North Cruise Berth Projects
PortMiami

AAPA 2017 Facilities Engineering Seminar

Oct 24 – 26, 2017

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Intermodal Ports

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PortMiami

- "*The Cruise Capital of the World*"
- Contributes more than $41 billion annually to Miami-Dade County
- Miami's second largest economic engine
- Generates approximately 324,000 direct and indirect jobs
- Close to 20 cruise lines berthing 45 ships, PortMiami moved close to 5 million cruise passengers during 2016

PORTMIAMI

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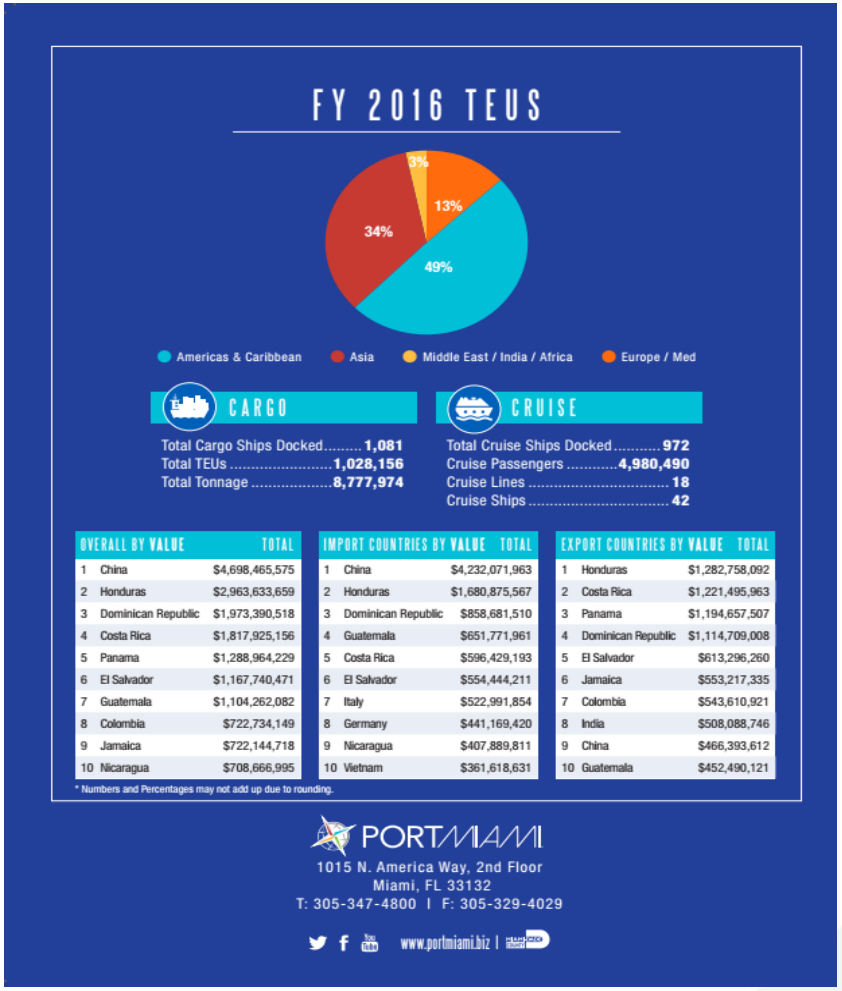
PortMiami



FY 2016 TEUS

CARGO

Total Cargo Ships Docked..... 1,081
Total TEUs 1,028,156
Total Tonnage 8,777,974

CRUISE

Total Cruise Ships Docked..... 972
Cruise Passengers 4,980,490
Cruise Lines 18
Cruise Ships 42

OVERALL BY VALUE		TOTAL
1	China	$4,698,465,575
2	Honduras	$2,963,633,659
3	Dominican Republic	$1,973,390,518
4	Costa Rica	$1,817,925,156
5	Panama	$1,288,964,229
6	El Salvador	$1,167,740,471
7	Guatemala	$1,104,262,082
8	Colombia	$722,734,149
9	Jamaica	$722,144,718
10	Nicaragua	$708,666,995

IMPORT COUNTRIES BY VALUE		TOTAL
1	China	$4,232,071,963
2	Honduras	$1,680,875,567
3	Dominican Republic	$858,681,510
4	Guatemala	$651,771,961
5	Costa Rica	$596,429,193
6	El Salvador	$554,444,211
7	Italy	$522,991,854
8	Germany	$441,169,420
9	Nicaragua	$407,889,811
10	Vietnam	$361,618,631

EXPORT COUNTRIES BY VALUE		TOTAL
1	Honduras	$1,282,758,092
2	Costa Rica	$1,221,495,963
3	Panama	$1,194,657,507
4	Dominican Republic	$1,114,709,008
5	El Salvador	$613,296,260
6	Jamaica	$553,217,335
7	Colombia	$543,610,921
8	India	$508,088,746
9	China	$466,393,612
10	Guatemala	$452,490,121

* Numbers and Percentages may not add up due to rounding.

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2016 Statistics

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North Cruise Berths 1 - 6

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North Cruise Berths Projects

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Atkins has been assisting PortMiami on several key assignments in support of their cruise berths over the past 10 years.

1. PortMiami North Bulkhead Realignment Program
2. NCB 1-6 Scour Bowl Restoration
3. NCB 1-6 Cruise Bulkhead Cathodic Protection
4. NCB 1-6 Seafloor Stabilization Pilot Program
5. Marine Improvement to Berth 7, Cruise Terminal A

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North Bulkhead Realignment Program

PortMiami North Bulkhead Realignment Program

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2035 Port Master Plan recommended the development of new cruise berths to accommodate future demand.

The fifteen year mid-term planning range for new cruise berths was adopted into the Miami-Dade County Comprehensive Development Master Plan (CDMP) on October 2, 2013 by the Miami-Dade County Board of County Commissioners.

