Technical Memo

Project: **Middle Harbor Enhancement Area (MHEA)**

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Date: March 6, 2020

Subject: **Beach Enhancement Options**

Introduction

Objective: Develop and evaluate conceptual beach enhancement options.

The Port of Oakland (Port) and the US Army Corps of Engineers San Francisco District (USACE) are evaluating options for enhancing conditions in Middle Harbor Enhancement Area (MHEA) at the Port of Oakland, CA. Three project elements are under review for improvements based on guidance from the MHEA Technical Advisory Committee (TAC): the public access beach (Beach), marsh area, and roosting islands. A design team of engineering and environmental consultants were gathered by the Port to review site conditions, develop feasible options for all three project elements, and evaluate the options relative to specific performance criteria. This memo summarizes Options for enhancements to the public access beach (Beach); evaluation of marsh and roosting island improvements was performed by others. Figure 1 shows elevations in Middle Harbor Enhancement Area (Gahagan & Bryant 2019), and Figure 2 shows a closeup of the elevations near the Beach. The Beach area encompasses roughly 240,000 SF between the shoreline and Mean Lower Low Water (MLLW) contour, and between Point Arnold and the Northern Groin.

Beach Enhancement Options

Beach enhancements were developed and evaluated by the authors noted above during a design charrette and follow-up meetings in November and December 2019. The following feasible beach enhancement Options were developed and evaluated:

1. Option #1 - no-action alternative
2. Option #2 - create a coarse sand area on top of the existing beach
3. Option #3 - create a widened coarse sand upper beach with greater resiliency to sea level rise

Figures 3, 5 and 6 show Options #1 to #3, respectively, with all figures oriented north facing up. Commentary on the proposed construction methodology for each Option is included with each figure. Geotechnical analysis indicates that placement of coarse sand for Option #2 and Option #3 is feasible using typical bulldozers or other heavy equipment. Appendix A provides an overview of site geotechnical conditions (Bill Rudolph 2020).

Table 1 provides a descriptive evaluation of each Option based on the conceptual evaluation criteria developed by the Port. The design team determined that all Options provided here are feasible, and no preferred alternative has been selected.

Figure 1: Elevation model of Middle Harbor (data courtesy Gahagan & Bryant 2019)

Figure 2: Beach and dune area closeup (data courtesy Gahagan & Bryant 2019)

