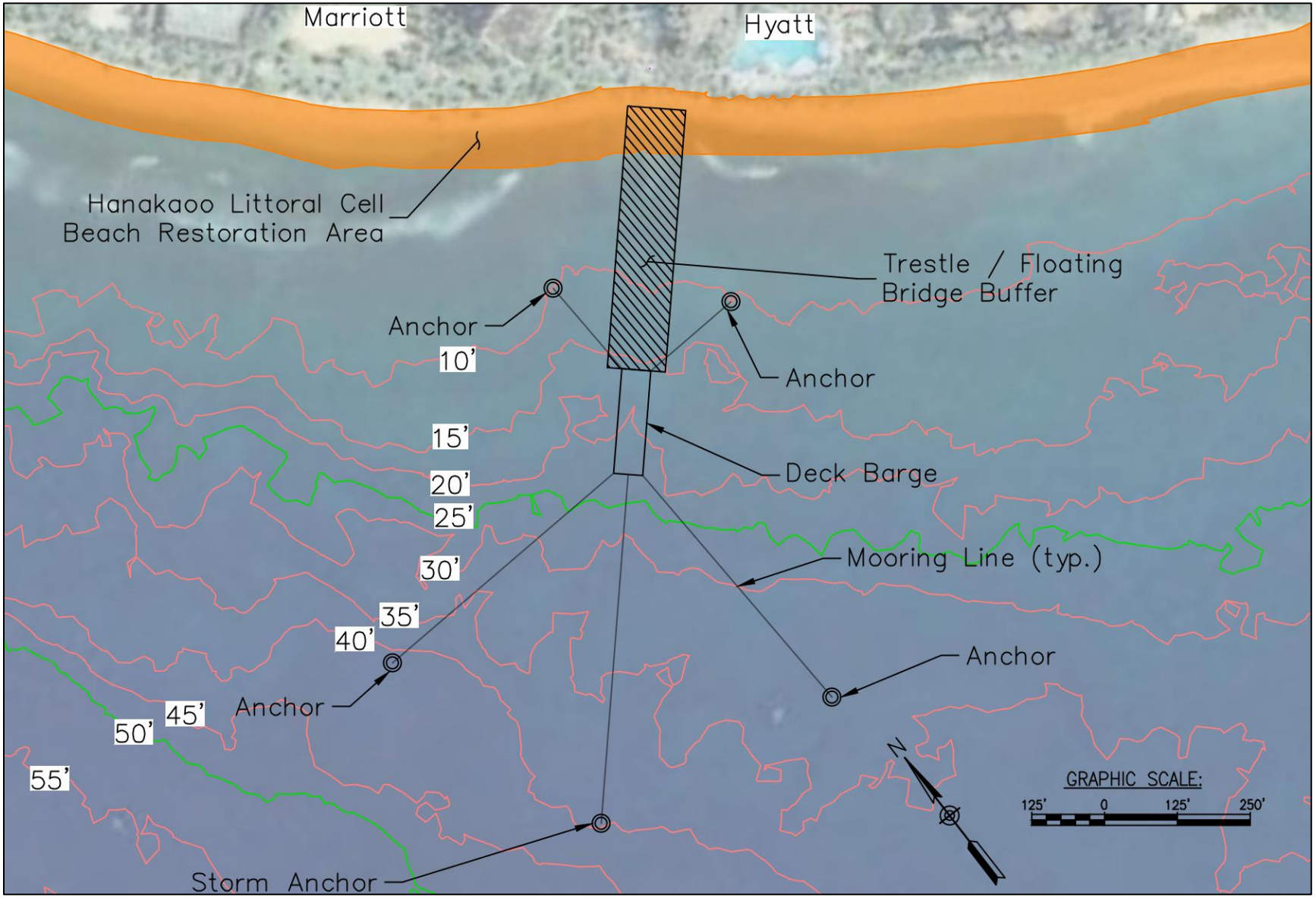


**Figure 1-16. Nearshore anchor spread for the South Offloading Location**

## 1.6 Regulatory Context

### *1.6.1 Chapter 343, Hawaii Revised Statutes Requirements*

The proposed action will require work within the State Conservation District. State funded projects and work within the State Conservation District are actions that require preparation and processing of an Environmental Assessment or an Environmental Impact Statement (EIS) per Hawaii Revised Statutes (HRS) Chapter 343. As the project could potentially have local and vicinity-related impacts along a broad reach of shoreline, an EIS is being prepared.

### *1.6.2 Special Management Area (SMA)*

The Hawaii Coastal Zone Management (CZM) Program (HRS Chapter 205A) regulates all types of land uses and activities ("development") in the Special Management Area (SMA). The SMA on Maui is regulated by the County of Maui, Department of Planning. Portions of the project, project staging areas, and ingress/egress routes that are located within the SMA will be subject to the SMA rules and regulations for the County of Maui.

Special Management Area designation are required by Chapter 205A (HRS) to promote the CZM policies and objectives for coastal areas that are in county jurisdiction. The project should therefore comply with the objectives and policies contained in 205A-2, HRS and the review guidelines contained in 205A-26, HRS.

### *1.6.3 State Conservation District*

The Board of Land and Natural Resources (BLNR) regulates uses of the State Conservation District by issuing Conservation District Use Permits (CDUP) for approved activities.

Statutes governing use administration procedures of the Conservation District are written in Hawaii Revised Statutes, Chapter 183C (HRS Chapter 183C Conservation District). Administration is further clarified by the Hawaii Administrative Rules, Title 13, Chapter 5 (HAR §13-5 Conservation District). The project area in the Conservation District is classified as a Resource Subzone. The identified land use for the project is P-16 Beach Restoration. As specified in HAR §13-5-24(c)(4), the proposed use is permitted in the Resource Subzone with the issuance of a BLNR-approved "D-1" (Board) Conservation District Use Permit for sand placement in excess of 10,000 cubic yards.

The criteria that the DLNR-OCCL will use in evaluating the project are outlined in HAR §13-5-30.

### *1.6.4 Governor's Executive Order No. 4230*

Governor's Executive Order No. 4230 grants regulation of ocean recreation, boating, and coastal activities at Kāʻanapali Beach to the Division of Boating and Ocean Recreation (DOBOR).

### *1.6.5 State Water Quality Certification*

The Clean Water Act (CWA) is the key legislation governing surface water quality protection in the United States. Sections 401, 402, and 404 of the Act require permits for actions that involve

wastewater discharges or discharge of dredged of fill material into waters of the United States. In Hawaii, the U.S. Environmental Protection Agency (EPA) has delegated responsibility for implementing the Act to the State Department of Health, Clean Water Branch (DOH-CWB).

Actions that may constitute fill into waters of the United States include:

- Placement of mooring blocks around the Puʻu Kekaʻa Sand Area
- Placement of temporary piers and mooring blocks at the North and South offloading locations
- Removal of sand from the Puʻu Kekaʻa Sand Area
- Placement of sand in the Hanakaʻōʻō Littoral Cell below the MHHW line

The Water Quality Certification (WQC) will require submission of an Applicable Monitoring and Assessment Plan (AMAP) to the DOH, which will detail the water quality sampling and testing necessary during construction and outline Best Management Practices (BMPs) that will be used to prevent contamination of coastal waters.

### *1.6.6 National Pollutant Discharge Elimination System*

Section 402 of the CWA required A National Pollutant Discharge Elimination System (NPDES) authorization any time construction activity covers an area one (1) acre in size or greater, and is intended to prevent pollutants from reaching coastal waters as a result of storm water runoff. Information required to obtain a permit include project specific details and construction drawings, receiving state water information, storm and non-storm water discharge, a Best Management Practices Plan (BMPP), and Post-Construction Pollutant Control Measures. The permit application procedure requires the applicant to show that the necessary BMPs will be in effect during the construction phase, and these BMPs must be sufficient to prevent pollution resulting from a 10-year rain event.

### *1.6.7 State Coastal Zone Management Consistency*

Enacted as Chapter 205A, HRS, the Hawaii Coastal Zone Management (CZM) Program was promulgated in 1977 in response to the Federal Coastal Zone Management Act of 1972. The CZM area encompasses the entire state, including all marine waters seaward to the extent of the state's police power and management authority, as well as the 12-mile U.S. territorial sea and all archipelagic waters. Application will be made to the State Office of Planning, CZM Program, for a CZM Consistency Determination.

### *1.6.8 Department of the Army, Section 10 and Section 404*

Department of the Army (DA) permits are issued by the U.S. Army Corps of Engineers (USACE) pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 USC § 403) and Section 404 of the Clean Water Act of 1972 (33 USC 1344). All work or structures that obstructs or alters navigable waters of the U.S will require a DA permit pursuant to Section 10. All actions that involve the discharge of dredged or fill material into waters of the U.S. will require a DA permit pursuant to Section 404. As the proposed project will involve work in the navigable waters of the

U.S. and will result in a discharge of fill material it will require a DA permit issued pursuant to both Section 10 and Section 404.

# 2. DESCRIPTION OF THE EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

## 2.1 Physical Environment

### *2.1.1 Surrounding Land Use*

Existing Condition

According to the West Maui Community Plan land use maps, the beach area at Kāʻanapali is designated as OS (Open Space). Adjacent land use includes H (hotel), B (business/commercial), and PK (park). Hanakaʻōʻō Beach Park, the Hyatt Regency Maui Resort & Spa and the Marriott's Maui Ocean Club are located adjacent to the Hanakaʻōʻō Littoral Cell Beach Restoration area. The Marriott's Maui Ocean Club, the Kāʻanapali Aliʻi, the Westin Maui Resort and Spa, and Whalers Village commercial center are located adjacent to the Hanakaʻōʻō Point Berm Enhancement area. The Kāʻanapali Beach Hotel and the Sheraton Maui Resort & Spa are located adjacent to the Puʻu Kekaʻa Berm Enhancement area.

Potential Impacts and Proposed Mitigation Measures

The proposed project is an environmental restoration project, and does not include the construction of permanent structures or alteration of land use at Kāʻanapali Beach. The proposed project is anticipated to have negligible impact to the surrounding land use.

### *2.1.2 Climate*

Existing Condition

The Hawaiian Island chain is situated south of the large eastern Pacific semi-permanent high pressure cell, the dominant feature affecting air circulation and climate in the region. Over the Hawaiian Islands, this high-pressure cell produces persistent northeasterly winds called tradewinds. During the winter months, cold fronts sweep across the north-central Pacific Ocean, bringing rain to the Hawaiian Islands and intermittently modifying the tradewind regime. Thunderstorms, which are rare but most frequent in the mountains, also contribute to annual precipitation.

Due to the tempering influence of the Pacific Ocean and their low-latitude location, the Hawaiian Islands experience extremely small diurnal and seasonal variations in ambient temperature. Average temperatures in the coolest and warmest months in Lāhainā are 73˚F (January) and 79.5˚F (August). These temperature variations are quite modest compared to those that occur at inland continental locations.

Topography and the dominant northeast tradewinds are the two primary factors that influence the amount of rainfall on any given location on Maui. Near the peaks of the West Maui Mountains and the windward slope of Haleakala, which are fully exposed to the tradewinds, rainfall averages nearly 250 inches per year. On the leeward side of the island, where the project is located, the rainfall is much lower with average annual rainfall in Kāʻanapali being less than 15 inches per year. Although the project area is on the leeward side of the island, the humidity is still moderately high, ranging from mid-60 to mid-70 percent.

During the summer months of April through October, the tradewinds occur 80-95 percent of the time with average speeds of 10-20 mph. The tradewind frequency decreases to 50-60 percent of the time during the winter months, when southerly or "Kona" winds may occur. Kona winds are generally associated with local low pressure systems. Kona conditions occur about 10 percent of the time during a typical year, with winds ranging from light and variable to gale strength. A severe, relatively long duration Kona storm which occurred in January 1980 produced sustained wind speeds of 30 mph, with gusts in excess of 50 mph, from the southwest. Winds of hurricane strength occur infrequently in Hawaii, but they are sometimes important for design purposes because of their intensity.

The West Maui Mountains have a blocking effect that decreases the influence of tradewinds in the Kāʻanapali area and causes the winds to come from a more northerly directions (following the land contours). A land-sea breeze condition caused by the diurnal heating and cooling of the land often predominates in coastal areas. Wind speeds in the channels between Maui, Molokaʻi, and Lānaʻi can be significantly faster due to the funneling effect caused by the land masses.

Potential Impacts and Proposed Mitigation Measures
The proposed project is anticipated to have negligible impact on the climate.

### *2.1.3 Topography*

Existing Condition
The project is located within the active beach area of Kāʻanapali Beach. The active beach is the sandy portion of the beach profile that may interact with the ocean. The beach profile shape varies along Kāʻanapali Beach throughout the year. The average beach crest elevation is +10 feet MLLW. The average beach face slope is 1 vertical unit to 7 horizontal units. The dry beach width (the distance between the beach crest and vegetation line) varies from 0 feet fronting the Hyatt and the Marriott to up to 220 feet at Hanakaʻōʻō Point. The dry beach is on average narrower within the Hanakaʻōʻō Littoral Cell compared to the dry beach within the Kāʻanapali Littoral Cell.

Potential Impacts
The proposed project is intended to alter the topography along Kāʻanapali Beach by building the beach wider and/or increasing the beach berm elevation compared to its present configuration. Restoring the beach to the approximate position shown in the 1988 aerial photograph would widen the dry beach by between 41 and 78 feet. A plan view of the proposed beach restoration was shown previously in Figure 1-4. Profile views of the proposed beach restoration were shown in Figure 1-5 and Figure 1-6.

The berm enhancement portion of the project would increase the elevation of the beach berm by 3.5 feet fronting the Marriott, Kāʻanapali Aliʻi, Westin, and Whaler's Village ("Hanakaʻōʻō Point Berm Enhancement") and fronting the Sheraton and the Kāʻanapali Beach Hotel ("Puʻu Kekaʻa Berm Enhancement"). A plan view of the Hanakaʻōʻō Point Berm Enhancement was shown previously in Figure 1-7. Profile views of the berm enhancement were shown in Figure 1-8. A plan view of the Puʻu Kekaʻa Berm

Enhancement was shown in Figure 1-9. Profile views of the berm enhancement were shown in Figure 1-10.

### *2.1.4 Sand Characteristics*

Kāʻanapali Beach is composed primarily of carbonate sand with a small basalt component (less than 10% by mass) and minimal fine material. Carbonate sand is the most common type of beach sand along Hawaii's shorelines and is the product of bioerosion and biological production on offshore reefs. Carbonate sand can be composed of pieces of coral, algae, sea urchin spines, shells, or other marine organisms that have been tumbled in the surf or along the ocean floor. The composition of sand is determined by the relative abundance of each species in the region and, therefore, varies with location.

Carbonate sands range in color from pure white to yellow, brown, and dark grey. Beyond the aesthetic value, color also affects temperature, as darker sands achieve higher temperatures under the bright tropical sunlight than a lighter shade of sand. Native beach sand in Kāʻanapali is golden or tan in color.