- Currently the Port has six (6) north berths in operation
- Two (2) additional berths were considered (Berth 7 and Berth 8)

PortMiami North Bulkhead Realignment Program

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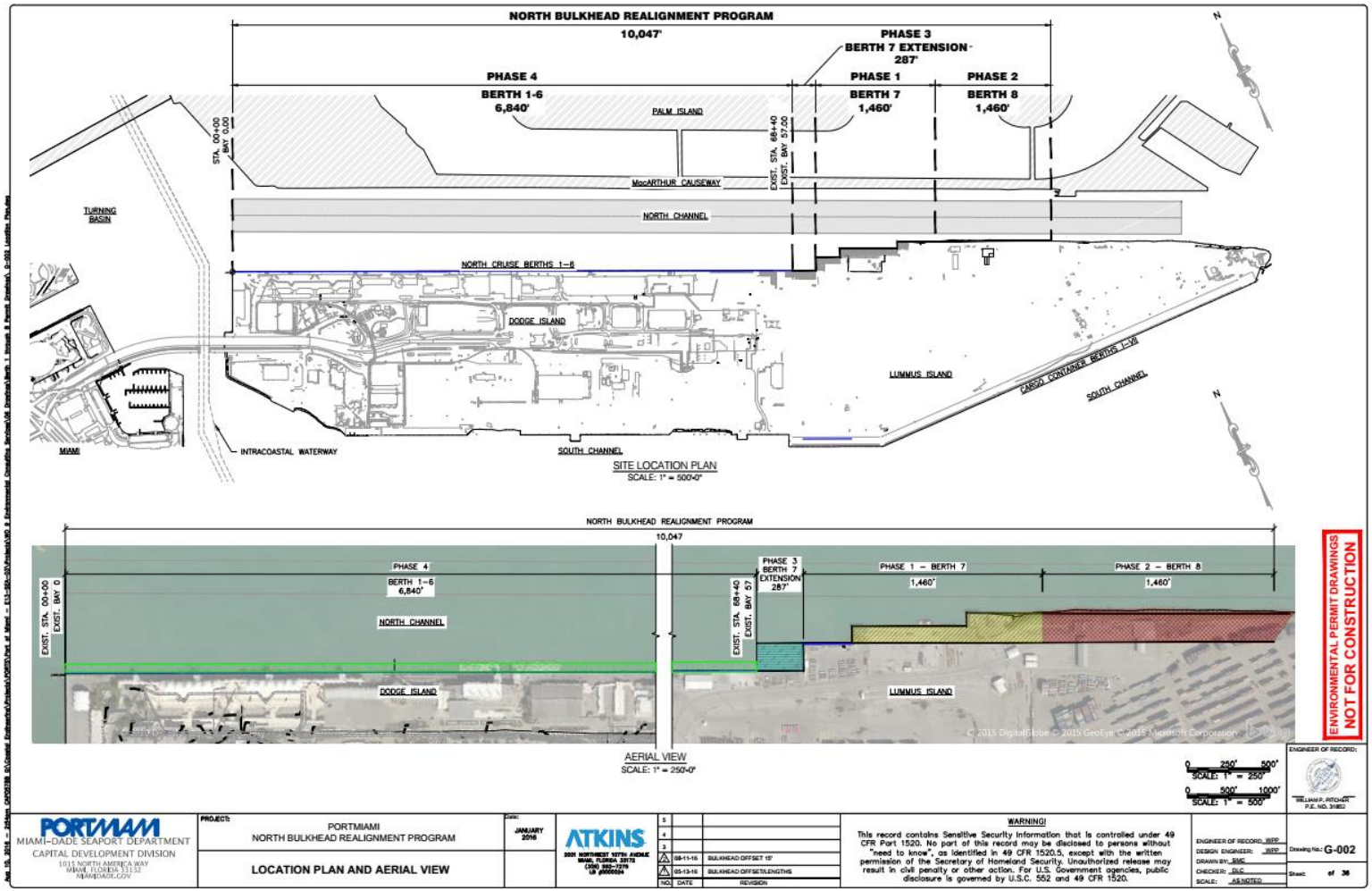

PortMiami North Bulkhead Realignment Program

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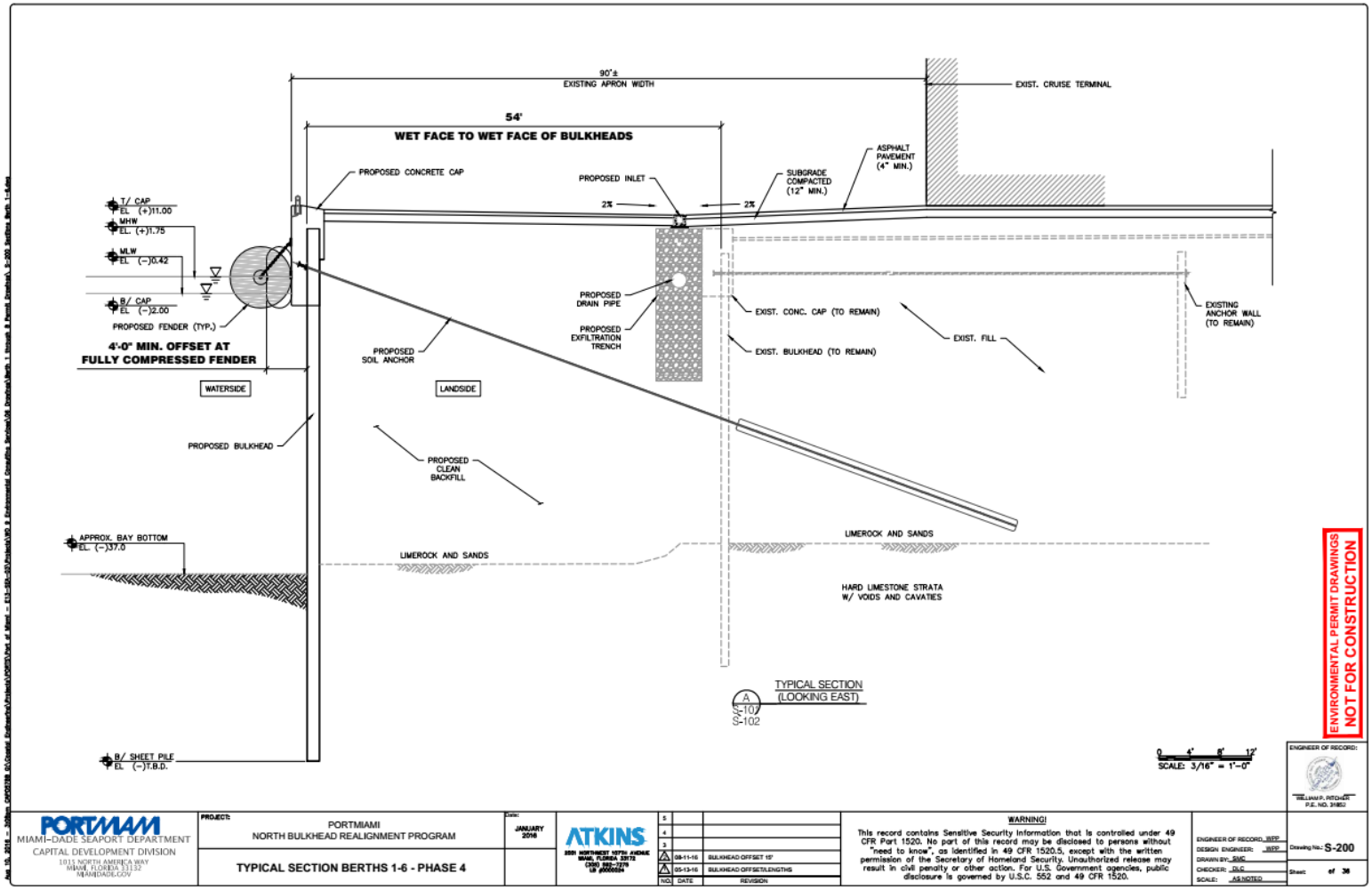

