Don Young Port of Alaska
1871 Anchorage Port Road
Anchorage, Alaska 99501

Revision prepared by:

Ruthanna Carr, Safety Coordinator

TERMINAL MANUAL

Port of Alaska, Anchorage

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TERMINAL MANUAL

for

Don Young Port of Alaska

1871 Anchorage Port Road
Anchorage, Alaska 99501
1-907-343-6200

Original Date of Plan: March 2023
Date of Scheduled Plan Review: October 2024

Designated Person Accountable for This Manual:
Operations Manager and Maintenance Superintendent

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PORT STAFF DIRECTORY *

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* As of October 2024

TERMINAL MANUAL PLAN REVIEW

PLAN REVIEW STRATEGY

A review and evaluation of this Terminal Manual will be conducted annually by the POA Commission and POA Management Staff. As a result of this review and evaluation, the Port of Alaska (POA) will amend the Terminal Manual within six months of the review.

Scheduled reviews and Terminal Manual amendments are recorded in the review log below. This log should be completed even if no amendment is made to the Terminal Manual because of the review. Unless a technical or administrative change prompts an earlier review, the next scheduled review of this Terminal Manual must occur by December 2024.

Review Date	Comments	Signature of Port Director
12/31/2023	- No recommended changes	Stephen Ribuffo
10/10/2024	- Edited for personnel, port name and address, and phone number changes - Added new info for PCT petroleum operating parameters as requested by the users	Stephen Ribuffo
10/10/2024	Items added: - PCT Mooring Analysis - PCT Mooring Hardware	Stephen Ribuffo

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APPENDIX

ACRONYMS AND ABBREVIATIONS

Acronyms	Definition
bbl	Barrel. US measurement of 42 gallons.
COA	Certificate of Adequacy
COTP	Captain of The Port
FTZ	Foreign Trade Zone
Hazmat	Hazardous Materials
hr	Hour
Lb	Pound
MAWP	Maximum Allowable Working Pressure.
MHW	Mean High Water
MHHW	Mean Higher High Water
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
MTL	Mean Tide Level
MTSA	Marine Transportation Safety Recovery
NOAA	National Oceanic and Atmospheric Administration
PCT	Petroleum Cement Terminal
POA	Port of Alaska
POL	Petroleum Oil Lubricants
PSIG	Pounds per Square Inch Gauge
UKC	Under Keel Clearance
USCG	United States Coast Guard
PFD	Personal Flotation Device

1. GENERAL INFORMATION

1.1 PURPOSE OF THIS MANUAL

The purpose of this manual is to outline the basic marine terminal related infrastructure, environmental, and operational parameters for the Port of Alaska. It is meant as a guideline and does not necessarily encompass all facets. There are ongoing infrastructure improvement and replacement projects. There is also ongoing routine dredging of the navigation channel and berths at the facility. Therefore, certain portions of this manual will need to be periodically updated.

1.2 GENERAL REQUIREMENTS

1. Vessels departing or berthing at piers or wharves, must use sufficient tugs so that the vessel can be berthed or removed in a safe manner.

2. Due to the extreme tide range and strong currents in the Cook Inlet, 24-hour mooring line tending is mandatory for all vessels moored at the Port.

3. Vessel master, ship pilots, and terminal operators shall determine if conditions at time of and during mooring require additional lines above the minimum requirements.

4. Regardless of anything written in this manual, the vessel captain is ultimately responsible for the safe and efficient operation of the ship, including its seaworthiness, safety and security, cargo operations, navigation, crew management, and legal compliance, and for the persons and cargo on board.

1.3 NAME OF TERMINAL

Don Young Port of Alaska, Anchorage (POA)

1.4 FACILITY OWNER AND ADDRESS

Owner-Municipality of
Anchorage

Port of Alaska
1871 Anchorage Port Rd
Anchorage, Alaska 99501

1.5 FACILITY CONTACTS

All can be reached during business hours at 907-343-6200. Names and contact information for each title are located on page iii of this manual.

1.6 ABOUT THE DON YOUNG PORT OF ALASKA

Don Young Port of Alaska, commonly called *Port of Alaska*, is a Municipality of Anchorage-owned and -operated facility that handles half of all Alaska inbound freight – some 4.9 million tons of fuel and cargo in 2021 – half of which is delivered to final destinations outside of Anchorage. It is an intermodal transport hub that efficiently connects Alaska's primary marine, road, rail, pipeline, and air cargo systems; a Department of Defense commercial strategic seaport that projects U.S. power across Alaska, the Pacific Rim and the Arctic; and Anchorage's only foreign trade zone (FTZ no. 160) that extends U.S. Customs benefits to businesses and sites throughout the surrounding community. It handles five times more inbound cargo annually than all other Southcentral Alaska ports combined.

Port of Alaska serves deep-water vessels operating year-round. Matson Inc. and TOTE Maritime Inc. each provide twice-weekly scheduled container ship service from Port of Tacoma. Domestic and foreign carriers provide routine bulk deliveries of petroleum products, cement, building materials and other commodities.

Facilities include: 4,000 feet dock frontage, three general cargo terminals, with two 30-ton gantry cranes, one 40-ton gantry crane and proprietary roll-on-off capability, three petroleum terminals with 15, eight-inch, tide-compensating hose lines, dry- and break-bulk handling, two floating, small-vessel docks, and a seasonally available dry-barge landing. All berths are dredged to 35-foot depth at mean lower low water, two miles of rail-spur connected to Alaska Railroad, 125 acres of cargo handling and storage yard, 60,000 tons of bulk cement storage and 3.1 million barrels of liquid fuel storage.

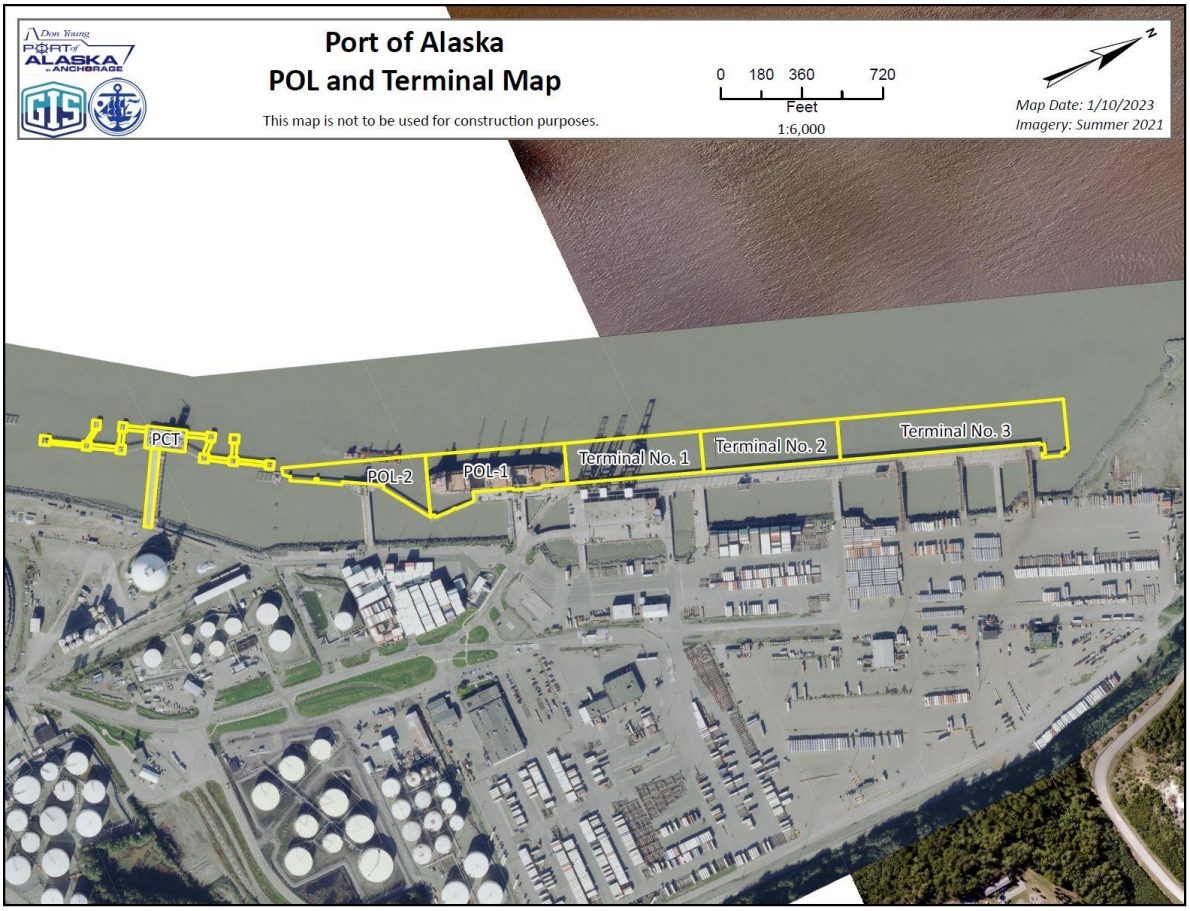


Figure 1: TERMINAL MAP

1.7 TIDES

The Cook Inlet has one of the highest tidal ranges in North America. There is an active National Oceanic and Atmospheric Administration (NOAA) tidal station located at the Port. Tide information is published and available from NOAA.

NOAA publishes the following tidal statistics for the Port:

Highest Observed Water (10/24/1980)	34.55 feet
Mean Higher High Water (MHHW)	29.00 feet
Mean High Water (MHW)	29.00 feet
Mean Sea Level (MSL)	16.45 feet
Mean Tide Level (MTL)	15.29 feet
Mean Low Water (MLW)	2.29 feet
Mean Lower Low Water (MLLW)	0.00 feet
Lowest Observed Water (03/25/1967)	-6.21 feet

TIDAL CURRENTS

Tidal current information is published and available from NOAA and can be found at:

https://tidesandcurrents.noaa.gov/stationhome.html?id=9455920

1.8 WEATHER AND ICE CONDITIONS

ICE can be present in the Cook Inlet from November through April. The ice can form in pans of several acres in size and several feet thick. Ice conditions in the Cook Inlet are monitored and reported by NOAA. *The USCG annually publishes OPERATING GUIDELINES FOR ICE CONDITIONS IN COOK INLET.* Copies are available through the POA Operations Manager, upon request.

Ice forecasts can be found at https://www.weather.gov/afc/ice.

WIND High winds that may affect vessel and dock operations are to be expected. Wind speeds of 29 knots from the west and **44 knots from the north have been recorded at the Port. Three second gust wind speeds of over 100 knots have been reported in the Anchorage area.**

WAVES Significant wave heights of 4.0 feet from the West and 4.5 feet from the North have been estimated. Extreme wave heights of 6.5 feet are possible.

TEMPERATURE Temperatures at the Port can range from 85 degrees Fahrenheit in the summer, to -20 degrees Fahrenheit in the winter.

1.9 DEPTH OF WATER

1. The waters of the Cook Inlet are heavily loaded with silts and sediments that originate from the numerous glacially fed rivers and streams that empty into the Inlet. Two glacial rivers, the Knik and Matanuska, feed the Knik Arm of the Cook Inlet near the Port.

2. The US Army Corps of Engineers maintains the navigation channels to the Port thorough an annual dredging program with the following goals:

a. Federally authorized depth at the dock face: -35 feet MLLW (not guaranteed)
b. Federally authorized depth at the Knik Arm Navigation Channel: -38 feet MLLW

The nominal depth of water at the berth as outlined above are the permitted depths. Actual depths may vary.

3. Seasonal shoaling and sedimentation are likely. Dredging operations are conducted in the ice-free months and depth information is regularly updated. Vessels are advised to contact the US Army Corps of Engineers, Alaska District Civil Works Division for the latest soundings on Knik Arm Navigation Channel and alongside the dock, and closely coordinate operations with the tide cycles paying special attention to low or minus tides. Sedimentation rates of 4 feet per year have been recorded.

4. The POA recommends all vessels maintain a minimum Under Keel Clearance of 3 feet alongside its facilities. As applicable by federal regulations, all vessels must remain afloat, except barges in the dry barge berth.

1.10 WINTER USE OF THE PORT

1. The POA is open year-round. However, extreme temperatures, winter siltation, and ice provide several challenges during the winter months. Ice in the navigation channel and at the berths can cause difficulty in maneuvering and can exert unusually high mooring line forces. Winter siltation may cause decreases in available draft. Machinery, including fuel systems, cooling systems, winches, anchors, ballast water systems, and other auxiliary systems must be winterized and maintained in a state for use in the extreme environment. Tug assistance aids in mitigating these conditions.

2. The US Coast Guard (USCG) Captain of the Port (COTP) has published operating guidelines for ice conditions in Cook Inlet. Copies of this document are available from the USCG.

1.11 SECURITY

1. The Port maintains compliance with the Maritime Transportation Security Act (MTSA) 33CFR Chapter 1-USCG, United States Department of Homeland Security.

2. Entry upon Port property or docking at the terminal by a person or vessel shall be regarded as constituting an agreement to comply with all rules, regulations, and security requirements. All people entering the Port must have government issued photo ID and be prepared to pass through a security screening facility.

POA employees or stakeholder employees working on POA grounds must undergo a security training session, receive a Port of Alaska Proximity Access Card, and secure a Transportation Worker Identity Credential.

3. **Prohibited items** on the POA include but are not limited to: Firearms, Ammunition, Black Powder, Explosives, Fireworks, Aerial Flares, Smokeless gun powder, Firearms, Primers, Uncontrolled Hazmat, and any other substance that could cause a Transportation Security Incident (TSI). Note: Regular Road flares are allowed.

1.12 SAFETY, SANITATION AND HOUSEKEEPING

1. SAFETY AND SANITATION: Users/Operators of the Port of Alaska facilities **will be required to comply with all safety and sanitation rules** applicable on/in any Port of Alaska structures, properties, and facilities **as required by Federal, State, local law, and the Port of Alaska.**

2. Rubbish and refuse of other materials **must**, upon demand, be removed from the terminal by the persons placing it there. The POA is a USCG approved reception facility for MARPOL I-Oil and MARPOL V-Garbage and maintains a Certificate of Adequacy. *The Vessel Agent and/owner are responsible to ensure compliance of 33CFR 158.*

3. If the user/operator does not properly clean property used, the Port Director shall order the work performed and the user/operator will be billed at cost, including 15 percent overhead.

4. No rubbish or materials of any kind shall be dumped overboard from vessels or wharves.

5. Vessels may not discharge fluids overboard.

6. Vessel may not discharge ballast water anywhere within Cook Inlet.

7. Potable water is available in all terminals at the POA. We can provide potable water hose up to the dock face.

1.13 BERTHING POLICY/BERTHING RESERVATIONS

Recognized Terminal Operator Permittees may secure reserved berth space under the following conditions:

1. All berthing reservations will be processed and managed through the Port's "Port Call" on-line system.

2. An approved Berthing Reservation and, only if required by the Port Director, prepaid dockage must be received by the Port a minimum of 48 hours prior to scheduled vessel arrival.

3. If required by the Port Director, full dockage fees will be paid to the Port at the time of reservation. Prepaid dockage fees will be non-refundable unless a written cancellation is received by the Port a minimum of 48 hours prior to scheduled vessel arrival.

4. Vessels that dock at berths without prior-approved reservations do not have berthing privileges or priority and must vacate the berth to accommodate a vessel with a valid reservation if directed to do so. The operator or agent shall complete a berthing reservation immediately after docking.

5. *VESSELS REQUIRED TO VACATE BERTHS:* With the Port Director's approval, vessels may occupy a berth, subject to charges named in Section 2, provided such vessel shall vacate the berth upon direction of the Port Director. Vessels refusing to vacate a berth on demand may be moved by tug or otherwise, and any expenses or damages to the vessel, other vessels, or wharf structures during such removal shall be charged to the owner of the vessel so moved.

6. *CHARGES ON VESSEL SHIFTING*: When a vessel is shifted directly from one wharf to another wharf owned by the Port, the total time at such berths will be considered together in computing the dockage charge.

7. *CHARGES TO ASSISTING VESSELS*: A single vessel, when actively engaged as a tugboat, assisting, and made fast outboard of a vessel loading or discharging cargo, will be accorded free dockage. A tugboat leaving its tended vessel for any purpose shall waive its right to free dockage for the period of berthing it left its tended vessel until it secures back to its tended vessel. when docked in Terminals 1, 2, 3, POL 1, POL 2 or the PCT. In those instances, dockage rates apply.

NOTE: *The Port will make every attempt possible to avoid berthing conflicts during the scheduling process. The published berthing schedule will be developed such that all berthing vessels have a discrete time window assigned in accordance with the information provided in their application. Should conflicts emerge during operations, it is the responsibility of the vessel operators and/or their agents to reach a reasonable accommodation for both parties. The final decision shall be subject to the Port Director's discretion.*

1.14 SMOKING

1. No smoking shall be allowed on any wharf, pier or in any warehouse or transit shed except in **approved areas** specifically designated for that purpose. Designated Smoking Areas are posted at the petroleum docks.

2. Persons violating this rule may be barred, at the discretion of the Port Director, from the further use of any wharf and, in addition, shall be subject to prosecution under applicable Federal, State, and local Laws.

1.15 RESPONSIBILITY FOR PROPERTY DAMAGE

Damaged Port property and facilities **must be reported immediately** to the Port Director. The initial reporting of damages should be communicated by the most expeditious means, followed in writing. Owners/operators damaging Port property will be responsible for repairs. Should the repairs be undertaken by the Port, the owners/operators will be billed for repairs to damaged property at cost, including 15 percent over head.

2. CARGO TERMINALS

2.1 WHARVES

Terminal No. 1

Terminal operator: Port of Alaska
Location: Upper Cook Inlet, Anchorage, AK
Use: Cruise ships, container and breakbulk
Cargo-handling equipment: Two Paceco container cranes, rail-mounted electric at 30 tons; one Mitsubishi container crane, rail-mounted electric at 40 tons; portable cranes available up to 150 tons; forklifts available up to 30 tons

Terminal No. 2

Terminal operator: Port of Alaska
Location: Upper Cook Inlet, Anchorage, AK
Use: Container and breakbulk
Primary use: Lo/Lo container operations
Cargo-handling equipment: Two Paceco container cranes,
rail-mounted electric at 30 tons; one Mitsubishi container crane, rail-mounted electric at 40 tons; portable cranes available up to 150 tons; forklifts available up to 30 tons

Terminal No. 3

Terminal operator: Port of Alaska
Location: Upper Cook Inlet, Anchorage, AK
Use: Container and breakbulk
Primary use: Proprietary Ro/Ro operations
Cargo-handling equipment: Portable cranes available up to 150 tons; forklifts available up to 30 tons

Dry Barge Berth

Location: Upper Cook Inlet, Anchorage, AK
Use: Barge, breakbulk, storage
Primary use: Barge, 400 ft

2.2 ALLOWABLE VESSEL APPROACH ANGLE AND VELOCITY

Cargo docks / Terminals 1 through 3

Approach angle maximum 10 degrees.

The fendering system for the cargo terminals has the following operational limits:

Vessel Displacement	Allowable Approach Velocity Perpendicular to Dock Face		
Long Ton*	Knots	Feet/Minute	Feet/Second
30,000 or less	0.21	21	0.36
30,000 to 50,000	0.16	16	0.28
50,000 to 70,000	0.14	14	0.23
Greater than 70,000	0.1	10	0.18

*One long ton equals 2,240 pounds.

2.3 MOORING LINE LOAD GUIDELINES

1. There are three general types of mooring points at the Port: double bollards, single bollards, and 36-inch cleats. The allowable line loads for these are listed below:
    - 36-inch cleat – allowable line load 30,000 pounds
    - Single bollard – allowable line load 50,000 pounds
    - Double bollard – allowable line load 50,000 pounds per post

2. 24-Hour Line Tending: Due to the extreme tide range and strong currents in the Cook Inlet, 24-hour mooring line tending is mandatory for all vessels moored at the Port.

3. See POA Berthing, Mooring, and Deck Load Limits drawing in the appendix of this document.

2.4 WIND

The table below summarizes the various conditional recommended maximum wind speed for the cargo terminals. Sustained wind is taken to be 30 second average. The berthing wind speed is that for which vessels initially arrive at the dock and tie up. The operational wind speed is that for which cargo operations are allowed. This wind speed may be controlled by the operational parameters of the cranes or other handling equipment. The departure wind speed is that at which it is recommend that the vessel return to sea to ride out the storm event.

Maximum Recommended Sustained Wind Speed		
Condition	Knots	MPH
Berthing	25	28.8
Operational	To be determined by cargo operations	
Departure	50	57.5

2.5 PIERS AND TRESTLES DECK LOAD GUIDELINES

1. Cargo shall be stacked on the piers to produce a uniform load no greater than the limits as prescribed in the table on the next page.

2. Sharp or angular loads shall be cushioned with timber or rubber tire dunnage to protect the deck from damage or marring. Any damage to the deck from loading shall be repaired at no cost to the Port.

3. Cargo shall not be stacked or stored on the approach trestles. Cargo shall not be stacked or stored at the petroleum terminals. Cranes and heavy loads will be evaluated and permitted on a case-by-case basis.