Both density and grain size play an important role in how sand behaves on a beach. Grain size on Hawaii beaches can range from a very fine silt to large coral cobbles. The density of calcium carbonate crystals is roughly a constant 2.72 g/cm$^3$; however, microscopic pores and hollow grains make the effective density of individual grains somewhat lower. Smith and Cheung (2002) found the effective density of carbonate sand grains to be 2.4 g/cm$^3$.

The grain size characteristics of sand are typically determined by passing or shaking a sand sample through a series of sieves with successively smaller openings. The amount of sand remaining on each sieve is weighed, and the corresponding percentage that this weight represents of the entire sample weight is computed. The results are presented graphically by plotting the percentage of the sample that is collected at each particular grain size on a logarithmic graph, with grain size plotted on a log base 10 x-axis.

The median diameter (diameter at which 50% of the sample's mass is composed of particles less than this value), or $D_{50}$, is often used by engineers to represent the grain size of a sample. $D_{16}$ (diameter at which 16% of the sample's mass is composed of particles less than this value) and $D_{84}$ (diameter at which 84% of the sample's mass is composed of particles less than this value) are used to quantify the range of grain sizes present in a sample known as sorting, $\sigma$, defined by:

$$\sigma = \frac{\varphi_{84} - \varphi_{16}}{2}$$

where $\varphi = -\log_2 D$. Descriptive sorting values are presented in Table 2-1.

**Table 2-1. Sorting value descriptions**

| ***Sorting Range (Φ)*** | ***Description*** |
|---|---|
| 0.00 – 0.35 | very well sorted |
| 0.35 – 0.50 | well sorted |
| 0.50 – 0.71 | moderately well sorted |
| 0.71 – 1.00 | moderately sorted |
| 1.00 – 2.00 | poorly sorted |
| 2.00 – 4.00 | very poorly sorted |
| > 4.00 | Extremely poorly sorted |

Composite beach samples were taken at locations within the Hanakaʻōʻō and Kāʻanapali Littoral Cells. Composite beach samples contain sand from the beach berm, beach crest, beach face, and beach toe. Sample locations are listed in Table 2-2. Grain size analysis of representative sand samples, presented graphically in Figure 2-1, indicate that the average median grain size is approximately 0.31 mm within the HLC and 0.36 mm within the KLC. Both of these average sizes are considered medium grained sand according to the Wentworth Grain Size Classification.

Beaches typically have a higher degree of sorting (i.e., a narrower distribution of grain size) than other environments due to the mediums doing the sorting (sea water and air) and the processes that move sand (waves, currents, and wind). In addition, open ocean beaches tend to have relatively low percent, by mass, of fines, as wave energy and currents mobilize these smaller grains and transport them away from the beach face into deeper water. Wind can also deliver finer grains across the backshore to dune systems. The sands within Kāʻanapali Beach have both of these characteristics: higher degree of sorting and very low percentage of fines.

Table 2-2 shows the beach samples to be well or moderately well sorted with < 0.16% fines by mass. Figure 2-1 displays each sample's grain size distribution, for comparison to adjacent areas.

**Table 2-2. Sediment size characteristics, Kāʻanapali Beach samples**

| Profile Name | Littoral Cell | $D_{50}$ (mm) | Sorting (ϕ) | % Fine |
|---|---|---|---|---|
| K1 | Hanakaʻōʻō | 0.21 | 0.67 | 0.00 |
| K2 | Hanakaʻōʻō | 0.36 | 0.70 | 0.11 |
| K4 | Hanakaʻōʻō | 0.32 | 0.50 | 0.16 |
| K5 | Hanakaʻōʻō | 0.30 | 0.52 | 0.14 |
| K6 | Hanakaʻōʻō | 0.31 | 0.56 | 0.15 |
| K7 | Kāʻanapali / Hanakaʻōʻō | 0.37 | 0.59 | 0.00 |
| K11 | Kāʻanapali | 0.34 | 0.51 | 0.00 |
| K12 | Kāʻanapali | 0.37 | 0.79 | 0.00 |
| HLC Average | Hanakaʻōʻō | 0.31 | 0.64 | 0.09 |
| KLC Average | Kāʻanapali | 0.36 | 0.54 | 0.00 |
| Kāʻanapali Average | All | 0.32 | 0.63 | 0.07 |

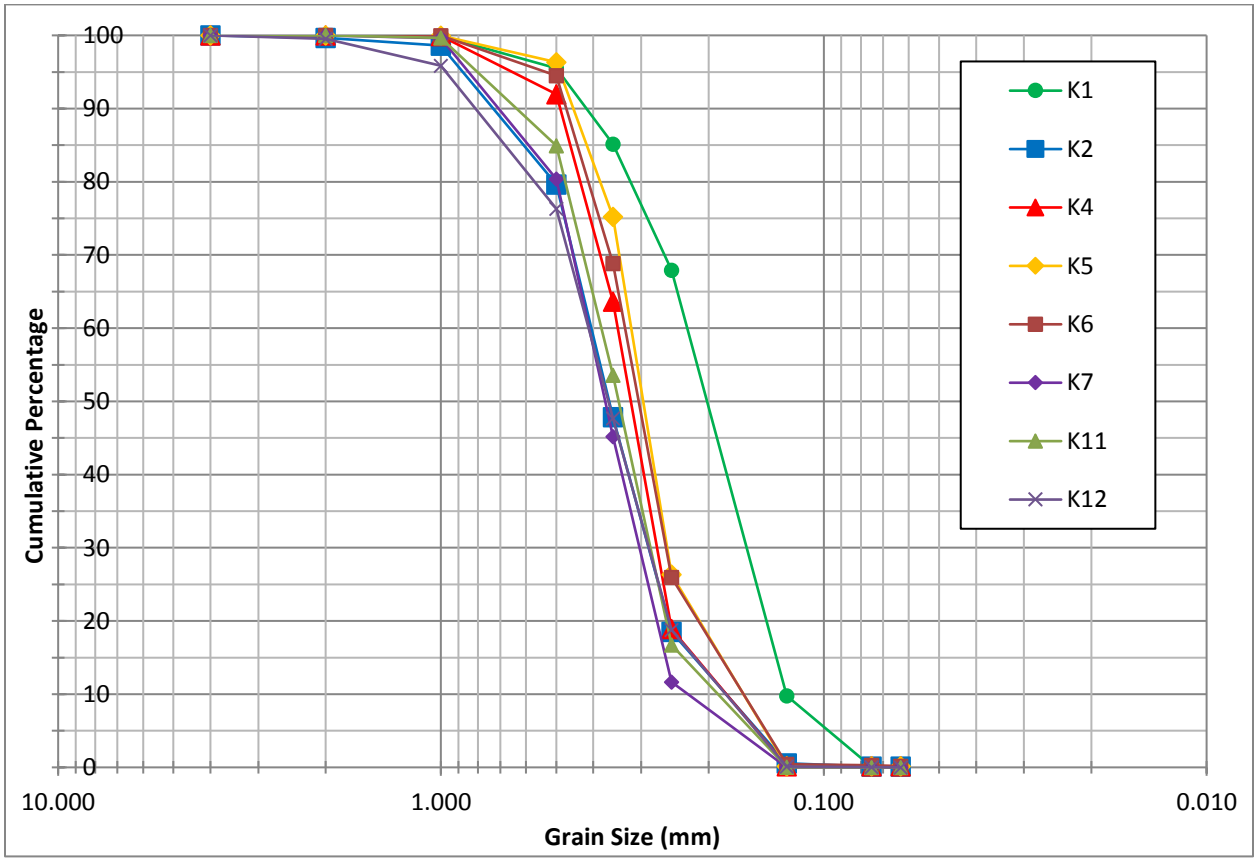


**Figure 2-1. Sand grain distribution, Kāʻanapali Beach samples**

Potential Impacts and Proposed Mitigation Measures

A critical component for successful beach restoration projects is availability of suitable sand for placement. Placed sand should closely match the grain size distribution, color,

composition, and density of the native beach sand. Deviation from these characteristics may result in unpredictable behavior of the beach restoration project. In addition, the State Department of Land and Natural Resources (DLNR) Small Scale Beach Nourishment guidelines specify that sand used to nourish a beach must meet several specific requirements:

- The sand shall contain no more than six (6) percent silt material (sand grain size smaller than 0.074 mm).
- The sand shall contain no more than ten (10) percent coarse material (sand grain size greater than 4.76 mm).
- The grain size distribution would fall within 20% of the existing beach grain size distribution.
- The overfill ratio of the fill sand to existing sand shall not exceed 1.5.
- The sand would be free of contaminants such as silt, clay, sludge, organic matter, turbidity, grease, pollutants, and others.
- The sand would be primarily composed of naturally occurring carbonate beach or dune sand.

Multiple sources of marine and terrestrial sand were carefully evaluated in terms of quality, quantity, recovery cost, and proximity to Kāʻanapali Beach. Initial investigations for this project concluded that there was no readily available, economical terrestrial source of sand and that local offshore sand resources should be evaluated. Offshore investigations for this project took place along the nearshore reef complex offshore to a water depth of approximately 200 feet. The search included a thorough investigation of the seafloor from just north of Mala Wharf (south of Kāʻanapali Beach) to offshore of Kahekili Beach Park (north of Puʻu Kekaʻa). Through multiple sand investigation efforts, spanning over a decade and including multiple square miles of seafloor, a suitable sand deposit was identified near Puʻu Kekaʻa, referred to in the rest of this document as the "Puʻu Kekaʻa Sand Area".

The proposed project includes recovering 75,000 cubic yards of sand from 8.5 acres of the Puʻu Kekaʻa Sand Area for use in restoring the beach in the HLC and enhancing the beach berm in the KLC. Seventeen vibracore samples, ranging in length from 2 to 8.5 feet, were obtained by Sea Engineering at various locations in the Puʻu Kekaʻa Sand Area during field operations in 2008 and 2016. Grain size analysis indicates that the Puʻu Kekaʻa Sand Area samples meet the grain size requirements as specified by DLNR. Figure 2-2 and Figure 2-3 show the average grain size distribution for the Puʻu Kekaʻa Sand Area compared with the average littoral cell grain size distributions and +/- 20% DLNR limits for the HLC and KLC, respectively.

Even sand that is suitable for placement can have undesirable performance that is difficult to predict. Potential problems include compaction and lithification of placed sand, coral cobbles in the placed sand, anoxic conditions in placed sand, and change in beach color.

Compaction occurs when grains are pressed together, reducing pore space between them. Heavily compacted sand can become partially or wholly lithified (solidified), having

consistency ranging from compact but friable (able to be easily broken down into sand grains), to more rock-like. Indurated (hardened) beach rock cannot be easily broken up into individual sand grains.

Sand compaction was observed following the 2012 Waikiki Beach Maintenance project along the truck haul route between the dewatering basin and the sand placement area. A 1- to 3-foot tall hardened berm formed along the seaward edge of the haul route. SEI engineers attributed this sand compaction to heavy loaded dump trucks traveling over the beach fill. Additionally, chemical processes in the form of carbonate dissolution likely contributed to the hardening of the beach fill.

Sand fill for the present project would be moved along the beach from the offloading locations using equipment similar to that used in the Waikiki Beach Maintenance project. The combination of pressure, dissolution of calcium carbonate material from fresh water, and the presence of fines could increase the chances of induration (hardening) of the placed sand. Compaction from trucks will be minimized by mechanically loosening or turning the sand along the truck haul route at regular intervals. Moreover, haul routes can be monitored and plowed after project completion, if needed.

Coral cobbles and rubble, which occur naturally in offshore sand deposits, were an issue during the 2012 Waikiki Beach Maintenance project. These larger grains were uncomfortable for beach users, as they tended to accumulate in the nearshore at the toe of the beach. The potential for coral rubble was addressed by engineers during the design process, and efforts were made to reduce recovery of large pieces of rubble from the offshore sand deposit. However, the amount of rubble reaching the beach still exceeded construction specifications, specifically for long and narrow pieces of rubble that were able to fit through a screen on the hydraulic sand pump. After placement, the rubble became concentrated at the beach toe, just offshore of the waterline. The contractor removed coral rubble by hand, and the Waikiki Improvement Association organized volunteer rock picking efforts.

Though the grain size distribution of the sediment in the Puʻu Kekaʻa Sand Area has been thoroughly investigated, coral rubble, or sediment grains that are cobble-sized or larger, may exist sporadically within the sand deposit. During offshore sand sample recovery, no coral rubble larger than 1 inch in diameter was encountered at the Puʻu Kekaʻa sand deposit. Additionally, air jet probing encountered no layers of coral rubble between the sand surface and 6 feet below the ocean floor. However, rubble may exist in discreet pockets within the sand deposit.

One of the disadvantages of clamshell dredging is that there is no method to screen coral rubble from the recovered sand at the dredge site. The contractor, therefore, should monitor the sand for coral rubble as the clamshell bucket empties the sand onto the barges, transfers the sand to shore, and then places the sand on the beach. If excessive coral rubble is encountered in an area within the offshore sand deposit, sand recovery operations will move to a different location within the deposit.

Screening the sand as it is offloaded from the barges is possible, but would drastically slow production and could still allow cobbles to enter the beach system. Visual inspection of the sand as it is being recovered is an effective way to minimize cobble content by identifying any areas that have higher volumes of large grains. Additionally, sieve testing will be performed periodically on the deck barge as sand is being recovered by the clam shell bucket. If excessive cobble is encountered, recovery operations will be relocated within the Puʻu Kekaʻa Sand Area.

A suitable offshore sand source would preferably match the color of the existing beach sand. While natural calcareous beaches can range in color from light brown to white, sand in offshore deposits usually turns a gray color as a result of anoxic conditions typically produced by a lack of wave action and associated mixing and aeration of the sand, or with depth within the deposit. Figure 2-4 shows a dry color comparison of offshore samples from the Puʻu Kekaʻa Sand Area with native beach sand. Offshore samples in the figure were taken from various layers in the offshore sand deposit, and dried under direct sunlight. All samples pictured represent a typical color for that layer in the area where the vibracore sample was taken. The color of the offshore samples, after several days of drying, closely match the native beach sand, though some samples have a slightly greyer color. Color comparison tests and drying suggest that the grey may fade in sunlight. In addition, mixing of offshore sand and native sand is expected to produce a final color may be closer to that of the existing beach.

Sand recovered from anoxic environments can also have an unpleasant scent. Based on previous sand recovery efforts in Hawaii, any odor from recovered sand is anticipated to fade with exposure to sun and air.