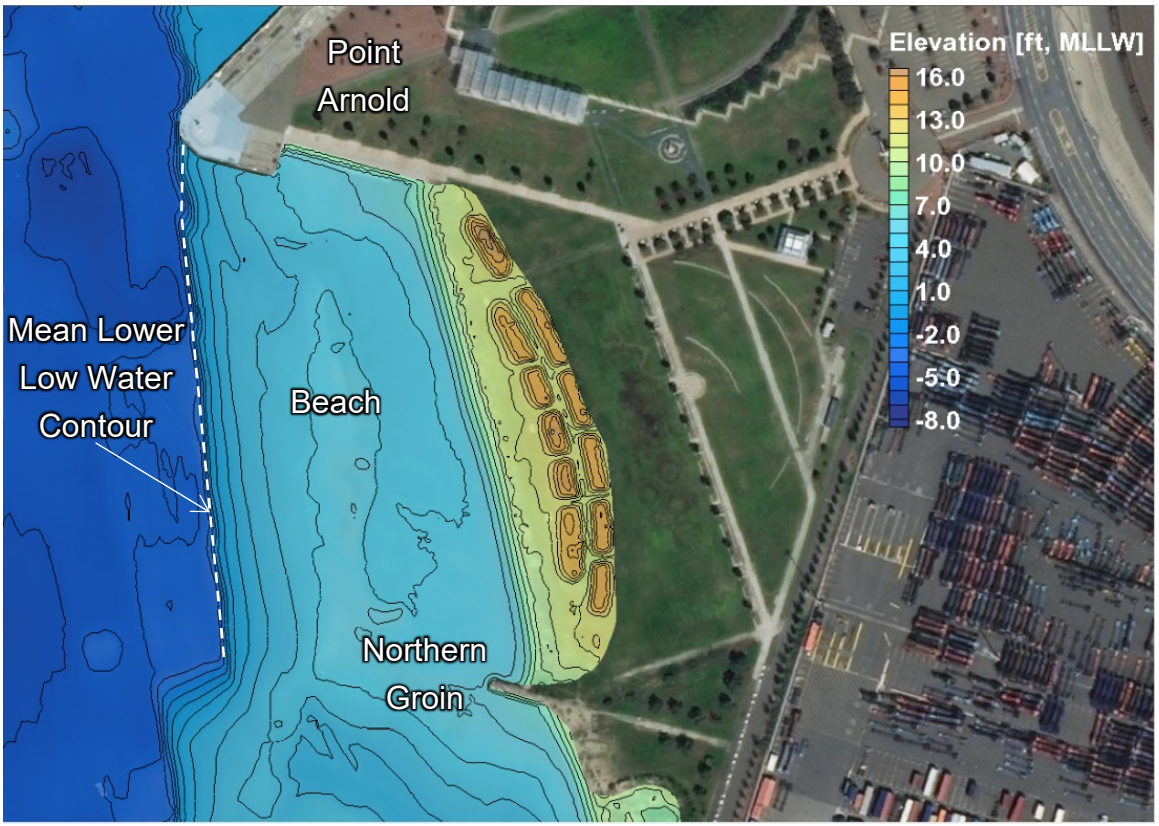


Figure 3: Option #1: Existing Beach (No Action). Photo: Scott Fenical

Option #1 is the no-action alternative and therefore no construction activities would take place under Option #1. Figure 3 shows the existing beach at Middle Harbor Enhancement Area. Natural sorting has resulted in a sandy upper beach (Merritt Sands) and a mix of sand and Bay Mud on the flat lower slope. This configuration is similar to natural East Bay beaches.

Figure 4 shows two other beaches in the East Bay near Emeryville (left) and Berkeley (right). These beaches exhibit similar characteristics, with a fine sand upper beach and flat lower beach with muddy sediments.

Figure 4: Nearby beaches in Emeryville, CA (left) and Berkeley, CA (right). Photos: Google Earth