DOCK AND TRESTLE LOAD RATING TABLE

Terminal	Area	Uniform / Lbs. Per Sq. Ft.	Vehicle Load	Crane Load
Terminal 1	Dock	600	HS-20 S16 44	30 Tons
	West Trestle	OUT OF SERVICE	Pedestrian only	
	East Trestle	200	HS-20 S16 44	
	Trestles 1 and 1B	200	HS-20 S16 44	
	Crane Turnout (Longshore Parking Area)	350	HS-20 44	38 kip per wheel, 3 wheels at 2' 11" OC 72 kip per wheel, 3 wheels at 2'-11" OC, bents A and D only
Terminal 2	Dock Phase	600	HS-20 S16 44	71 kip per wheel, 6 wheels at 5’ OC 72 kip per wheel, 3 wheels at 2.5’ OC
	Dock Extension1	650	HS-20 44	71 kip per wheel, 6 wheels at 5’ OC 72 kip per wheel, 3 wheels at 2.5’ OC
	Trestle 2	200	HS-20 44	
Terminal 3	Dock	650	HS-20 44	71 kip per wheel, 6 wheels at 5’ OC 72 kip per wheel, 3 wheels at 2.5. OC
	Trestle 3, 3A & 3B	200	HS-20 44	
	Trestle 3C	600		140-ton truck crane

TARGET FENDER LOCATIONS AND DISTANCES

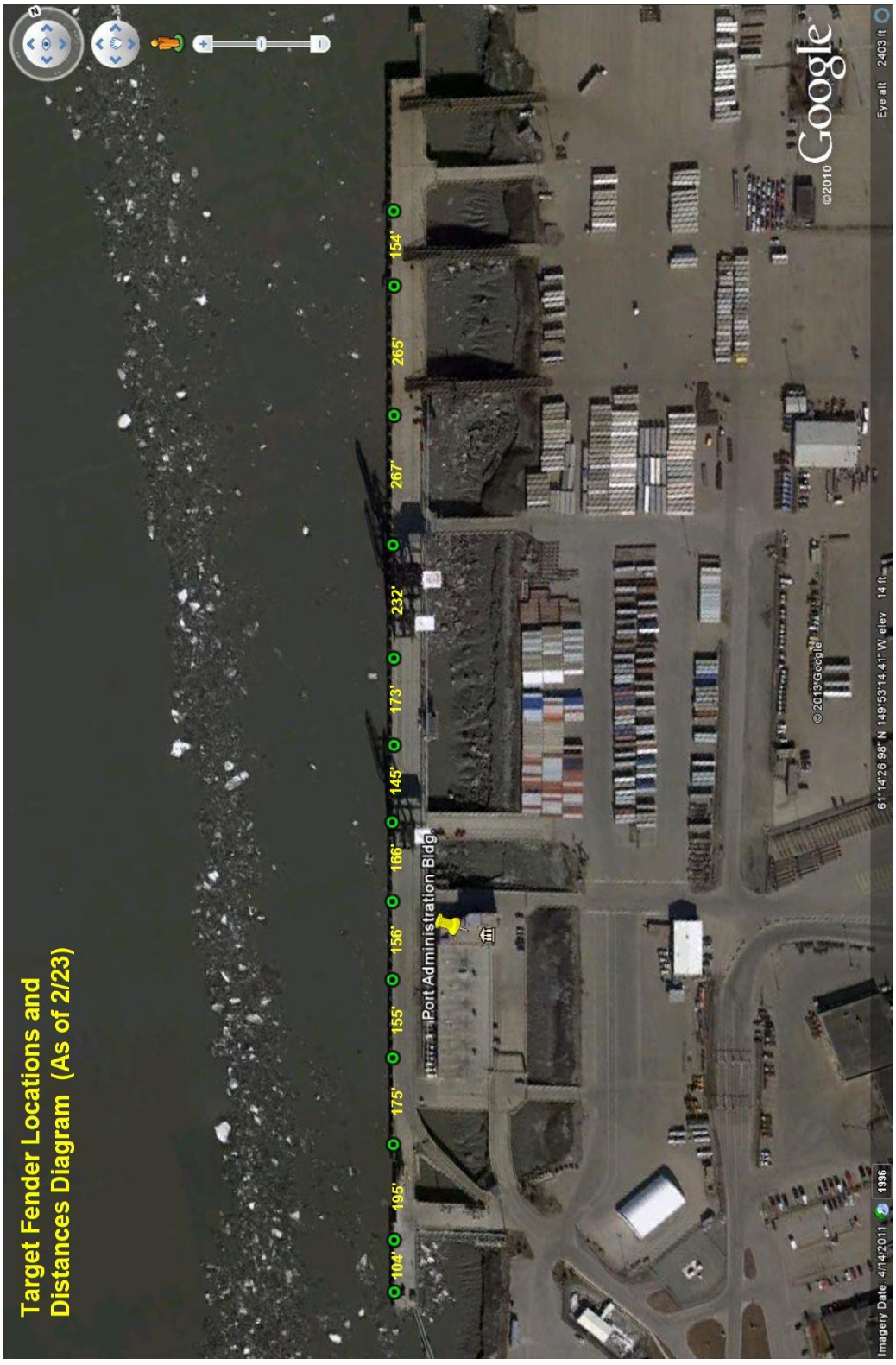


Figure 2: TARGET FENDER LOCATIONS

2.6 EMERGENCY LIFESAVING EQUIPMENT

1. On the dock, there are yellow cabinets that contain a USCG 30" life ring with 90' of floating rope, which is attached. Prior to doing work on the dock, familiarize you and your employees with the life ring cabinet locations and their contents.

2. Attached to each overhead container crane, is a life ring cabinet with a "Rescue Stick" inside. The rescue stick is a type of self-inflating PFD that is thrown to a person that has fallen into the water.

3. Stokes baskets are in the following locations:
- In front of Matson Marine building.
- PCT Safety Room

4. Rescue Disks are in the following locations:
- All POA vehicles
- Denali Security "Rover" truck

Figure 3: TYPICAL LIFE RING

3. PETROLEUM TERMINALS

3.1 TERMINAL INFORMATION *(All petroleum transfer facilities are 33 CFR 154 compliant, and the POA retains a current COA IAW 33 CFR 158.)*

POL 1 Terminal: The dock supports a steel framed, 35' tall hose tower structure, containing four 8" rubber fuel hoses used for fuel transfers. The MAWP of the fuel transfer hoses is 150 PSIG and are tested annually. POL 1 has two aromatic lines and two distillate lines. The facility has a small, 10' x 6' operations building, used to conduct the fuel transfer and control the pedestal crane by two hose watch personnel. The facility has an OSHA compliant, 3000lb lifting capacity pedestal type crane, used to lift personnel on/off the vessels, via an OSHA compliant man basket. *All crane operators must be trained and qualified.* The facility has a small spill response kit, which contains appropriate PPE, boom, and absorbent pads. Communication between vessel and operations building is provided by the hose watch company and is intrinsically safe. The operations building has an intrinsically safe telephone for local calls only. *No gangway is provided.*

POL 2 Terminal: The dock supports a steel framed, 35' tall hose tower structure, containing five, 8" rubber fuel hoses used for fuel transfers. The MAWP of the fuel transfer hoses is 150 PSIG and are tested annually. POL 2 has three distillate lines; one is dedicated to ULSD, and two aromatic lines, one of which is dedicated to methanol. The facility has a small, 10' x 6' operation building used to control the fuel transfer by two hose watch personnel. The facility has an OSHA compliant, 3000lb lifting capacity pedestal type crane, used to lift personnel on/off the vessels, via an OSHA compliant man basket. *All crane operators must be trained and qualified.* The facility has a small spill response kit, which contains appropriate PPE, boom, and absorbent pads. Communication between vessel and operations building is provided by the hose watch company and is intrinsically safe. The operations building has an intrinsically safe telephone for local calls only. *No gangway is provided.*

PCT (Petroleum Cement Terminal): The dock supports a steel framed, 45' tall hose tower structure, containing six, 8" rubber fuel hoses with loading arms, used for fuel transfers. The PCT has one distillate line, two aromatic lines, two ULSD line, and one methanol line. The PCT facility has a two-story operation building used to control the fuel transfer by two hose watch personnel. On top of the tower is a pedestal type crane used to lift personnel on/off the vessels via an OSHA compliant man basket. *All crane operators must be trained and qualified.* The operations building has a fixed combustible gas detection system within, to alert works of a hazardous atmosphere. The facility has a small spill response kit, which contains appropriate PPE, boom, and absorbent pads to be used by hose watch personnel in the event of a small leak or spill. Communication between vessel and operations building is provided by the hose watch company and is intrinsically safe. The operations building has an intrinsically safe telephone for local calls only. The PCT is also used as a work platform for off-loading cement, when not being used as a fuel transfer facility. *As of 2-3-23, a gangway is in the procurement stage.*

3.2 POL Facility Address and Coordinates

Facility	Physical Address	Latitude	Longitude
POL 1	1959 Anchorage Port Road	61°14'17.98"N	149°53'23.29"W
POL 2	1964 Anchorage Port Road	61°14'11.22"N	149°53'30.46"W
PCT	1390 Ocean Dock Road	61°14'4.45"N	149°53'39.31"W

3.3 Design Vessels

Facility	Maximum Size of Vessels	Type	Number of vessels
POL 1	600' tanker / 400' barge	Barge, tanker	1
POL 2	600' tanker / 400' barge	Barge, tanker	1
PCT	750' tanker / 580' barge / 600' Cement Bulk Carrier	Barge, tanker	1

3.4 PRODUCT HANDLED AT FACILITIES

Facility	Products Handled
POL 1	Gasoline, ultra-low sulphur diesel, aviation fuel, diesel fuel
POL 2	Gasoline, ultra-low sulphur diesel, diesel fuel, aviation fuel, jet fuel, JP-8, methanol
PCT	Gasoline, ultra-low sulphur diesel, diesel fuel, aviation fuel, jet fuel, JP-8, methanol

3.5 ALLOWABLE VESSEL APPROACH ANGLE AND VELOCITY

Approach angle maximum 10 degrees

POL 1 and 2 Terminals

The fendering system for the POL1 and POL2 terminals has the following operational limits:

Vessel Displacement	Allowable Approach Velocity Perpendicular to Dock Face		
Long Ton*	Knots	Feet/Minute	Feet/Second
30,000 or less	0.21	21	0.36
30,000 to 50,000	0.16	16	0.28
50,000 to 70,000	0.14	14	0.23
Greater than 70,000	0.1	10	0.18

Petroleum and Cement Terminal (PCT)

The fendering system at the PCT is designed for the following conditions:

Vessel Displacement	Allowable Approach Velocity Perpendicular to Dock Face		
Long Ton*	Knots	Feet/Minute	Feet/Second
74,000	0.27	27.6	0.46
40,000	0.35	35.4	0.59

3.6 WIND

The table below summarizes the various conditional recommended maximum wind speed for the petroleum terminals. Sustained wind is taken to be 30 second average. The berthing wind speed is that for which vessels initially arrive at the dock and tie up. The operational wind speed is that for which fuel or cement operations are allowed. This wind speed may be controlled by the operational parameters of the loading arms or other handling equipment. The departure wind speed is that at which it is recommend that the vessel return to sea to ride out the storm event.

Maximum Recommended Sustained Wind Speed POL1 &2		
Condition	Knots	MPH
Berthing	25	28.8
Operational	To be determined by cargo operations	
Departure	50	57.5

Maximum Recommended Sustained Wind Speed PCT - Petroleum Tanker		
Condition	Knots	MPH
Berthing	25	28.8
Operational	39	45
Departure	52	60

Maximum Recommended Sustained Wind Speed PCT- Cement Bulk Carrier		
Condition	Knots	MPH
Berthing	25	28.8
Operational	39	45
Departure	43.5	50

3.7 MOORING LINE LOAD GUIDELINES

1. There are three general types of mooring points at POL1 and 2: double bollards, single bollards, and 36-inch cleats. The allowable line loads for these are listed below:

- 36-inch cleat – allowable line load 30,000 pounds
- Single bollard – allowable line load 50,000 pounds
- Double bollard – allowable line load 50,000 pounds per post

2. The PCT is equipped with quick release hooks and an instrumented line tension monitoring station in the operations building.

- Breasting Dolphin – double back-to-back QRH - 100 metric tons per hook.
- Mooring Dolphin Quad QRH - 100 metric ton each hook.
- Fixed Bollard – 100 metric ton each.

3.8 PETROLEUM DOCKS LOAD RATING TABLE

Terminal	Area	Uniform / Lbs. Per Sq. Ft.	Vehicle Load	Crane Load
PCT	Deck	400	HS-25 Truck	N/A
	Trestle	400	HS-25 Truck	N/A
	Walkways	60	N/A	N/A
POL 1	South Pier Extension	600	HS-20 S16 44	30 Tons
	Loading Platform	400	HS-20 S16 44	
	Roadway Bridge		HS-20 S16 44	N/A
	Walkway Bridge	100	None	N/A
	Trestle 1A	200	None	N/A
POL 2	Dock	400	HS20-44	N/A
	Walkway	100	None	N/A

3.9 PCT BERTHING LAYOUTS

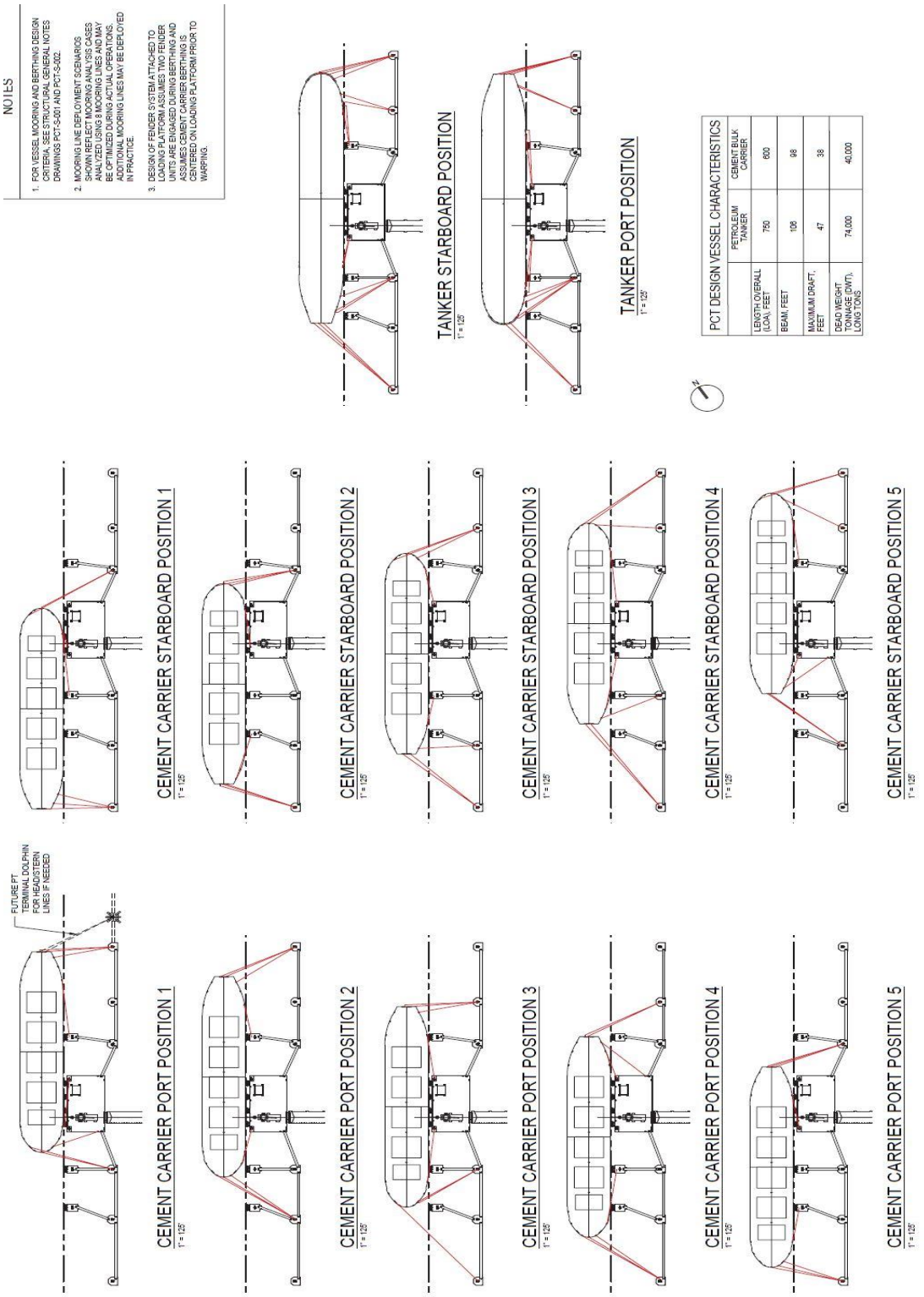


Figure 4: PCT BERTHING LAYOUTS

3.10 DESIGNATED PARKING and SMOKING AREAS Marked IN RED

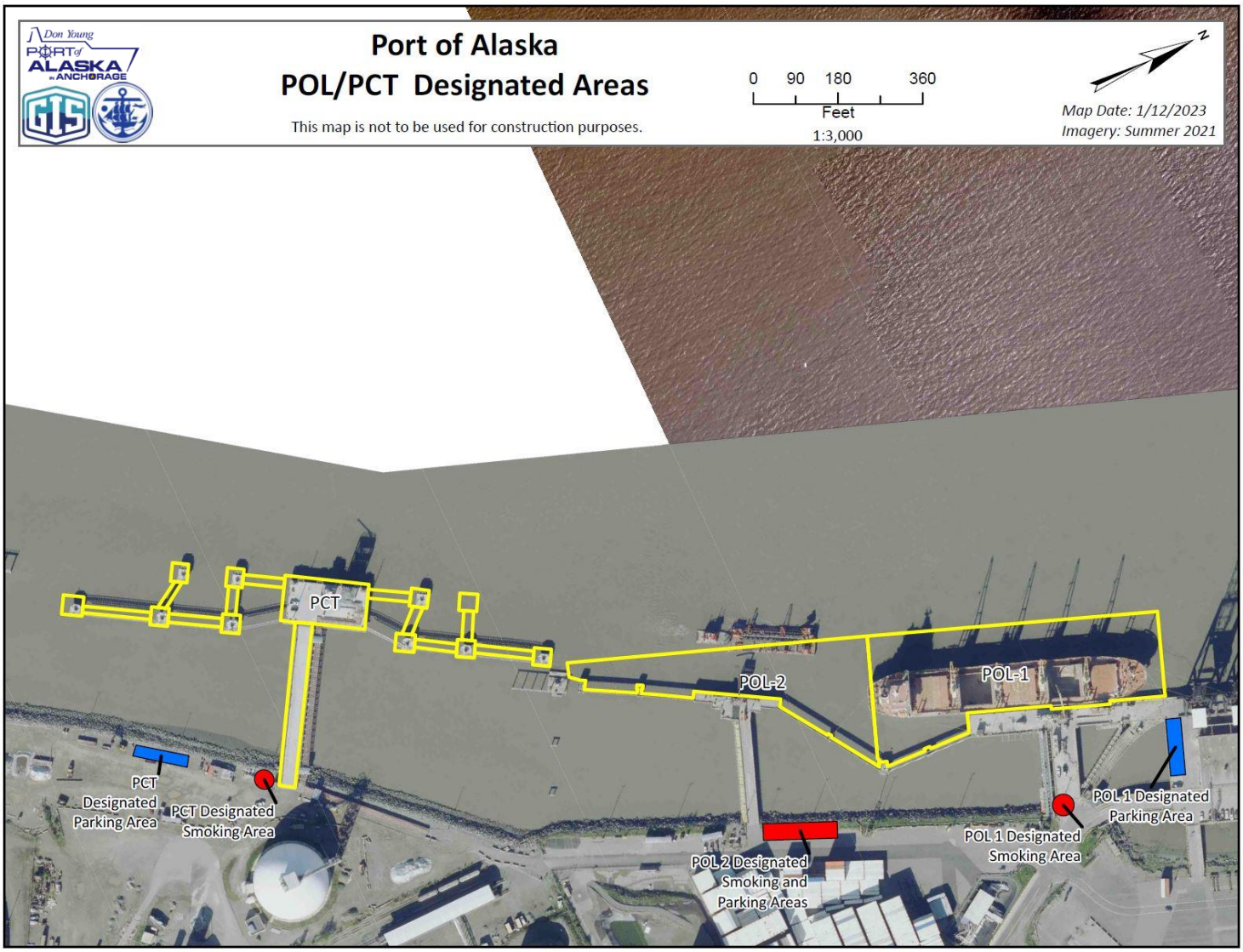


Figure 5: PARKING AND SMOKING AREAS

3.11 HAZARDOUS CLASSIFIED AREAS

1. The areas within 100’ of the marine header at the three petroleum docks is a Class 1 Division 2 area.

2. The use of non-rated/intrinsically safe equipment is *strictly prohibited* in this rated area during a fuel transfer. *This includes the use of cellphones.*

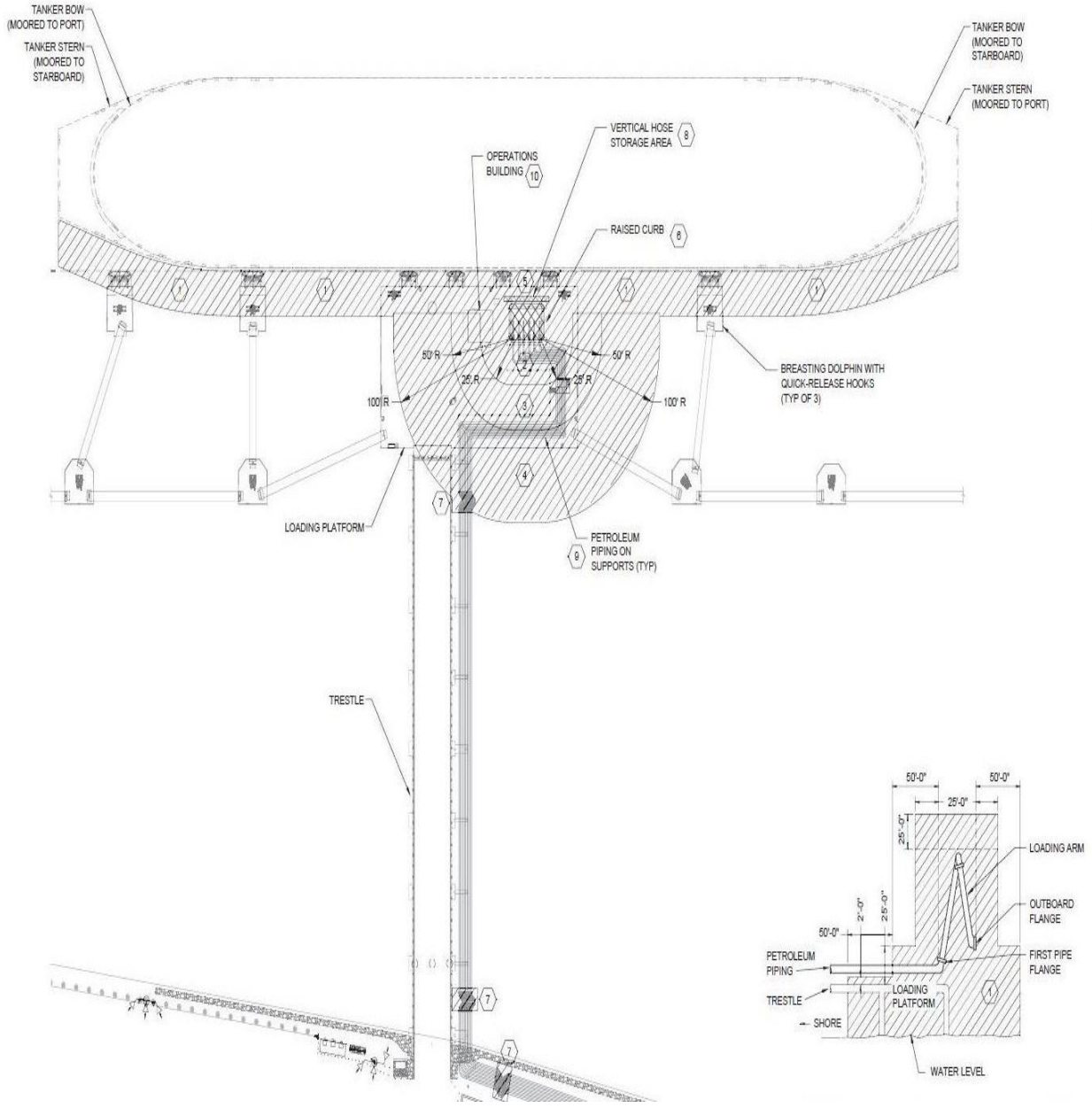
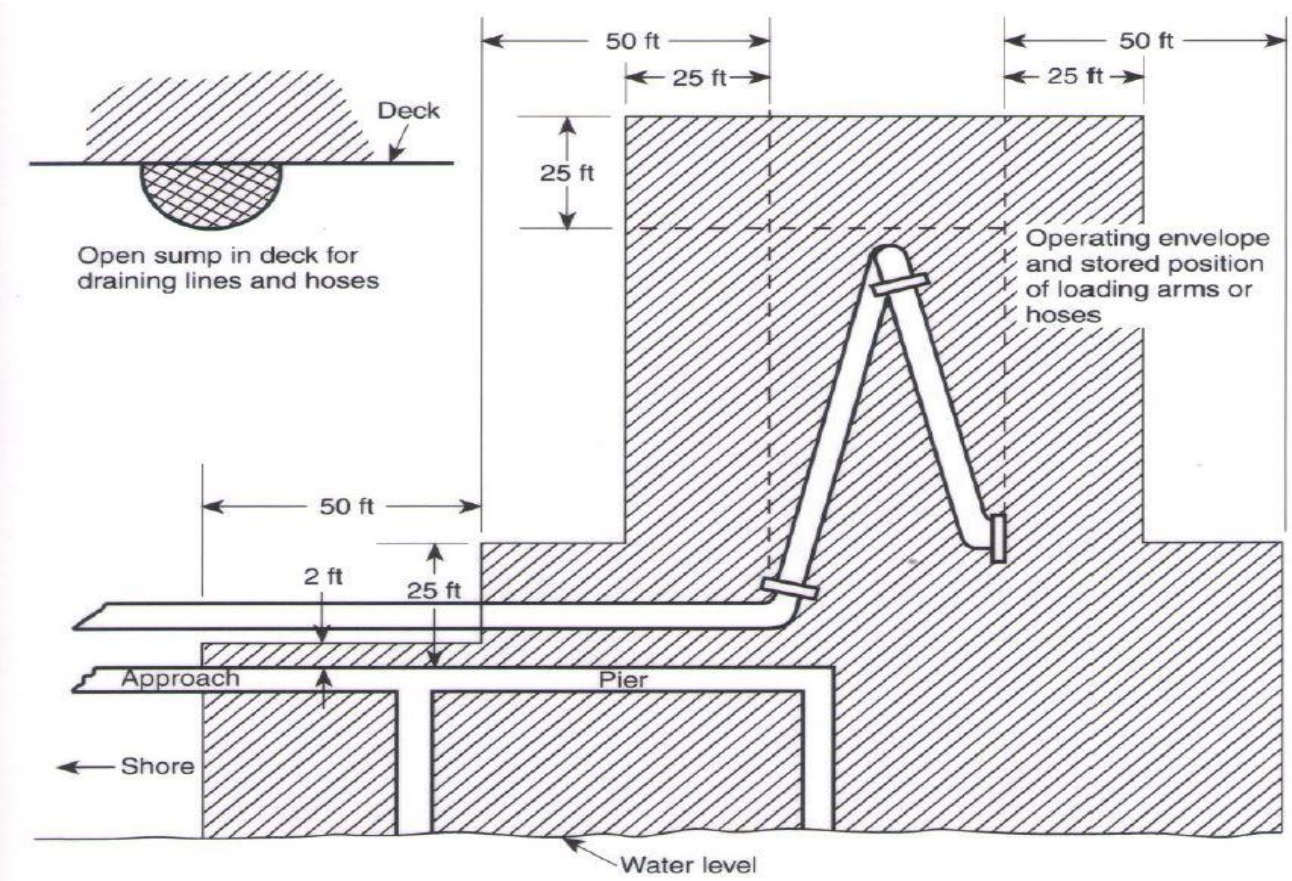


Figure 6: PCT HAZARDOUS AREAS CLASSIFICATION

Figure7: POL 1 and 2 HAZARDOUS AREAS CLASSIFICATION



For SI units, 1 in. = 25 mm; 1 ft = 0.3 m.