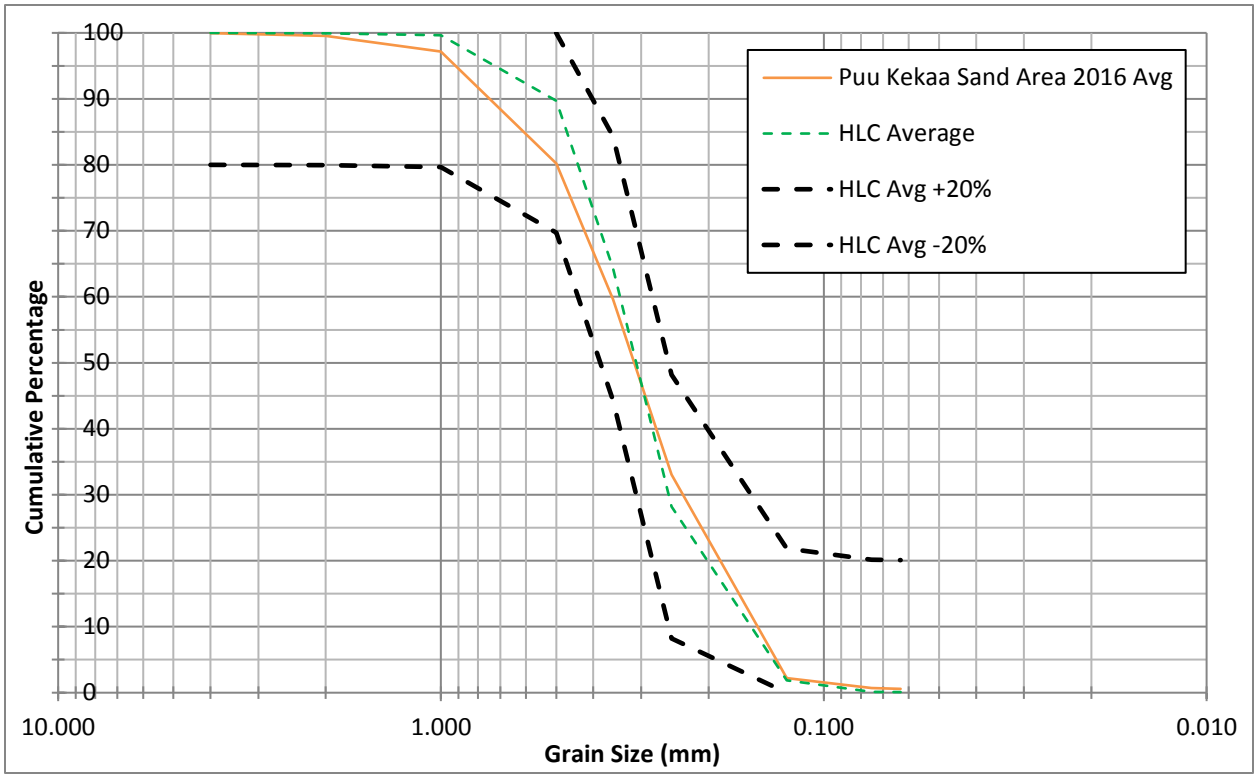


**Figure 2-2. 2016 Puʻu Kekaʻa Sand Area average with HLC average and ±20% limits (dashed)**

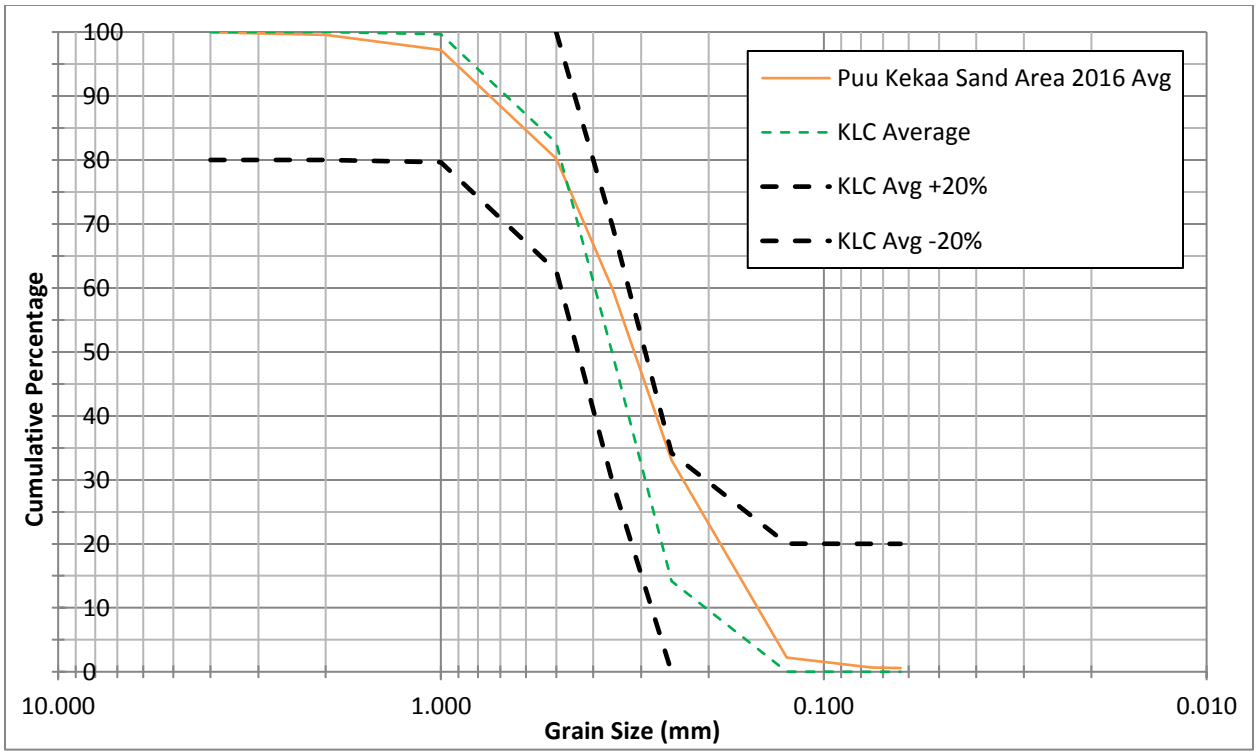


**Figure 2-3. 2016 Puʻu Kekaʻa Sand Area average with KLC and ±20% limits (dashed)**

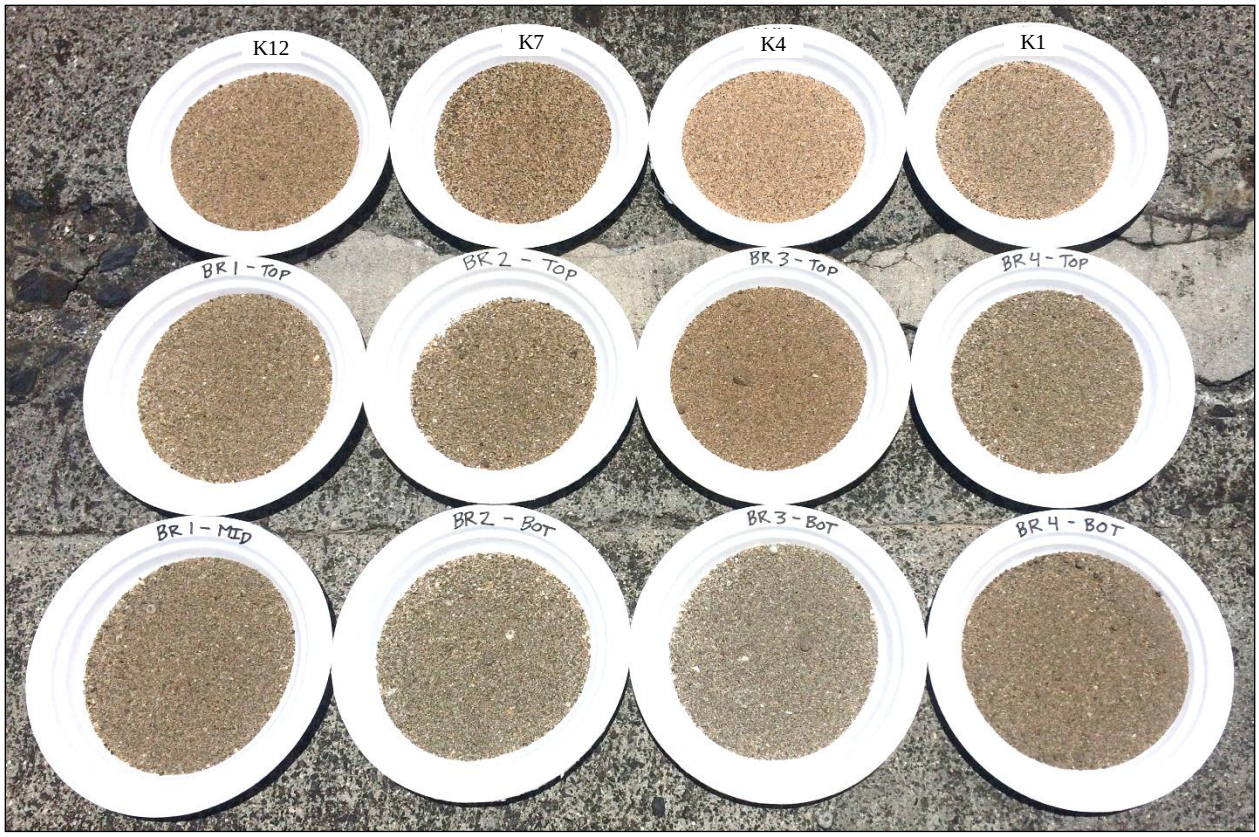


**Figure 2-4. Dry color comparison between native beach sand (top row) and offshore sand (bottom two rows)**

### *2.1.5 Flood and Tsunami Hazard*

Existing Condition

Flood hazards for the portion of Kāʻanapali in which the project is located are depicted on Flood Insurance Rate Map (FIRM) Flood Sheets 1500030351F and 1500030353F. The proposed project is in Zone VE with a base flood elevation that varies between 9 and 11 feet above MSL. The maps indicates that the shoreline is exposed to flooding caused by storm waves and tsunami.

Potential Impacts and Proposed Mitigation Measures

The proposed project will extend the shoreline seaward, increasing the space between the water and the existing backshore infrastructure. This will greatly increase the wave energy dissipating properties of the beach and decrease the landward extent of wave runup. The increased energy dissipation of the widened beach is anticipated to reduce the susceptibility to backshore flooding from large wave events.

The proposed project is anticipated to have negligible impact on the existing tsunami flood hazard because the elevation of the backshore will remain unchanged.

### *2.1.6 Flora and Fauna*

Existing Condition

The Kāʻanapali Resort is professionally landscaped. The vegetation immediately mauka of the active beach is composed of typical coastal vegetation, including naupaka and beach morning glory. This transient vegetation has the tendency to grow out onto the active beach berm when the beach is wide. Grasses, both native and introduced, and a wide variety of palms can be found in the Beachwalk area between the active beach and the hotels.

Fauna found in the beach restoration and berm enhancement areas include shorebirds, coastal crustaceans, and other sandy coastal ecosystem organisms.

Potential Impacts and Proposed Mitigation Measures

Berm enhancement involves placing sand on the beach between the beach crest and the stable vegetation line. Small amounts of transient vegetation such as naupaka and morning glory that has overgrown onto the active beach may be covered during the Berm Enhancement portions of the project. Overall, the proposed project is anticipated to have negligible impact on the flora and fauna on Kāʻanapali Beach.

### *2.1.7 Marine Biology*

Existing Condition

The documented structure of the marine communities fronting the beach restoration and the Hanakaʻōʻō Point Berm Enhancement area indicate that within the nearshore area where waves regularly break, the physical habitat is either sand or a flat barren limestone bench with essentially no benthic community and no corals present (Marine Research Consultants, Inc. 2017). At intermediate distances from shore, corals begin to colonize the hard surfaces. At deeper zones wave forces and sand resuspension are reduced to a level where coral communities can settle and grow, and the deep reefs are characterized by high densities of a variety of species of Hawaiian reef corals.

The Puʻu Kekaʻa Berm Enhancement area is located closest to the sand borrow site, and as a result is more influenced by sand scour and coverage of the reef surface than the other two survey areas. The nearshore area consists of a continuous sand bottom that is a state of near continuous resuspension. Seaward of the sand flat, bottom composition consists of irregularly spaced fossil limestone reef structure that contain only scattered coral colonies, primarily of the species *pocillopora meandrina* (cauliflower coral). The relatively barren reef platform extends approximately 150 m from the shoreline, where it abuts a sand plain. Tufts of the green calcareous alga *halimeda* occur in the sand plain.

The Puʻu Kekaʻa Sand Area is a broad plain of white-grey sand located within a larger sand field that begins inshore at Puʻu Kekaʻa and continues offshore to depths greater than 200 feet. The sand field runs parallel to shore along the length of the Kāʻanapali Littoral Cell and the Honokowai Littoral Cell. South of Hanakaʻōʻō Point, the sand field is broken up by patches of reef and pavement. The only prominent biotic colonizer of the sand plain are patches of halimeda. No coral or hard bottom was observed during reconnaissance swims through the sand borrow area. "Benthic infauna" are aquatic animals that live within

the bottom substratum (sand) rather than on its surface. Common infauna found in Hawaii include various types of worms, arthropods, echinoderms, and mullusks. An assessment of the infauna in the Puʻu Kekaʻa Sand Area will be carried out as part of the environmental review process and included in the DEIS.

Potential Impacts and Proposed Mitigation Measures
An assessment of the potential impact to marine biotic communities will be carried out as part of the environmental review process and included in the DEIS.

### *2.1.8 Protected Species*

Existing Condition
The beaches and coastline of Maui are used by the endangered Hawaiian monk seal (*monachus schauinslandi*) for hauling out and for pupping and nursing. These marine mammals are frequently observed in the waters of Kāʻanapali. The majority of monk seal sighting information collected in the main Hawaiian Islands is reported by the general public and is highly biased by location and reporting effort. Systematic monk seal count data come from aerial surveys conducted by the Pacific Islands Fisheries Science Center (PIFSC). Aerial surveys of all the main Hawaiian Islands were conducted in 2000-2001 and in 2008 (Baker and Johanos, 2004, PIFSC unpublished data).

Reports by the general public, which are non-systematic and not representative of overall seal use of main Hawaiian Islands shorelines, have been collected in the main Hawaiian Islands since the early 1980s. The NOAA Monk Seal Population Assessment Program keeps records of monk seal sightings throughout the populated Hawaiian Islands. A sighting is defined as a calendar day during which an individual seal was documented as present at a given location. It should be noted that the majority of monk seal sightings are reported when seals are sighted onshore.

A NOAA report of monk seal sightings was produced for this project (Mercer, 2015). The report compiled sightings from Hanakaʻōʻō Beach Park to Kahekili Beach Park for the years 2005 through 2014. For that time period, 245 monk seals sightings were documented, with more than half occurring near Puʻu Kekaʻa. There were only 35 monk seal sightings during that time period from Hanakaʻōʻō Beach Park to Hanakaʻōʻō Point. No births have been documented for the area.