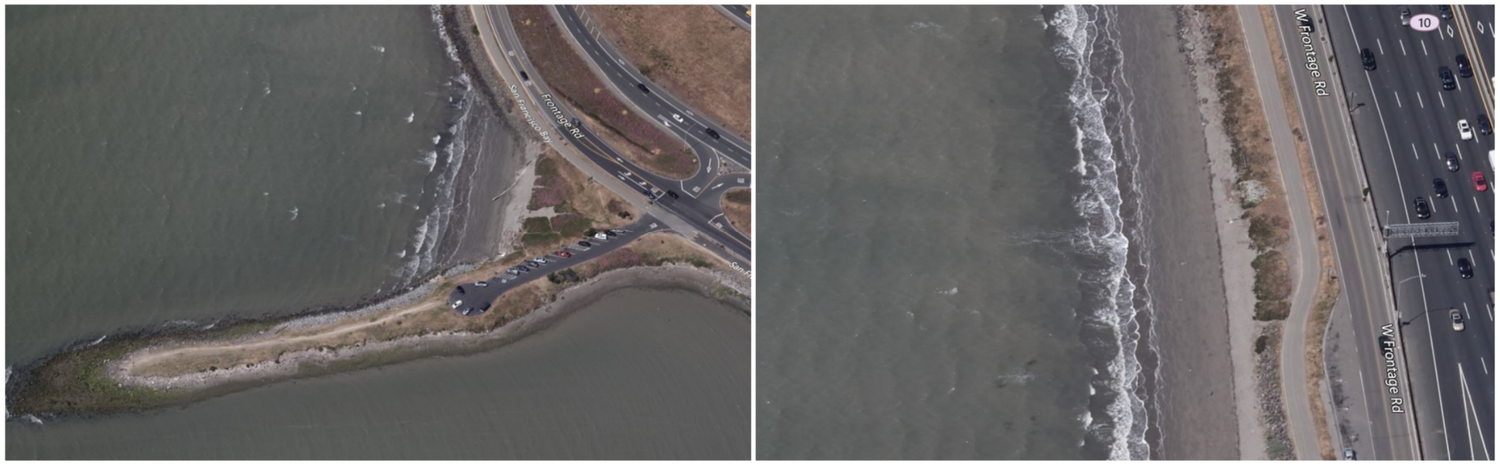
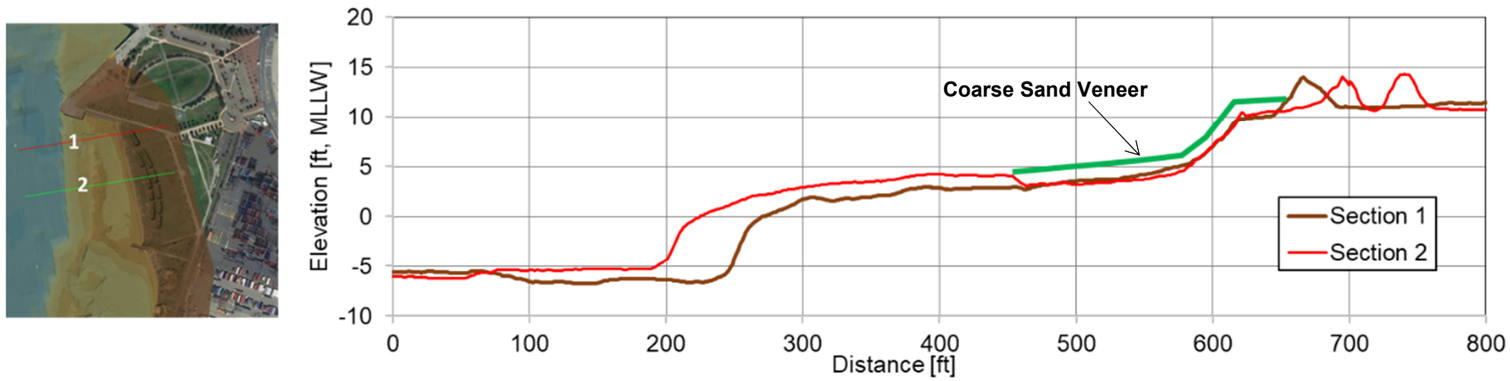
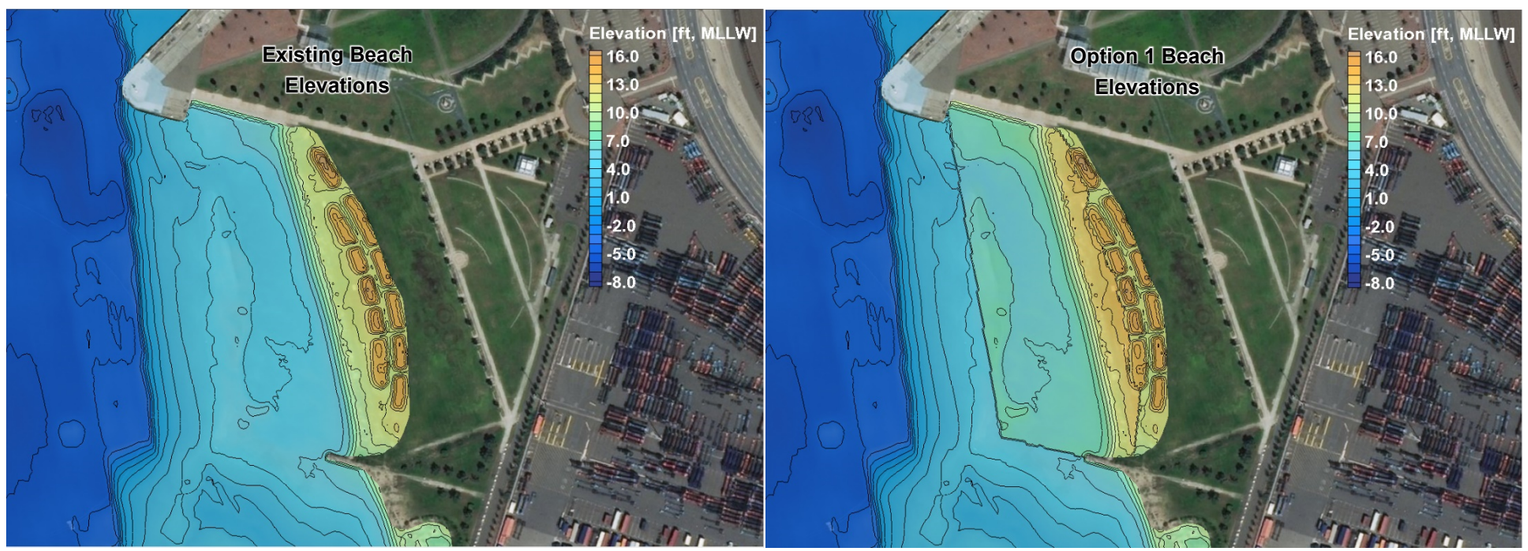


Figure 5: Option #2: Coarse Sand Veneer





Option #2 would create a coarse sand area on top of the existing beach. Figure 5 (top) shows Option #2 in the form of sections taken through the beach at two locations, with a coarse sand veneer (green line) over the existing beach.