PortMiami North Bulkhead Realignment Program

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The Port entered into an MOU with a terminal operator to construct new berth 7 along the north side of the Port.

Royal Caribbean Cruise Lines (RCL) began construction of this new berth on February 27, 2017.

Procured as a DFBOM-T, overall cost of the new terminal is approximately $216M.

Second P3 initiative that PortMiami has done.

PortMiami North Bulkhead Realignment Program

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NCB 1-6 Scour Bowl Restoration

NCB 1-6 Scour Bowl Restoration

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The objective of the scour bowl restoration is to prevent the existing scour bowls from undermining the integrity of the embedment of the existing bulkhead wall. The proposed sheet pile toe wall combined with a concrete fill between the existing wall and proposed wall will offer passive resistance and stabilize the wall preventing sheet pile embedment failure. The target elevation to fill the scour bowls is at EL. (-) 37.0 NGVD,

NCB 1-6 Scour Bowl Restoration

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Benefits

- provides for adequate embedment against scour.
- reduces lateral stress on the sea bottom
- reduces the negative and positive bending moment stresses

Challenges

- cutting, shaping and removing the sea bottom prior to installing sheet piling
- installing/driving new toe wall sheet piling into the dense limestone sea bottom
- Installing the toe wall in close proximity to the existing bulkhead
- cutting the toe wall underwater to final grade
- placing concrete underwater between the toe wall and existing sheet piling
- environmental permitting required

Construction Issues

- toe wall can be installed from landside
- toe wall can be constructed in sections
- installation crews can be working at different locations
- installation equipment can be moved off the apron in cruise days
- cruise ship berthing schedules can be accommodated

NCB 1-6 Scour Bowl Restoration

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A multi-beam bathymetric survey was done by Morgan & Eklund in 2015 and updated in 2016. This information was used by Atkins to confirm the presence (or lack thereof) of propeller washouts, scour bowls and other sea bottom anomalies that may have impact on the existing bulkheads.

Scour Bowl No.	Cruise Terminal	Bay No.	Station	Sheet Pile Tip (EL., NGVD)	Scour Depth (EL., NGVD)	Target (EL., NGVD)	Approx. Length (Feet)	Approx. Width (Feet)	Approx. Depth (Feet)
3	G	26	31+75	-50	-44	-37	40	20	6
4	D	28 to 30	34+00 to 36+00	-45	-44.5	-37	200	20	6
5	G	33	40+45	-45	-41	-37	20	15	3
6	D	36	43+10	-45	-41	-37	15	10	3
7	G	39	47+40	-45	-42	-37	40	10	5
8	D	53	64+15	-45	-41	-37	30	10	3
9	D	57	69+00	-45	-41	-37	20	10	3

Other Scour bowls along the North Bulkhead

NCB 1-6 Scour Bowl Restoration

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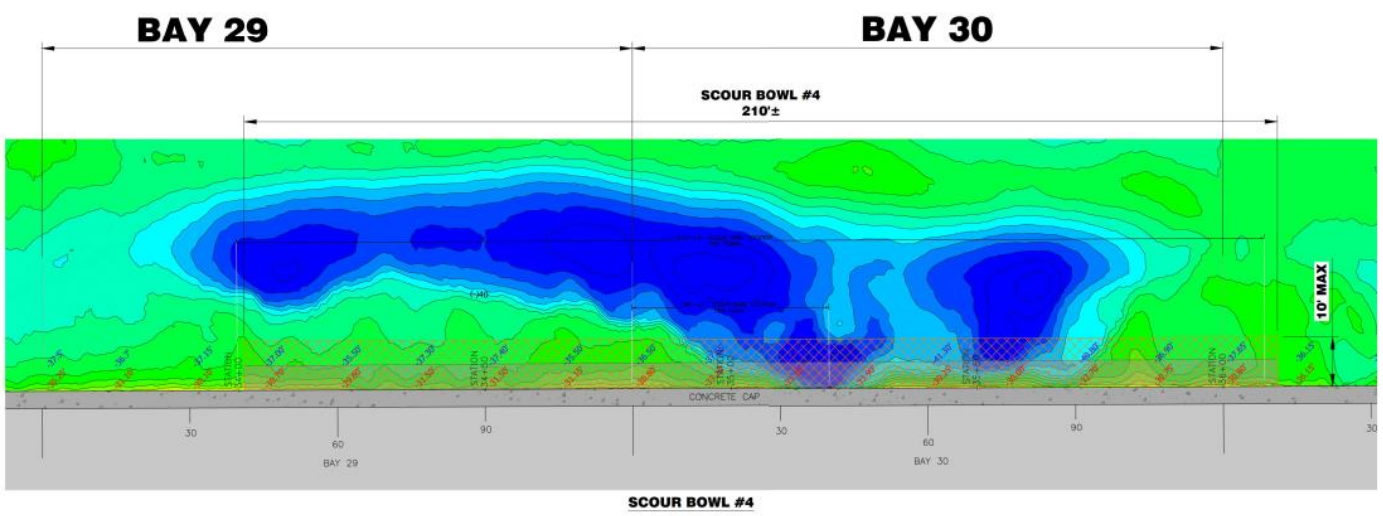