Division 1 Division 2 Nonclassified

Notes:
1. The "source of vapor" is the operating envelope and stored position of the outboard flange connection of the loading arm (or hose).
2. The berth area adjacent to tanker and barge cargo tanks is to be Division 2 to the following extent:
   (a) 25 ft (7.6 m) horizontally in all directions on the pier side from t portion of the hull containing cargo tanks.
   (b) From the water level to 25 ft (7.6 m) above the cargo tanks at their highest position.
3. Additional locations can be classified as required by the presence of other sources of flammable liquids on the berth, or by Coast Guard or other regulations.

ALLOWABLE VESSEL APPROACH VELOCITY

VESSEL DISPLACEMENT	ALLOWABLE APPROACH VELOCITY PERPENDICULAR TO DOCK FACE		
DWT TON*	KNOTS	FEET/MINUTE	FEET/SECOND
30,000 OR LESS	0.21	21	0.36
30,000 TO 50,000	0.15	15	0.28
50,000 TO 70,000	0.14	14	0.23
GREATER THAN 70,000	0.1	10	0.18

* ONE LONG TON EQUALS 2240 POUNDS

ALLOWABLE MOORING LINE LOAD LIMITS

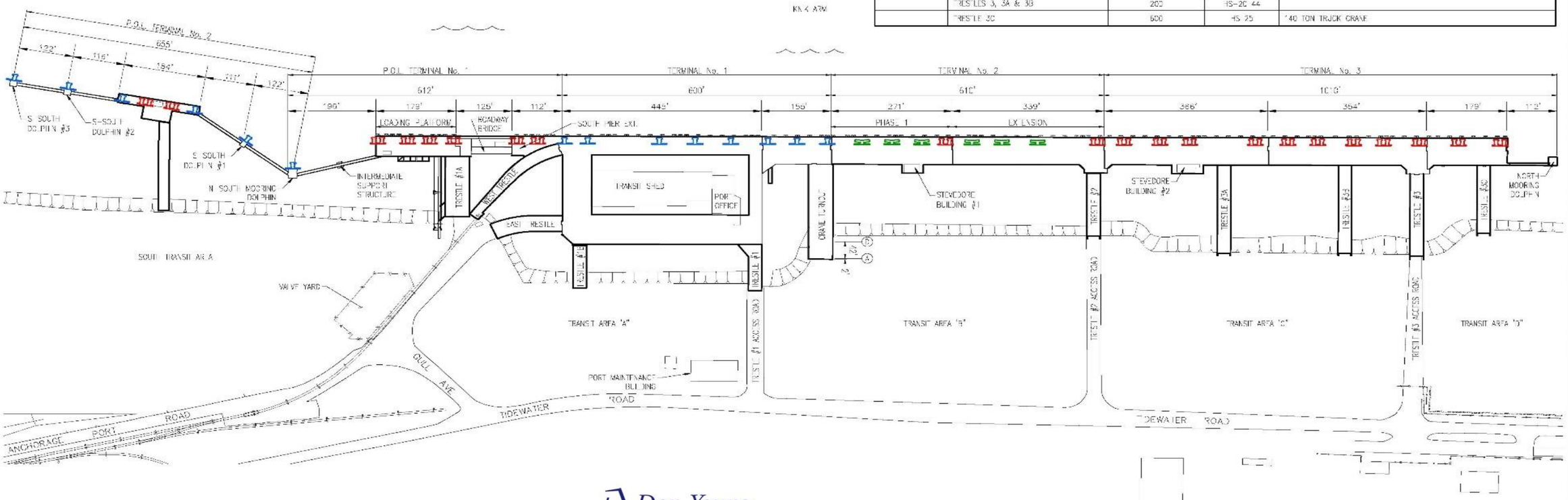
BOLLARD	LOAD LIMIT
36" CLEAT	30,000 LBS
SINGLE BOLLARD	60,000 LBS
DOUBLE BOLLARD (EACH POST)	60,000 LBS

TIDES

ITEM	HEIGHT (FEET)
HIGHEST OBSERVED WATER (10/24/1950)	34.55'
MEAN HIGHER HIGH WATER (MHHW)	29.03'
MEAN HIGH WATER (MHW)	28.33'
MEAN SEA LEVEL (MSL)	16.45'
MEAN TIDE LEVEL (MTL)	15.29'
MEAN LOW WATER (MLW)	2.59'
MEAN LOWER LOW WATER (MLLW)	0.00'
LOWEST OBSERVED WATER (03/25/1967)	-6.21'

DECK LOAD LIMITS

DOCK	ITEM	DESIGN LOAD PSF	DESIGN VEHICLE	CRANES
POL No. 1	SOUTH PIER EXTENSION	600	HS-20 S16-44	30 TONS
	LOADING PLATFORM	400	HS-20 S16-44	
	ROADWAY BRIDGE		HS-20 S16-44	
	WALKWAY BRIDGE	100		
	TRESTLE 1A	200	HS-20-44	
POL No. 2	DOCK	400	HS-20-44	
	WALKWAY	100	HS-20-44	
TERMINAL 1	DOCK	600	HS-20 S16-44	30 TONS
	WEST TRESTLE	0	PEDESTRIAN ONLY	
	EAST TRESTLE, TRESTLES 1 & 1B	200	HS-20 S16-44	
	CRANE TURNOUT	350	HS-20-44	38-KIP PER WHEEL 3 WHEELS AT 2'-11" OC 72-KIP PER WHEEL 3 WHEELS AT 2'-11" OC 30NTS A AND D ONLY
TERMINAL 2	DOCK PHASE 1	600	HS-20 S16-44	7[illegible]-KIP PER WHEEL 6 WHEELS AT 5' OC 72-KIP PER WHEEL 3 WHEELS AT 2.5' OC
	DOCK EXTENSION	650	HS-20-44	7[illegible]-KIP PER WHEEL 6 WHEELS AT 5' OC 72-KIP PER WHEEL 3 WHEELS AT 2.5' OC
	TRESTLE 2	200	HS-20-44	
TERMINAL 3	DOCK	650	HS-20-44	7[illegible]-KIP PER WHEEL 6 WHEELS AT 5' OC 72-KIP PER WHEEL 3 WHEELS AT 2.5' OC
	TRESTLES 3, 3A & 3B	200	HS-20-44	
	TRESTLE 3C	600	HS-25	140 TON TRUCK CRANE



LEGEND
- FENDER
- S2 3S" CLEAT
- SINGLE BOLLARD
- DOUBLE BOLLARD

PORT OF ANCHORAGE
2000 ANCHORAGE PORT ROAD
(907) 343-6200

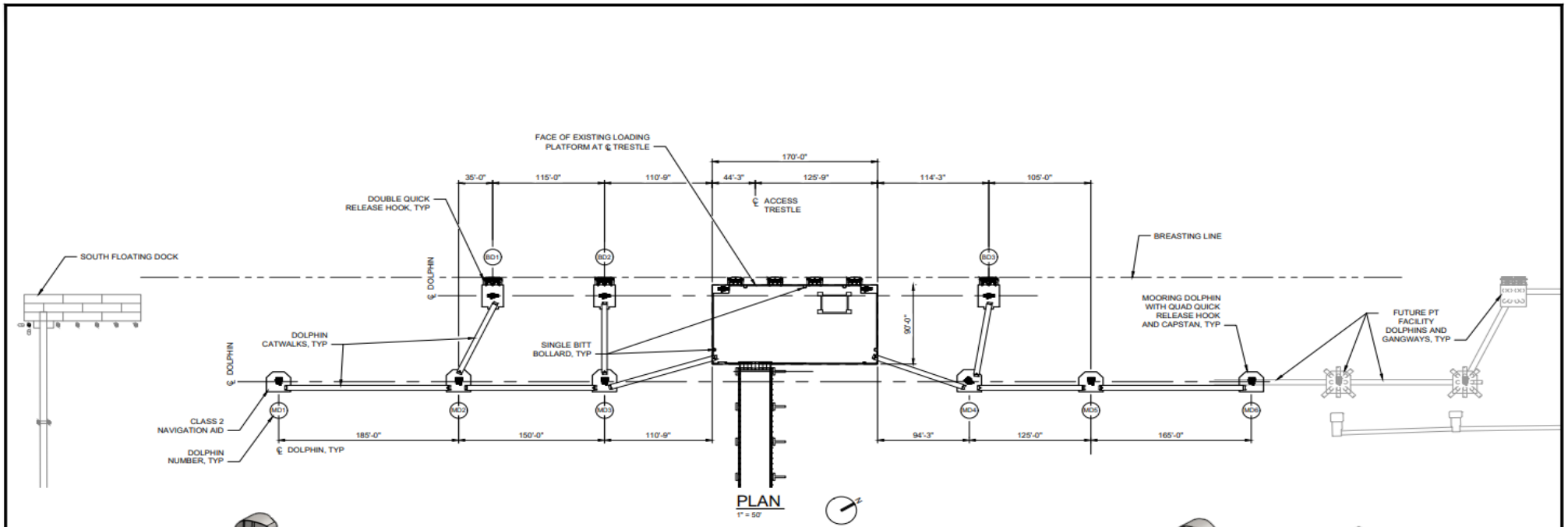
Don Young PORT of ALASKA IN ANCHORAGE

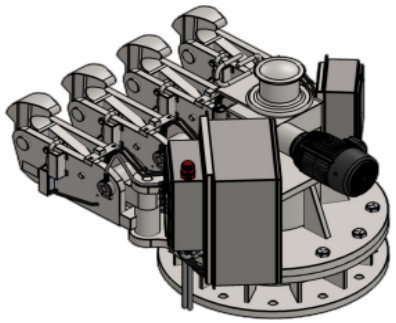
PORT OF ANCHORAGE

BERTHING, MOORING, & DECK LOAD LIMITS

JULY 2013 | **1 / 1**

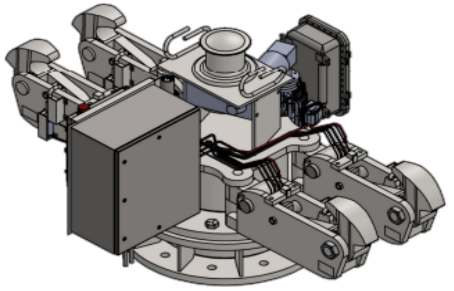
APPENDIX A PCT Mooring Hardware Layout





MOORING DOLPHIN (MD)
QUAD QUICK RELEASE HOOK AND CAPSTAN

BOLLARD



BREASTING DOLPHIN (BD)
DOUBLE QUICK RELEASE HOOK

REV	DATE	DESCRIPTION	BY	APVD

REVISIONS | DSGN | DR | CHK | APVD | CONSULTANT | SEAL

MOORING HARDWARE LAYOUT

PORT OF ALASKA
PORT OF ALASKA MODERNIZATION PROGRAM
PETROLEUM AND CEMENT TERMINAL
ANCHORAGE, ALASKA
HORIZ SCALE: AS SHOWN | DATE: 8/19/22
VERT SCALE: N/A | SHEET: 1 OF 1

APPENDIX B PCT – G - 007B – MOORING LAYOUT – REMAIN AT BIRTH

MOORING LINE DESCRIPTION:

MINIMUM MOORING LINE REQUIREMENTS:

NO. OF HEAD LINES	2
NO. OF AFT LINES	2
NO. OF BREAST LINES	2 FWD, 2 AFT
NO. OF SPRING LINES	2 FWD, 2 AFT
MINIMUM BREAKING LOAD, MBL (KIPS / SHORT TONS)	156 / 78

VESSEL DESCRIPTION:

DEADWEIGHT TONNAGE, DWT (LONG TONS)	74,000
DISPLACEMENT, M_D (LONG TONS)	79,117
LENGTH OVERALL, LOA (FEET)	750
BEAM, B (FEET)	106
MAXIMUM ARRIVAL DRAFT AT MLLW (FEET)	36

MOORING NOTES:

1. VESSEL MASTER, SHIP PILOTS, AND TERMINAL OPERATORS SHALL DETERMINE IF CONDITIONS AT TIME OF AND DURING MOORING REQUIRE ADDITIONAL LINES ABOVE THE MINIMUM REQUIREMENTS.
2. STARBOARD-SIDE-TO MOORING POSITION SHOWN, PORT-SIDE-TO MOORING IS SIMILAR AND REQUIRES SAME MINIMUM LINE REQUIREMENTS.
3. SMART QUICK RELEASE HOOKS INSTALLED FOR MOORING, WITH CAPSTAN FOR WINCHING IN LINES.

MOORING NOTES:

WIND RESTRICTION DIAGRAM APPLICABLE FOR:

FLOOD CURRENT, TOWARDS 032°T (KNOTS)	2.6 (OPERATIONAL CONDITION LIMIT) / 3.3 (SURVIVAL LIMIT)
EBB CURRENT, TOWARDS 212°T (KNOTS)	2.2 (OPERATIONAL CONDITION LIMIT) / 2.8 (SURVIVAL LIMIT)
WAVE HEIGHTS AND PERIODS	SEE "MAXIMUM WAVE CONDITIONS BY DIRECTION" TABLES

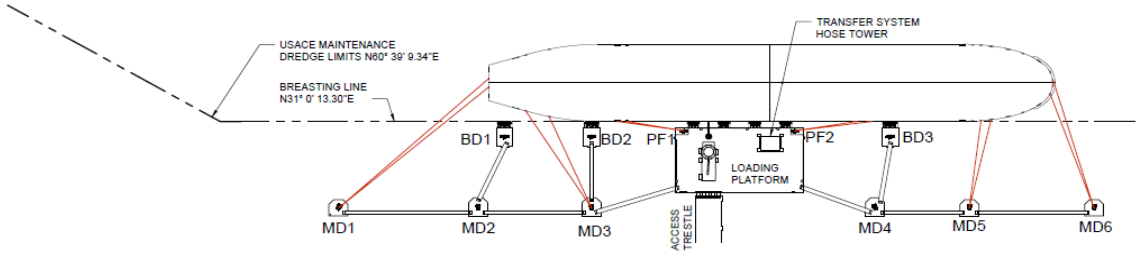
BERTH INFORMATION:

USACE MAINTENANCE DREDGE DEPTH AT MLLW (FEET)	-38
MINIMUM UNDERKEEL CLEARANCE (FEET)	3 (OR PILOTS RECOMMENDED BEST PRACTICE)

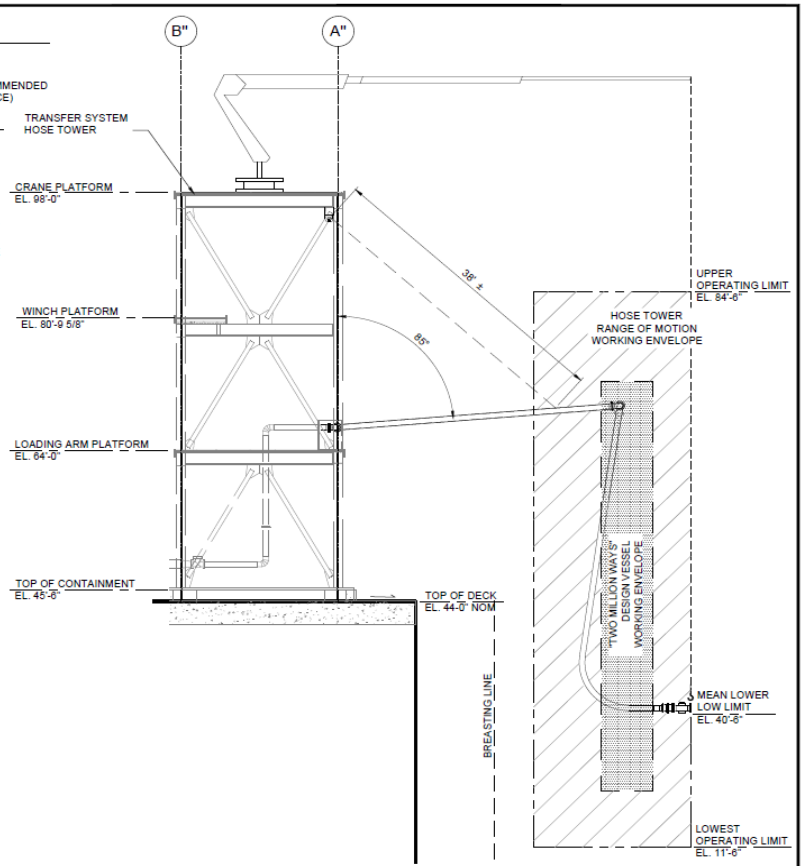
BERTHING NOTES:

MAXIMUM BERTHING VELOCITY (FT/S / KNOTS)	0.46 / 0.27
MAXIMUM BERTHING ANGLE	10°
MAXIMUM BERTHING WIND VELOCITY (KNOTS)	25

1. MINIMUM WATER DEPTH STATED IS THE PERMITTED DEPTH OF THE BERTH. THE ACTUAL WATER DEPTH MAY VARY. REGULARLY CHECK WATER DEPTH AND RESTRICT ARRIVAL DRAFTS AS NEEDED. SEDIMENTATION RATES IN EXCESS OF 4 FT/YEAR HAVE BEEN RECORDED.
2. DEPTH OF BERTH RELATED TO SEDIMENTATION AND TIDE CONDITION, TO BE CONFIRMED BY VESSEL MASTER PRIOR TO ARRIVAL.
3. MAXIMUM ARRIVAL DRAFT RELATED TO THE ACTUAL WATER DEPTH AND THE LEGALLY REQUIRED UNDERKEEL CLEARANCE.
4. TOP OF FENDER PANELS (APPROX) + 40' MLLW
   BOTTOM OF FENDER PANELS + 0.00' MLLW

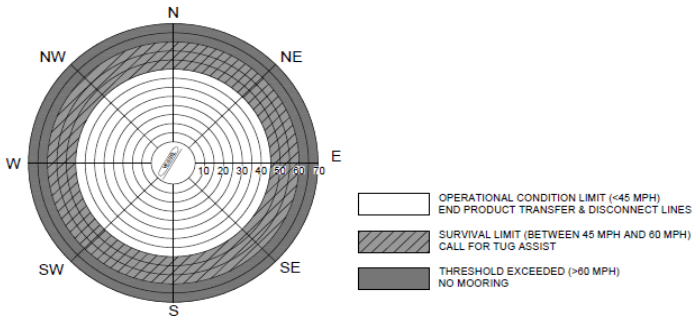


MOORING LAYOUT - REMAIN AT BERTH
NTS



LOADING ARM AT MEAN TIDE LEVEL
NTS

ENVIRONMENTAL CONDITION LIMITS:



WIND SPEED IN MILES PER HOUR (MPH)
REFERENCE: PORT OF ALASKA MODERNIZATION PROGRAM PCT MOORING ANALYSIS REPORT MAY 16TH, 2018.