Figure 5 (bottom) shows existing elevations (left), and elevations after the 2-ft veneer of sand has been added to the existing grades (right, approximately 15kCY). The addition is shown as a constant veneer, but lower-elevation areas can be filled to eliminate ponding at low tide.

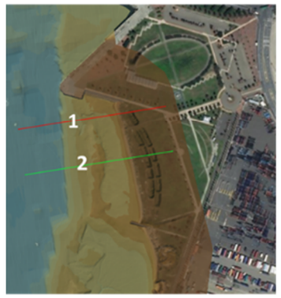
Construction Description

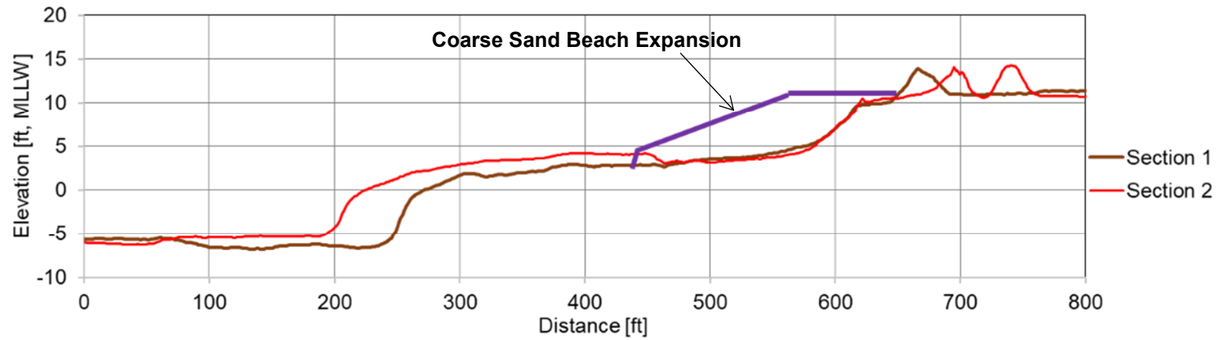
1. No removal of existing materials.
2. Import coarse sand fill by truck to be placed as a veneer (2 feet) on top of existing grades. Recommended coarse sand is Angel Island Sand, mined from the Bay and provided by Hanson Aggregates.
3. Place and grade imported material by bulldozer.

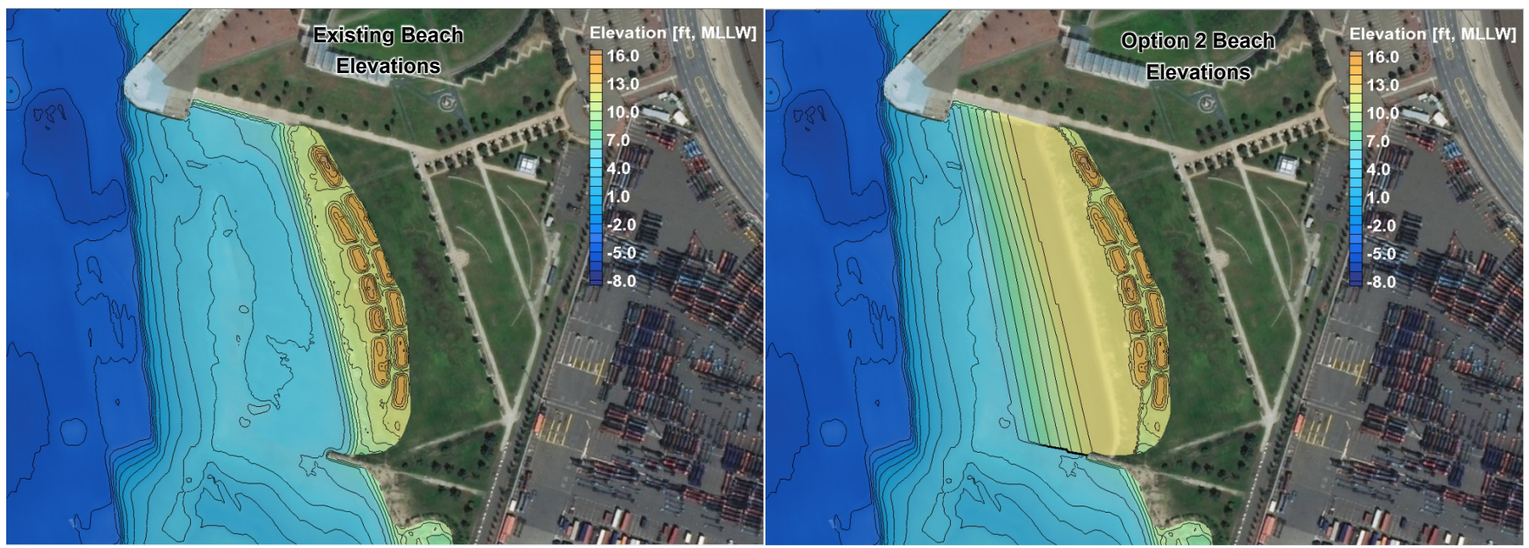
Option #2 could be placed on the entire North Cell as shown in Figure 5, or a smaller portion of the shoreline at the northern end near Point Arnold. The smaller placement area would reduce loss of mudflat habitat and reduce costs. The smaller placement area also avoids interaction with marsh alternatives if they are constructed in the middle cell area.