As of 2015, both the Main Hawaiian Islands and the remote Northwestern Hawaiian Islands are considered critical habitat for this species (50 CFR 226), as was published in NOAA's Final Rule (80 FR 50925). The marine environment from 200 m below sea level to the shoreline, and the terrestrial environment to 5 m inland of the shoreline are considered Hawaiian monk seal critical habitat at the project site. The project area is located in the Terrestrial Critical Habitat segment between MA 61 and MA 62 on Maui's western coastline.

The humpback whale or *kohola* (*megaptera novaeangliae*) was listed as endangered in 1970 under the ESA. In 1993, it was estimated that there were 6,000 humpback whales in the North Pacific Ocean, and that 4,000 of these regularly came to the Hawaiian Islands.

The population is estimated to be growing at between 4 and 7% per year. Today, as many as 10,000 humpback whales may visit Hawaii each year (HIHWNMS, 2014). Humpback whales normally frequent Hawaiian waters annually from November to May with the peak between January and March (HIHWNMS, 2014).

Of the sea turtles found in the Hawaiian Islands, only the green sea turtle (*chelonia mydas)* is common in the project vicinity. The hawksbill sea turtle (*eretmochelys imbricata*) is rare in the Hawaiian Islands and is only known to nest in the southern reaches of the state (NMFS-USFWS, 1998; NOAA-NMFS, 2007). In 1978, the green sea turtle was listed as a threatened species under the Endangered Species Act (ESA; USFWS, 1978, 2001). Since protection, the green sea turtle has become the most common sea turtle in Hawaiian waters with a steadily growing population (Chaloupka et al., 2008). Green sea turtle nesting mostly occurs on beaches of the Northwestern Hawaiian Islands, with 90% occurring at French Frigate Shoals (Balazs et al., 1992). None of the Hawaiian sea turtles is known to nest in the project vicinity.

The green sea turtle diet consists primarily of benthic macroalgae (Arthur and Balazs, 2008), which the shallow reefs of the main Hawaiian Islands provide in abundance. Red macroalgae generally make up 78% of their diet, whereas green macroalgae make up 12%. Turbidity (murky water) does not appear to deter green sea turtles from foraging and resting areas and construction projects in Hawaii have found sea turtles adaptable and tolerant of construction-related disturbances (Brock, 1998a, b). The preferred algal food species are found near the project site, and turtles are commonly observed foraging in the vicinity of Kāʻanapali Beach.

<u>Potential Impacts and Proposed Mitigation Measures</u>
An assessment of the potential impact to protected species will be carried out as part of the environmental review process and included in the DEIS.

### *2.1.9 Air Quality*

<u>Existing Condition</u>
The EPA has set national ambient air quality standards (NAAQS) for ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, 2.5-micron and 10-micron particulate matter (PM2.5 and PM10), and airborne lead. The NAAQS establish the maximum concentrations of pollution considered acceptable, with an adequate margin of safety, to protect public health and welfare. The State of Hawaii has also adopted ambient air quality standards for certain pollutants, some of which are more stringent than the Federal standards. The State currently has set standards for 5 of the 6 criteria pollutants (excluding PM2.5) in addition to hydrogen sulfide (DOH, 2003).

Generally, air quality in the area is excellent. The State of Hawaii DOH monitors ambient air quality on Maui using a system of 3 monitoring sites. The primary purpose of the monitoring network is to measure ambient air concentrations of the 6 criteria NAAQS pollutants. DOH monitoring data for 2008 shows that at no time in the past year did air quality exceed the short-term or long-term State or National standards for the 6 pollutants measured [particulate matter (PM2.5 and PM10), nitrogen dioxide (NO2), sulfur dioxide

(SO2), carbon monoxide, and hydrogen sulfide]. The State of Hawaii Department of Health's only ozone monitoring station is located at Sand Island on Oʻahu. Existing ozone concentrations at that location also meet State and Federal ambient air quality standards.

Potential Impacts and Proposed Mitigation Measures

Because most of the work will take place on the sandy shoreline, the preferred alternative differs from many construction projects in that it involves little or no on-site soil disturbance that could result in particulate emissions (i.e., dust or dirt). Potential sources of air pollution as a result of the project are related to the construction phase.

During the actual construction process, construction activities will create temporary degradation in air quality in the immediate vicinity of the project area. This negative impact to air quality will be limited to typical work hours, and will end once the beach nourishment and berm enhancement sand is in place. As part of the construction process, the contractor will observe all BMPs to keep construction related emissions to the lowest practicable levels.

Short-term degradation of air quality may occur due to emissions from construction equipment and would include carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOCs), directly-emitted particulate matter ($PM_{10}$ and $PM_{2.5}$), and toxic air contaminants such as diesel exhaust particulate matter. Sulfur dioxide ($SO_2$) is generated by oxidation during combustion of organic sulfur compounds contained in diesel fuel. Off-road diesel fuel meeting Federal standards can contain up to 5,000 parts per million (ppm) of sulfur, whereas on-road diesel is restricted to less than 15 ppm of sulfur.

These minor effects on air quality are short-term in duration and, therefore, will not result in adverse or long-term impacts. Implementation of the following measures will reduce any air quality impacts resulting from construction activities:

- Apply water or dust palliative to the site and equipment as frequently as necessary to control fugitive dust emissions.
- Properly tune and maintain construction equipment and vehicles.
- Locate equipment and materials storage sites as far away from hotels and commercial uses as practical. Keep construction areas clean and orderly.

Once construction is completed and construction equipment leaves the site, the project is anticipated to have negligible long-term air emissions or impact on air quality.

### *2.1.10 Water Quality*

Existing Condition

Results of a water quality reconnaissance survey conducted in 2017 indicate a small component of groundwater entering the ocean near the shoreline. The groundwater input is rapidly mixed to background coastal oceanic values through wave action, and likely only affects the very nearshore waters where macrobenthos (corals and algae) do not occur. Turbidity of the water column is peak at the shoreline and decreases steadily with distance from shore as a result of wave resuspension of naturally occurring bottom sediments.

State of Hawaii Department of Health Water Quality Standards (HDOH-WQS) that apply to the areas offshore of Kāʻanapali Beach Restoration area classify the area as "open coastal water" in HRS Chapter §11-54-6(b). Two sets of standards are listed depending on whether an area receives more than 3 million gallons per day (mgd) of freshwater input per shoreline mile ("wet standards"), or less than 3 mgd of freshwater input per shoreline mile ("dry"). As the Kāʻanapali shoreline area probably receives less than 3 mgd per mile, dry criteria is appropriate for this area.

The HDOH-WQS are also separated into three standards: geometric means, "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time." As these classifications require multiple samplings, they cannot be used for a strict evaluation of whether waters at the sampling site were within compliance standards. However, these values provide a guideline to evaluate the overall status of sampled waters in terms of the relation with State standards.

During a reconnaissance survey in 2017, the only nutrient constituents to exceed State of Hawaii water quality standards for the "not to exceed more than 10% of the time" criteria under dry conditions were:

- Nitrate-nitrogen ($NO_3^-$) at the shoreline of the HLC and KLC
- Several values of ammonium nitrogen ($NH_4^+$) within 25 m offshore
- Turbidity at the shoreline of the KLC

The elevated concentration of $NO_3^-$ near the shoreline is likely a result of mixing of groundwater with ocean water. The elevated concentrations of turbidity are likely a result of resuspension of fine-grained naturally occurring sediment by breaking waves in the nearshore zone. Beyond 50 m from shore, all values of turbidity were well below the standards.

When the active beach is narrow, backshore bank erosion can occur during periods of high wave and water levels. Backshore fill at Kāʻanapali has been observed to be composed of sediment with a finer grain size than the native beach sand. The material can become suspended by wave action and transported offshore. This can cause elevated turbidity levels offshore that can be harmful to coral reef health.

<u>Potential Impacts and Proposed Mitigation Measures</u>
Though sand recovered from the Puʻu Kekaʻa Sand Area satisfies the DLNR requirements for beach-quality sand (see Section 2.1.4), it still has some fine content that will be winnowed from the beach system and moved offshore as the beach is reshaped by wave action. Recovery, transport, and placement of carbonate sand can also increase the percent of fines through mechanical abrasion of the friable grains leading to more potential for turbidity due to the construction process.

Nearshore turbidity is anticipated along the beach restoration shoreline during construction. Turbidity occurs when fine sediment particles are suspended in the water column. Turbidity is anticipated to be a temporary construction impact, and would

naturally dissipate as fine suspended sediment is diluted with clean seawater and is transported away. Silt curtains and containment barriers would be deployed along the shoreline where sand placement is occurring to contain the turbidity.

Offshore turbidity is also expected at the dredge site. As the clamshell bucket grabs sand from the seafloor, it would disturb fine particles adjacent to the bucket. As the bucket is raised through the water column, minor volumes of sand containing fine particles would escape the bucket and be released into the water column. Turbidity at the dredge site will be reduced by using an environmental clamshell bucket, which is an industry best practice and has been used to minimize turbidity during dredging of harbor channels in Hawaii. Environmental clamshell buckets typically have tighter seals and overlapping sides. These buckets are designed to minimize sediment loss from within the bucket, resuspension at the dredge site, and water entrainment with each grab.

Approximately 0.5% material grabbed by the clamshell bucket will be released into the water column during the recovery. Turbidity generated from dredging operations at Puʻu Kekaʻa is expected to have a net transport to the south, with the currents moving parallel to shore. The nearest live corals down-current from the dredge site are located approximately 3,000 feet to the south, towards Hanakaʻōʻō Point. While the sand sized particles will fall out of the water column rapidly, returning to the sand field, a negligible amount of turbidity, less than one cubic foot of fine material each day, will remain in the water column long enough to be transported to the coral reef's northern end. This material will be widely distributed within the nearshore waters.

Following placement of sand on the beach within the HLC, there will likely be periodic turbidity associated with equilibration of the beach profile and planform, as sand moves along the beach and cross-shore. Any turbidity generated during beach restoration at the HLC is expected to have a net transport to the north, towards Hanakaʻōʻō Point. Larger sand size grains are currently stable along the coastline and make up the existing beach face; however, finer material will likely remain suspended until it has moved offshore. Average fine sediment content in the proposed nourishment sand is 0.6%. This is equivalent to 300 cubic yards of fine sediment placed within the HLC. Though periodic turbidity is expected during high wave and water level events, the preferred alternative is anticipated to reduce the potential for turbidity from the release of fill material and sediment from bank erosion into the nearshore environment.

Initially, the material placed on the beach berm within the KLC won't interact with nearshore waters. During the erosive season (winter for the Puʻu Kekaʻa Berm Enhancement and summer for the Hanakaʻōʻō Point Berm Enhancement) the placed sand will gradually become incorporated into the active beach system. Similar to the existing condition, placed sand will be carried alongshore in the direction of the wave generated current. Some fines may be released into nearshore waters as the beach face moves landward. Turbidity generated from these fines would move in the direction of wave propagation.

### *2.1.11 Noise*

Existing Condition

Existing ambient noise levels vary considerably within the project area both spatially (i.e., from place to place) and temporally (i.e., from one time to another). In general, existing background sound levels are the result of vehicle traffic, aircraft, ongoing maintenance, construction equipment, surf, boats, and wind. In the vicinity of significant construction activity noise levels can intermittently reach 80 dBA.

Potential Impacts and Proposed Mitigation Measures

HAR §11-46, "Community Noise Control" establishes maximum permissible sound levels (see Table 2-3) and provides for the prevention, control, and abatement of noise pollution in the State from stationary noise sources and from equipment related to agricultural, construction, and industrial activities. The standards are also intended to protect public health and welfare, and to prevent the significant degradation of the environment and quality of life. The limits are applicable at the property line rather than at some pre-determined distance from the sound source. Because of that, the Class B limits applicable to land zoned for resort use appears the most applicable. HAR §11-46-7 grants the Director of the State of Hawaii Department of Health the authority to issue permits to operate a noise source which emits sound in excess of the maximum permissible levels specified in Table 2-3 if it is in the public interest and subject to any reasonable conditions. Those conditions can include requirements to employ the best available noise control technology.

It may not be possible to mitigate construction noise to the extent that it does not at times exceed existing background noise levels or is inaudible to beach users, hotel guests, etc. Some reduction is practical, however, and the following measures would be implemented:

- Equipment operation on the shoreline will be limited to the hours between 7:00 a.m. and 6:30 p.m.
- Broadband noise backup alarms in lieu of higher frequency beepers will be required for construction vehicles and equipment. Broadband noise alarms tend to be less audible and intrusive with distance as they blend in with other background noise sources.
- The project will specify use of the quietest locally available equipment, e.g., high insertion loss mufflers, fully enclosed engines, and rubber tired equipment when possible.
- The use of horns for signaling will be prohibited.
- Worker training on ways to minimize impact noise and banging will be required.

A noise complaint hotline will be provided at the job site to allow for feedback from the hotel operators, which can be used to help develop modifications to construction operations whenever feasible.

Once construction is completed and construction equipment has left the site, the project is anticipated to have no long-term noise emissions.

**Table 2-3 Maximum Permissible Sound Levels in dBA**

| Zoning Districts | Daytime (7 a.m. to 10 p.m.) | Nighttime (10 p.m. to 7 a.m.) |
|---|---|---|
| Class A | 55 | 45 |
| Class B | 60 | 50 |
| Class C | 70 | 70 |

Table Notes:

(1) Class A zoning districts include all areas equivalent to lands zoned residential, conservation, preservation, public space, open space, or similar type.

(2) Class B zoning districts include all areas equivalent to lands zoned for multi-family dwellings, apartment, business, commercial, hotel, resort, or similar type.

(3) Class C zoning districts include all areas equivalent to lands zoned agriculture, country, industrial, or similar type.

(4) The maximum permissible sound levels apply to any excessive noise source emanating within the specified zoning district, and at any point at or beyond (past) the property line of the premises. Noise levels may exceed the limit up to 10% of the time within any 20-minute period. Higher noise levels are allowed only by permit or variance issued under sections 11-46-7 and 11-46-8.

(5) For mixed zoning districts, the primary land use designation is used to determine the applicable zoning district class and the maximum permissible sound level.

(6) The maximum permissible sound level for impulsive noise is 10 dBA (as measured by the "Fast" meter response) above the maximum permissible sound levels shown.

*Source: Hawaii Administrative Rules §11-46, "Community Noise Control"*

### *2.1.12 Streams*

Existing Condition

There are no perennial streams located within the Project Area. The nearest perennial stream is Kahoma Stream that drains into the ocean at Mala Wharf, 3 miles to the south of the Project Area. An ephemeral stream is located within the Project Area between the Hyatt Regency and Hanakaʻōʻō Beach Park. This ephemeral stream originates in Hāhākea Gulch and passes under Honoapiʻilani Highway via concrete box culvert.

Potential Impacts and Proposed Mitigation Measures

Since there is no discharge associated with the project, the proposed project is anticipated to have negligible impact on perennial and intermittent/ephemeral streams.