MAXIMUM WAVE CONDITIONS BY DIRECTION

OPERATIONAL CONDITION LIMIT

	WIND DIRECTION (FROM °T)							
WAVE PARAMETER	0	45	90	135	180	225	270	315
SIGNIFICANT HEIGHT (FEET)	3.3	3.2	1.8	1.1	2.6	4.9	5.0	3.5
MEAN PERIOD (SEC)	3.0	3.2	3.2	1.4	2.6	4.5	4.1	2.7
DIRECTION (FROM °T)	2	10	37	155	233	254	260	296

SURVIVAL LIMIT

	WIND DIRECTION (FROM °T)							
WAVE PARAMETER	0	45	90	135	180	225	270	315
SIGNIFICANT HEIGHT (FEET)	5.8	5.4	3.2	2.1	4.5	7.6	8.0	6.2
MEAN PERIOD (SEC)	3.7	3.8	2.3	1.7	3.2	4.5	5.0	3.4
DIRECTION (FROM °T)	0	9	45	152	228	254	262	298

MOORING EQUIPMENT INFORMATION

MOORING POINT	MOORING DEVICE WITH CAPSTAN	CAPACITY (KIPS)	CAPACITY (SHORT TONS)
MD1	QUAD QRH	220	110
MD2	QUAD QRH	220	110
MD3	QUAD QRH	220	110
MD4	QUAD QRH	220	110
MD5	QUAD QRH	220	110
MD6	QUAD QRH	220	110
BD1	DOUBLE BACK-TO-BACK QRH	220	110
BD2	DOUBLE BACK-TO-BACK QRH	220	110
BD3	DOUBLE BACK-TO-BACK QRH	220	110
PF1	DOUBLE BACK-TO-BACK QRH	220	110
PF2	DOUBLE BACK-TO-BACK QRH	220	110

MD = MOORING DOLPHIN
BD = BREASTING DOLPHIN
PF = PLATFORM

REV	DATE	DESCRIPTION	BY	APVD

REVISIONS

BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

COWI

DSGN	DR	CHK	APVD
C. THOMAS	K. BUNGER	P. GUENTHER	P. GUENTHER

CONSULTANT

SEAL

Don Young PORT of ALASKA IN ANCHORAGE

PORT OF ALASKA MODERNIZATION PROGRAM

GENERAL
STATEMENT OF
OPERATING TERMINAL LIMITS
PETROLEUM TANKER

PORT OF ALASKA
PORT OF ALASKA MODERNIZATION PROGRAM
PETROLEUM AND CEMENT TERMINAL
SEASON 2
ANCHORAGE, ALASKA

HORIZ SCALE: AS SHOWN	DATE: FEB 2, 2022	PCT-G-007B
VERT SCALE: N/A	SHEET: 8B OF 283	

Drawing: APMP_PCT-G-007B.DWG
Date: Feb 02, 2022 - 11:29am

FINAL REPORT

Port of Alaska Modernization Program
PCT Mooring Analysis

Prepared for

Port of Alaska

Don Young Port of Alaska in Anchorage

2000 Anchorage Port Road
Anchorage, Alaska 99501

Date: May 16, 2018

Prepared and
Submitted by:

COWI

COWI North America, Inc.

in Association with:

R&M Consultants, Inc.
Great Northern Engineering
Foldenauer Engineering
CWA Engineers

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Acronyms, Abbreviations, and Symbols

App.	Appendix
Approx.	Approximately
BD	Breasting Dolphin
CER	Coastal Engineering Report (COWI, May, 2018)
DWT	Dead Weight Tonnage
Elev.	Elevation
ft	Feet
in.	Inches
IWRC	Independent Wire Rope Core
kip	Kilo-Pound = 1000 Pounds
LP	Loading Platform
Max.	Maximum
MBL	Minimum Breaking Load
MD	Mooring Dolphin
MHHW	Mean Higher-High Water
MLLW	Mean Lower-Low Water
mm	Millimeters
MOTEMS	Marine Oil Terminals Engineering Maintenance Standards
mph	Miles per Hour
MT	Metric Tonnes
N/A	Not Applicable
PAMP	Port of Alaska Modernization Program (formerly Anchorage Port Modernization Program)
PCT	Petroleum and Cement Terminal
PIANC	World Association for Waterborne Transport Infrastructure
POA	Port of Alaska (formerly Port of Anchorage)
QRH	Quick Release Hook
Ref.	Reference
s, sec	Seconds
SDM	Seismic Design Manual
Sig.	Significant
SLR	Sea Level Rise
UHMW	Ultra High Molecular Weight

UKC	Under Keel Clearance
yr	Year
°T	Degrees True North
-	Not Applicable
%	Percent
$V_{30\text{-}s}$	Thirty-Second Duration Wind Speed

Executive Summary

This report describes and summarizes the mooring analyses performed for the Petroleum and Cement Terminal (PCT) at the Port of Alaska (POA). Design and construction of the facility is part of the Port of Alaska Modernization Program (PAMP).

Mooring analyses were completed in accordance with the PAMP Seismic Design Manual (SDM) (CH2M Hill Engineers Inc., Sept 2017), and MOTEMS 3103F.5 and 3105F.2 (State of California, 2016). Static and dynamic analyses with OPTIMOOR Dynamic (Tension Tech, 2017) were used to perform the mooring analyses.

The table below summarizes the recommended wind speed thresholds for the PCT, based on the results of the mooring analyses. It is noted that most of the thresholds presented are somewhat lower than the targets identified in the SDM. The proposed mooring hardware and fender system were found to be adequate for mooring and breasting forces under these conditions.

Summary of Recommended, 30-s Duration, Wind Speed Thresholds

Vessel	Normal Operational[a]	Remain at Berth[b]
74,000 DWT Petroleum Tanker	45 mph	60 mph[c]
40,000 Cement Bulk Carrier	45 mph	50 mph[c] *(center-warp position only)*

Table Notes

[a]Computed considering simultaneous operational ebb or flood current, and waves consistent with winds.
[b]Computed considering simultaneous extreme ebb or flood current, and waves consistent with winds.
[c]Lower than target wind speed threshold of 70 mph identified in SDM Section 4.2.14.1.

The thresholds presented above are based on open water conditions and consider wind, current, and wave loading. During winter conditions, when ice is present in concentrations greater than about 5/10^{ths}, significant waves will not be present and an additional mooring analysis was used to determine the maximum ice loads that can be safely tolerated on the moored tanker, simultaneous with the stated wind and currents. Ice loads on the bulk carrier were not evaluated exhaustively since historical vessel call information provided by the POA indicates that cement unloading operations did not coincide with significant ice events. This historical trend, coupled with the results of the present analysis which indicate a limited ability of the moored bulk carrier to withstand ice loads (particularly in warped positions) in addition to wind and current, lead to the conclusion that cement unloading operations should not be undertaken when significant ice is present. The values shown in Table 17 and Figure 19 indicate the residual ice load capabilities associated with the tanker; analogous values for the bulk carrier were found to be too low to correspond to any practical ice scenario (i.e., even mild ice conditions).

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Introduction

1.1 Project Overview and Description

The Port of Alaska (POA) is in the process of modernizing its port facilities through the implementation of the Port of Alaska Modernization Program (PAMP). The intent of the program is to provide port facilities that will efficiently meet demands for delivery of food, fuel, cement, and other commodities to Anchorage and the rest of South Central Alaska for a minimum service life of 75 years.

A key component of the program is the new Petroleum and Cement Terminal (PCT), which will be used for petroleum, oil, lubricant, and cement unloading operations. The new terminal will be situated on Cook Inlet at the POA, near the southern end of the port (Figure 1).

Figure 1 Location of New PCT

1.2 Document Scope

This report summarizes the mooring analyses performed for the new PCT. Table 1 gives the key basis for the analysis. All mooring analyses were completed with Tension Technology OPTIMOOR software, using both static and dynamic analysis modules.

1

Table 1 Basis for PCT Mooring Analysis

Mooring Analysis Parameter	Breakdown Details			
Vessels	Petroleum Tanker	74,000 DWT	Port Starboard	Vessel Manifold Centered on PCT Petroleum Offloading System
	Cement Bulk Carrier	40,000 DWT	Port Starboard	Vessel Warped to Three Positions Along PCT Berth: PCT Cement Unloading System Approximately Centered on Hatches 1, 3 and 5. These envelope the vessel in its extreme forward and aft warp positions.
Draft	Ballast Draft			
	Laden Draft, Considering Minimum Allowable Under Keel Clearance (UKC)			
Tide Levels	Future Mean Higher High Water (MHHW), with Sea Level Rise (SLR)			
	Existing Mean Lower Low Water (MLLW)			
Wind Criteria	360° – Sweep, in 45° Increments			Normal Operational Limit – 45 mph (39.1 knots)[a] *(30-second duration)*
				Remain at Berth Limit – 70 mph (60.8 knots)[a] *(30-second duration)*
Current[b]	Flood		2.6 and 3.3 knots for Operational and Remain at Berth conditions, respectively.	Towards 032°T
	Ebb		2.2 and 2.8 knots for Operational and Remain at Berth conditions, respectively.	Towards 212°T
Waves[b]	Wave height, period, and direction vary as a function of wind speed and direction; see Section 2.1.3.			

Table Notes

[a]Target values in accordance with SDM Section 4.2.14.1.
[b]See PCT Coastal Engineering Report (COWI, May 2018) for additional information.

The following key results and conclusions are presented:

- maximum vessel excursions
- maximum vessel mooring line forces
- maximum fender reactions
- maximum bollard/hook forces
- recommended wind speed threshold for normal operations (open water and winter conditions)
- recommended wind speed threshold for remaining at berth (open water and winter conditions)

2 Background Information

2.1 Environmental Data

2.1.1 Tidal Datums

Table 2 provides tidal datums for the PCT. It is noted that future MHHW and existing MLLW were used for the mooring analyses.

Table 2 Tidal Datums at the PCT

Tidal Datum	Abbreviation	Present Elevation (ft MLLW)	Future Elevation[a] (ft MLLW)
Highest Observed	HO	+34.85	-
Mean Higher-High Water	MHHW	+29.16	+33.36[b]
Mean High Water	MHW	+28.43	+32.63
Mean Sea Level	MSL	+16.47	+20.67
Mean Tide Level	MTL	+15.34	+19.54
Mean Low Water	MLW	+2.25	+6.45
Mean Lower-Low Water	MLLW	+0.00[b]	+4.20
Lowest Observed	LO	-6.39	-

Table Notes

[a]Future datum elevations determined by adding the estimated sea-level-rise (SLR) of +4.2 feet to the existing datum elevations.

[b]Tidal datum used for the PCT mooring analysis; see Appendix A.

2.1.2 Currents

Table 3 provides the current data for the PCT. It is noted that this data reflects the predicted effect of the PCT transitional dredging design (COWI, Feb 2018) on local currents; consequently, the parameters do not strictly conform to the SDM. See the PCT Coastal Engineering Report (COWI, May 2018) for additional information.

Table 3 Design Current Parameters at the PCT

	Normal Operational		Remain at Berth	
Tide Stage	*Current Speed (knots)*	*Current Direction (towards °T)*	*Current Speed (knots)*	*Current Direction (towards °T)*
Flood	2.6	032	3.3	032
Ebb	2.2	212	2.8	212

3

2.1.3 Wind and Waves

Table 4 and Table 5 provide the relationship between wind and wave parameters for 30-second duration wind speeds of 45 mph and 70 mph, respectively. These 30-s duration wind speeds are listed as the target thresholds for normal operational and remain at berth conditions by the SDM Section 4.2.14.

Table 4 Wave Parameters Resulting from 30-Second Duration Wind Speed of 45 mph (39.1 knots)

	Wind Direction (from °T)							
Wave Parameter	**0**	**45**	**90**	**135**	**180**	**225**	**270**	**315**
Significant Height (feet)	3.3	3.2	1.8	1.1	2.6	4.9	5.0	3.5
Mean Period (sec)	3.0	3.2	3.2	1.4	2.6	4.5	4.1	2.7
Direction (from °T)	2	10	37	155	233	254	260	296

Table 5 Wave Parameters Resulting from 30-Second Duration Wind Speed of 70 mph (60.8 knots)

	Wind Direction (from °T)							
Wave Parameter	**0**	**45**	**90**	**135**	**180**	**225**	**270**	**315**
Significant Height (feet)	5.8	5.4	3.2	2.1	4.5	7.6	8	6.2
Mean Period (sec)	3.7	3.8	2.3	1.7	3.2	4.5	5.0	3.4
Direction (from °T)	0	9	45	152	228	254	262	298

Note the above wind-wave conditions were developed from detailed coastal modeling of Cook Inlet (COWI, May 2018), and are more severe than those listed in SDM Section 4.2.14.3.

2.1.4 Ice

During winter conditions when ice is present in concentrations greater than about 5/10^{ths}, significant waves will not be present. The mooring analysis was used to determine the maximum ice loads that can be safely tolerated on the moored tanker simultaneous to wind and currents. Ice loads on the bulk carrier were not evaluated exhaustively since historical vessel call information provided by the POA indicate that cement unloading operations do not coincide with significant ice events. This historical trend, coupled with the results of the present analysis, which indicate a limited ability of the moored bulk carrier to withstand ice loads in addition to wind and current (particularly in warped positions), lead to the conclusion that cement unloading operations should not be undertaken when significant ice is present.

2.2 Passing Vessel Effects

According to MOTEMS 3105F.3.2, effects generated by a passing vessel event (PVE) need to be considered in mooring analyses if all of the following conditions are met:

- the passing vessel size exceeds 25,000 DWT,
- the clear distance, L, between passing vessel and moored vessel is 500 feet or less,
- and the passing vessel relative speed, V, is greater than V_{crit}, as defined by the following formula:

$$V_{crit} = 1.5 + \frac{L - 2B}{500 - 2B} * 4.5knots$$

Figure 2 shows the 500 foot clear distance threshold that requires PVE analysis. Table 6 provides a schedule for the critical passing vessel relative speed, V_{crit}, for a passing clear distance of 500 feet.

Figure 2 PCT Location and 500 ft Clear Distance

BACKGROUND INFORMATION

Table 6 Critical Passing Vessel Speed, V_{crit}, for Operational Current Speeds at PCT

	Current Speed		
		Ebb	*Flood*
Vessel Movement Direction	***None***	***2.2 knots***	***2.6 knots***
Vessel Moves With Current	6.0 knots	8.2 knots	8.6 knots
Vessel Moves Against Current	6.0 knots	3.8 knots	3.4 knots

Table Notes

The above velocities were computed for the 74,000 DWT petroleum moored tanker and comparably sized passing vessel; results are similar for the design cement bulk carrier.

Passing vessel events were not considered in the PCT mooring analysis for the following reasons:

- the PCT location and significant sea room allow large clear distances for passing vessels,
- vessels calling at the Port of Alaska are assumed to be moving at slowed speeds during their approach to and departure from berths, and
- the POA have authority to restrict vessel speeds in the future if deemed necessary.

2.3 Berth

The proposed general layout for the PCT facility includes:

- one loading platform
- one access trestle
- three breasting dolphins (BD)
- six mooring dolphins (MD)
- series of catwalks to access dolphins
- a fender system along the PCT platform breasting line

2.3.1 Overall Geometry

A plan of the proposed PCT facility layout is shown by Figure 3, a typical cross-section is shown in Figure 4. Table 7 lists the key geometry of the PCT berth.

Figure 3 PCT Berth Proposed Plan Layout

6

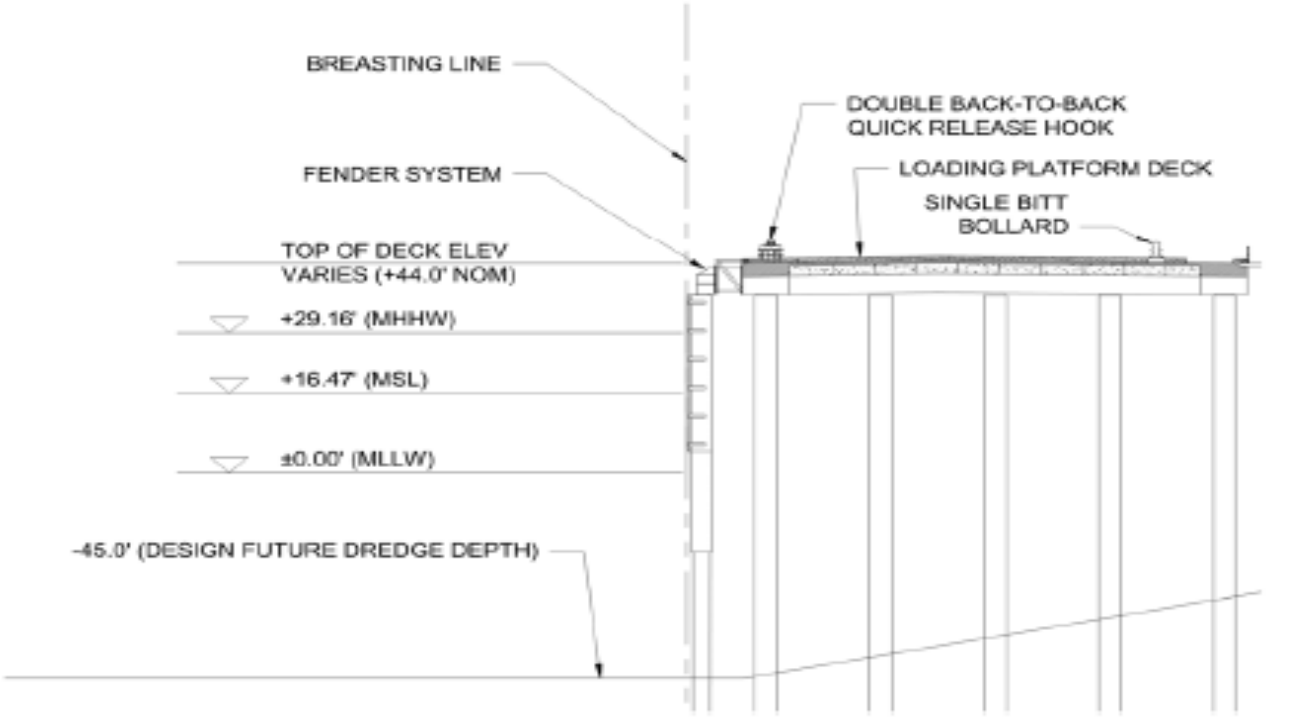

Figure 4 PCT Berth Typical Cross Section at Loading Platform

Table 7 PCT Key Geometry

Geometry Parameter	Design Value
Deck Elevation	+44.0 ft MLLW
Dredge Elevation	-45.0 ft MLLW *(design future dredge)*
Breasting Line Orientation	Approx. +31° from True North
Breasting Line Length	535 ft-long, out-out *(measured parallel to breasting line)*
Distance between End Mooring Dolphins	1,000 ft-long, center-center *(measured parallel to breasting line)*

Table Notes

The future dredge elevation of -45.0 ft MLLW was modeled instead of present depth as the former generates the highest longitudinal current load for the tanker due the requirement of maintaining a minimum 2 ft under keel clearance. Although the reverse is true for the bulk carrier, a constant berth seabed elevation of -45 ft MLLW was maintained for clarity given that current loads are less important than winds due to the close alignment of the berth with local currents.

2.3.2 Mooring Equipment and Fenders

Available mooring equipment and fenders along the PCT berth are summarized in Table 8.

Table 8 Proposed Mooring Equipment and Fenders for the PCT

Component	Breasting Dolphin (BD) *Three Total*	Mooring Dolphin (MD) *Six Total*	Loading Platform *One Total*	Access Trestle *One Total*
Fender System	Two Fender Panels and Two Fenders per BD	None	Four Fender Panels and Four Fenders Along Loading Platform Seaward Edge	None
Mooring Points	One Double Back-to-Back Quick Release Hook (QRH) with Capstan per BD	One Quadruple Quick Release Hook (QRH) with Capstan per MD	One Double Back-to-Back QRH with Capstan at Each Platform Seaward Corner (Two Total) Five Fixed Single Bitt Bollards Around Loading Platform Perimeter	None

2.3.2.1 Fender System Components

Figure 5 shows front and side elevation views of the 35% Design level fender system for the PCT berth. Note that the fender system details are preliminary and are still in design at the time of this report.

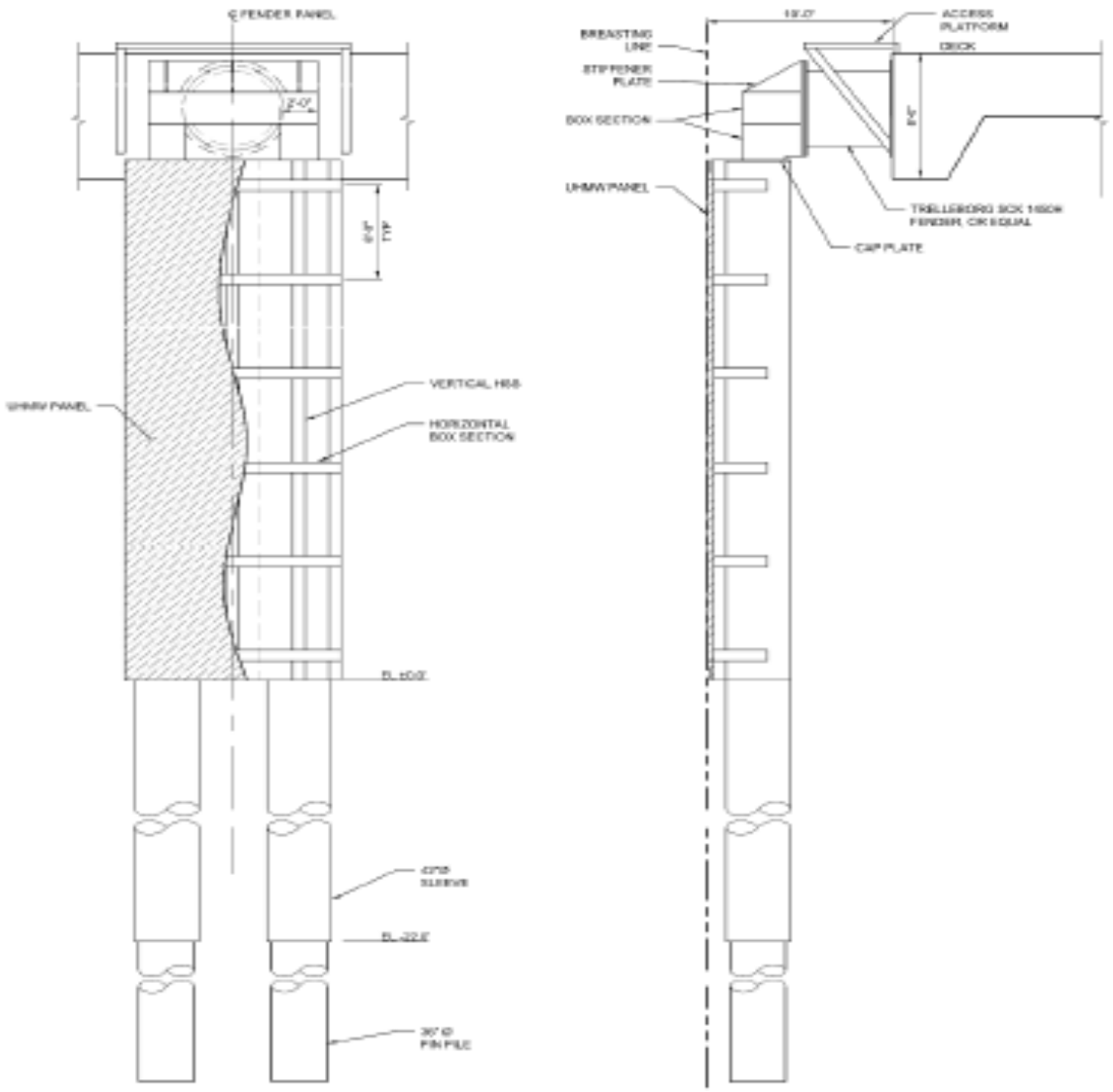

Figure 5 Presently Proposed Fender System Front (left) and Side (right) Elevations

Fender Panels. Ultra-high molecular weight (UHMW) panels are proposed for the PCT berth. The panels will be approximately 12 ft-wide, and have the vertical limits of 0.0 ft MLLW to approximately +37.0 ft MLLW. Each panel is to be supported on a pair of steel pipe pin piles.

Fenders. Trelleborg SCK 1450 rubber cell fenders (or approved equal) are proposed for the PCT berth. The fender product was selected on the basis of vessel berthing analysis and design (not presented in this report). A single cell fender will be used to provide reaction against each fender panel. Figure 6 shows the general geometry of the proposed fender. Figure 7 shows the normalized performance curve for the proposed cell fenders (Trelleborg Marine Systems, 2017).