The cost of Option #2 could potentially also be reduced by using the existing finer material present in the uplands as partial fill beneath the coarse sand. However, volumes of available upland materials are unknown, and minimal fine material could be used under a thin veneer.

Figure 6: Option #3: Coarse Sand Beach Expansion







Option #3 would create a widened coarse sand upper beach with greater resiliency to sea level rise and would be placed on existing grades. Figure 6 (top) shows conceptual Option #3 in the form of sections taken through the beach at two locations, with a wedge of coarse sand placed along the upper beach.

Figure 6 (bottom) shows existing elevations (left), and elevations after the wedge of coarse sand has been added to the existing grades (right, approximately 30kCY).

Construction Description

1. No removal of existing materials.
2. Import coarse sand fill by truck to be placed on top of existing grades. Recommended coarse sand is Angel Island Sand, mined from the Bay and provided by Hanson Aggregates.
3. Build upper beach width at elevation +12' MLLW to be extended roughly 100 feet seaward, then slope down at roughly 7H:1V to intersect the existing slope. No muddy depression would remain, so no standing water would be present at low tide.
4. Place and grade imported material by bulldozer.

Option #3 could be placed on the entire North Cell as shown in Figure 6, or a smaller portion of the shoreline at the northern end near Point Arnold. The smaller placement area would reduce loss of mudflat habitat and reduce costs. The smaller placement area also avoids interaction with marsh alternatives if they are constructed in the middle cell area.

The cost of Option #3 could potentially also be reduced by using the existing finer material present in the uplands as partial fill beneath the coarse sand. However, volumes of available upland materials are unknown.

Table 1: Beach Alternatives Evaluation

Criterion	Option #1: Existing Beach (No Action)	Option #2: Coarse Sand Veneer	Option #3: Coarse Sand Beach Expansion
Self-sustaining	Very good based on present performance	Reasonably so. Coarse sand will be stable but may experience migration of nearby finer sand onto the coarse sand	Reasonably so. Coarse sand will be stable but may experience migration of nearby finer sand onto the coarse sand
Construction impacts to Eelgrass	Zero impacts	Should be minimal with turbidity control	Should be minimal with turbidity control
Cost	Zero	Relatively high cost for imported/placed coarse sand.	Highest cost for imported/placed coarse sand due to larger volumes
Habitat Value	Significant – keeps existing bird foraging and benthic habitat	Loss of benthic habitat because coarse sand is less suitable	Loss of benthic habitat because coarse sand is less suitable
Provides Avian Benefit	Significant – keeps existing bird foraging habitat	Loss of foraging habitat, since coarse sand is likely less biologically productive than existing lower beach.	Loss of foraging habitat, since coarse sand is likely less biologically productive than existing lower beach. However, provides wider area of storm refuge.
Constructability (Difficulty level)	Zero difficulty	Geotechnical consideration of use of heavy equipment on the mudflat was made and no issues are anticipated bulldozing material	Geotechnical consideration of use of heavy equipment on the mudflat was made and no issues are anticipated bulldozing material
Minimize Post-Construction Permitting Actions	Zero post-construction permitting	Unlikely to require post-construction permitting.	Unlikely to require post-construction permitting.
Overall Site Compatibility	Good compatibility, there are no specific goals violated by the condition of the existing beach	Compatible, this was the area's originally intended purpose	Compatible, this was the area's originally intended purpose
Impacts to Existing Habitat	Zero impacts	Potential loss of foraging habitat mentioned above.	Potential loss of foraging habitat mentioned above. Greater potential for new sand fill to migrate to adjacent bird foraging areas. However, provides wider area of storm refuge.
Resiliency (SLR)	Minimal, narrow upper beach width. However, dunes are in place to prevent flooding from waves area at higher water levels	Provides additional beach width at high elevation, prolonging the life of usable beach area into the future with higher water levels. Coarse sand will prevent erosion.	Provides significant additional beach width at high elevation, prolonging the life of usable beach area far into the future with higher water levels. Coarse sand will prevent erosion.
Regulatory Requirements for Construction	None	Permits are required for fill placement. However, fill volumes are low and favorably viewed.	Permits are required for fill placement. Fill volumes are higher than Option #2, requiring demonstration of necessity to accomplish project goals.
Recreational Benefit	Existing only	Improvement to recreational experience at lower tides.	Improvement to recreational experience at all tides and during long-term sea level rise conditions.