The additional sand from the beach restoration at the mouth of the ephemeral Hāhākea Gulch stream could alter the stream's path to the ocean. Presently the stream runs parallel to the Hyatt's parking lot in an approximate straight line before reaching the ocean. The stream has in the past cut a path to the south, through Hanakaʻōʻō Beach Park. Future

stream mouth migration within the sand beach is likely to continue to occur after the beach nourishment.

Regardless of path the stream takes, the proposed project will result in an elongation of the stream mouth for the ephemeral Hāhākea Gulch stream, as it would cross a longer beach berm. Typically, this ephemeral stream brings upland sediment to the nearshore waters, so an elongated mouth on the sand beach may allow for additional natural filtration of the stream discharge.

### *2.1.13 Coastal Processes*

Existing Conditions

Kāʻanapali Beach is located on the west shore of the island of Maui, extending south from Puʻu Kekaʻa around Hanakaʻōʻō Point to Hanakaʻōʻō Beach Park, a distance of approximately 7,450 feet. Within Kāʻanapali Beach are the Kāʻanapali Littoral Cell (KLC), located between Puʻu Kekaʻa and Hanakaʻōʻō Point, and the Hanakaʻōʻō Littoral Cell (HLC), located between Hanakaʻōʻō Point and Hanakaʻōʻō Beach Park. A littoral cell is a segment of coast that is more or less isolated sedimentologically from adjacent coastal segments.

The Kāʻanapali Littoral Cell shoreline, spanning approximately 3,850 feet of coastline, is dynamic, and portions of it undergo pronounced seasonal changes. The west-facing beach is exposed to North Pacific swell and Kona storm waves in the winter and south swell in the summer. The waves approach the shore at an oblique angle, and the breaking waves and longshore currents they create transport sand along the shoreline. The predominant transport direction in the winter months is to the south, under the influence of the prevailing North Pacific swell. This southward transport causes the north end of the littoral cell, Puʻu Kekaʻa, to erode while the south end, Hanakaʻōʻō Point, accretes. Waves generated by irregularly occurring winter season Kona storms approach from the south and southwest and move sand northward along the beach, temporarily reversing the pattern. The alongshore transport direction reverses in the summertime, with the prevailing south swell moving sand to the north. This seasonally variable wave climate results in pronounced shifts in the winter/summer sandy beach widths at each end of the beach.

During most years, the seasonal movement of sand between the north and south ends of the KLC proceeds without impact to the hotels and beach users. The beach narrows, but the seasonal reversal of transport occurs before shoreline and property loss happens. Periodically, however, the seasonal shift is extreme and the ends of the littoral cell are depleted of sand. This is often due to a stronger or weaker than average swell season from the north or the south. These occasional extreme seasonal events can result in significant shoreline erosion and recession of the edge of vegetation.

The Hanakaʻōʻō Littoral Cell is approximately 3,600 feet of shoreline that encompasses Hanakaʻōʻō Beach Park and the beach fronting the Hyatt and the Marriott resorts. The southwest-facing beach in this cell is primarily affected by southern hemisphere swell, Kona storms, and higher water levels that allow more wave energy across the shallow fringing reef.

The shoreline in the HLC has been steadily moving landward as a result of chronic erosion. Much of this erosion trend has been the result of a stepwise migration resulting from episodic erosion events. These extreme erosion events, which create significant landward jumps in the vegetation line, are more likely to occur during the summer when the coastline is directly exposed to south Pacific swells. Anecdotal accounts from personnel at the resort properties confirm that south swell and high tides are the primary cause of erosion events.

Potential Impacts and Proposed Mitigation Measures

The Puʻu Kekaʻa Sand Area is located offshore of the boundary between the Honokowai and Kāʻanapali Littoral Cells. The proposed project includes excavation of 75,000 cubic yards of sand from an approximate 8.5 acre area within the sand deposit. This would create a submarine excavation pit that is approximately 6 feet deep. There is the potential for sand from the adjacent seafloor to naturally fill in the pit. However, the sand deposit is well offshore of the depth of closure of the beach toe, which has been measured to be near the 12-foot contour and it is unlikely that this would result in erosion of the adjacent shorelines.

Sand bars, waves, and ripples are currently present in the natural beach system, and would continue to develop in both the beach restoration area and berm enhancement area. Following sand placement there will be a period of beach equilibration, during which the beach profile and offshore water depths can be expected to vary as the beach adjusts to the prevailing wave conditions and the beach assumes its stable configuration. Chronic erosion would continue to affect the shoreline along the full length of Kāʻanapali Beach, as would seasonal and episodic erosion and beach adjustment events. In addition to these natural phenomena, the littoral cells may also be impacted by large magnitude events such as strong Kona storms, hurricanes, tsunamis, extreme water level changes, and other oceanographic and atmospheric events.

Any and all of these can affect a large-scale change in the beach, as the project site is located on an open ocean coastline that is exposed to a wide range of events and hazards. As a result of one or more of these events, all placed sand and some or all of the existing sand could be lost from the beaches.

The proposed project does not include construction of any permanent structures that would alter the coastal processes along Kāʻanapali Beach. Furthermore, the volume of sand proposed for the beach nourishment effort would only extend the beach seaward to its approximate position shown in the 1988 aerial photo. The berm enhancement portion of the project only includes placement of sand landward of the waterline at the time of construction.

### *2.1.14 Archaeological Resources*

Existing Condition

Like other parts of the Hawaiian Islands, west Maui was divided into districts and sub-districts, with the land belonging to the Aliʻi (ruling class). Pre-contact, the land was used primarily for agriculture, where such crops included taro, sugar cane, banana, breadfruit,

coconut, and sweet potato. At least 8 heiau (temples) were reported around Lāhainā. The Kāʻanapali coastline was also the site of numerous battles.

The monumental basalt cliff Puʻu Kekaʻa is the only location within the project area that is mentioned in Hawaiian tradition. Traditional Hawaiian religion sanctifies Puʻu Kekaʻa as a *leina a ka uhane*, or a leaping place for departed souls, where deceased spirits passed westward—in the direction of the setting sun—into the afterlife; this function has been similarly attributed to westward-facing geographical features on other islands, such as Kaena Point on Oʻahu. This association with death and the afterlife might have attracted the large number of burials and cemeteries on and around Puʻu Kekaʻa that have been noted in archaeological and historical records. During the late 19th century, thousands of skeletons were reportedly visible on and around Puʻu Kekaʻa, completely covering the sand.

Following a decline in the whaling industry in the mid-1800s, the Hawaiian capitol moved from Lāhainā to Honolulu, after which the Lāhainā District economy transitioned to commercial sugar cane and pineapple agriculture. Puʻu Kekaʻa was used as a shipping point. Some of the agriculture land was developed into the present-day Kāʻanapali resort region. The expansive agriculture, and the subsequent resort development, reportedly greatly altered the landscape and disturbed the archeological record.

A single archaeological site—the Hanakaʻōʻō grinding stones (SIHP 50-50-03-1204)—has been identified within the project HLC Beach Restoration subarea. The site contains eight smooth, shallow, and roughly circular depressions distributed across the superior surfaces of two basalt boulders. These *hoana*, or grindstones, were used to shape and sharpen traditional Hawaiian adzes; the depressions were formed by the grinding action (facilitated by sand and water) of innumerable stone tools upon the boulder surfaces. The site is located among a cluster of basalt boulders on the Hanakaʻōʻō Park beach, approximately 30 feet west of the park bathrooms.

The general dearth of archaeological features within the project area is plausible for several reasons: the Kāʻanapali shoreline is seasonally overturned by wave and tidal action; the beach has been subject to severe erosional events related to Kona storms and hurricane waves for at least the last 60 years; it has also been highly trafficked by visitors since the adjacent vacation resorts were built on land to the east of the beach in the 1960s. Given these conditions, virtually all prehistoric or historic resources formerly located on the beach would almost certainly have been destroyed long ago. The offshore sand areas are highly unlikely to have ever contained in situ cultural resources, and would additionally be subject to the same volatile environmental forces as the beach itself (International Archaeology, LLC, 2015).

<u>Potential Impacts and Proposed Mitigation Measures</u>

The proposed project includes no subaerial excavation; therefore, no disturbance to archaeological resources is anticipated. The proposed sand placement locations are located makai of archeological features that have been found in the Kāʻanapali area. Within the KLC, sand in the placement area erodes and then accretes during the following swell

season. Within the HLC, the proposed sand placement area is located where there presently is no soft substrate necessary for a burial. The offshore sand deposit is marine sands in 28 to 56 feet water depth, and there is no archaeological expectation to find *kapuna iwi* within this deposit (International Archaeology, LLC, 2015).

Regardless, project construction activity will be monitored by a qualified archaeologist. If either a historic property or *kapuna iwi* are inadvertently encountered during construction, all work in the surrounding area will immediately cease, and the appropriate agencies (including the State Historic Preservation Division) will be promptly notified. The full extent of monitoring will be determined during development of an Archaeological Monitoring Plan, which will be reviewed and approved by the SHPD before project construction begins.

### *2.1.15 Cultural Impact Assessment*

Existing Condition

Following Hawaii statehood in 1959, unproductive plantation lands along the Kāʻanapali coast were cleared and repurposed as a vacation destination, with the first major hotel on Kāʻanapali Beach—the Sheraton Maui Hotel (now the Sheraton Maui Resort & Spa)—opening in 1963 on Puʻu Kekaʻa. Over the next 20 years, 7 additional resorts and shopping complexes were constructed immediately inland of the project area.

Kāʻanapali Beach is now largely dedicated to tourism-related recreational activities, including sunbathing, snorkeling, and beach volleyball. Some of the most popular water sports among visitors, such as surfing and paddleboarding, originated in Polynesian—and particularly Hawaiian—traditional culture. Local events are routinely held at Kāʻanapali Beach in conjunction with resort activities. Two examples are the Hawaii Sailing Canoe Association's annual visit to the beach, which provides a hands-on cultural learning experience, and the Maui Jim Ocean Fest, which brings together some of the top watermen and women in the Pacific to compete in a range of ocean activities. The local community continues to utilize Kāʻanapali Beach for fishing and outrigger canoeing, cultural practices that are deeply rooted in the history of the area.

Potential Impacts and Proposed Mitigation Measures

The Kāʻanapali area has a rich historical and cultural legacy. However, there does not appear to be any known traditional Hawaiian cultural practices that would be adversely affected by the proposed project. Neither does it seem like the activities associated with the project will conflict with traditional cultural practices as expressed in legend. If cultural practices are taking place within the project site, but have not been observed, then all effort will be made to minimize and mitigate any project impacts.

Any construction work around Puʻu Kekaʻa could potentially offend members of the local Hawaiian community for several reasons. Puʻu Kekaʻa is considered a *leina a ka uhane* (a place where deceased spirits pass into the afterlife), with an intangible boundary that may extend far beyond the cliff itself. Any construction work within this boundary would violate the sanctity of the place. The presence of resort hotels and other tourism facilities on and around Puʻu Kekaʻa violates a sacred Hawaiian cultural place. Community

members may react negatively to any construction project near Puʻu Kekaʻa that is perceived to serve the resorts' interest. Hundreds, if not thousands, of *iwi kupuna* (ancestral remains) have been disturbed or displaced by resort construction on and around Puʻu Kekaʻa over the last 55 years. The general disrespect accorded to these burials during the modern era is considered an act of profound desecration by many members of the Hawaiian community. The prospect of disturbing additional burials during further ground disturbing construction activities may raise concerns among community members.

Public meetings will be held and the local community will be regularly consulted during EIS development to solicit community feedback concerning the potential cultural impacts of construction activity.

### *2.1.16 Scenic and Open Space Resources*

Existing Condition

The Kāʻanapali shoreline is a globally-recognized visitor destination. The wide expanse of water with typically calm conditions, the deep blue colors of the ocean, and an unobstructed view of the island of Lānaʻi make the seaward and alongshore views from the shoreline spectacular. At the same time, the tall buildings that have been developed relatively close to the ocean along portions of the shoreline in the project area block views of the West Maui Mountains.

The appearance of the beach is of significant interest to the Kāʻanapali Resort, as their guests represent the most numerous and closest viewers. However, it is also of considerable interest to those who own and/or use adjacent areas and the Kāʻanapali Beachwalk. This beach, like all sandy shorelines in Hawaii, is available to any member of the public, and can be visited and enjoyed at any time. Thus, the project area is also of interest to members of the public who frequent the area.

The ongoing erosion within the HLC is having deleterious effects on the scenic and aesthetic value of the shoreline. Emergency shore protection in the form of geotextile sandbags, geotextile fabric, road plates, and jersey barriers have been or are currently deployed to protect the Beachwalk from erosion. Emergency shore protection is typically unsightly, as are active erosion scarps, salt-damaged vegetation, collapsed trees, and turbidity from bank erosion.

Potential Impacts and Proposed Mitigation Measures

Impacts to scenic and open space resources will largely be confined to the construction phase of the proposed project. Visible turbidity during construction may impact the deep-blue colors of the ocean offshore of the Kāʻanapali shoreline. Turbidity is further discussed in Section 2.1.10.

Construction equipment including barges, tug boats, cranes, temporary piers or trestles, dump trucks, off-road capable vehicles, loaders, etc., will be present both on the beach and offshore throughout the duration of construction. The dredge barge at the Puʻu Kekaʻa Sand Area is expected to be particularly unsightly. During sand recovery operations, the

barge and crane will at times be directly offshore and within 300 feet of the Moana Hale building of the Sheraton.

The proposed beach maintenance project is anticipated to have a positive long-term impact on the scenic and aesthetic resources of the area, as emergency shore protection that is currently installed may be removed and existing erosion scarps will be buried. The color of sand from the Puʻu Kekaʻa Sand Area is slightly greyer than the native beach sand; however, after a season of mixing and fading in the sun, the color difference is anticipated to be negligible.

## 2.2 Socio-Economic Environment

### *2.2.1 Community Character*

Existing Condition

The Kāʻanapali Resort area includes the typical features of a resort community: hotel and condominium buildings, restaurants, shopping, golf, entertainment, and more. There is no residential housing within Kāʻanapali Resort and minimal housing located nearby. The nearest residential housing is mauka of Honoapiʻilani Highway. Most residential housing in West Maui is concentrated in Lāhainā, south of the project site. West Maui residents still frequent the Kāʻanapali area. Kāʻanapali Beach is accessible via multiple beach access paths and lateral access is available via the Kāʻanapali Beachwalk. Hanakaʻōʻō Beach Park is a "local's park" with plentiful parking and amenities for public use including picnic tables, benches, and barbeque pits.

Potential Impacts and Proposed Mitigation Measures

As the proposed project is a resource restoration project, it is anticipated to have negligible impact on community character. The proposed beach restoration and berm enhancement project is necessary to protect the Kāʻanapali Beachwalk from coastal erosion. Protection of the Beachwalk, which allows lateral beach access for both visitors and residents, is essential for maintaining community character along Kāʻanapali Beach.