BACKGROUND INFORMATION

SCK Cell Fenders
DIMENSIONS

	H	ØW	ØB	D	ANCHORS / HEAD BOLTS ^	WEIGHT
SCK 1450	1450	1850	1650	43 – 53	6 × M48	2300

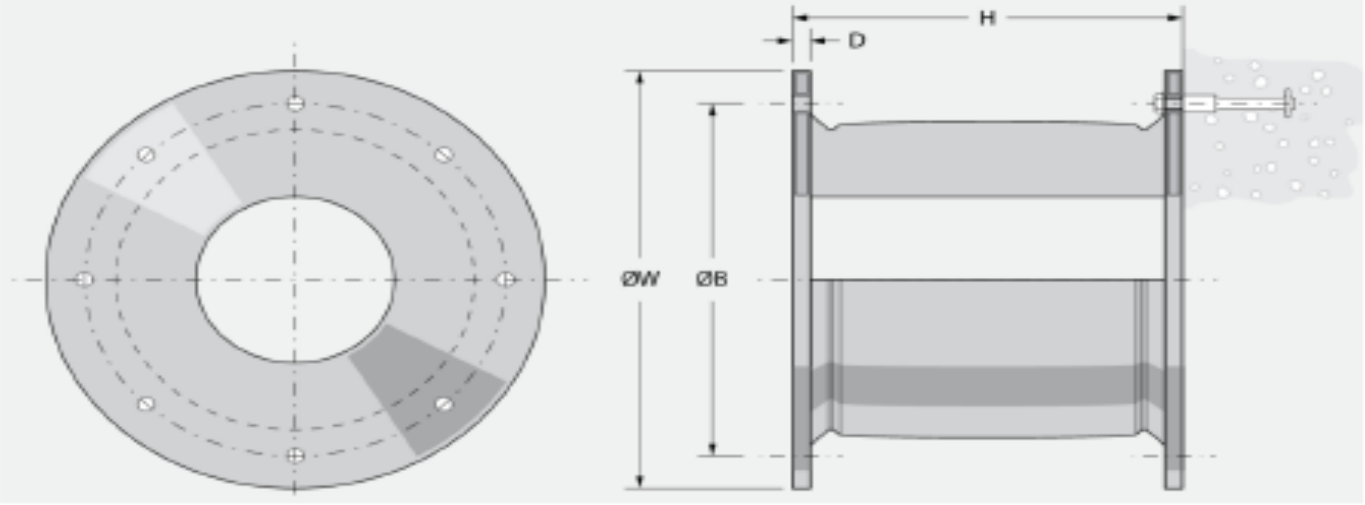

Figure 6 Proposed Cell Fender for PCT Berth
(taken from Trelleborg Marine Systems Fender Systems Product Brochure – all units of measure in millimeters)

SCK Cell Fenders
INTERMEDIATE DEFLECTIONS

D (%)	0	5	10	15	20	25	30	35	40	45	50	52.5	55
E (%)	0	2	7	16	26	38	50	61	72	83	94	100	106
R (%)	0	32	60	81	94	99	99	96	92	92	96	100	106

Nominal rated deflection may vary at RPD... Refer to the Performance Tolerances table in the Fender Application Design Manual.

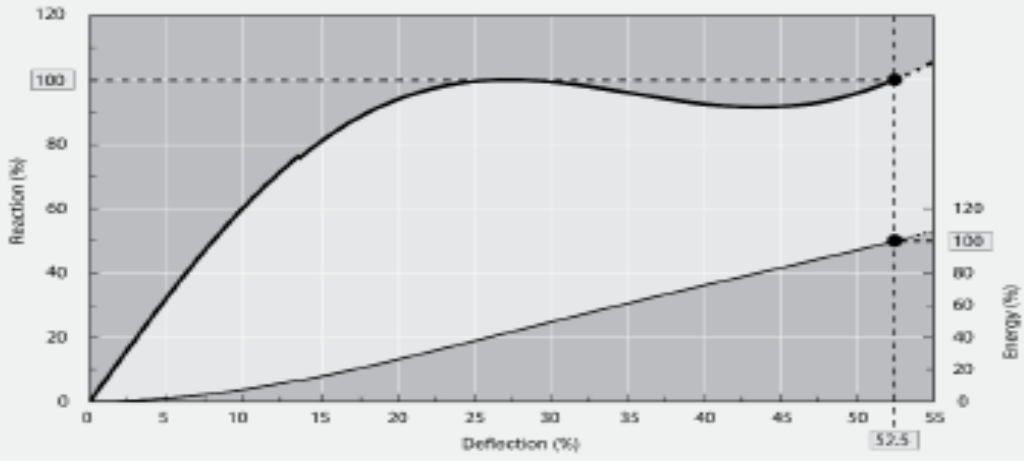

Figure 7 Normalized Fender Reaction Curve for Proposed Cell Fenders
(taken from Trelleborg Marine Systems Fender Systems Product Brochure)

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2.3.2.2 Mooring Components

Double Back-to-Back Quick Release Hooks. A single, Double Back-to-Back QRH is proposed for each breasting dolphin. Further, a Double Back-to-Back QRH is proposed for the two seaward corners of the loading platform. Each hook has a rated capacity of 100 MT. Each QRH will be provided with a motorized capstan.

Quadruple Quick Release Hooks. A single, Quadruple QRH is proposed for each mooring dolphin. Each hook has a rated capacity of 100 MT. Each QRH will be provided with a motorized capstan.

Bollards. Five fixed 100 MT, single bitt bollards are proposed at the loading platform: three along the seaward edge, and one near each landward corners. These bollards will primarily serve as spring line mooring points and provide for some line placement flexibility during bulk carrier warping.

2.4 Design Vessels

Two generic vessels are applicable to the PCT design:

- 74,000 DWT Petroleum Tanker
- 40,000 DWT Cement Bulk Carrier

Table 9 provides basic data for each vessel. Data was taken from the SDM where available, or from vessel questionnaires and general arrangement drawings of reference vessels. Two Million Ways (Q88 - Intertanko, July 2017) and Ince Point (The Baltic Exchange, March 2017) were selected as the reference vessels for the petroleum tanker and cement bulk carrier, respectively.

BACKGROUND INFORMATION

Table 9 Design Vessel Data

Vessel Parameter		Petroleum Tanker	Cement Bulk Carrier
Reference Vessel		Two Million Ways	Ince Point
PCT Berthing Orientation		Port and Starboard Vessel center manifold centered on loading platform petroleum offloading system.	Port and Starboard Three warp positions along PCT berth: vessel hatches approximately centered on loading platform future cement unloading system.
Length Over All		750 feet	600 feet
Length Between Perpendiculars		715 feet	577 feet
Beam		106 feet	98 feet
Depth		67.8 feet	49.2 feet
Ship Displacement (DWT)		74,000 long tons	40,000 long tons
Normal Ballast Draft		23.7 feet	20.8 feet
Laden Draft		47 feet	38 feet
Minimum Under Keel Clearance		2 feet from design dredge elevation *(assumed)*	2 feet from design dredge elevation *(assumed)*
Mooring Lines	Composition	Steel *(6x36 IWRC)*	Synthetic Polypropylene
	Circumference	3.96 in. *(32 mm diameter)*	7.9 in.[a] *(64 mm diameter)*
	Minimum Breaking Load (MBL)	156 kip *(70.6 tonnes)*	104 kip[a] *(47 tonnes)*
	Available Winched Mooring Lines on Vessel	16 total: 6 bow, 6 stern, 2 midship forward, 2 midship aft	8 total: 4 bow and 4 stern
Mooring Tails	Composition	50% Polyester / 50% High Tenacity Polypropylene Blend *("Composite Megaflex" tradename)*	Not applicable.
	Circumference	8.04 in. *(65 mm diameter)*	
	Minimum	201 kip *(91.0 tonnes)*	

Table Notes

[a]Values obtained from BS 6349-4, Table 9 (The British Standards Institution, 1994).

2.5 Criteria for Mooring Conditions

Table 10 summarizes the various design criteria for PCT moorage conditions, including environmental inputs and required performance.

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Table 10 Vessel Mooring Criteria for PCT

Input Criteria or Design Constraint		Normal Operational	Remain at Berth
Vessel Operations[a]		Ships are expected to carry out normal loading and offloading activities.	Ships can safely remain at berth; bulk carrier in center warp position. At higher wind speeds, ships will be expected to leave the berth.
30-s Duration Wind Speed[a]		45 mph (39.1 knots)	70 mph (60.8 knots)
Current	Flood	2.6 knots	3.3 knots
	Ebb	2.2 knots	2.8 knots
Petroleum Tanker Excursion Limits	Surge	+/- 5.0 feet from initial equilibrium[b]	
	Sway	2.0 feet from breasting line[c]	
Cement Bulk Carrier Excursion Limits	Surge	+/- 6 feet[d]	N/A - Not to exceed allowable line tension, fender reaction, or mooring hardware capacities.
	Sway	+/- 6 feet[d]	N/A - Not to exceed allowable line tension, fender reaction, or mooring hardware capacities.
Allowable Line Tension		Limited in accordance with safety factors for ropes given in MOTEMS 3103F.9 such that the maximum allowable line tension is 55% and 50% of the minimum breaking load (MBL) for the tanker and bulk carrier respectively; this corresponds to values of 86 kips and 52 kips.	
Allowable Forces on Fenders and Mooring Hardware		In accordance with the proposed capacity of fenders, bollards, and QRH's. See capacities given in Table 11.	

Table Notes

[a]In accordance with the SDM Section 4.2.14.
[b]In accordance with PIANC WG No. 24 (MarCom Working Group 24, 1995).
[c]In accordance with MOTEMS 3105F.2.
[d]Communication with Mr Scott De Wandel of ABI Cement Port

3 Mooring Assessment

All mooring analyses were undertaken using Tension Technology's OPTIMOOR software. Static batch runs were completed for the entire load case envelope of applicable vessel orientation, wind, wave, and current (see Appendix A for environmental load case table). Dynamic runs (three hour prototype simulations) were then completed for the governing cases identified in the static batch results.

3.1 Berth Configuration

Figure 8 shows the OPTIMOOR berth configuration; identification of moorage hardware and fender points is shown in the figure and Table 11.

Figure 8 OPTIMOOR Berth Configuration
Note that the petroleum offloading system has been set as the shore target.

Table 11 Identification of PCT Fendering and Mooring Hardware

	PCT Design Element	Hardware Capacity	Design Plan Label*	OPTIMOOR Model Label
Fender Points	Double Cell Fender at Breasting Dolphins	476 kip[b]	BD3	aa
	Single Cell Fenders Along Loading Platform	238 kip[c]	LP A9	bb
			LP A6	cc
			LP A4	dd
			LP A1	ee
	Double Cell Fender at Breasting Dolphins	476 kip[b]	BD2	ff
			BD1	gg
Mooring Hardware	Breasting Line Double Back-to-Back QRH's	440 kip[d]	BD3	A
			LP A9	B
			LP A1	E
			BD2	F
			BD1	G
	Loading Platform Single Bitt Bollards	220 kip[e]	LP E9	V
			LP A7	W
			LP A5	X
			LP A3	Y
			LP E1	Z
	Mooring Dolphin Quad QRH's	880 kip[f]	MD6	*A
			MD5	*B
			MD4	*C
			MD3	*D
			MD2	*E
			MD1	*F

Table Notes

*Loading platform QRH's, bollards, and fenders are not explicitly labeled on the PCT design plans. These elements are identified in the above table by noting the nearest loading platform grid coordinate.
[b]Corresponds to the uncorrected, unfactored reaction of two Trelleborg SCK 1450 rubber cell fenders.
[c]Corresponds to the uncorrected, unfactored reaction of one Trelleborg SCK 1450 rubber cell fenders.
[d]Capacity of two 100 MT hooks on a Double Back-to-Back QRH.
[e]Capacity of 100 MT single bitt bollards.
[f]Capacity of four 100 MT hooks on a Quad QRH.

MOORING ASSESSMENT

3.2 Vessel and Mooring Configurations

3.2.1 74,000 DWT Petroleum Tanker

The petroleum tanker was evaluated for both port and starboard side berthing. The vessel manifolds were centered on the petroleum offloading system of the loading platform for both normal operational and remain at berth conditions. Figure 9 and Figure 10 show the mooring arrangement for port and starboard side berthing, respectively.

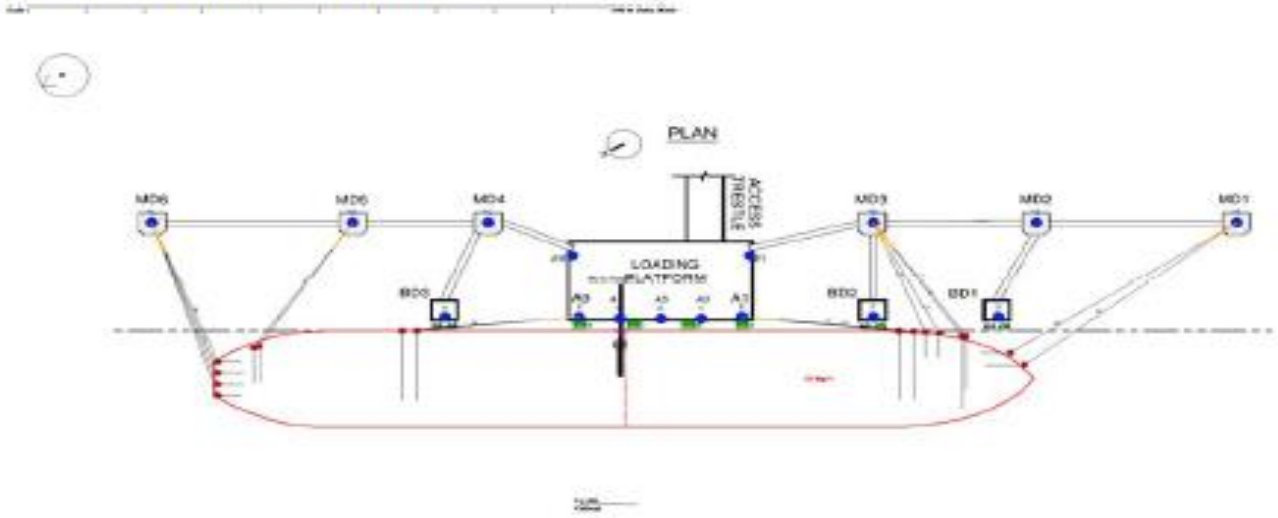

Figure 9 Petroleum Tanker – Port Side Orientation

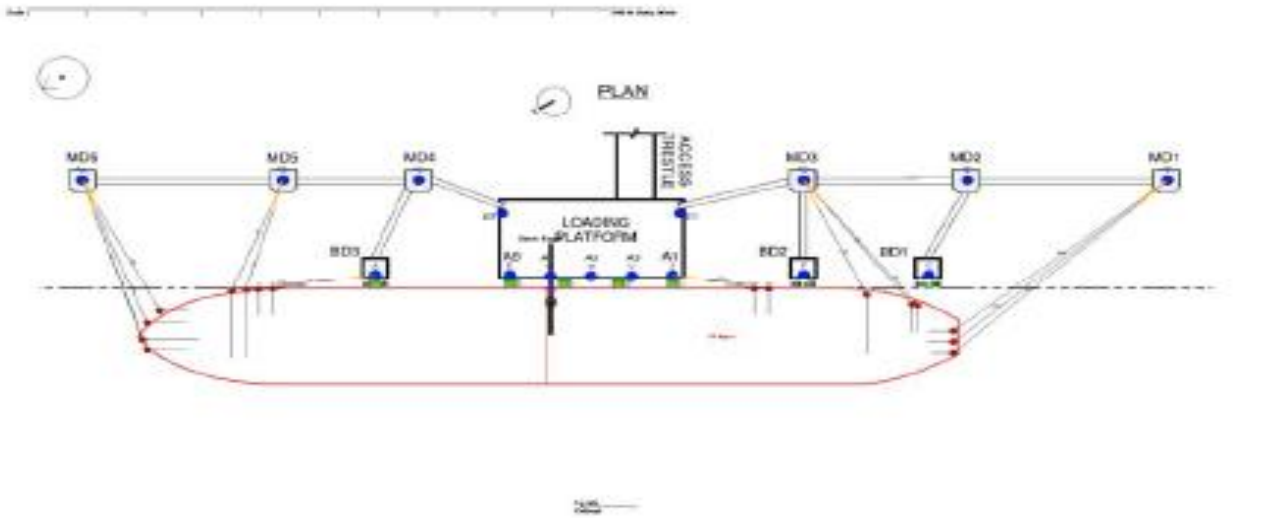

Figure 10 Petroleum Tanker – Starboard Side Orientation

Further, the tanker was checked at both future MHHW with normal ballast draft and at existing MLLW with laden draft (limited by a minimum UKC of 2 feet), for both orientations.

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3.2.2 40,000 DWT Cement Bulk Carrier

The cement bulk carrier was evaluated according to Table 12. Figure 11 through Figure 18 show the mooring arrangement for the various vessel configurations.

Table 12 Evaluated Configurations for the 40,000 DWT Cement Bulk Carrier

Vessel Configurations	Normal Operational Condition	Remain at Berth Condition
Warp Positions	Hatches 1, 3, and 5 centered on the loading platform cement unloader location.	As shown below, vessel was positioned to achieve mooring layout symmetry and efficiency.
Orientations	Port Starboard	Port Starboard

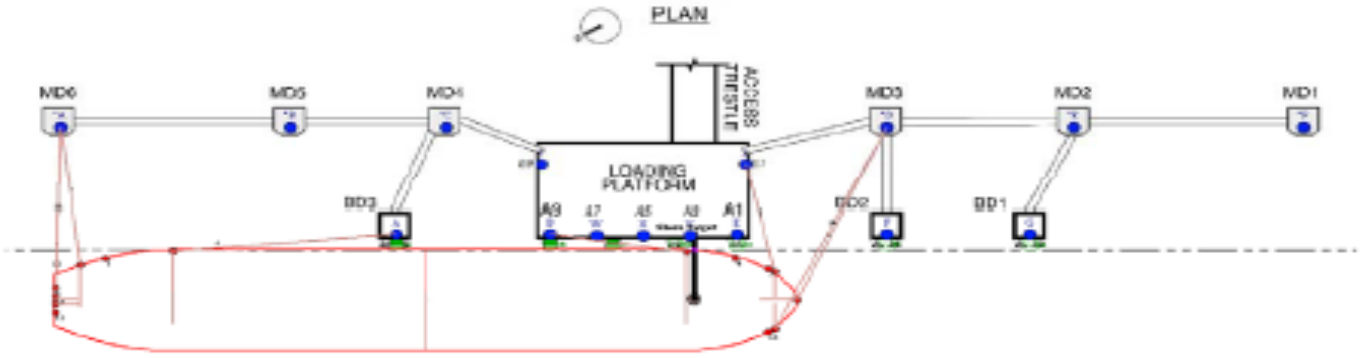

Figure 11 Bulk Carrier– Port Side Orientation - Hatch 1

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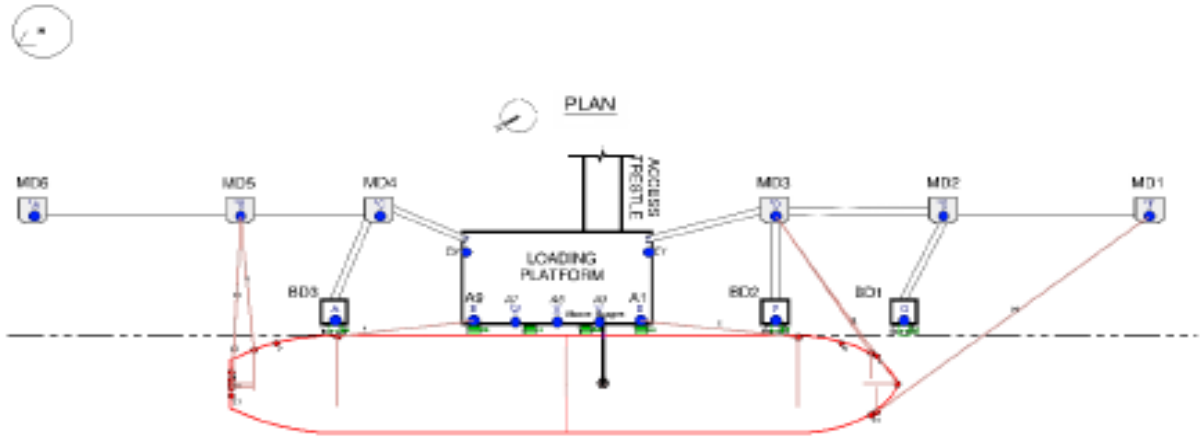