References

Gahagan & Bryant. 2019. *Hydrographic survey of Middle Harbor.*

Rudolph, Bill. 2020. *Middle Harbor Beach Geotechnical Conditions and Considerations*.

Appendix A

Middle Harbor Beach Geotechnical Conditions and Considerations

(Bill Rudolph 2020)

SIMPSON GUMPERTZ & HEGER

Engineering of Structures and Building Enclosures

Memorandum

Date: 6 March 2020

To: Jan Novak – Port of Oakland

Copies: Scott Fenical – Mott MacDonald
Dilip Trivedi – Moffatt Nichol
Edwin Draper – Port of Oakland

From: R. William Rudolph, P.E., G.E.

Project: 197571

Subject: **Middle Harbor Beach Geotechnical Conditions and Considerations**

This memorandum provides geotechnical engineering input relative to improvement of the sand beach at the Port of Oakland's (Port) Middle Harbor Enhancement Area (MHEA) and Middle Harbor Shoreline Park (MHSP). These discussions were provided as part of a design charrette organized by the Port, the local sponsor of the United States Army Corp of Engineer's (Corps) MHEA project, to address final modification to the Marsh, Avian Island, and Beach areas. These are ancillary features whose performance goals have been called into question by the MHEA Technical Advisory Committee.

History

Figures 1 - 3 are Google Earth images which show the construction process used to develop the current Middle Harbor Beach. Prior to the MHSP and MHEA restoration projects (starting in the year 2000), the Middle Harbor was operated by the United States Navy. The harbor was initially dredged up to -40 ft MLLW in the beach area. During construction of Berths 56 - 58, a rockfill dike was constructed along the alignment of the current Middle Harbor shoreline forming a fill "cell" isolated from the harbor. The cell was initially filled with clam shell dredged bay mud to about elevation 0 MLLW. Above this elevation dredged sand fill was placed to approximately current elevations. Wick drains were installed through the sand fill and bay mud. Surcharge fill was then placed to pre-consolidate the bay mud in order to mitigate future settlement of the beach and park areas.

The surcharge fill was subsequently removed using conventional track-mounted excavation equipment. The offshore portion of the beach was excavated during low tide. The excavation mainly exposed sand fill. However, the upper portion of the rock dike was also removed. The isolated rocks presently observed in the offshore portions of the beach are remnants of the rock fill dike.

A portion of the rock dike was inadvertently left in place creating both an offshore berm and a lagoon like area formed between the beach front and the dike. The berm is evident in Figure 3 and is also seen in more recent aerial photographs and the current bathymetric surveys. This area appears to have allowed sediment to accumulate during filling of the MHEA with dredge material. It is this sediment that probably resulted in the soft conditions offshore of the beach noted by beach users.

Construction Recommendations

Relative to geotechnical construction considerations for beach modification, the onshore and offshore portions of the beach should be able to support conventional track-mounted construction equipment. Where the mantle of sediment exists, it is likely less than a few feet thick and the tracked equipment should find solid support at a shallow depth. Since the area has been previously surcharged during initial construction, additional settlement resulting from new sand placement should be negligible.