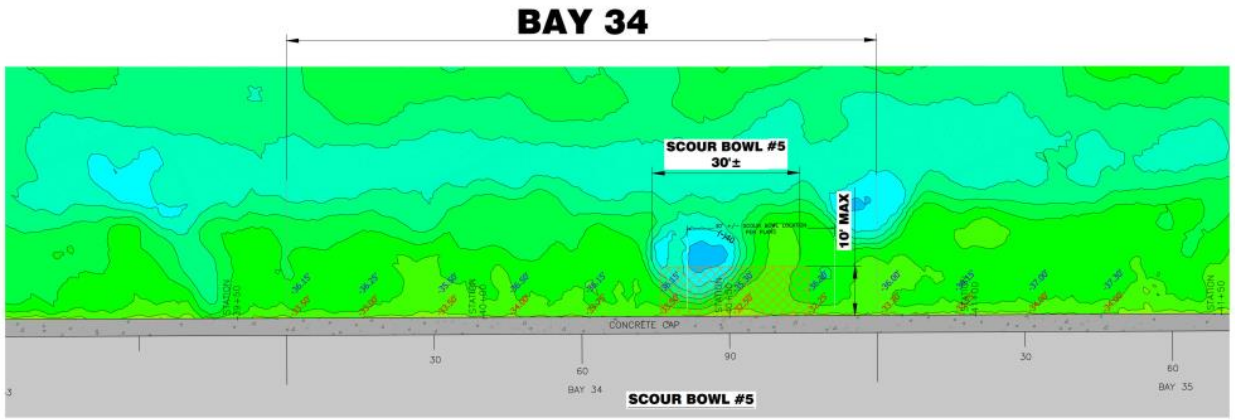

ELEVATION TABLE

MLLW		NVGD29		
Min Elev	Max Elev	Min Elev	Max Elev	Color
-47	-44	-47.54	-44.54	
-44	-43	-44.54	-43.54	
-43	-42	-43.54	-42.54	
-42	-41	-42.54	-41.54	
-41	-40	-41.54	-40.54	
-40	-39	-40.54	-39.54	
-39	-38	-39.54	-38.54	
-38	-37	-38.54	-37.54	
-37	-36	-37.54	-36.54	
-36	-35	-36.54	-35.54	
-35	-34	-35.54	-34.54	
-34	-33	-34.54	-33.54	
-33	-32	-33.54	-32.54	
-32	-31	-32.54	-31.54	
-31	-30	-31.54	-30.54	
-30	-29	-30.54	-29.54	

NCB 1-6 Scour Bowl Restoration

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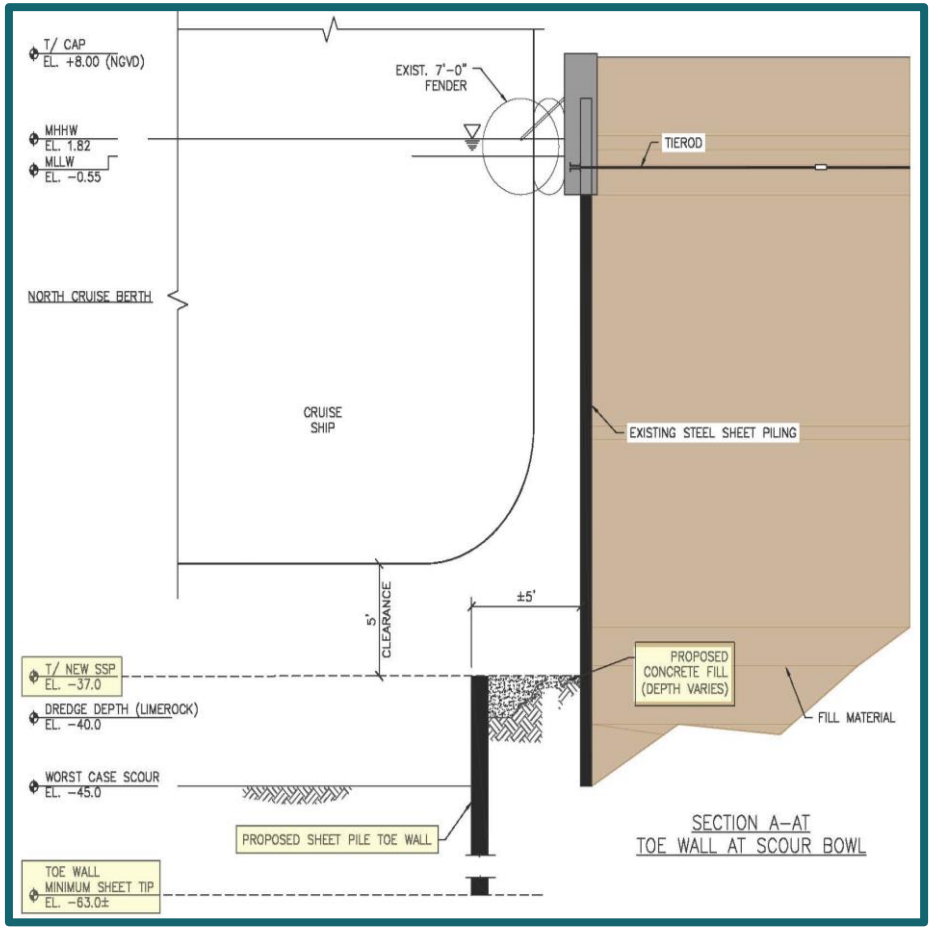
Proposed installation of a new sheet pile toe wall at ~ 5 feet waterward of existing bulkhead.