Figure 12 Bulk Carrier– Port Side Orientation - Hatch 3

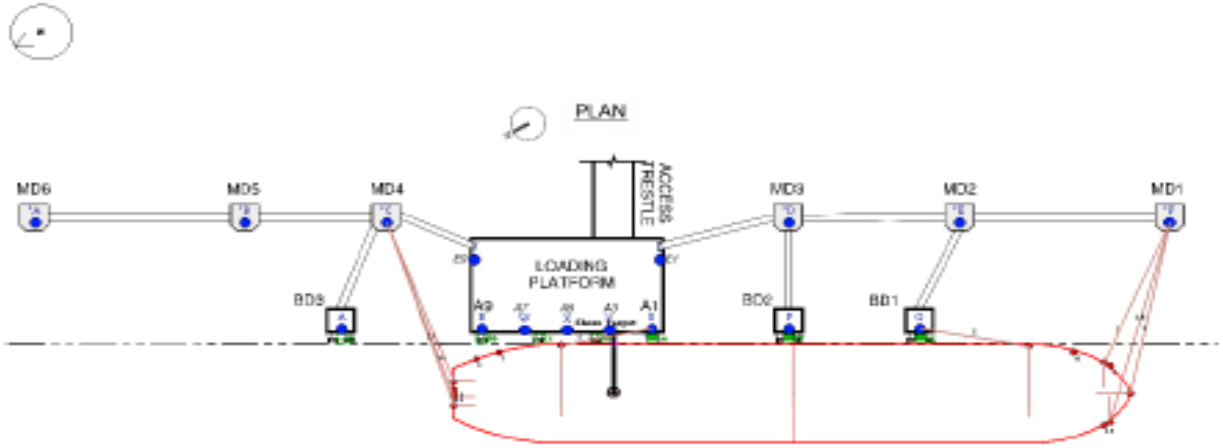

Figure 13 Bulk Carrier– Port Side Orientation - Hatch 5

18

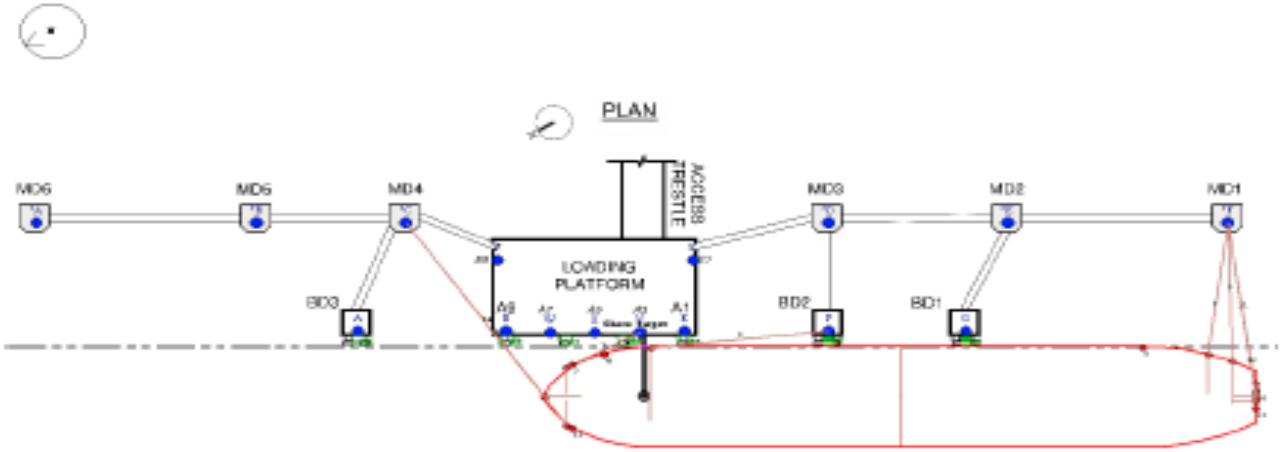

Figure 14 Bulk Carrier– Starboard Side Orientation - Hatch 1

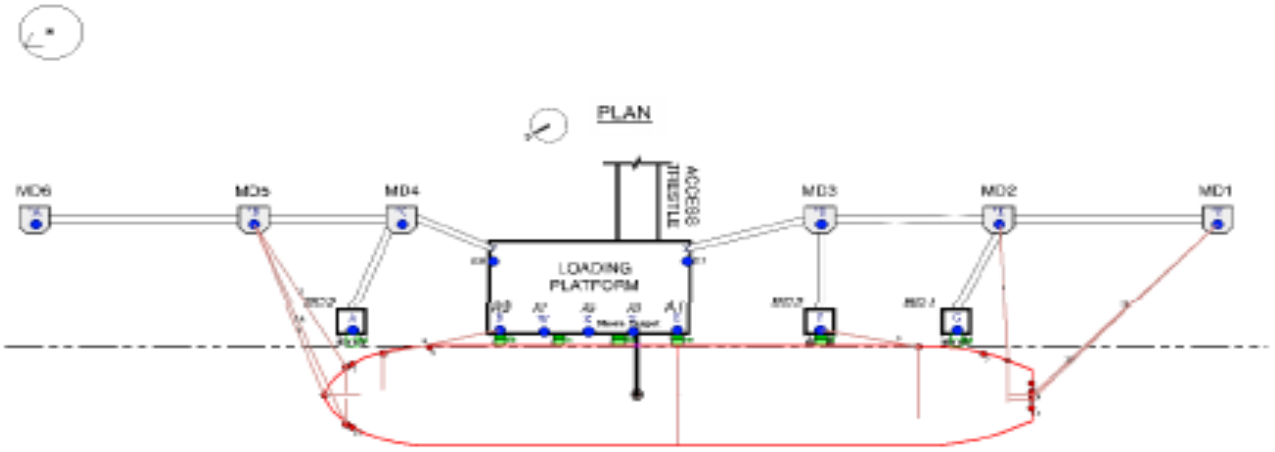

Figure 15 Bulk Carrier– Starboard Side Orientation - Hatch 3

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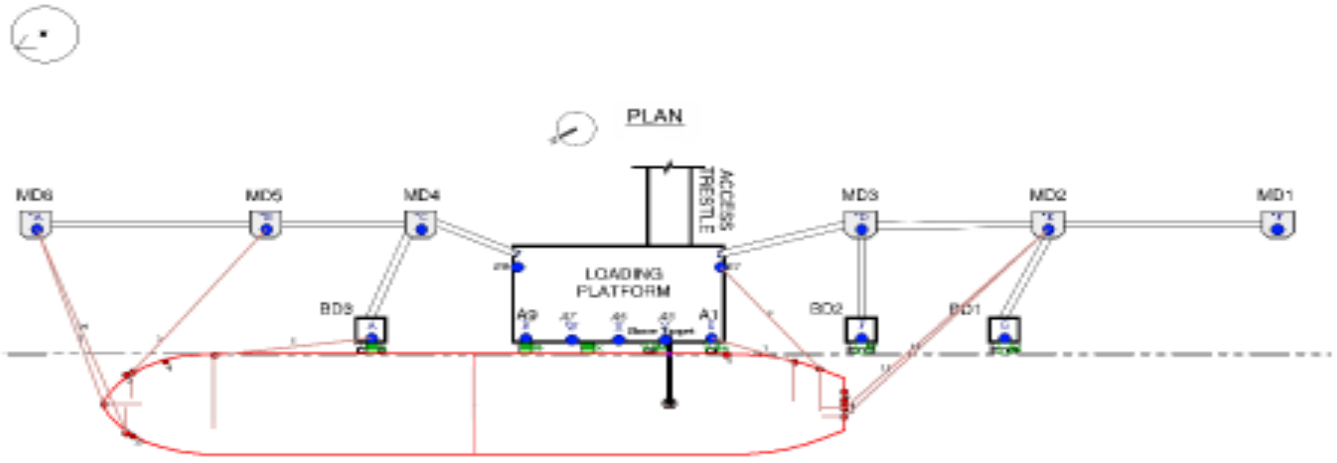

Figure 16 Bulk Carrier– Starboard Side Orientation - Hatch 5

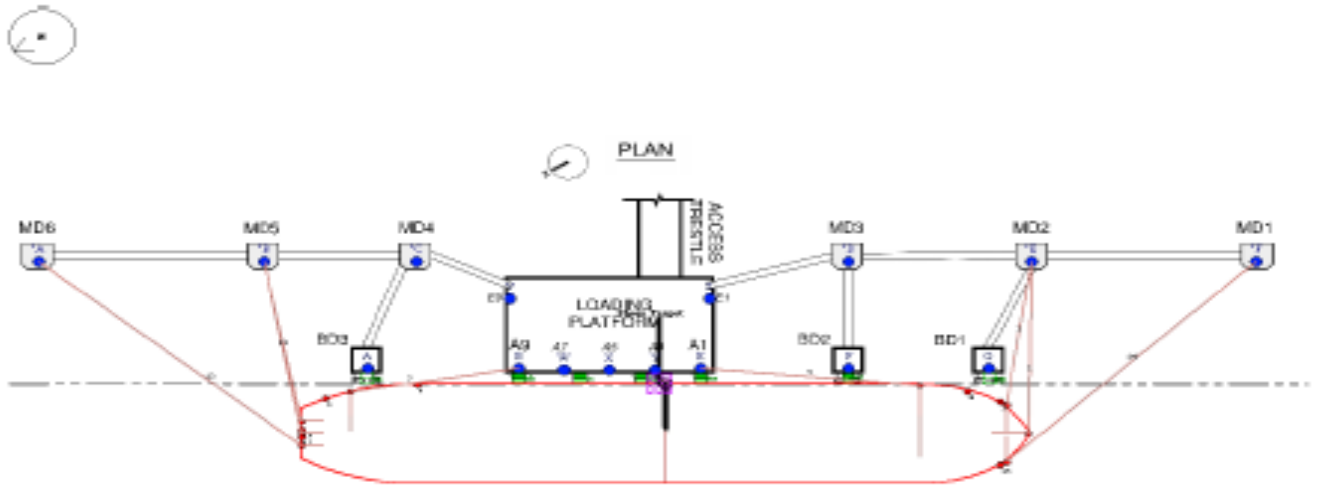

Figure 17 Bulk Carrier - Port Side Orientation - Remain at Berth Position

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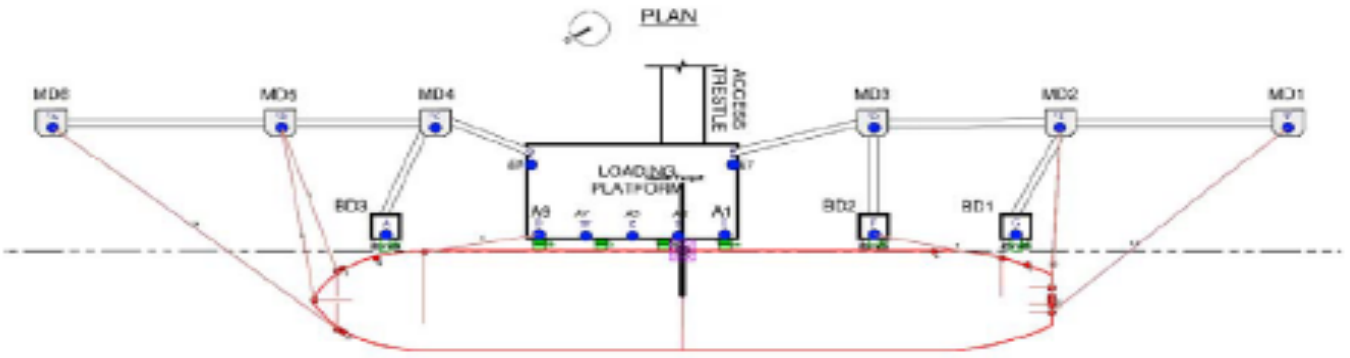

Figure 18 Bulk Carrier - Starboard Side Orientation - Remain at Berth Position

Further, the cement bulk carrier was checked at both future MHHW with normal ballast draft and at existing MLLW with fully laden draft, for all vessel configurations.

3.3 Analysis Approach

3.3.1 Initial Static Scoping Runs

Batch static scoping runs were first completed for the full range of vessel type, vessel orientation, tidal level, and environmental conditions considered (see Appendix A for a tabulation of full load case envelope). The results were reviewed and used to identify the governing load cases requiring more accurate dynamic analysis (see Section 3.3.2), based on statically predicted values of:

- vessel surge
- vessel sway
- mooring line tension
- fender thrust, and
- bollard/hook force.

3.3.2 Dynamic Runs

The governing load cases identified in the static scoping analysis were re-analyzed using the dynamic module of OPTIMOOR, which considers the time variation of wind and wave conditions rather than treating these as constant loads.

For any load case that resulted in unsafe mooring conditions, the original target wind speed threshold was reduced incrementally until the analysis showed that the vessel could be safely moored in those conditions. It is noted that associated wave parameters (significant height, mean period, and direction) were also adjusted to remain physically consistent with each reduced wind speed. The minimum wind speed that resulted in safe mooring conditions for all directions is then presented as the recommended overall safe wind speed threshold.

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3.3.3 Concurrent Ice Loads

During winter conditions when ice is present, ice loads may act instead of waves. The maximum ice load magnitude that the mooring system can safely tolerate in addition to wind and current was determined.

Table 14 summarizes the load cases investigated for the petroleum tanker; as noted previously, mooring of the bulk carrier in ice conditions is not recommended. Figure 19 and Figure 20 show sketches of each of these load cases. Note that these figures are provided to show the mooring arrangement and application of ice load; see Section 3.4.1.3 Response to Concurrent Ice Loads for actual results.

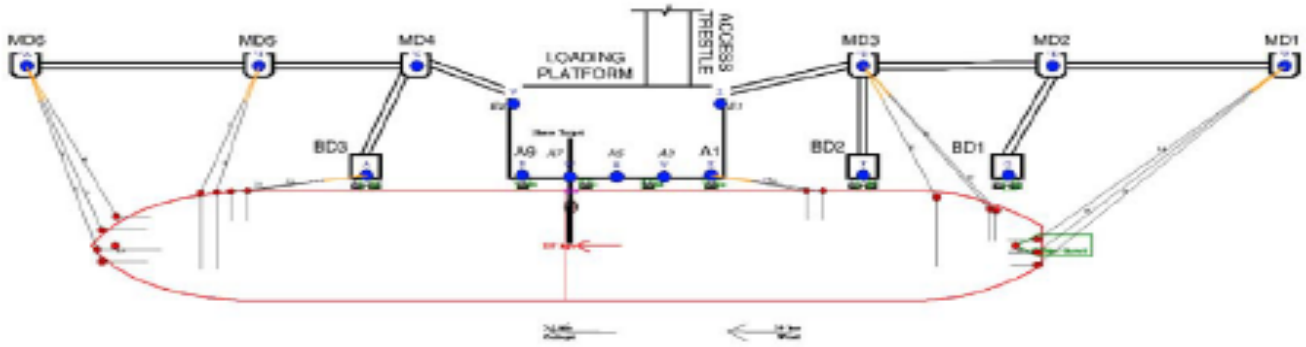
Table 13 Load Case Schedule for Concurrent Ice Load during Vessel Mooring

Ice Load Case	Vessel Orientation	Current	Ice Floe Loads
1	Port	Flood	Vessel Bow
2	Port	Ebb	Vessel Stern
3	Starboard	Flood	Vessel Stern
4	Starboard	Ebb	Vessel Bow

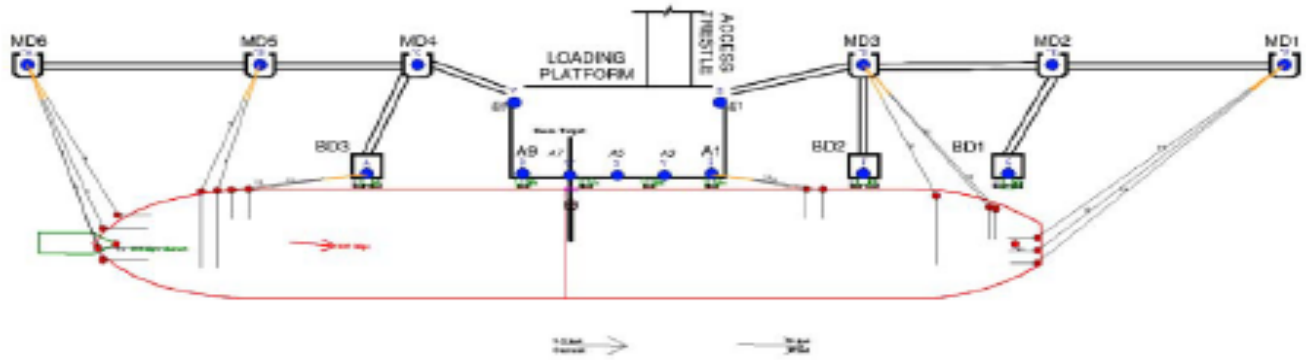
Ice Load Case 1 – Port Side Mooring with Flood Current

Ice Load Case 2 – Port Side Mooring with Ebb Current

Figure 19 Ice Load Cases 1 (top) and 2 (bottom) for Evaluation of Moored Petroleum Tanker
(the green pentagon represents the application of ice load)



Ice Load Case 3 – Starboard Side Mooring with Flood Current



Ice Load Case 4 – Starboard Side Mooring with Ebb Current

Figure 20 Ice Load Cases 3 (top) and 4 (bottom) for Evaluation of Moored Petroleum Tanker
(the green pentagon represents the application of ice load)

It is noted that the vessel was checked for both laden draft at MLLW and normal ballast draft at MHHW for every ice load case, and that the vessel was checked for both normal operational and remain at berth wind speeds for every ice load case.

3.4 Results

3.4.1 74,000 DWT Petroleum Tanker

3.4.1.1 Recommended Wind Speed Thresholds

Table 14 provides the recommended wind speed thresholds for the petroleum tanker. These wind speeds were determined with OPTIMOOR analysis results, and are the maximum 30-s wind speeds for which all mooring design criteria are satisfied.

Table 14 Recommended Wind Speed Thresholds for 74,000 DWT Petroleum Tanker

Mooring Condition	Recommended, 30-second Duration, Wind Speed Threshold	Relation to SDM Requirement	Controlling Design Criteria
Normal Operational	45 mph *(39 knots)*	Meets SDM requirement of 45 mph *(39 knots)*.	General practice for offloading vessels.
Remain at Berth	60 mph *(52 knots)*	Reduced from SDM requirement of 70 mph *(61 knots)*.	Mooring Line Tensions

MOORING ASSESSMENT

It is noted that the Remain at Berth threshold noted above could be increased through the deployment of additional mooring lines (storm mooring pattern) or through tug assist; however, this effect was not quantified. Although terminal throughput analysis is outside the scope of this document, it is noted that a 52 knot gust is expected, on average, less than once every two years based on historical winds.

3.4.1.2 Envelope Results Breakdown

Table 15 provides the maximum design results from all OPTIMOOR analyses of the petroleum tanker.

Table 15 Mooring Analysis Envelope Results for 74,000 DWT Petroleum Tanker

		Normal Operational Condition, V_{30s} = 45 mph			Remain at Berth Condition, V_{30s} = 60 mph		
Analysis Result	Detail	Max. Analysis. Result	Design Limit	Check	Max. Analysis Result	Design Limit	Check
Vessel Results	Surge	0.69 ft	5.0 ft	OKAY	1.17 ft	5.0 ft	OKAY
	Sway	0.36 ft	2.0 ft	OKAY	1.82 ft	2.0 ft	OKAY
	Line Tension	40.6 kip	85.8 kip	OKAY	80.0 kip	85.8 kip	OKAY
Fender Thrusts	aa (BD3)	164 kip	476 kip	OKAY	321 kip	476 kip	OKAY
	bb	131 kip	238 kip	OKAY	232 kip	238 kip	OKAY
	cc	114 kip	238 kip	OKAY	211 kip	238 kip	OKAY
	dd	107 kip	238 kip	OKAY	175 kip	238 kip	OKAY
	ee	118 kip	238 kip	OKAY	196 kip	238 kip	OKAY
	ff (BD2)	-	476 kip	OKAY	-	476 kip	OKAY
	gg (BD1)	-	476 kip	OKAY	-	476 kip	OKAY
Force in Breasting Line Double Back-to-Back QRH's	A (BD3)	70 kip	440 kip	OKAY	99 kip	440 kip	OKAY
	B	66 kip	440 kip	OKAY	94.8 kip	440 kip	OKAY
	E	49 kip	440 kip	OKAY	71 kip	440 kip	OKAY
	F (BD2)	-	440 kip	OKAY	-	440 kip	OKAY
	G (BD3)	-	440 kip	OKAY	-	440 kip	OKAY
Force in Loading Platform Single Bitt Bollards	V	-	220 kip	OKAY	-	220 kip	OKAY
	W	-	220 kip	OKAY	-	220 kip	OKAY
	X	-	220 kip	OKAY	-	220 kip	OKAY
	Y	-	220 kip	OKAY	-	220 kip	OKAY
	Z	-	220 kip	OKAY	-	220 kip	OKAY
Force in Mooring Dolphin Quad QRH's	*A (MD6)	134 kip	880 kip	OKAY	210 kip	880 kip	OKAY
	*B (MD5)	70 kip	880 kip	OKAY	102 kip	880 kip	OKAY
	*C (MD4)	-	880 kip	OKAY	-	880 kip	OKAY
	*D (MD3)	110 kip	880 kip	OKAY	287 kip	880 kip	OKAY
	*E (MD2)	-	880 kip	OKAY	-	880 kip	OKAY
	*F (MD1)	94 kip	880 kip	OKAY	190 kip	880 kip	OKAY

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3.4.1.3 Response to Concurrent Ice Loads

Table 16 gives the capacity for the petroleum tanker mooring line deployment to resist ice load in addition to wind and current for each of the ice load cases described in Table 13. The tabulated results are the maximum additional ice load for which all mooring design performance criteria are still satisfied.

Table 16 Mooring Arrangement Capacity to Resist Additional Ice Load on Petroleum Tanker

Ice Load Case	Normal Operational	Remain at Berth
1	210 kip	183 kip
2	208 kip	193 kip
3	180 kip	154 kip
4	181 kip	158 kip
Governing	***180 kip***	***154 kip***

The table shows that the worst case is Ice Load Case 3, namely the tanker moored starboard side with flood tide conditions. In that scenario, the mooring system has a residual ice load capacity of 180 kip and 154 kip under Normal Operational in Remain at Berth conditions, respectively.

These stated ice loads can be induced by an unlimited number of possible scenarios ranging from direct, unhindered collision with a small isolated ice floe, to a cluster of floes at rest against the ship and being acted upon by current and wind shear force. Table 17 presents a range of potential indicative ice scenarios capable of generating ice loads exceeding the computed residual capacity.

Table 17 Indicative Ice Scenarios Capable of Generating Ice Loads Exceeding Computed Residual Capacity

Ice Scenario	Normal Operational (180 kips residual capacity)	Remain at Berth (154 kips residual capacity)
A[a]	90 ft wide, 16" thick floe colliding at 2.6 knots	65 ft wide, 16" thick floe colliding at 3.3 knots
B[b]	60 ft wide, 36" thick floe colliding at 2.6 knots	40 ft wide, 36" thick floe colliding at 3.3 knots
C[c]	750 ft wide, 36" thick floe breasting against stern in collinear operational currents and wind	750 ft wide, 36" thick floe breasting against stern in collinear extreme currents and wind

Table Notes

[a]Annual ice thickness.
[b]Design ice thickness according to SDM.
[c]Design ice floe size and thickness according to SDM, with loads estimated by computing current and wind shear force on floe and adding a nominal allowance for additional load induced by adjacent upstream ice.

3.4.2 40,000 DWT Cement Bulk Carrier

3.4.2.1 Recommended Wind Speed Thresholds

Table 18 provides the recommended wind speed thresholds for the cement bulk carrier. These wind speeds were determined with OPTIMOOR analysis results, and are the maximum 30-s duration wind speeds for which all mooring design criteria are satisfied.

Table 18 Recommended Wind Speed Thresholds for 40,000 DWT Cement Bulk Carrier

Mooring Condition	Recommended, 30-second Duration, Wind Speed Threshold	Relation to SDM Requirement	Controlling Design Criteria
Normal Operational	45 mph *(39 knots)*	Meets SDM requirement of 45 mph.	Mooring Line Tensions
Remain at Berth	50 mph *(43.5 knots)*	Reduced from SDM requirement of 70 mph.	Mooring Line Tensions

It should be noted that the thresholds given above are based on the bulk carrier deploying its eight winched lines only. The number of lines on winches for this vessel was determined from a desktop study where general arrangement drawings and mooring plans for similar sized vessels were referenced. If the bulker were to utilize additional static lines (lines not on winches) then these thresholds could potentially increase, but given the complexities of warping with static lines, these additional lines have not been considered in the analyses.

3.4.2.2 Envelope Results Breakdown

Table 19 provides the maximum design results from all OPTIMOOR analyses of the cement bulk carrier.

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Table 19 Mooring Analysis Envelope Results for 40,000 DWT Cement Bulk Carrier

		Normal Operational Condition, $V_{30\text{-}s}$ = 45 mph			Remain at Berth Condition, $V_{30\text{-}s}$ = 50 mph		
Analysis Result	Detail	Max. Analysis. Result	Design Limit	Check	Max. Analysis Result	Design Limit	Check
Vessel Results	Surge	5.0	6 ft	OKAY	3.1 ft	N/A	OKAY
	Sway	4.8	6 ft	OKAY	4.7 ft	N/A	OKAY
	Line Tension	49	52 kip	OKAY	53 kip[a]	52 kip	OKAY
Fender Thrusts	aa (BD3)	309	476 kip	OKAY	-	476 kip	OKAY
	bb	182	238 kip	OKAY	145 kip	238 kip	OKAY
	cc	176	238 kip	OKAY	151 kip	238 kip	OKAY
	dd	115	238 kip	OKAY	168 kip	238 kip	OKAY
	ee	153	238 kip	OKAY	219 kip	238 kip	OKAY
	ff (BD2)	301	476 kip	OKAY	333 kip	476 kip	OKAY
	gg (BD1)	316	476 kip	OKAY	-	476 kip	OKAY
Force in Breasting Line Double Back-to-Back QRH's	A (BD3)	25	440 kip	OKAY	-	440 kip	OKAY
	B	44	440 kip	OKAY	46 kip	440 kip	OKAY
	E	42	440 kip	OKAY	28 kip	440 kip	OKAY
	F (BD2)	32	440 kip	OKAY	46 kip	440 kip	OKAY
	G (BD3)	23	440 kip	OKAY	-	440 kip	OKAY
Force in Loading Platform Single Bitt Bollards	V	-	220 kip	OKAY	-	220 kip	OKAY
	W	-	220 kip	OKAY	-	220 kip	OKAY
	X	-	220 kip	OKAY	-	220 kip	OKAY
	Y	35	220 kip	OKAY	-	220 kip	OKAY
	Z	44	220 kip	OKAY	-	220 kip	OKAY
Force in Mooring Dolphin Quad QRH's	*A (MD6)	91	880 kip	OKAY	30 kip	880 kip	OKAY
	*B (MD5)	84	880 kip	OKAY	94 kip	880 kip	OKAY
	*C (MD4)	89	880 kip	OKAY	-	880 kip	OKAY
	*D (MD3)	78	880 kip	OKAY	-	880 kip	OKAY
	*E (MD2)	68	880 kip	OKAY	99 kip	880 kip	OKAY
	*F (MD1)	92	880 kip	OKAY	28 kip	880 kip	OKAY

Table Notes

[a] Target tensions were slightly exceeded but are deemed satisfactory as

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4 Conclusions and Discussion

A mooring analysis has been completed for the Petroleum and Cement Terminal at the Port of Alaska in accordance with the PAMP Seismic Design Manual, and MOTEMS 3103F.5 and 3105F.2 (State of California, 2016). Static and dynamic analyses were performed using OPTIMOOR (Tension Tech, 2017) based on two design vessels: a 74,000 DWT Petroleum Tanker and a 40,000 DWT Cement Bulk Carrier.