### *2.2.2 Beach Access*

Existing Condition

Pedestrian beach access to Kāʻanapali Beach is available via six public right-of-ways that are oriented perpendicular to the shoreline. Two are located at the northern and southern boundaries of the Hyatt Regency Maui property. Two are located between the Kāʻanapali Aliʻi and the Marriott and the Kāʻanapali Aliʻi and the Westin. Another is located at Whaler's Village, and the northernmost access is located between the Sheraton and the Kāʻanapali Beach Hotel. Lateral shoreline access through the region is available via the Kāʻanapali Beachwalk that runs from Hanakaʻōʻō Beach Park to Puʻu Kekaʻa.

The Beachwalk is the only ADA-compliant thoroughfare along the beach. Property managers along the coast view the Beachwalk as the main pedestrian artery that makes Kāʻanapali a community. The Beachwalk is a public amenity, available to any and all beachgoers visiting Kāʻanapali. In some locations between Hanakaʻōʻō Beach Park and Hanakaʻōʻō Point the beach is severely narrowed due to both chronic and episodic erosion.

In these locations, the beach is wet at higher tides and during swell events, and the Beachwalk is the only access along the coastline. There is very little or no vegetative buffer remaining between the deflated beach face and the scarp on the seaward side of the Beachwalk in these eroded sections.

The Beachwalk is actively used from before dawn to well after sunset each day of the week. A 2016 pedestrian study (SSFM, 2016) in the vicinity of the Hyatt documented pedestrian flow rates of 9 to 20 people per minute at peak usage periods on the Beachwalk. Approximately 70% of the Beachwalk travelers were from the continental U.S., while 12% were from international locations and 18% were from Hawaii. Approximately 0.1% of these travelers were mobility disadvantaged. Though this number is low, relative to the full volume, it is significant in that this group can only access the coastline along the Beachwalk.

Potential Impacts and Proposed Mitigation Measures

Placement operations on the beach would require lengths of the coast to be cordoned off during trucking operations. Crossing guards would be placed at designated crossings along the shoreline and Beachwalk to assist the public in transiting across the access route. While operating, the heavy machinery would emit noise and exhaust. Working longer days and seven days a week will limit the overall impact by reducing overall project duration.

### *2.2.3 Coastal and Nearshore Recreation*

Existing Condition

Swimming, snorkeling, and scuba diving takes place along the entire Kāʻanapali coastline; however, it is most concentrated around Puʻu Kekaʻa due to the sand bottom adjacent to stunning rock formations. As an example, the 10-mile Maui Channel Swim from Lānaʻi to Maui finishes on the beach fronting the Kāʻanapali Beach Hotel.

Surfing along Kāʻanapali Beach typically takes place along the reef edge just to the north of Hanakaʻōʻō Point, although there is some surfing between Hanakaʻōʻō Beach Park and Hanakaʻōʻō Point. Surfing generally takes place during the summer months under southern swell conditions, but can happen year around. During the first south swells of the season, the surfing waves can be adversely affected by reflected waves from the sand point, which is usually large and closer to the surfing break at the beginning of the summer surf season. The first south swells cut the sand point back, reducing the effect of wave reflection on the surfing break.

Hanakaʻōʻō Beach Park is sometimes called Canoe Beach, as Lāhainā Canoe Club, Kahana Canoe Club, and Napili Canoe Club all hold practices there. The three canoe clubs store their canoes in a single canoe hale and along a grassy area behind the beach. Hanakaʻōʻō Beach Park is one of only two lifeguarded beaches in West Maui, and the only one in the Kāʻanapali/Lāhainā area. Regatta style races with canoe clubs from throughout the island often take place in the course just offshore of Hanakaʻōʻō Beach.

Potential Impacts and Proposed Mitigation Measures

There will be disruption to coastal and nearshore recreation during construction of the proposed project.

Five (5) anchor lines at the Puʻu Kekaʻa Sand Area will be in place for the duration of sand recovery operations, and floating sections or anchor line would be marked with floats and lights as needed. The machinery operating on the barge would be run from the early morning until later in the afternoon each day. Some lighting would be needed on the barge to conduct operations during the morning hours.

Delivery of sand to shore would require the emplacement of bridge structures from the shoreline to 15 feet of water depth. In addition, the delivery barges would utilize a four-point mooring system with a storm anchor positioned directly offshore. Any floating portions of these anchor lines would be marked. Delivery operations would require tug boats to maneuver the barges close to shore, where they can be secured in the four-point mooring system.

All of these marine construction activities would be taking place in the nearshore waters, and are expected to directly impact ocean recreation and access in the area. The waters within the Puʻu Kekaʻa Sand Area and offloading locations would be closed to ocean recreation for the duration of construction. Careful planning has gone into minimizing the disruption to ocean recreation, resulting in a construction schedule that includes longer work days, and working seven days a week in an effort to limit the duration of the project. This accelerated construction schedule will significantly reduce the overall duration of the project.

Public safety during construction will be of utmost importance. A Notice to Mariners detailing construction activities and locations will be publicly issued through the United States Coast Guard prior to mobilization of construction equipment on site. A public awareness campaign will be initiated through OCCL and DOBOR to help spread awareness about construction activities.

Resort activity coordinators, beach vendors, and concessions will be coordinated with so they may inform customers of construction activities. All onshore and offshore hazards will be clearly marked with signage and/or marker floats. Transit corridors, both on the beach and in the water, will be clearly labeled. Flag persons will be provided as needed.

Placement operations on the beach would require lengths of the coast to be cordoned off during trucking operations. Crossing guards would be placed intermittently along the shoreline to assist the public in transiting across the access route.

There is the potential for the proposed project to initially have some impact to surfing at Hanakaʻōʻō Point. Because the additional sand will be placed directly on the berm at Hanakaʻōʻō Point, the shoreline will not be extended further offshore than it would be naturally. However, the additional sand will cause the sand point to erode slower than it

would without the berm enhancement. This could cause undesirable wave reflection to continue past the first few swells of the summer surf season.

This delayed erosion of the point is expected to occur only during the first southern swell season after sand placement. Historical aerial photographs and topographic surveys show that the point has a maximum sediment volume that is reached towards the end of winter during extreme North Pacific swell seasons. This volume is independent of the volume of sand contained within the KLC, because wave action at the point prevents further seaward accretion of the beach. Since the sandy point cannot grow beyond this wave controlled seaward extent, sand begins to bypass the point and continue into the HLC. The beach restoration and berm enhancement project is expected to have no effect on surfing after the first southern swell season.

The proposed project is anticipated to have negligible long-term impact to coastal and nearshore recreation.

### *2.2.4 Economy and Labor Force*

Existing Condition

Before Kāʻanapali became a tourist destination, the West Maui economy was largely based on agriculture, including sugar cane and pineapple. In the early 20th century, immigrant workers lived in plantation camps that dotted the landscape. Evidence of West Maui's plantation history are still visible today at the Kekaʻa Landing Pier on the north side of Puʻu Kekaʻa, the Hanakaʻōʻō Cemetery behind Hanakaʻōʻō Beach Park, and the Lāhainā, Kāʻanapali and Pacific Railroad (the "Sugar Cane Train") located inland of the Kāʻanapali Resort.

Post-war Maui saw a sharp decline in population due to the decline of the sugar and pineapple industries and the bourgeoning Oʻahu and mainland U.S. economies. Maui lost 24 percent of its population from 1940 to 1960 as the younger generation left in search of employment. In 1959, the *Report of Land Use for the Island of Maui*, prepared by Community Planning Inc., identified tourism as a potential solution to reversing the downward population trend on the island. Later in 1959, Amfac, Inc. (formerly American Factors) began developing the Kāʻanapali shoreline into a master-planned resort destination area, the first of its kind in Hawaii. Over the next 50 years, extensive construction took place along Kāʻanapali Beach, and the backshore is now fully developed with resort hotels and condominiums.

The present-day West Maui economy is especially depended on tourism, with Kāʻanapali Resort contributing an estimated $2 billion annually in economic impact. During a 2008 study of Waikiki Beach on Oʻahu, visitors said they are less likely to return if Waikiki Beach is eroded or unavailable. Visitors to Kāʻanapali would likely have a similar response to beach erosion.

Potential Impacts and Proposed Mitigation Measures

The proposed project is expected to create temporary construction and construction-related jobs. Impacts to the economy and labor force will be further discussed in the DEIS.

### *2.2.5 Population*

Existing Condition

The region of West Maui has a permanent population of 28,300 settled over approximately 37.6 square miles, with the major population center being Lāhainā. The high density of hotels and condominiums results in a high transient population in West Maui that can at times outnumber the permanent residents.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on transient or permanent population characteristics.

### *2.2.6 Housing*

Existing Condition

There is no residential housing within Kāʻanapali Resort and minimal housing located nearby. The nearest residential housing is mauka of Honoapiʻilani Highway. Most residential housing in West Maui is concentrated in Lāhainā, south of the project site.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on housing.

## 2.3 Public Services

### *2.3.1 Solid Waste Disposal*

Existing Condition

The County of Maui provides solid waste collection service to West Maui. Construction waste is accepted at the Pohakulepo Concrete Recycling Facility and the Maui Demolition and Construction Landfill located in Central Maui.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on solid waste disposal. Minimal construction waste is anticipated to be generated from the proposed project.

### *2.3.2 Medical Facilities*

Existing Condition

Currently the nearest hospital to Kāʻanapali is the Maui Memorial Medical Center in Kahului. Ambulance service is operated under a state contract with American Medical Response (AMR). Two units operate in West Maui, out of the Napili Fire Station and the Lāhainā Comprehensive Health Center. Other health services in West Maui include the Maui Medical Group, Lāhainā Physicians, West Maui Healthcare Center, Kaiser Permanente's Lāhainā Clinic, and other small private practices.

The West Maui Hospital and Medical Center is expected to open in late 2018. When completed, the hospital will include a 24-hour emergency room with 25 critical access beds and three operating rooms. Also on the campus will be a 40-bed Skilled Nursing Facility,

a 40-bed Assisted Living Facility, and a 40-bed Drug and Alcohol Rehabilitation Facility. Two new medical office buildings will provide clinical care as well.

Potential Impacts and Proposed Mitigation Measures
The proposed project is anticipated to have negligible impact on medical facilities in West Maui.

### *2.3.3 Police and Fire Protection*

Existing Condition
Law enforcement in West Maui is provided by the Maui Police Department, Lāhainā District. The Lāhainā Police Station is located at the Lāhainā Civic Center. Fire protection in West Maui is provided by the Maui County Department of Fire and Public Safety. Two fire stations are located in West Maui: the Lāhainā Fire Station, located at the Lāhainā Civic Center, and the Napili Fire Station, located on Honoapiʻilani Highway in Napili.

Potential Impacts and Proposed Mitigation Measures
The proposed project is anticipated to have negligible impact on police and fire protection.

### *2.3.4 Schools*

Existing Condition
The State of Hawaii Department of Education (DOE) operates four public schools in West Maui. Additionally, two private schools serve the Kāʻanapali area. University of Hawaii Maui College operates the Lāhainā Education Center, which provides higher education opportunities to the area. West Maui schools are listed in Table 2-4.

**Table 2-4. West Maui Schools and Educational Facilities**

| School | Type | Location |
|---|---|---|
| Kamehameha III | Elementary | Lāhainā |
| Princess Nāhiʻenaʻena | Elementary | Lāhainā |
| Lāhainā | Intermediate | Lāhainā |
| Lāhaināluna | High School | Lāhainā |
| University of Hawaii Maui College (Lāhainā Ed Center) | Higher Education | Lāhainā |
| Maui Preparatory Academy | Private (PK-12) | Napili |
| Sacred Hearts School & Early Learning Center | Private (PK-8) | Lāhainā |

Potential Impacts and Proposed Mitigation Measures
The proposed project is anticipated to have negligible impact on schools and education facilities.

### *2.3.5 Recreational Facilities*

Existing Condition

Public recreational facilities in West Maui are concentrated in Lāhainā, including the Lāhainā Civic Center, the Lāhainā Aquatic Center and Skate Park, and the Lāhainā Recreation Center. The Kāʻanapali Resort has two 18-hole golf courses that are open to the public. The canoe regatta course offshore of Hanakaʻōʻō Beach Park can also be used by the public.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on recreational facilities. Brief disruptions may occur to the canoe area at Hanakaʻōʻō Beach Park during sand placement operations. No offshore construction activity is anticipated in the vicinity of Hanakaʻōʻō Beach Park that would prevent use of the regatta course.

## 2.4 Infrastructure

### *2.4.1 Roadways*

Existing Condition

West Maui is served by Honoapiʻilani Highway (Hawaii Route 30). This is the only highway that provides vehicle access between West Maui and Kahului, the main population center of the island. Most traffic into and out of the Kāʻanapali Resort is via Kāʻanapali Parkway. Kekaʻa Drive also allows vehicle access between Kāʻanapali Resort and Honoapiʻilani Highway.

Potential Impacts and Proposed Mitigation Measures

Some large construction equipment is not available locally in West Maui, and some specialized equipment will likely have to be sourced from off island. Construction mobilization and demobilization, therefore, will require bringing in large equipment from Central Maui and Kahului to West Maui via Honoapiʻilani Highway. Impacts to traffic patterns is anticipated to be minor.

After demobilization, the proposed project is anticipated to have negligible impact on the West Maui roadways.

### *2.4.2 Water System*

Existing Condition

The County of Maui, Department of Water Supply supplies potable water to West Maui. Water in West Maui is sourced from the Kanaha Stream. Water treatment and storage takes place at the Lāhainā Water Treatment Facility above Lāhaināluna High School. The average daily production is 1.6 million gallons per day.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on the water system in West Maui.

### *2.4.3 Wastewater System*

Existing Condition

Wastewater in Kāʻanapali is treated at the Lāhainā Wastewater Reclamation Facility (WWRF), located 2 miles to the north of the project site. Treated wastewater is either used to supplement irrigation of the Kāʻanapali golf courses or it is disposed into injection wells at the facility. A tracer study (Glenn 2013) demonstrated a hydrogeologic connection between the injection wells at the Lāhainā WWRF and West Maui coastal waters.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on the wastewater system or the hydrogeologic connection between the Lāhainā WWRF and the nearby coastal waters.

### *2.4.4 Drainage System*

Existing Condition

The golf course lagoon water features provide drainage for the Kāʻanapali Resort. The lagoons have an outlet to ocean via four diffuser pipes that run under the Hyatt Regency into the paleochannel.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact on the drainage system. The beach restoration fronting the Hyatt would restore the beach to the position shown in the 1988 aerial photo. The diffuser pipes in the paleochannel were built prior to 1988 and functioned properly under full beach width conditions; therefore, their performance should not be affected by the additional sand volume.

### *2.4.5 Electrical, Telephone, and Cable Television Services*

Existing Condition

Electrical service to West Maui is provided by Maui Electric Company, Ltd. Hawaiian Telecom provides telephone service and Spectrum provides cable television service. No electrical, telephone, or CATV infrastructure is located in the project area. Underground cables may be located where equipment will access the beach.