Concrete fill to be placed between new sheet pile toe wall and existing bulkhead wall

Re-establishment of embedment at existing bulkhead wall.



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NCB 1-6 Bulkhead Cathodic Protection

NCB 1-6 Bulkhead Cathodic Protection

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The objective of the Cathodic Protection program is to develop a plan for the installation of a ten (10) year (minimum) cathodic protection system for the existing steel sheet pile bulkhead along North Cruise Berths 1 through 6.

Atkins and their subconsultant, Vector Corrosion Services, evaluated the use of corrosion management (cathodic protection) to reduce the rate of corrosion of the steel sheet pilings (below water) and thereby preserve the remaining structural integrity which would gain additional service life. Corrosion management in the form of cathodic protection is a proven cost effective method and may be applied to steel sheet pile bulkheads of the age installed along the Project

NCB 1-6 Bulkhead Cathodic Protection

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Data sets were utilized for the corrosion rate analysis

Each data set contained measurements at the top, mid-height and bottom of wall.

Corrosion rate selected for anode design was 3.5 mpy.

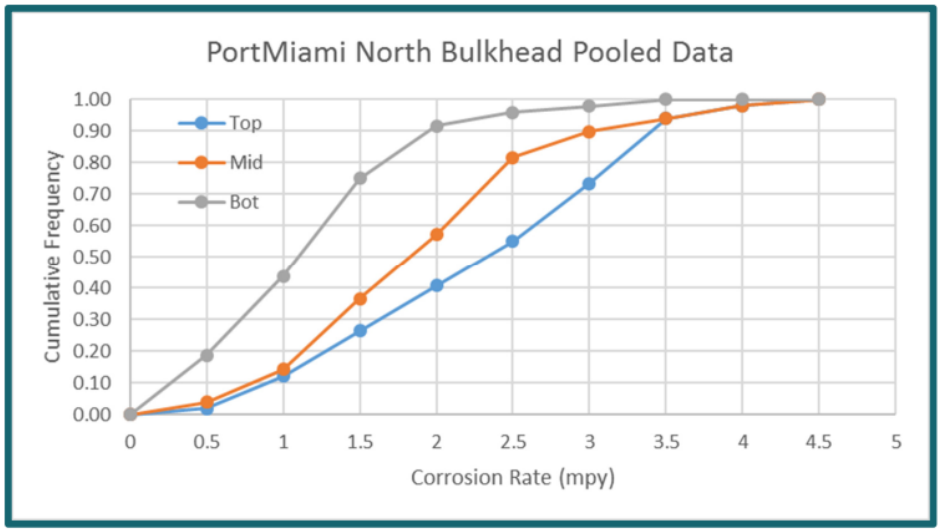

Figure 3.1
Cumulative Frequency

NCB 1-6 Bulkhead Cathodic Protection

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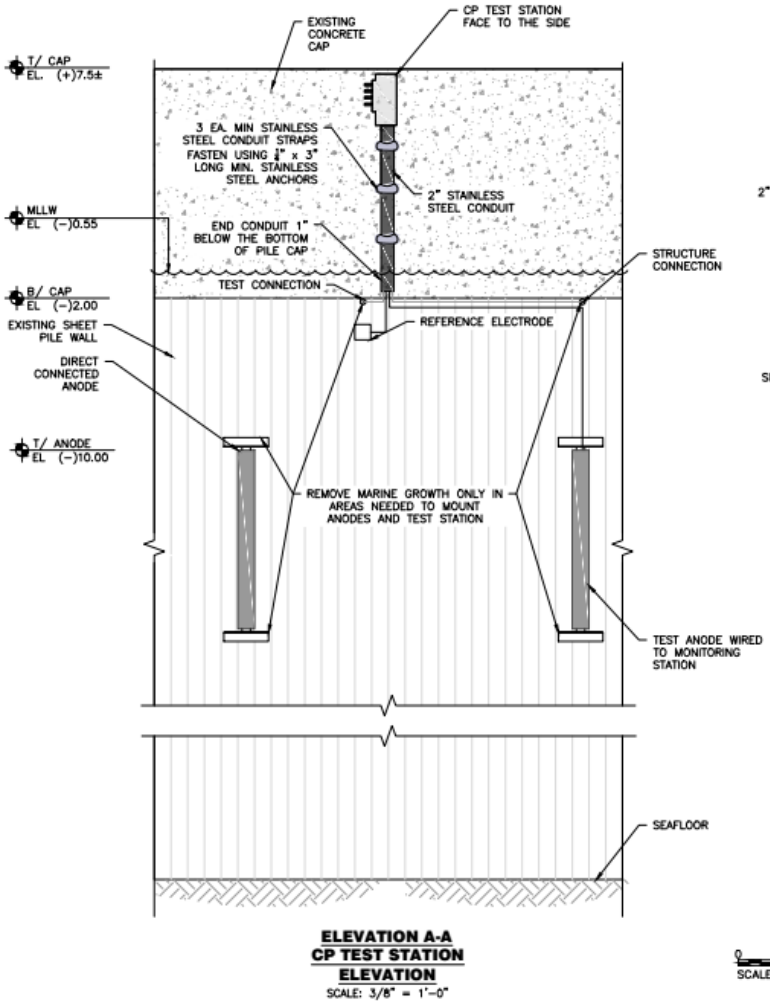