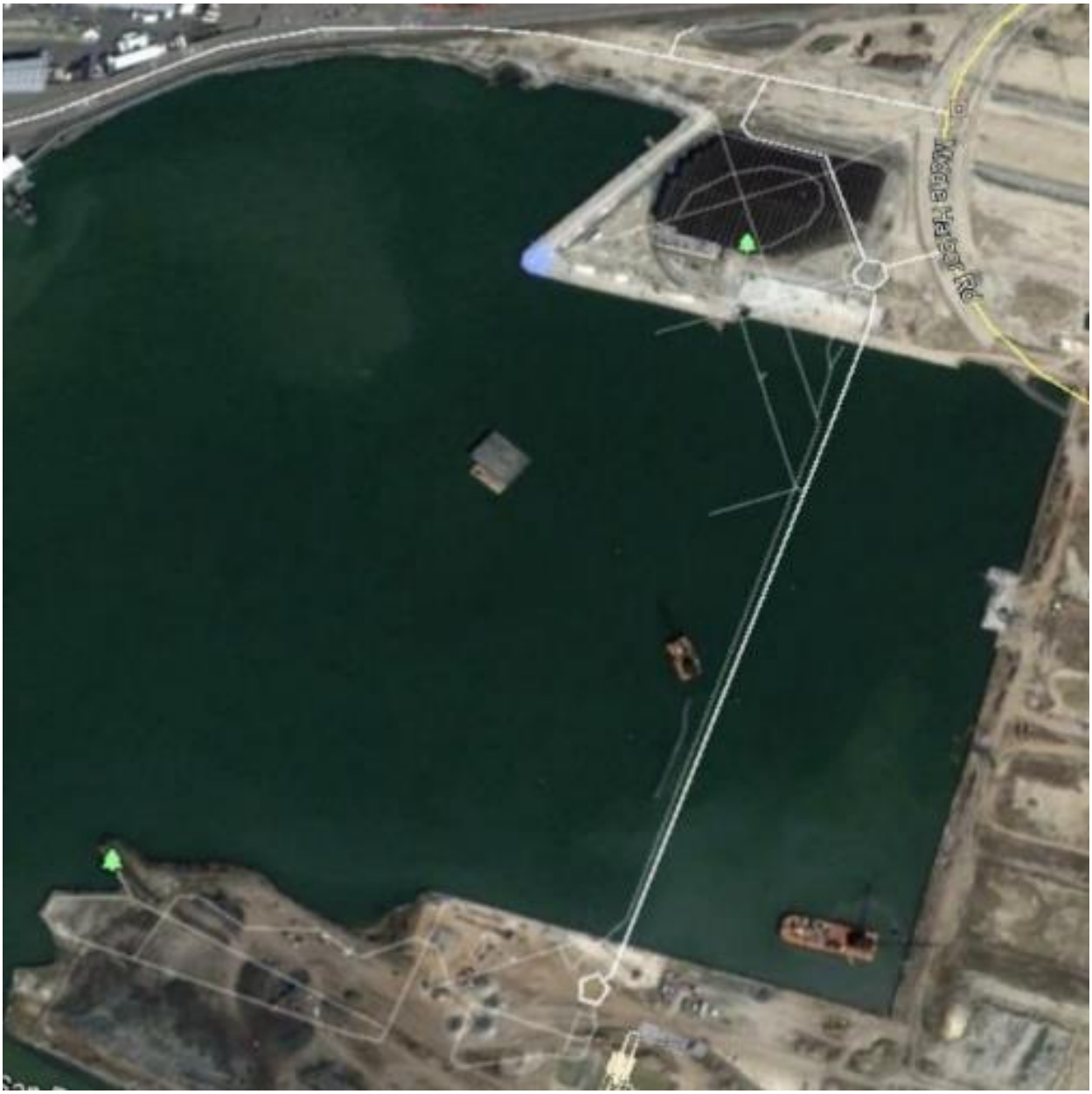


Figure 1 - Google Earth Air Photo March 2000
Beach Area Open Water Prior to Dike and Fill Placement

Figure 2 – Google Earth Air Photo October 2002
Rock Dike, Fill and Surcharge Fill In-place Including Beach Area

Figure 3 – Google Earth Photo October 2018
Surcharge Fill Removed Onshore and Beach Excavated
Dredged Sand and Remnants of Rock Dike Exposed in Offshore Beach Area
Portions of Rock Dike Remain Creating Submerged Berm that Remains Today