Potential Impacts and Proposed Mitigation Measures

The proposed project is anticipated to have negligible impact or interruptions to electrical, telephone, and cable television (CATV) services or infrastructure.

## 2.5 Cumulative and Secondary Impacts

Pursuant to the Hawaii Administrative Rules, Chapter 200, Section 11-200-2, entitled Environmental Impact Statement Rules, a cumulative impact means:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative*

> *impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Secondary impacts are those which have the potential to occur later in time or farther in distance, but are still reasonably foreseeable. They can be viewed as actions of other that are taken because of the presence of the project. Secondary impacts from highway projects, for example, can occur because they can induce development by removing one of the impediments to growth.

Both cumulative impacts and secondary impacts will be discussed in further detail in the DEIS.

# 3. RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

## 3.1 State Land Use Districts

Pursuant to Chapter 205A, Hawaii Revised Statutes, all lands in the State have been divided and placed into one of four land use districts by the State Land Use Commission. These land use districts have been designated "Urban", "Rural", "Agricultural", and "Conservation". The proposed project is located within the State "Conservation" district. The proposed action is compatible with and permissible within the State "Conservation" land use district, Resource Subzone.

## 3.2 Chapter 226, Hawaii State Plan

The relationship between the proposed project and the Hawaii State Plan will be further addressed in the DEIS.

## 3.3 State Functional Plans

The relationship between the proposed project and the State Functional Plans will be further addressed in the DEIS.

## 3.4 Maui County General Plan

### *3.4.1 Countywide Policy Plan*

The relationship between the proposed project and the Countywide Policy Plan will be further addressed in the DEIS.

### *3.4.2 Maui Island Plan*

The relationship between the proposed project and the Maui Island Plan will be further addressed in the DEIS.

## 3.5 West Maui Community Plan

The West Maui Community Plan is one of nine community plans for Maui County. The community plans detail desired land use patterns and goals, objectives, policies, and implementing actions for various functional areas. The Kāʻanapali Resort is located on lands designated H (Hotel).

The relationship between the proposed project and the West Maui Community Plan will be further addressed in the DEIS.

## 3.6 Maui County Zoning

The project area, including the offshore sand area, beach nourishment area, berm enhancement area, and barge offloading areas, is all within the State Conservation District, Resource Subzone and is not located within the County of Maui's jurisdiction.

# 4. ALTERNATIVES TO THE PROPOSED ACTION

## 4.1 Formulation of the Preferred Alternative

Several beach management plans have been written that encompass beaches of the Hawaiian Islands in general, the island of Maui, and specifically Kāʻanapali. The plans have the same general emphasis, outlining the problems and giving overviews of possible management alternatives. These plans, and any resulting actions generated from the plans, typically address key management issues identified for the region. The regulatory environment, coastal processes, shoreline history, and local and agency interests in the area produced the following key management considerations:

- DLNR prefers beach restoration over shoreline armoring.
- Severe storms, such as the Kona storms of December 2007 and 2008, can cause rapid erosion damage along the entire coast.
- The HLC is less seasonally dynamic. It is experiencing chronic erosion and is also subject to severe storm damage. The beach is narrow, and dry beach may be non-existent at high tide.
- The KLC is highly dynamic and experiences large seasonal fluctuations in beach width at the ends of the cell. Transport of approximately 70,000 cubic yards of sand in a 2-month period and maximum average daily rates of 800 cubic yards were measured following the 1998 erosion event. Following the 2003 erosion event, approximately 19,000 cy of sand accreted in front of the Kāʻanapali Aliʻi within one to two weeks at an estimated rate of 1,350 to 2,700 cy/day. Occasional extreme seasonal events, such as occurred in 1998 and 2003, can result in rapid, significant shoreline erosion, beach narrowing, and damage to property.
- Inland dune sand is not a good match for the beach sand in either the Hanakaʻōʻō or Kāʻanapali littoral cells.

Given these considerations, SEI has developed concept designs for the following beach management tasks:

- Restoration of the HLC, through placement of additional beach sand. This is a technique that is supported by the State and County regulatory agencies.
- Adding sand to the dry berm area ("berm enhancement") in the KLC. This would augment the existing sand volume, providing greater capacity for the littoral cell to respond to and recover from episodic events.
- Harvesting nearshore beach compatible sand from offshore of Kāʻanapali Beach. This would provide a local sand source that is a good match for both littoral cells.

## 4.2 No-Action Alternative and Deferral of Action Alternative

The No-Action Alternative provides a benchmark against which to compare the magnitude of environmental effects of the proposed alternative. It provides a reasonable baseline for assessing the impacts of an "action" alternative.

"Retreat" and "No-Action" have similar areas of coverage and similar impacts to the backshore. These two alternatives, therefore, are addressed together. Retreat would entail

removing existing infrastructure along Kāʻanapali Beach while allowing the shoreline to naturally migrate landward. The Kāʻanapali Beachwalk is the first infrastructure that would be threatened under this option.

The beach between Hanakaʻōʻō Beach Park and Hanakaʻōʻō Point is severely narrowed due to both chronic and episodic erosion. There is very little or no vegetative buffer remaining between the deflated beach face and the scarp on the seaward side of the Beachwalk. Relocation of the Beachwalk further landward at already narrowed locations is infeasible due to existing infrastructure. Deferral of action would likely result in erosion, undermining, and failure of the Beachwalk.

Erosion along Kāʻanapali Beach is presently releasing fill material, including cinders and topsoil, into the nearshore waters. The "No Action" alternative would lead to increased turbidity and nearshore biological impacts as a result of continued bank erosion.

The shoreline along Kāʻanapali Beach is moving landward at up to 2 feet per year. Episodic events could result in higher erosion rates. Impacts to existing infrastructure under current erosion rates will be discusses in the DEIS.

## 4.3 Other Alternatives

Alternatives to the proposed project will be thoroughly discussed in the DEIS. The advantages and disadvantages for each option will be carefully described.

### *4.3.1 Alternative Sand Sources*

After extensive investigation, sampling, and analysis of available sand sources, the Puʻu Kekaʻa Sand Area has been identified as the best source of sand for the proposed beach restoration and berm enhancement project. The sand quality is a very close match to the existing beach, and there is suitable volume to complete the project. In addition, the water depths at the sand deposit are suitable for recovery work, and the sand field is close to the proposed project shorelines. Other sand sources considered for the proposed project, after extensive investigation of the regional seafloor, include the following:

<u>"Sand Wave Area"</u>
Sand source investigations in 2007 identified an area of potential beach quality sand in 115 to 130 feet of water depth offshore of Puʻu Kekaʻa. The Sand Wave Area covers approximately 8.5 acres with an estimated average thickness of 20 feet. This corresponds to a total estimated volume of 629,000 cubic yards of sand in the offshore deposit. Water depth, wide range of grain sizes, dark sand color, and high percentage of halimeda flakes make the Sand Wave Area less desirable as a sand source for the Kāʻanapali Beach Restoration and Berm Enhancement project.

<u>Mala Ramp Sand Deposit</u>
Sand source investigations in 2015 revealed a sand deposit located 3,000 feet to the northwest of Mala Wharf in Lāhainā. The sand deposit has a surface area of 10 acres, a

sand thickness in excess of 6 feet, and was located in approximately 60 to 70 feet water depth.

Grain size analysis revealed that the sand at this location was is too fine to be compatible with the Kāʻanapali Beach sand. Furthermore, dry color comparison with native Kāʻanapali Beach sand showed that the offshore sand was greyer in color. Fine grain size and grayish sand color make the Mala Ramp sand deposit less desirable as a sand source for the Kāʻanapali Beach Restoration and Berm Enhancement project.

Reef Runway, Oʻahu

Numerous offshore sand reconnaissance studies have indicated the presence of a relatively large and thick sand deposit approximately 4,000 feet offshore of the Daniel K. Inouye International Airport (HNL) "Reef Runway" on Oʻahu. Seismic surveys, high resolution subbottom profiling, and sand sample probes have confirmed the presence of the large sand field (Ocean Innovators 1997 and 1991; E.K. Noda and Associates 1991; Barry 1993; Sea Engineering 2017). The probing and subbottom profiling indicated variable thicknesses of sand with alternating deep and shallow pockets. The maximum probed sand thickness was 37 feet. Typical sand thickness is 10 to 15 feet.

More than 50 sand samples have been collected and analyzed from the deposit. Grain size distributions of the samples show that sand characteristics vary greatly within the deposit, with median grain sizes ranging from 0.18 mm to 1.4 mm. All samples analyzed were more poorly sorted, with a higher percentage of both fine and coarse material, than Kāʻanapali Beach sand. The sand is primarily grayish in color.

High spatial variability of sand characteristics and deposit thickness, grayish sand color, and distance from Kāʻanapali Beach make the Reef Runway sand deposit less desirable as a sand source for the Kāʻanapali Beach Restoration and Berm Enhancement project.

Maui Dune Sand

Inland sand dunes behind Maalaea Bay have been built up over thousands of years by mostly wind-blown sand. Maui dune sand has been used in the past to nourish eroded beaches on the islands. The sand is typically medium to dark brown and moderately sorted. The typical median grain size is around 0.23 mm. Maui dune sand is significantly finer than Kāʻanapali Beach sand, which has a median grain size around 0.32 mm. The Maui dune grain size distribution mostly falls outside the 20% compatibility limit required by State regulations.

Extensive screening could yield sand that falls within the required 20% compatibility limits for sand placement on Kāʻanapali Beach. However, washing out all the material finer than 0.2 mm would entail removing 40% of the material.

Maui dune sand is presently unavailable. Lack of availability in the desired quantity and grain size characteristics make Maui dune sand less desirable as a sand source for the Kāʻanapali Beach Restoration and Berm Enhancement project.

### *4.3.2 Temporary Shore Protection*

Temporary, non-emergency shore protection has been used to protect landscaping, boardwalks, and pool complexes at Kāʻanapali while permanent solutions are planned and designed, or until the erosive condition passes. The allowable installation term set forth by DLNR for temporary shore protection is typically three years or less. The most commonly utilized form of temporary shore protection is stacks of large geotextile sand bags. Geotextile fabric draped over an erosion scarp ("erosion skirt") has also been successful at slowing the progress of erosion in areas of low wave energy.

Temporary shore protection has been deployed along Kāʻanapali Beach in areas suffering from chronic erosion, where property or infrastructure is threatened with damage. This was done on the narrow beach fronting the Hyatt, where the Beachwalk had become undermined. An erosion skirt installed in 2015 has successfully prevented further loss of the Kāʻanapali Beachwalk.

Temporary shore protection is often less expensive than permanent shore protection. It can be deployed and removed easier than permanent shore protection. If carefully implemented, it can also have less of an environmental impact than permanent shore protection.

Temporary shore protection is often unsightly and unnatural in appearance. There are minimal design guidelines for temporary shore protection, and performance in large wave events such as hurricanes or tsunamis is unpredictable. Temporary shore protection projects have the tendency to degrade rapidly, and often require considerable maintenance in both the mid-term and long-term.

### *4.3.3 Permanent Shore Protection*

Permanent shore protection uses hard, durable materials to fix the shoreline in a desired location. Permanent shore protection includes revetments, seawalls, groins, and breakwaters.

Revetments and seawalls are effective at stabilizing long stretches of shoreline. A revetment is a sloping, uncemented structure built of wave-resistant material such as rock or concrete armor units. A seawall is a vertical or sloping concrete or concrete rubble masonry (CRM) wall used to protect the land from wave damage and erosion. If properly designed and constructed, both revetments and seawalls are proven, durable shore protection methods that require relatively low maintenance. This alternative generally will not support a sand beach in front of the structure under chronic erosion conditions.

A "backstop" structure is a type of permanent shore protection that has been proposed in the past along Kāʻanapali Beach. These structures, typically seawalls or revetments, would be set back from the current shoreline location but in front of existing infrastructure, such as buildings. This would be in anticipation of future erosion that may threaten the infrastructure. Should erosion reach the structure, the structure would prevent damage to the infrastructure that it is fronting. Ideally, backstop structures are coupled with long-

term beach maintenance programs, where the structures provide protection to infrastructure between beach maintenance efforts.

Groins and breakwaters are structures, often made of rock or concrete, that extend offshore or are completely disconnected from the shoreline. One or more groins along Kāʻanapali Beach would likely slow the seasonal and episodic transport of sand. A well-engineered groin structure at Hanakaʻōʻō Point could adequately separate the two cells and provide limited protection from southern swell for a portion of the point within the Kāʻanapali Littoral Cell. The popularity of the surf break and the presence of a living reef would make this a difficult place to build a structure; however, a relatively short groin, which does not extend into the surf zone, might provide sufficient protection to the point. This structure would be buried during the accretion seasons and exposed during the erosion seasons. This groin would still be very effective at blocking the erosive waves that come across the point from the south when the sand volume at the point is diminished. Offshore breakwaters would not be effective within the Kāʻanapali Littoral Cell, due to the changing, oblique seasonal wave patterns. A breakwater may be partially effective at the paleochannel in the middle of the Hanakaʻōʻō Littoral Cell, where wave refraction creates an erosion hotspot along the shoreline. In this instance, changing the wave field characteristics may provide a partial improvement to the localized, accelerated, shoreline erosion problem.

### *4.3.4 Adaptation*

Adaptation would entail preparing existing infrastructure along Kāʻanapali Beach for inundation while allowing the shoreline to naturally migrate landward. Erosion adaptation along the shoreline usually involves retreat, but may also include elevation of structures as a short-term to mid-term option.

Retreat, or relocation of infrastructure and uses to a more mauka location, requires open land inshore of the current footprints. In Kāʻanapali, the inshore areas have been utilized for existing infrastructure and uses. As a result, any retreat or relocation requires removal of the current infrastructure and uses to repurpose the land.

Currently, increasing the elevation of a structure would only applicable to The Kāʻanapali Beachwalk, which is also the first infrastructure that would be threatened under the adaptation option. Replacing the Beachwalk with an elevated boardwalk constructed on piles suitable for the nearshore environment has been assessed. The openness of the pile system would allow the shoreline to move under the boardwalk while not immediately threatening the coastal access path. Boardwalks are commonly constructed to allow users to traverse sensitive dune systems and are found worldwide. An elevated boardwalk has been installed along the shoreline at Wailea on the island of Maui. The boardwalk was initially supported by wooden piling; however, those pilings have been heavily reinforced with concrete.

Though an elevated boardwalk would maintain coastal lateral access, it is not an ideal solution for this coastline. Erosion rates of around 2.0 feet per year would result in the boardwalk being detached from the backshore in numerous locations and suspended above the active beach face. This would limit ingress and egress points from the structure. The

close spacing of large piles would also limit beach use and potentially perturb coastal processes beneath the structure. The beach near and beneath the structure would not be safe for use during wave events, due to turbulent water currents in and amongst the piles.