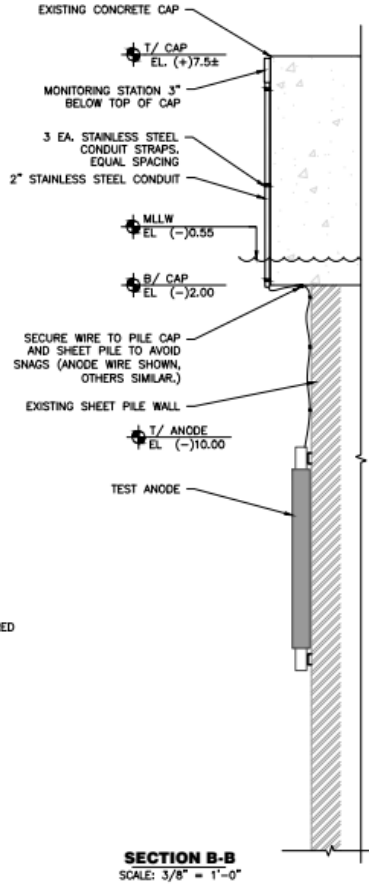

725 LB ALUMINUM PLATFORM TYPE A–S ANODE 9''X9.4''X96'' LONG WITH 4"ø SCHEDULE 80 PIPE CORE. ANODE ALLOY MILA–A–24779(SH)

NCB 1-6 Seafloor Stabilization Program

NCB 1-6 Seafloor Stabilization Program

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The purpose of the seafloor stabilization program is to improve the characteristics of the low quality rock strata at the base of the bulkheads. The stabilization program under evaluation is a pilot program that would address about 500 feet of the total 7,000-plus linear feet of bulkhead serving Berths 1 through 6.

The seafloor at the toe of the sheet pile typically consists of poor quality limestone. Stabilization of the seafloor is planned to strengthen the limestone, increase resistance against a toe failure of the sheet pile wall, and help protect against scour adjacent to the sheet piles.

NCB 1-6 Seafloor Stabilization Program

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Benefits

- reduces sheet pile embedment requirements
- strengthens the sea-bottom against scour

Challenges

- drilling grout tubes underwater
- filling the tubes with grout
- controlling the grout disbursement

Construction Issues

- grout tubes can be installed from landside but divers are required.
- grouting can be deployed in sections
- installation crews can be working at different locations
- installation equipment can be moved off the apron in cruise days
- cruise ship berthing schedules can be accommodated
- environmental permitting required

NCB 1-6 Seafloor Stabilization Program

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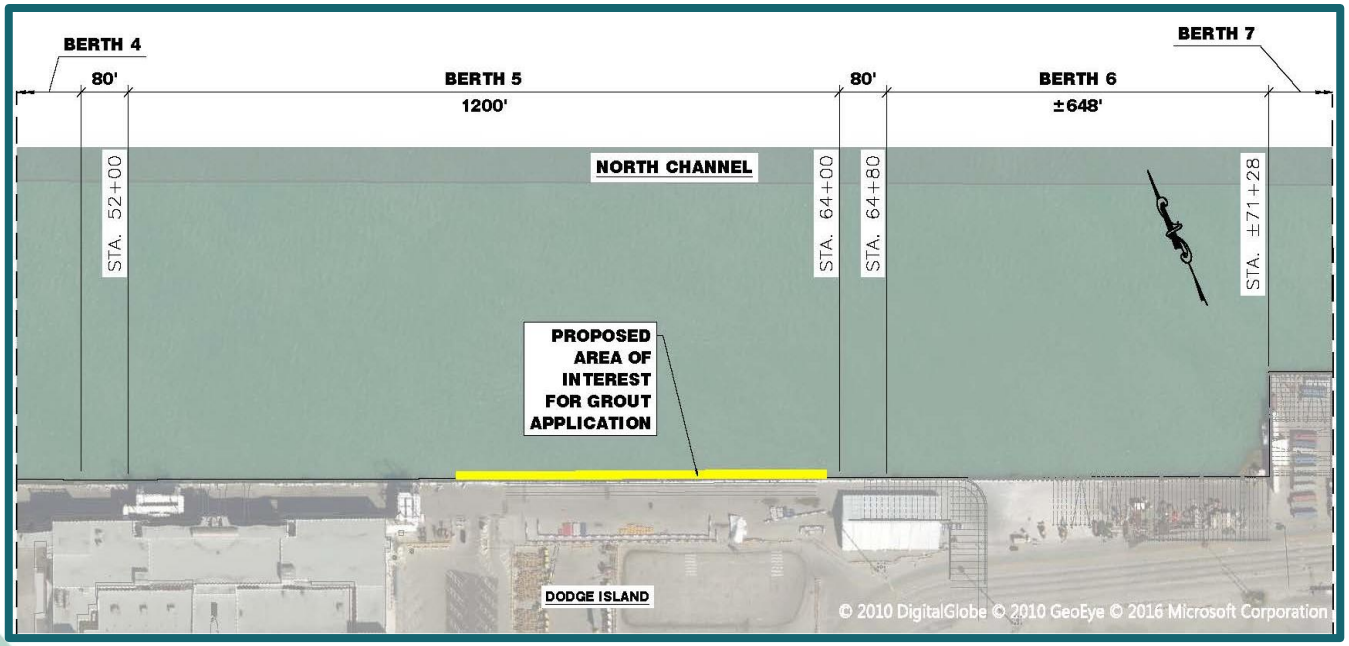
The suggested location for the pilot program implementation is within the limits of Berth 5. The area from station 58+80 to station 63+80 is located within the limits of the original 1960's bulkhead wall and does not overlap with any of the scour bowl restoration areas .