Table 20 presents the recommended wind speed thresholds for the PCT based on the results of the mooring analysis. The proposed mooring hardware and fender system were found to be adequate for mooring and breasting forces under these conditions.

Table 20 Summary of Recommended, 30-s Duration, Wind Speed Thresholds for PCT

Vessel	Normal Operational[a]	Remain at Berth[b]
74,000 DWT Petroleum Tanker	45 mph	60 mph[d]
40,000 Cement Bulk Carrier	45 mph[c]	50 mph[d] *(center-warp position only)*

Table Notes
[a]Computed considering simultaneous operational ebb and flood current and waves consistent with winds.
[b]Computed considering simultaneous extreme ebb and flood current and waves consistent with winds.
[c]Equal to target wind speed threshold of 45 mph identified in SDM Section 4.2.14.1.
[d]Lower than target wind speed threshold of 70 mph identified in SDM Section 4.2.14.1.

The thresholds presented above are based on open water conditions and consider wind, current and wave loading. During winter conditions when ice is present in concentrations greater than about 5/10^{ths}, waves will not be present and the mooring model was used to determine the maximum ice loads that can be safely tolerated on the moored tanker simultaneous to the stated wind and currents. Ice loads on the bulk carrier were not evaluated exhaustively since historical vessel call information provided by the POA indicate that cement unloading operations do not coincide with significant ice events. This historical trend, coupled with the results of the present analysis which indicate a limited ability of the moored bulk carrier to withstand ice loads in addition to wind and current, lead to the conclusion that cement unloading operations should not be undertaken when significant ice is present.

It is noted that most of the thresholds presented above are somewhat lower than the targets identified in the SDM (CH2M Hill Engineers Inc., Sept 2017). Preliminary analyses and designs were completed during initial planning stages of the PAMP, which was named the Anchorage Port Modernization Program (APMP) at the time. Part of this engineering phase included mooring analyses for various, proposed berths at the POA, including the PCT. The summary report for this preliminary mooring analysis was titled "DRAFT Anchorage Port Modernization Program Mooring Analysis" (CH2M Hill Engineers, Inc., Dec 2016), and was transmitted to the PCT final design team during project kick-off.

However, several key engineering criteria have been updated or reconsidered for the final PCT mooring analysis, which affected conclusions and recommendations. Table 21 lists these key differences, along with the effect on the final mooring recommendations.

CONCLUSIONS AND DISCUSSION

Table 21 Key Discrepancies between Preliminary and Final Mooring Analyses

	Preliminary Mooring Analysis		Final Mooring Analysis		
Basis	*Ref.*[a]	*Narrative*	*Ref.*[b]	*Narrative*	*Effect*
Analysis Type	Section 3.2	Static analysis-only justified on the basis that the SDM-required, "Remain at Berth" wind speeds have an associated 50-yr return period, as opposed to the 25-yr return period wind speed for MOTEMS 3103F "Survival Condition".	Section 3.3.2	The final design project team's interpretation of SDM "Remain at Berth" condition is simply more conservative than that required by MOTEMS. Dynamic analyses are required to better capture the effects of dynamic amplification and wave response for the final recommended wind speed thresholds, regardless of the return periods attached to those wind speeds.	Dynamic effects are considerable, especially with severe wave activity. Reduces wind speed thresholds.
Wave Parameters	Table 3-3	Adopt preliminary wave input from SDM Section 4.2.14.3.	Section 2.1.3	Wave parameters have been developed for Cook Inlet for varying wind direction and speed (COWI, May 2018). These wave characteristics are more severe than that listed in the SDM.	Large, low-period waves have significant effect on mooring response. Reduces wind speed thresholds.
Cement Bulk Carrier Sway Limit	Section 4.3	8.2 feet	Table 10	+/-6 feet	Somewhat reduces operational wind speed threshold for the bulk carrier.
Cement Bulk Carrier Mooring Lines	App. E	Sixteen pre-tensioned lines are available for mooring.	Table 9 and Section 3.4.2.1	Eight pre-tensioned lines are available.	Significantly reduces wind speed thresholds for the bulk carrier.
Petroleum Tanker Mooring Line Composition	Table 5-4	Polypropylene with MBL = 141 kip (from BS 6349-4 recommendations)	Table 9	Steel IWRC with MBL = 156 kip (from Two Million Ways vessel survey)	Effectively raises wind speed threshold, all things being equal.
Ice Loads Acting on Cement Bulk Carrier	Section 3.4, 6.10	Considered current and wind drag acting on 1 and 0.5 acre ice floes, which then act on moored vessel.	Section 2.1.4	Ice loads were not applied to the moored cement bulk carrier due to limited reserve mooring line capacity and historically infrequent open water ship calls	Recommendations for ice conditions during bulk carrier mooring are not provided. Does not affect recommended open water wind speed thresholds.

Table Notes
[a]Reference refers to the preliminary PAMP mooring analysis report (CH2M Hill Engineers, Inc., Dec 2016).
[b]Reference refers to this final PCT mooring analysis report.

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A Environmental Load Case Table

APPENDIXES

Table A.1 Environmental Load Case Table for Normal Operational Wind Speed

		Tidal Input		Current Input			Wind Input		Wave Input		
Load Case	Vessel Draft	Datum	Elev. (ft MLLW)	Type	Speed (knot)	Direction (° T)	30-s Wind Speed (knot)	Direction (° T)	Sig. Height (ft)	Mean Period (s)	Direction (° T)
1	Ballast	MHHW	33.4	Flood	2.6	212	39.1	0	3.3	3	2
2	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	0	3.3	3	2
3	Ballast	MHHW	33.4	Flood	2.6	212	39.1	45	3.2	3.2	10
4	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	45	3.2	3.2	10
5	Ballast	MHHW	33.4	Flood	2.6	212	39.1	90	1.8	3.2	37
6	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	90	1.8	3.2	37
7	Ballast	MHHW	33.4	Flood	2.6	212	39.1	135	1.1	1.4	155
8	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	135	1.1	1.4	155
9	Ballast	MHHW	33.4	Flood	2.6	212	39.1	180	2.6	2.6	233
10	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	180	2.6	2.6	233
11	Ballast	MHHW	33.4	Flood	2.6	212	39.1	225	4.9	4.5	254
12	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	225	4.9	4.5	254
13	Ballast	MHHW	33.4	Flood	2.6	212	39.1	270	5	4.1	260
14	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	270	5	4.1	260
15	Ballast	MHHW	33.4	Flood	2.6	212	39.1	315	3.5	2.7	296
16	Ballast	MHHW	33.4	Ebb	2.2	32	39.1	315	3.5	2.7	296
17	Laden	MLLW	0	Flood	2.6	212	39.1	0	3.3	3	2
18	Laden	MLLW	0	Ebb	2.2	32	39.1	0	3.3	3	2
19	Laden	MLLW	0	Flood	2.6	212	39.1	45	3.2	3.2	10
20	Laden	MLLW	0	Ebb	2.2	32	39.1	45	3.2	3.2	10
21	Laden	MLLW	0	Flood	2.6	212	39.1	90	1.8	3.2	37
22	Laden	MLLW	0	Ebb	2.2	32	39.1	90	1.8	3.2	37
23	Laden	MLLW	0	Flood	2.6	212	39.1	135	1.1	1.4	155
24	Laden	MLLW	0	Ebb	2.2	32	39.1	135	1.1	1.4	155
25	Laden	MLLW	0	Flood	2.6	212	39.1	180	2.6	2.6	233
26	Laden	MLLW	0	Ebb	2.2	32	39.1	180	2.6	2.6	233
27	Laden	MLLW	0	Flood	2.6	212	39.1	225	4.9	4.5	254
28	Laden	MLLW	0	Ebb	2.2	32	39.1	225	4.9	4.5	254
29	Laden	MLLW	0	Flood	2.6	212	39.1	270	5	4.1	260
30	Laden	MLLW	0	Ebb	2.2	32	39.1	270	5	4.1	260
31	Laden	MLLW	0	Flood	2.6	212	39.1	315	3.5	2.7	296
32	Laden	MLLW	0	Ebb	2.2	32	39.1	315	3.5	2.7	296

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Table A.2 Environmental Load Case Table for Remain at Berth Wind Speed

		Tidal Input		Current Input			Wind Input		Wave Input		
Load Case	Vessel Draft	*Datum*	*Elev.* (ft MLLW)	*Type*	*Speed* (knot)	*Direction* (° T)	*30-s Wind Speed* (knot)	*Direction* (° T)	*Sig. Height* (ft)	*Mean Period* (s)	*Direction* (° T)
1	Ballast	MHHW	33.4	Flood	3.3	212	60.8	0	5.8	3.7	0
2	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	0	5.8	3.7	0
3	Ballast	MHHW	33.4	Flood	3.3	212	60.8	45	5.4	3.8	9
4	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	45	5.4	3.8	9
5	Ballast	MHHW	33.4	Flood	3.3	212	60.8	90	3.2	2.3	45
6	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	90	3.2	2.3	45
7	Ballast	MHHW	33.4	Flood	3.3	212	60.8	135	2.1	1.7	152
8	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	135	2.1	1.7	152
9	Ballast	MHHW	33.4	Flood	3.3	212	60.8	180	4.5	3.2	228
10	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	180	4.5	3.2	228
11	Ballast	MHHW	33.4	Flood	3.3	212	60.8	225	7.6	5.4	254
12	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	225	7.6	5.4	254
13	Ballast	MHHW	33.4	Flood	3.3	212	60.8	270	8	5	262
14	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	270	8	5	262
15	Ballast	MHHW	33.4	Flood	3.3	212	60.8	315	6.2	3.4	298
16	Ballast	MHHW	33.4	Ebb	2.8	32	60.8	315	6.2	3.4	298
17	Laden	MLLW	0	Flood	3.3	212	60.8	0	5.8	3.7	0
18	Laden	MLLW	0	Ebb	2.8	32	60.8	0	5.8	3.7	0
19	Laden	MLLW	0	Flood	3.3	212	60.8	45	5.4	3.8	9
20	Laden	MLLW	0	Ebb	2.8	32	60.8	45	5.4	3.8	9
21	Laden	MLLW	0	Flood	3.3	212	60.8	90	3.2	2.3	45
22	Laden	MLLW	0	Ebb	2.8	32	60.8	90	3.2	2.3	45
23	Laden	MLLW	0	Flood	3.3	212	60.8	135	2.1	1.7	152
24	Laden	MLLW	0	Ebb	2.8	32	60.8	135	2.1	1.7	152
25	Laden	MLLW	0	Flood	3.3	212	60.8	180	4.5	3.2	228
26	Laden	MLLW	0	Ebb	2.8	32	60.8	180	4.5	3.2	228
27	Laden	MLLW	0	Flood	3.3	212	60.8	225	7.6	5.4	254
28	Laden	MLLW	0	Ebb	2.8	32	60.8	225	7.6	5.4	254
29	Laden	MLLW	0	Flood	3.3	212	60.8	270	8	5	262
30	Laden	MLLW	0	Ebb	2.8	32	60.8	270	8	5	262
31	Laden	MLLW	0	Flood	3.3	212	60.8	315	6.2	3.4	298
32	Laden	MLLW	0	Ebb	2.8	32	60.8	315	6.2	3.4	298

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B OPTIMOOR Analysis Input Files for 74,000 DWT Petroleum Tanker

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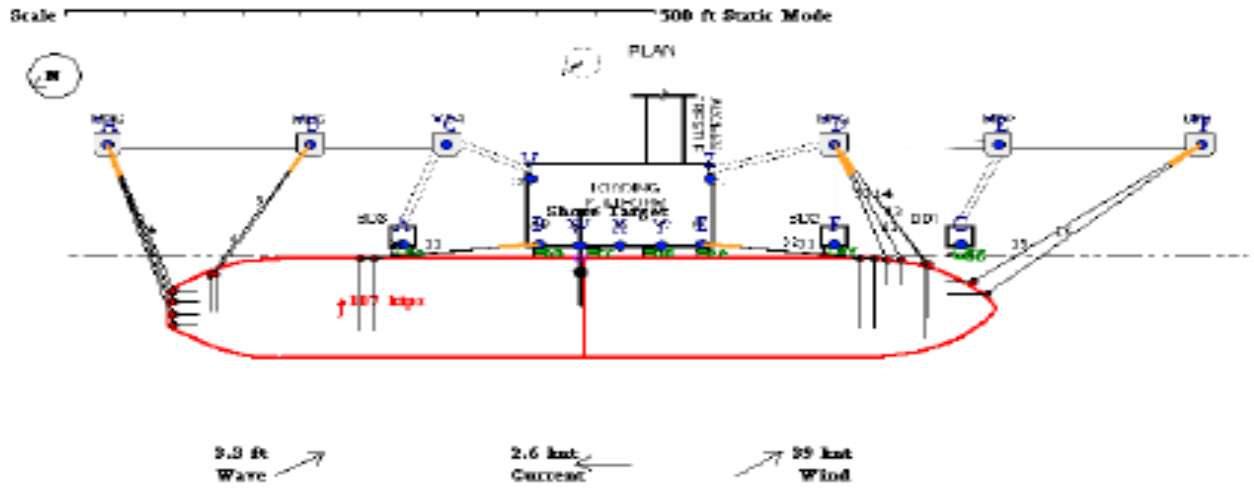
Arrangement for Tanker_Port at PCT Tanker



Berth Data for PCT Tanker

(file C:\Users\bnkn\Documents\BNKN\PAMP PCT\Tanker_Static 20180308\PCT_Tanker.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in Way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft:	± 5.00
Permissible Sway Excursion Port/Stbd:	± 2.00
Dist of Berth Target to Right of Origin:	432.1
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

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Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

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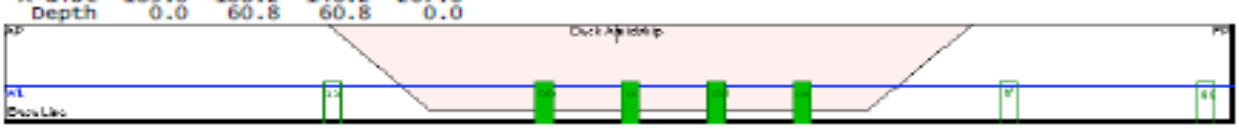
Vessel Data for Tanker_Port

(file C:\Users\bnkn\Documents\BNKN\PAMP PCT\Tanker_Static 20180308\Tanker_Port.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP:	715.2
Breadth:	105.6
Depth:	67.7
Port Target:	-4.0 fwd from midship -37.7 from CL and 6.7 above deck
Stbd Target:	-4.0 fwd from midship 37.7 from CL and 6.7 above deck
End-on projected windage area:	5125 above deck level
Side projected windage area:	7728 above deck level
Fendering possible from:	0.236 LBP aft of midship
to:	0.289 LBP fwd of midship
Current drag data based on:	OCIMF (Conventional Bow)
Wind drag data based on:	OCIMF Tanker (U-shaped Bow)
Wave motion data based on RAO data for:	VLCC
Roll Damping Coeff:	5% of Critical

Flatside Contour

X-dist	-169.0	-108.2	146.2	207.0
Depth	0.0	60.8	60.8	0.0

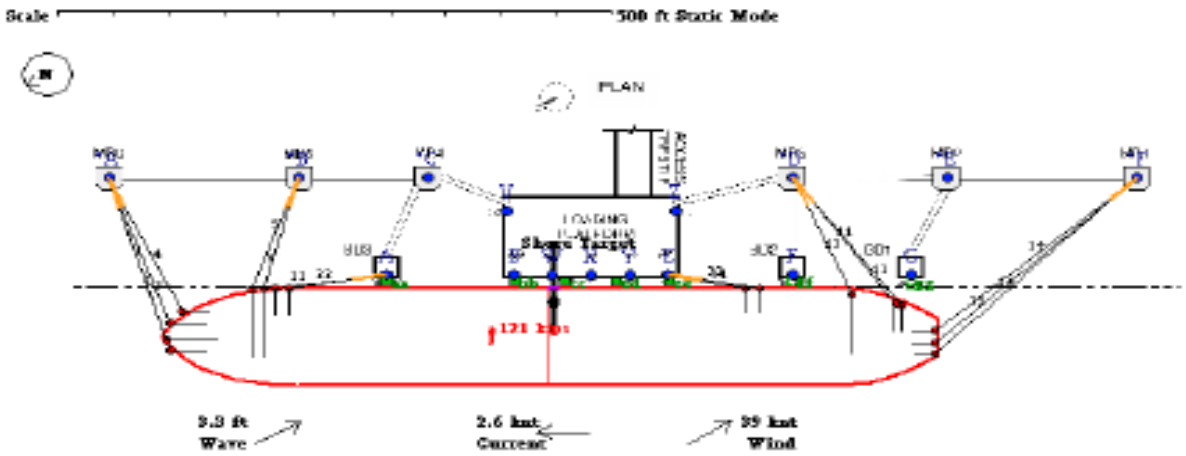


Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size	Line Type	Line BL	Tail Segment-1 Lgth	Tail Segment-1 Size	Tail Segment-1 Type	Tail Segment-1 BL
1	-375.0	-18.2	2.0	21.8	97	15	4.0	SW	156	36.1	8.0	pp	201
2	-375.0	-6.1	2.0	24.0	97	15	4.0	SW	156	36.1	8.0	pp	201
3	-375.0	6.1	2.0	23.7	97	15	4.0	SW	156	36.1	8.0	pp	201
4	-375.0	18.2	2.0	21.6	97	15	4.0	SW	156	36.1	8.0	pp	201
5	-342.1	34.0	2.0	38.3	97	15	4.0	SW	156	36.1	8.0	pp	201
6	-336.8	35.5	2.0	39.8	97	15	4.0	SW	156	36.1	8.0	pp	201
11	277.0	51.7	2.0	28.4	97	15	4.0	SW	156	36.1	8.0	pp	201
12	289.8	50.7	2.0	27.4	97	15	4.0	SW	156	36.1	8.0	pp	201
13	310.7	47.4	2.0	80.6	97	15	4.0	SW	156	36.1	8.0	pp	201
14	314.5	46.8	2.0	58.6	97	15	4.0	SW	156	36.1	8.0	pp	201
15	355.5	28.6	2.0	26.7	97	15	4.0	SW	156	36.1	8.0	pp	201
16	368.1	15.1	2.0	36.7	97	15	4.0	SW	156	36.1	8.0	pp	201
21	-204.8	52.8	2.0	76.9	97	15	4.0	SW	156	36.1	8.0	pp	201
22	-191.5	52.8	2.0	76.9	97	15	4.0	SW	156	36.1	8.0	pp	201
31	252.3	52.8	2.0	76.0	97	15	4.0	SW	156	36.1	8.0	pp	201
32	265.8	52.3	2.0	75.5	97	15	4.0	SW	156	36.1	8.0	pp	201

Codes for Types of Line:
SW: Steel Wire (steel core)
pp: polypropylene dry (broken-in)

4

Arrangement for Tanker_Star at PCT Tanker



Berth Data for PCT Tanker

(file C:\Users\bnkn\Documents\BNKN\PAMP PCT\Tanker_Static 20180308\PCT_Tanker.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in Way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft: ±	5.00
Permissible Sway Excursion Port/Stbd: ±	2.00
Dist of Berth Target to Right of Origin:	432.1
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

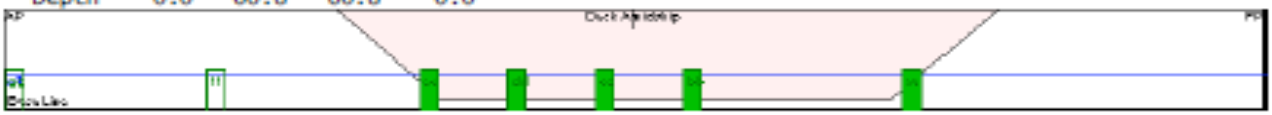
Vessel Data for Tanker_Star

(file C:\Users\bnkn\Documents\BNKN\PAMP PCT\Tanker_Static 20180308\Tanker_Star.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP:	715.2	
Breadth:	105.6	
Depth:	67.8	
Port Target:	-4.0 fwd from midship	-37.7 from CL and 6.7 above deck
Stbd Target:	-4.0 fwd from midship	37.7 from CL and 6.7 above deck
End-on projected windage area:	5125 above deck level	
Side projected windage area:	7728 above deck level	
Fendering possible from:	0.236 LBP aft of midship	
to:	0.289 LBP fwd of midship	
Current drag data based on:	OCIMF (Conventional Bow)	
Wind drag data based on:	OCIMF Tanker (U-shaped Bow)	
Wave motion data based on RAO data for:	VLCC	
Roll Damping Coeff:	5% of Critical	

Flatside Contour

X-dist	-169.0	-108.2	146.2	207.0
Depth	0.0	60.8	60.8	0.0



Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size	Line Type	Line BL	Tail Segment-1 Lgth	Tail Segment-1 Size	Tail Segment-1 Type	Tail Segment-1 BL
1	368.1	-15.1	2.0	36.7	97	15	4.0	SW	156	36.1	8.0	pp	201
2	372.1	-3.6	2.0	51.7	97	15	4.0	SW	156	36.1	8.0	pp	201
3	368.1	15.1	2.0	36.4	97	15	4.0	SW	156	36.1	8.0	pp	201
4	356.6	28.4	2.0	27.5	97	15	4.0	SW	156	36.1	8.0	pp	201
5	289.8	50.7	2.0	74.0	97	15	4.0	SW	156	36.1	8.0	pp	201
6	277.0	51.7	2.0	75.0	97	15	4.0	SW	156	36.1	8.0	pp	201
11	-336.8	35.5	2.0	31.2	97	15	4.0	SW	156	36.1	8.0	pp	201
12	-342.1	34.0	2.0	29.7	97	15	4.0	SW	156	36.1	8.0	pp	201
13	-294.9	46.4	2.0	66.4	97	15	4.0	SW	156	36.1	8.0	pp	201
14	-375.0	6.1	2.0	24.0	97	15	4.0	SW	156	36.1	8.0	pp	201
15	-375.0	-6.1	2.0	23.7	97	15	4.0	SW	156	36.1	8.0	pp	201
16	-375.0	-18.2	2.0	21.6	97	15	4.0	SW	156	36.1	8.0	pp	201
21	265.8	52.3	2.0	29.1	97	15	4.0	SW	156	36.1	8.0	pp	201
22	252.3	52.8	2.0	29.6	97	15	4.0	SW	156	36.1	8.0	pp	201
31	-191.5	52.8	2.0	28.7	97	15	4.0	SW	156	36.1	8.0	pp	201
32	-204.8	52.8	2.0	28.7	97	15	4.0	SW	156	36.1	8.0	pp	201