Adaptation becomes complicated when different types of infrastructure, such as pools and hotel buildings, are threatened. Each piece of infrastructure would need to be addressed on a case-by-case basis to determine if adaption or removal is the best option.

## 5. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The proposed project would be the first major construction project on the shoreline and in the nearshore at Kāʻanapali Beach. Emergency shore protection has been deployed during erosion events in the past; however, these installations have been temporary and removed with minimal environmental impact.

Past beach nourishment projects in Hawaii and domestically have generated data on potential project impacts to expect. Adverse environmental effects which cannot be avoided include the following:

- 75,000 cubic yards of sand will be removed from the Puʻu Kekaʻa Sand Area, altering the bathymetry and temporarily disrupting the ecology in the dredge extents.
- Sand recovered from the ocean, though highly compatible with the dry beach sand, would still have some fine content that would be winnowed from the beach system and moved offshore during the initial equilibration process and beach erosion events.
- Dredging, transport, and placement of carbonate sand can also increase the percent of fines through mechanical abrasion of the friable grains.
- Particles greater than one inch in diameter may also be present in the placed sand.
- Compaction of the sand could occur in high traffic areas during sand delivery and placement operations.
- When sand is recovered from anoxic environments, such as portions of the recovery site, it would typically have a grey color and scent.
- During sand recovery operations, minor turbidity is expected during clamshell operations as sand is brought from the seafloor to the barge.
- The anchor lines would be in place for the duration of sand recovery operations. Dredging and transport operations could disrupt ocean recreation in the area during construction.
- The machinery operating on the barge and the beach would be run from the early morning until later in the afternoon each day.
- Delivery to shore would require the emplacement of bridge structures from the shoreline to 15 feet of water depth.
- All of these marine activities would be taking place in the nearshore waters, and are expected to directly impact ocean recreation and access in the area.
- Placement operations on the beach would require lengths of the coast to be cordoned off during trucking operations. Access across the cordoned off area will be limited to specific crossing points with crossing guards.
- Sand placement in the Hanakaʻōʻō Littoral Cell will cover areas of “live rock” that have been exposed through beach erosion in recent decades.

## 6. LIST OF PERMITS AND APPROVALS

A summary of potential permitting requirements for the proposed action includes the following:

County of Maui

- Special Management Area (SMA)
- Shoreline Setback Variance (SSV)

State of Hawaii

- Conservation District Use Permit (CDUP) (DLNR-OCCL)
- Coastal Zone Management Consistency Review (DBEDT, Office of Planning, CZM Program)
- Clean Water Act, Section 401 Water Quality Certification (WQC) (DOH-CWB)
- National Pollutant Discharge Elimination System (NPDES) (DOH-CWB)

Federal

- Section 10, Work in Navigable Waters of the U.S. (U.S. Army Corps of Engineers)
- Section 404, Clean Water Act, for Fill in Waters of the U.S. (U.S. Army Corps of Engineers)
- Other Federal laws that may affect the project, including:
    a. Archaeological and Historic Preservation Act (16 USC § 469a-1);
    b. National Historic Preservation Act (NHPA) of 1966 (16 USC § 470(f));
    c. Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 USC § 3001);
    d. Clean Air Act (42 USC § 7506(C));
    e. Coastal Zone Management Act (16 USC § 1456(C) (1));
    f. Endangered Species Act (16 U.S.C. 1536(A) (2) and (4));
    g. Fish and Wildlife Coordination Act (FWCA) of 1934, as amended (16 USC §§ 661-666[C] et seq.);
    h. Magnuson-Stevens Fishery Conservation and Management Act (16 USC § 1801 et seq.);
    i. Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC §§ 1361-1421(H) et seq.);
    j. EO 13089, Coral Reef Protection (63 FR 32701)
    k. Migratory Bird Treaty Act of 1918, as amended (16 USC §§ 703-712)

# 7. EARLY CONSULTATION WITH AGENCIES AND ORGANIZATIONS IN THE PREPARATION OF THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE

Consultation between Sea Engineering (SEI), the Kāʻanapali Operations Association (KOA), and the Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) regarding Kāʻanapali Beach has been ongoing for several years. The purpose of this consultation was to develop a beach restoration plan that best incorporates the OCCL's goals and objectives while minimizing disruption to resort operations.

Prior to preparation of this Environmental Impact Statement Preparation Notice (EISPN), meetings were organized between SEI and the State of Hawaii, Department of Boating and Ocean Recreation (DOBOR); the State of Hawaii, Department of Aquatic Resources (DAR), Maui Land Division office; and the County of Maui, Planning Department. Outreach was conducted with local kapuna and beach and ocean recreation organizations and vendors that would be directly affected by construction activities.

## 8. AGENCIES AND ORGANIZATIONS TO BE CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

The following agencies, organizations, and individuals will be directly notified of publication of the Kāʻanapali Beach Restoration and Berm Enhancement EIS.

Federal Agencies
Department of the Interior, U.S. Geological Survey, Pacific Islands Water Science Center
Department of the Interior, U.S. Fish and Wildlife Service
Department of Commerce, National Marine Fisheries Service
Department of the Interior, National Parks Service
Department of Agriculture, National Resources Conservation Service
Department of the Army, U.S. Army Corps of Engineers
Department of Transportation, Federal Aviation Administration
Department of Transportation, Federal Transit Administration
Department of Homeland Security, U.S. Coast Guard
Environmental Protection Agency

Hawaii State Agencies
Department of Agriculture
Department of Accounting and General Services
Department of Business, Economic Development and Tourism
Department of Business, Economic Development and Tourism, Research Division Library
Department of Business, Economic Development and Tourism, Strategic Industries Division
Department of Business, Economic Development and Tourism, Office of Planning
Department of Defense
Department of Education, Hawaii State Library, Hawaii Documents Center
Department of Hawaiian Home Lands
Environmental Health Administration
Department of Land and Natural Resources
Department of Land and Natural Resources State Historic Preservation Division
Department of Transportation
University of Hawaii, Water Resources Research Center
University of Hawaii, Environmental Center
University of Hawaii, Thomas H. Hamilton Library
University of Hawaii, at Hilo Edwin H. Moʻokini Library
University of Hawaii, Maui College Library
University of Hawaii, Kauaʻi Community College Library
Office of Hawaiian Affairs
Legislative Reference Bureau Library

County Agencies
County of Maui Department of Planning
County of Maui Department of Public Works

State Libraries
Department of Education, Hawaii State Library
Department of Education, Hawaii State Library, Kaimuki Regional Library
Department of Education, Hawaii State Library, Kaneohe Regional Library
Department of Education, Hawaii State Library, Pearl City Regional Library
Department of Education, Hawaii State Library, Hawaii Kai Regional Library
Department of Education, Hawaii State Library, Hilo Regional Library
Department of Education, Hawaii State Library, Kahului Regional Library
Department of Education, Hawaii State Library, Līhuʻe Regional Library

Media
Honolulu Star Advertiser
Hawaii Tribune Herald
West Hawaii Today
The Garden Island
Maui News
Molokaʻi Dispatch
Lāhainā News
Honolulu Civil Beat

Other
U.S. Senator Mazie Hirono
U.S. Senator Brian Schatz
U.S. Representative Tulsi Gabbard
State Senator Rosalyn Baker
State Representative Angus McKelvey
Maui County Council Representative Elle Cochran

## 9. REFERENCES

Abbott, T. and Z. Norcross. 2005. Utilizing Erosion Rate-Based Construction Setback Rules for Shoreline Protection in Maui.

Balazs. 1996. "Behavioral changes within the recovering Hawaiian green turtle population." *Proceedings of the 15th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NMFS-SEFSC0387, p. 16-20.

Bodge, K.R. 2004. "Alternative Computation of Dean's Overfill Ratio", 17th Annual National Conference on Beach Preservation Technology, Florida Shore and Beach Preservation Association, Orlando, FL.

Bodge, K.R. 2006. "Alternative Computation of Dean's Overfill Ratio." *Journal of Waterway, Port, Coastal, and Ocean Engineering*, Vol. 132, No. 2, p133-138.

Bretschneider, C.L. and Edward K. Noda and Associates. 1985. *Hurricane Vulnerability Study for Honolulu, Hawaii, and Vicinity.*

Coastal Geology Group. Erosion maps.

Davidson-Arnott, R.G.D. 2005. "Conceptual Model of the Effects of Sea-level rise on Sandy Coasts." *Journal of Coastal Research*, Vol. 21, No. 6, p. 1166-1172.

Eversole, D. and C.H. Fletcher. 2003. "Longshore Sediment Transport Rates on a Reef-Fronted Beach: Field Data and Empirical Models Kāʻanapali Beach, Hawaii." *Journal of Coastal Research*, Vol. 19, p. 649-663.

Firing, Y. L. and M. A. Merrifield. 2004. "Extreme sea level events at Hawaii: influence of mesoscale eddies." *Geophysical Research Letters, 31:L24306*.

Fletcher, C.H. 2009. "Sea Level by the End of the 21st Century: A Review." *Shore and Beach*, v. 77, no. 4, pp. 1-9.

Fletcher, C.H., E. Newsome, and M. Barbee. 2010. "A Schedule of Local Relative Sea Level Inundation." Abstract submitted to *2010 Hawaii Conservation Conference, Pacific Ecosystem Management & Restoration: Applying Traditional and Western Knowledge Systems*.

Fletcher, Charles H. III, Eric E. Grossman, Bruce M. Richmond, and Ann E. Gibbs. (2002). *Atlas of Natural Hazards in the Hawaiian Coastal Zone*. Investigations Series I-2761. U.S. Geological Survey: Washington, D.C.

Gerritsen, F. 1978. *Beach and Surf Parameters in Hawaii*. Sea Grant Technical Report No. 78-02, University of Hawaii.

Glenn, Craig R. et al. 2013. *Lāhainā Groundwater Tracer Study*. Prepared for State of Hawaii Department of Health, U.S. EPA, U.S Army Engineer Research and Development Center.

Haraguchi, P. 1984. *Hurricanes in Hawaii*. Report Prepared for the U.S. Army Corps of Engineers.

Hwang, D.J. 2005. *Hawaii Coastal Hazard Mitigation Guidebook*. Prepared for the State of Hawaii Department of Land and Natural Resources, Office of Conservation and Coastal Lands; the State of Hawaii Office of Planning, Coastal Zone Management Program; the University of Hawaii Sea Grant College Program, School of Ocean and Earth Science and Technology; and the U.S. National Oceanic and Atmospheric Administration, Pacific and Coastal Services Center, Honolulu, HI.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007, The Physical Science Basis*. Cambridge University Press, Cambridge.

Kirby, J. T. and R. A. Dalrymple. 1994. *Combined Refraction/Diffraction Model, REF/DEF 1 version 2.5*, CACR Report No. 94-22.

Makai Ocean Engineering, Inc. and Sea Engineering, Inc. 1991. *Aerial photographic Analysis of Coastal Erosion on the Islands of Kauaʻi, Lānaʻi, Maui and Hawaii*. Office of Sate Planning, Coastal Zone Management Program, Honolulu, 200 p.

Mercer, T. 2015. "Hawaiian Monk Seal Use of Kāʻanapali, Maui." 3 pages.

Moberly, R., and T. Chamberlain, 1964 *Hawaiian Beach Systems*. Hawaii Institute of Geophysics, HIG-64-2

Mullane, R. and D. Suzuki. 1997. *Beach Management Plan for Maui*. 1st edition. 71 p.

Mullane, R. and D. Suzuki. 2000. *Kāʻanapali Beach Management Plan*. Prepared for Kāʻanapali Beach Operators. 45 p.

Munez-Perez, J.J., L. Tejedor, and R. Medina. 1997. "Equilibrium Beach Profile Model for Reef-Protected Beaches." *Journal of Coastal Research*, Vol. 15, No. 4, p. 95-957.

Norcross-Nuu, Z, C.H. Fletcher, and T. Abbott. 2008. *Beach Management Plan for Maui*. 2nd edition. 47 p.

Ocean Innovators, 1991. *Development of a Remotely Operable Jet Probe and Other Investigations related to Ocean Sand Resources*. Prepared for the Marine Mineral Technology Center, Ocean Basins Division, Honolulu, Hawaii

Pfeffer, W.T., J.T. Harper, and S. O'Neel. 2008. "Kinematic constraints on glacier contributions to 21st Century sea-level rise." *Science*, 321, p. 1340-1343.

PlanPacific and Sea Engineering, Inc. 2010. *Kailua Beach and Dune Management Plan*. Prepared for Hawaii Department of Land and Natural Resources and the University of Hawaii Sea Grant College Program. 83 p.

Rahmstorf, S. 2007. "A semi-empirical approach to projecting future sea-level rise." *Science*, 315, p. 368-370.

Sea Engineering, Inc., 1993. *Beach Nourishment Viability Study*. Prepared for the Office of State Planning, Coastal Zone Management Program

Sea Engineering, Inc. 1998. *Evaluation of Shoreline Condition, Maui Sheraton Maui Hotel*. Prepared for Belt Collins Hawaii, Inc.

Sea Engineering, Inc. 2003. *Shoreline History and Erosion Remediation, Kāʻanapali Aliʻi Condominiums*. Prepared for Classic Resorts, Lāhainā.

Sea Engineering, Inc., 2006. Kāʻanapali Beach Nourishment -Possible Sand Sources, Dredging Methods and Cost.

Sea Engineering, Inc., 2007. Kāʻanapali and Kahekili Beach Offshore Sand Reconnaissance Survey.

Smith and Cheung. 2002.

SSFM International Inc., 2006. *Inland Sand Resource Quantification Study*. Prepared for the County of Maui, Department of Public Works and Environmental Management

SSFM International Inc., 2016. *Kāʻanapali Beachwalk Pedestrian Study*. Prepared for Host Hotels and Resorts

U.S. Environmental Protection Agency. 2009. *Coastal Sensitivity to Sea-level rise: A Focus on the Mid-Atlantic Region*. January 15, 2009.

U.S. Army Corps of Engineers. 1998. *Depth of Closure in Beach-fill Design.* CETN II-40 (3/98)

U.S. Army Corps of Engineers. 2006. *Coastal Engineering Manual*.

U.S. Army Corps of Engineers. 2009. *Incorporating Sea-Level Change Considerations in Civil Works Programs.* EC 1165-2-211. Washington, DC.

Velicogna, I. 2009. "Increasing Rates of Ice Mass Loss from the Greenland and Antarctic Ice Sheets Revealed by GRACE." *Geophysical Research Letters*, Vol 36, L19503

Vermeer, M., and S. Rahmstorf. 2009. "Global Sea Level Linked to Global Temperature." Proc. Of the Academy of Sciences of the United States of America, available online (http://www.pnas.org/content/106/51/21527.full.pdf+html).

Vitousek, S., and C.H. Fletcher. 2008. "Maximum Annually Recurring Wave Heights in Hawaii." *Pacific Science*, vol. 62(4:541-553).