NCB 1-6 Seafloor Stabilization Program

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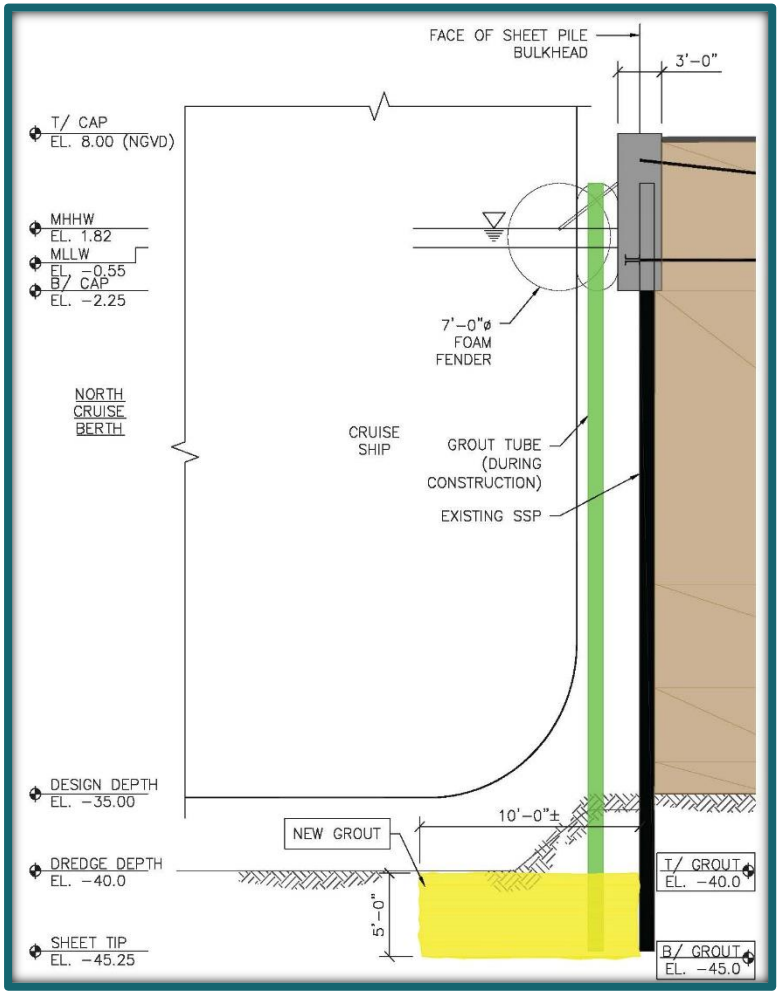
Grout tubes would be placed at 3-foot intervals to facilitate stabilization of the seafloor adjacent to the sheet piles



Marine Improvements North Cruise Berth 7 – Cruise Terminal A

Marine Improvements North Cruise Berth 7 – Cruise Terminal A

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In a public-private partnership (P3) agreement with Miami-Dade County, Miami Cruise Terminal A, LLC, will be constructing and operating a new signature cruise terminal (Cruise Terminal A), provisioning building, parking garage, intermodal areas and a new cruise ship berth all to be located on the northeast quadrant of PortMiami. The new cruise berth needs to accommodate a 400 meter LOA (1,312 feet) Stretch-Oasis Class RCCL cruise ship with extended mooring line zones, both forward and aft of the ship. When completed, new Cruise Berth 7 will have an overall length of about 443 meters (1,454 feet)

Marine Improvements North Cruise Berth 7 – Cruise Terminal A

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Image retrieve from Google Earth

Marine Improvements North Cruise Berth 7 – Cruise Terminal A

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Atkins was retained as the Engineer of Record and is providing marine engineering design for the bulkheads including walers, tie-rods and anchor walls, stormwater management plans, apron pavement and drainage.

The design vessel for this project is the RCL *Oasis of the Seas* and Stretch-Oasis Class vessels with the following characteristics:

Class: *Oasis of the Seas*
- Length Overall (LOA): 1,187 feet
- Distance between perpendiculars: 1,082.5 feet
- Beam at waterline: 154.2 feet
- Draft (fully laden) 30.5 feet
- Side Windage Area 162,158 square feet
- Displacement 104,350 long tons

Class: Stretch-Oasis Class Cruise Ship
- Length Overall (LOA): 1,312 feet
- Distance between perpendiculars: 1,148 feet
- Beam at waterline: 154.2 feet
- Draft (fully laden) 30.5 feet
- Side Windage Area 183,837 square feet
- Displacement 119,386 long tons

Marine Improvements North Cruise Berth 7 – Cruise Terminal A

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Structural Members

Member sizes considered for the bulkhead wall, anchor wall, and tie rods are as follows:

- Bulkhead wall: PAZ42/AZ26-700 Combi-Wall, 5/8-inch pipe thickness, ASTM A572, Grade 50
- Anchor wall: SKZ 31, Cold rolled ASTM A572, Grade 50
- Tie rods: 2.5-inch diameter, ASTM A615 Grade 75
- Waler at anchor wall: Double C15x40, ASTM A572, Grade 50, back-to back




Marine Improvements North Cruise Berth 7 – Cruise Terminal A

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Concrete Cap

The current bulkhead design includes a concrete cap with integrated removable curb railing. The top of the cap is sloped to drain water towards the apron and towards stormwater conveyance system. The high side of the top of the cap is at EL (+) 11.00, sloping back to EL (+) 10.75 on the landward side of the cap.

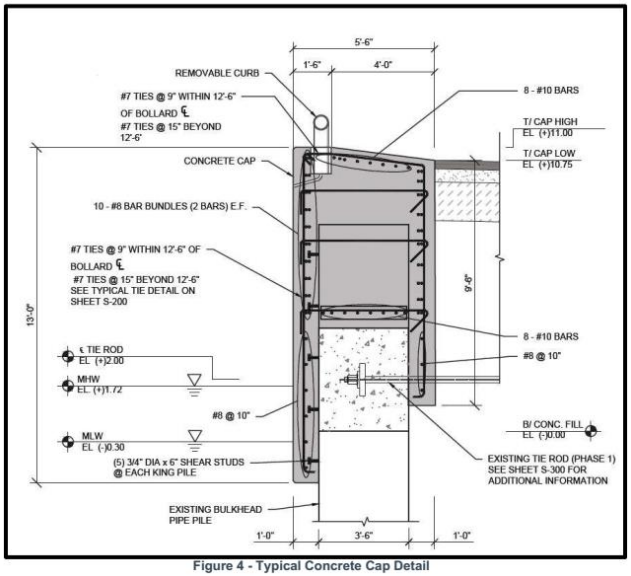

Figure 4 - Typical Concrete Cap Detail

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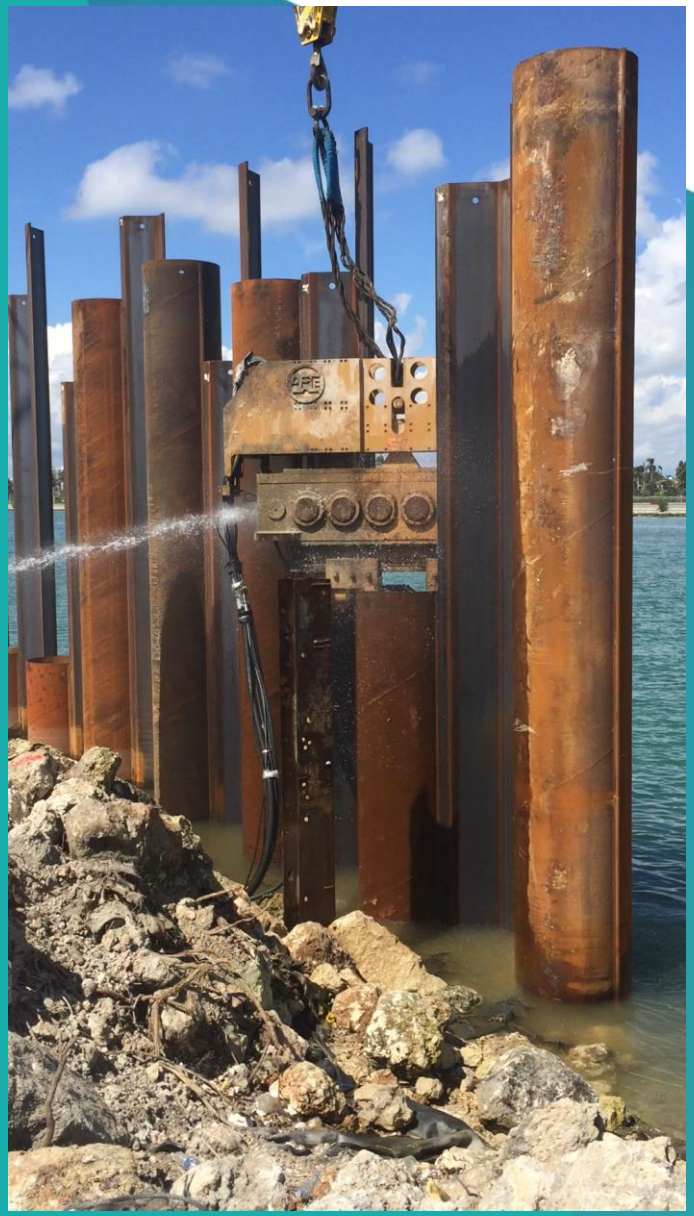
Combiwall Installation



Marine Improvements North Cruise Berth 7 – Cruise Terminal A

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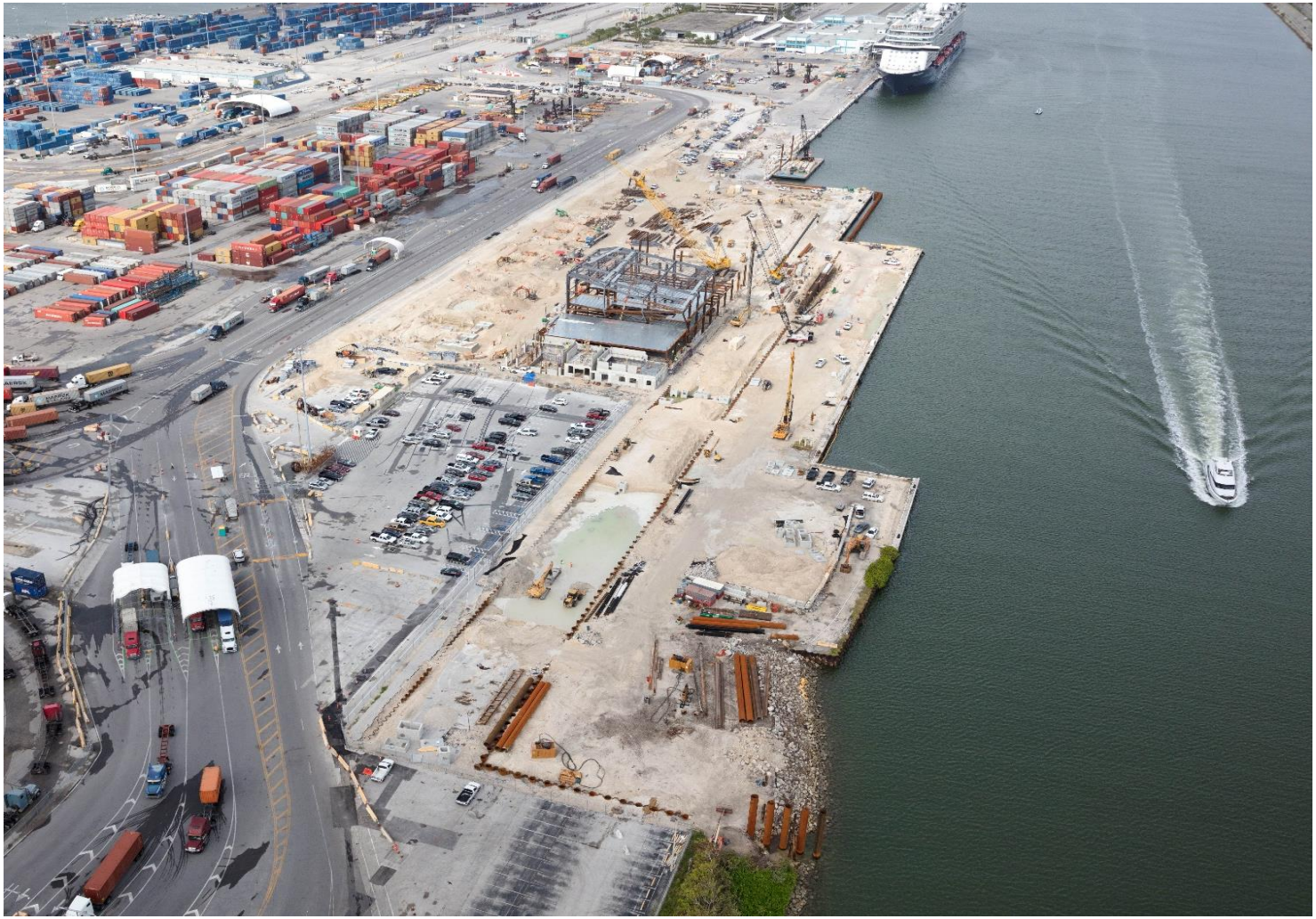

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