Codes for Types of Line:
SW: Steel Wire (steel core)
pp: polypropylene dry (broken-in)

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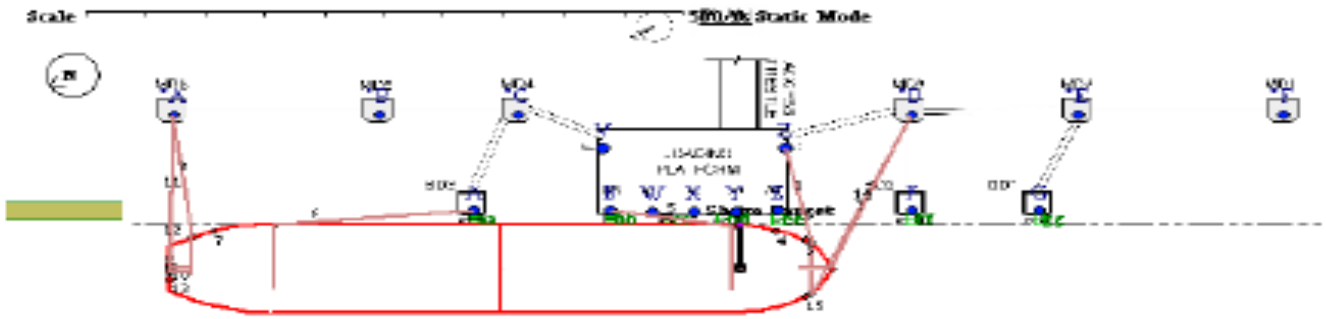
C OPTIMOOR Analysis Input Files for 40,000 DWT Cement Bulk Carrier

APPENDIXES

Arrangement for 40,000 DWT Bulk at PCT Bulker



Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Loading.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft: ±	6
Permissible Sway Excursion Port/Stbd: ±	6
Permissible Vertical Movement: ±	6
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

2

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_H1.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP: 577.0
Breadth: 97.8
Depth: 49.2
Port Target: 215.0 fwd from midship -0.9 from CL and 6.0 above deck
Stbd Target: 215.0 fwd from midship 0.9 from CL and 6.0 above deck
End-on projected windage area: 4000 above deck level
Side projected windage area: 12150 above deck level
Fendering possible from: 0.227 LBP aft of midship
to: 0.284 LBP fwd of midship
Current drag data based on: OCIMF (Conventional Bow)
Wind drag data based on: Bulk Carrier (L/B = 6.3)

Flatside Contour

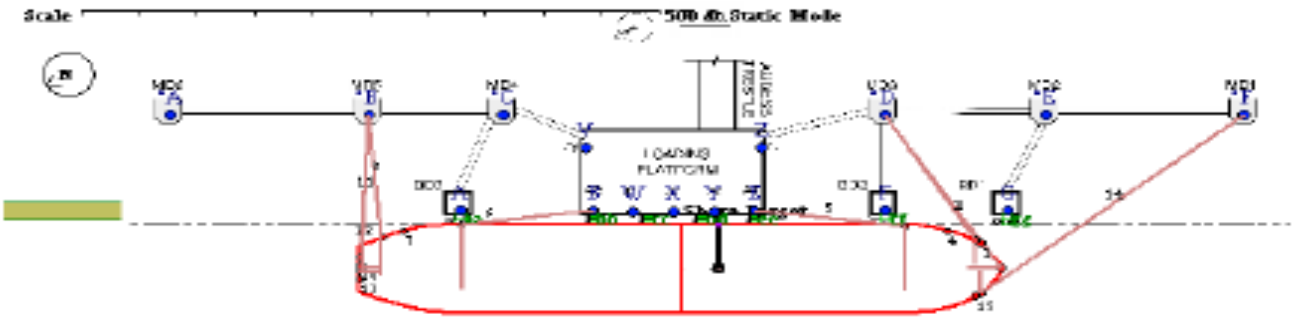
X-dist	-131.2	164.1
Depth	45.9	45.9

Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

APPENDIXES

Arrangement for 40,000 DWT Bulk at PCT Bulker



Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Loading.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft: ±	6
Permissible Sway Excursion Port/Stbd: ±	6
Permissible Vertical Movement: ±	6
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

4

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

APPENDIXES

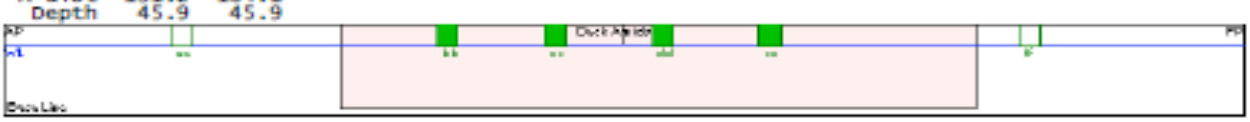
Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_H3.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP:	577.0	
Breadth:	97.8	
Depth:	49.2	
Port Target:	34.0 fwd from midship	-0.9 from CL and 6.0 above deck
Stbd Target:	34.0 fwd from midship	0.9 from CL and 6.0 above deck
End-on projected windage area:	4000 above deck level	
Side projected windage area:	12150 above deck level	
Fendering possible from:	0.227 LBP aft of midship	
to:	0.284 LBP fwd of midship	
Current drag data based on:	OCIMF (Conventional Bow)	
Wind drag data based on:	Bulk Carrier (L/B = 6.3)	

Flatside Contour

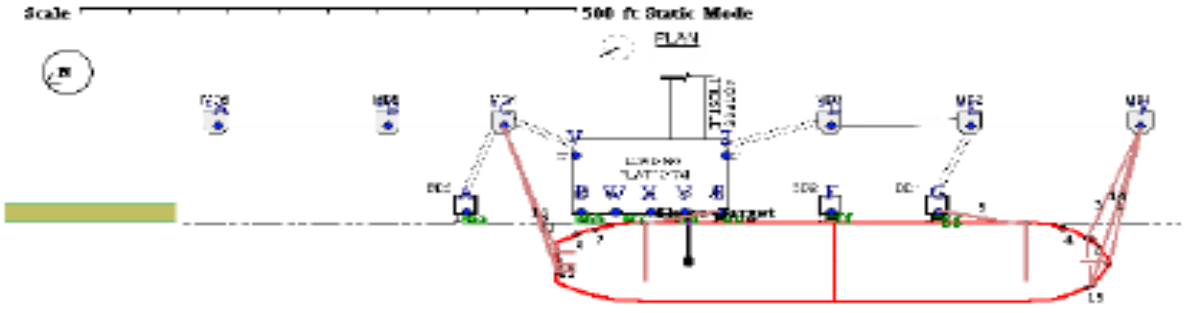
X-dist	-131.2	164.1
Depth	45.9	45.9



Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

Arrangement for 40,000 DWT Bulk at PCT Bulker



6

Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Loading.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft:	± 6
Permissible Sway Excursion Port/Stbd:	± 6
Permissible Vertical Movement:	± 6
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

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APPENDIXES

Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_H5.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP: 577.0
Breadth: 97.8
Depth: 49.2
Port Target:-158.0 fwd from midship -0.9 from CL and 6.0 above deck
Stbd Target:-158.0 fwd from midship 0.9 from CL and 6.0 above deck
End-on projected windage area: 4000 above deck level
Side projected windage area: 12150 above deck level
Fendering possible from: 0.227 LBP aft of midship
to: 0.284 LBP fwd of midship
Current drag data based on: OCIMF (Conventional Bow)
Wind drag data based on: Bulk Carrier (L/B = 6.3)

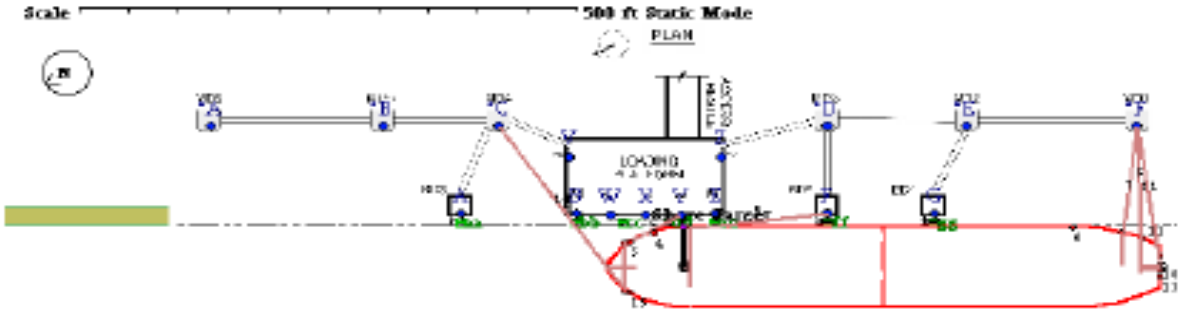
Flatside Contour

X-dist	-131.2	164.1
Depth	45.9	45.9

Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

Arrangement for 40,000 DWT Bulk at PCT Bulker



8

Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Loading.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in Way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft:	± 6
Permissible Sway Excursion Port/Stbd:	± 6
Permissible Vertical Movement:	± 6
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender	Load-Compression Data									
aa	152	286	386	447	471	438	438	457	476	505 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft
bb	76	143	193	224	236	219	219	228	238	252 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft
cc	76	143	193	224	236	219	219	228	238	252 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft
dd	76	143	193	224	236	219	219	228	238	252 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft
ee	76	143	193	224	236	219	219	228	238	252 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft
ff	152	286	386	447	471	438	438	457	476	505 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft
gg	152	286	386	447	471	438	438	457	476	505 kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62 ft

APPENDIXES

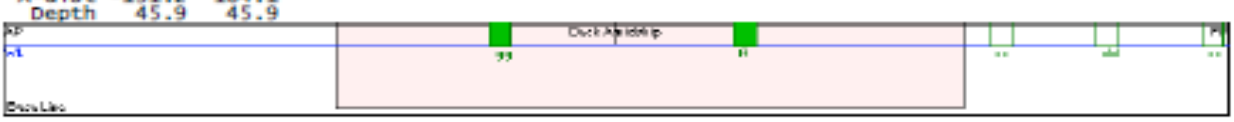
Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_H1.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP:	577.0	
Breadth:	97.8	
Depth:	49.2	
Port Target:	215.0 fwd from midship	-0.9 from CL and 6.0 above deck
Stbd Target:	215.0 fwd from midship	0.9 from CL and 6.0 above deck
End-on projected windage area:	4000 above deck level	
Side projected windage area:	12150 above deck level	
Fendering possible from:	0.227 LBP aft of midship	
to:	0.284 LBP fwd of midship	
Current drag data based on:	OCIMF (Conventional Bow)	
Wind drag data based on:	Bulk Carrier (L/B = 6.3)	

Flatside Contour

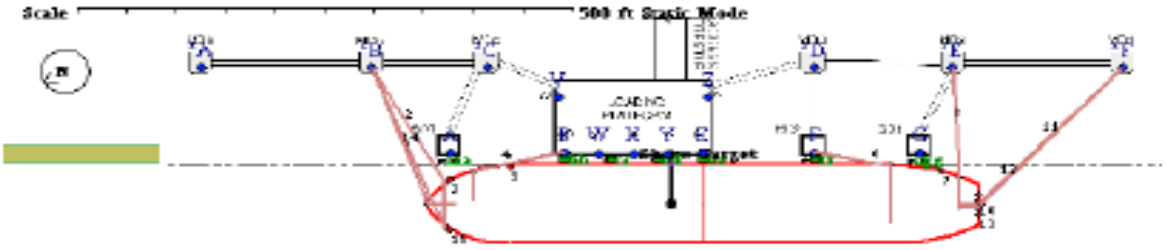
X-dist	-131.2	164.1
Depth	45.9	45.9



Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

Arrangement for 40,000 DWT Bulk at PCT Bulker



Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Loading.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in Way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft: ±	6
Permissible Sway Excursion Port/Stbd: ±	6
Permissible Vertical Movement: ±	6
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender	Load-Compression Data										
aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

APPENDIXES

Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_H3.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP:	577.0
Breadth:	97.8
Depth:	49.2
Port Target:	34.0 fwd from midship -0.9 from CL and 6.0 above deck
Stbd Target:	34.0 fwd from midship 0.9 from CL and 6.0 above deck
End-on projected windage area:	4000 above deck level
Side projected windage area:	12150 above deck level
Fendering possible from:	0.227 LBP aft of midship
to:	0.284 LBP fwd of midship
Current drag data based on:	OCIMF (Conventional Bow)
Wind drag data based on:	Bulk Carrier (L/B = 6.3)

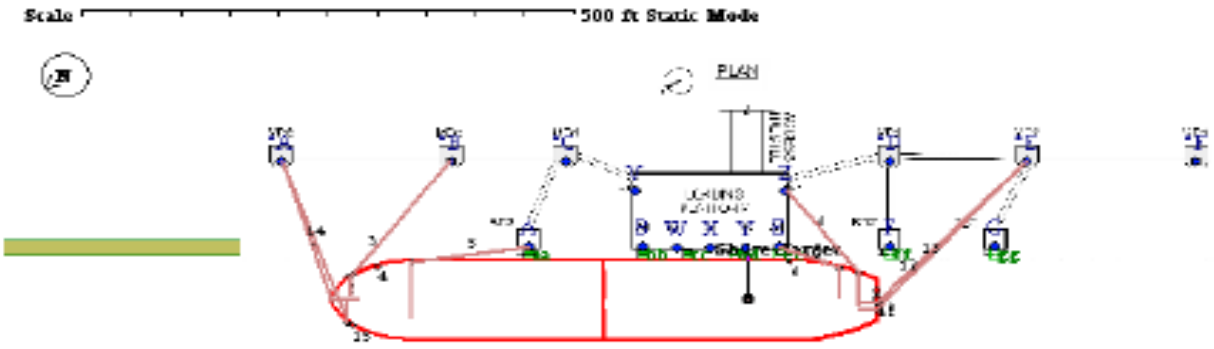
Flatside Contour

X-dist	-131.2	164.1
Depth	45.9	45.9

Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

Arrangement for 40,000 DWT Bulk at PCT Bulker



12

Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Loading.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft: ±	6
Permissible Sway Excursion Port/Stbd: ±	6
Permissible Vertical Movement: ±	6
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

APPENDIXES

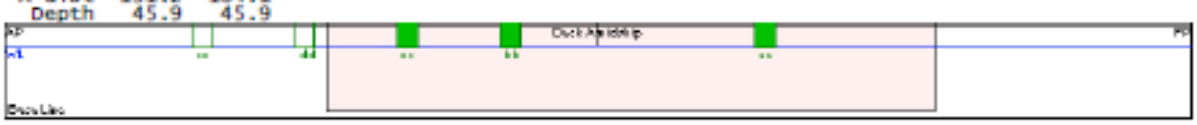
Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_HS.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP: 577.0
Breadth: 97.8
Depth: 49.2
Port Target:-158.0 fwd from midship -0.9 from CL and 6.0 above deck
Stbd Target:-158.0 fwd from midship 0.9 from CL and 6.0 above deck
End-on projected windage area: 4000 above deck level
Side projected windage area: 12150 above deck level
Fendering possible from: 0.227 LBP aft of midship
to: 0.284 LBP fwd of midship
Current drag data based on: OCIMF (Conventional Bow)
Wind drag data based on: Bulk Carrier (L/B = 6.3)

Flatside Contour

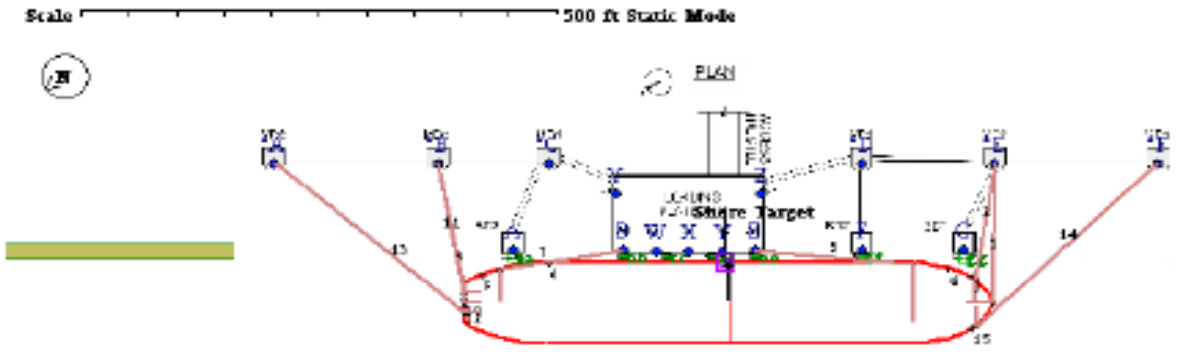
X-dist -131.2 164.1
Depth 45.9 45.9



Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

Arrangement for 40,000 DWT Bulk at PCT Bulker



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Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Remain.bth)

Units in ft & kips

Left to Right of Screen Site Plan Points:	211*
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in Way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft:	± 10.00
Permissible Sway Excursion Port/Stbd:	± 10.00
Permissible Vertical Movement:	± 10.00
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
F	665.0	15.0	1.4	440
G	780.1	15.0	1.4	440
V	387.2	83.6	1.9	220
W	431.4	13.5	1.9	220
X	469.0	13.5	1.9	220
Y	506.6	13.5	1.9	220
Z	551.1	83.6	1.9	220
*A	0.0	120.0	1.2	880
*B	185.0	120.0	1.2	880
*C	310.1	120.0	1.2	880
*D	665.0	120.0	1.2	880
*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender Load-Compression Data

aa	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

APPENDIXES

Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_Remain.vsl)
Units in ft, inches, & kips
Longitudinal datum at Midship

LBP:	577.0		
Breadth:	97.8		
Depth:	49.2		
Port Target:	0.0 fwd from midship	-48.9 from CL and 6.0 above deck	
Stbd Target:	0.0 fwd from midship	48.9 from CL and 6.0 above deck	
End-on projected windage area:	4000 above deck level		
Side projected windage area:	12150 above deck level		
Fendering possible from:	0.227 LBP aft of midship		
to:	0.284 LBP fwd of midship		
Current drag data based on:	OCIMF (Conventional Bow)		
Wind drag data based on:	Bulk Carrier (L/B = 6.3)		

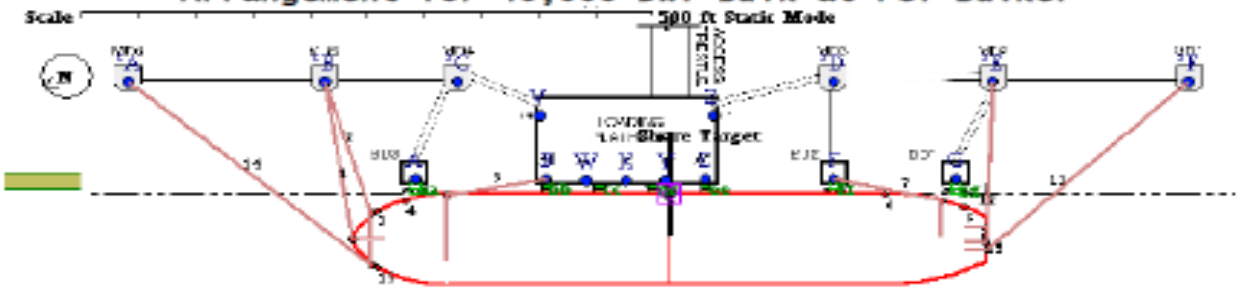
Flatside Contour

X-dist	-131.2	164.1
Depth	45.9	45.9

Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
1	298.0	0.0	7.0	30.0	62	9	7.9ppw 104	
2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
4	248.0	41.0	7.0	35.0	62	9	7.9ppw 104	
5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
9	-299.0	12.0	0.0	18.4	62	9	7.9ppw 104	
10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

Arrangement for 40,000 DWT Bulk at PCT Bulker



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Berth Data for PCT Bulker

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Berth\Berth_PCT_Bulker_Remain.bth)
Units in ft & kips

Left to Right of Screen Site Plan Points:	211°
Width of Channel (for Current):	5000
Pier Height (Fixed) above Datum:	44.0
Seabed Depth in way of Ship below Datum:	45.0
Permissible Surge Excursion Fwd/Aft:	± 10.00
Permissible Sway Excursion Port/Stbd:	± 10.00
Permissible Vertical Movement:	± 10.00
Dist of Berth Target to Right of Origin:	509.9
Wind Speed Specified at Height:	33.0
Current Specified at Depth:	mean

Hook/ Bollard	X-Dist to Origin	Dist to Fender Line	Ht above Pier	Allowable Load
A	270.1	15.0	1.4	440
B	394.0	15.0	1.4	440
E	544.0	15.0	1.4	440
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*E	815.3	120.0	1.2	880
*F	1000.0	120.0	1.2	880

Fender	X-Dist to Origin	Ht above Datum	Width Along Side	Face Contact Area (ft²)
aa	270.1	18.5	10.0	370.0
bb	394.0	18.5	10.0	370.0
cc	444.2	18.5	10.0	370.0
dd	494.3	18.5	10.0	370.0
ee	544.0	18.5	10.0	370.0
ff	665.0	18.5	10.0	370.0
gg	780.1	18.5	10.0	370.0

Fender	Load-Compression Data										
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	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
bb	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
cc	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
dd	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ee	76	143	193	224	236	219	219	228	238	252	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
ff	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft
gg	152	286	386	447	471	438	438	457	476	505	kips
	0.24	0.48	0.71	0.95	1.19	1.90	2.14	2.38	2.50	2.62	ft

APPENDIXES

Vessel Data for 40,000 DWT Bulk

(file \\cowi.net\projects\A085000\A087263\Structural\BNKN\2_4 Mooring Analysis\Calculations\OPTIMOORS\Vessel\40,000 DWT Ince Point_Remain.vsl)
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Longitudinal datum at Midship

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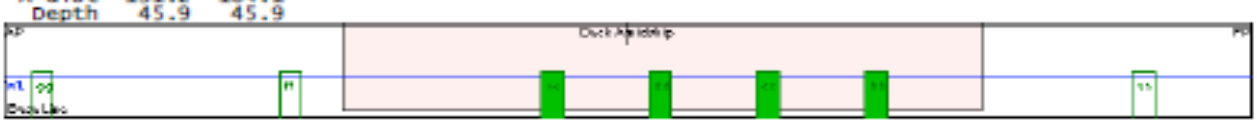
Wind drag data based on:	Bulk Carrier (L/B = 6.3)	

Flatside Contour

X-dist	-131.2	164.1
Depth	45.9	45.9



Line No.	Fair-Lead X	Fair-Lead Y	Ht on Deck	Dist to Winch	Brake Limit	Pre-Tension	Line Size-Type-BL	Tail Segment-1 Lgth-Size-Type-BL
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2	279.8	28.0	7.0	25.0	62	9	7.9ppw 104	
3	274.7	31.0	7.0	25.0	62	9	7.9ppw 104	
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5	209.0	47.0	7.0	70.0	62	9	7.9ppw 104	
6	-204.0	47.7	0.0	70.0	62	9	7.9ppw 104	
7	-258.8	40.7	0.0	37.7	62	9	7.9ppw 104	
8	-279.0	34.1	0.0	40.4	62	9	7.9ppw 104	
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10	-299.0	4.0	0.0	18.4	62	9	7.9ppw 104	
11	-299.0	0.0	0.0	18.0	62	9	7.9ppw 104	
12	-299.0	-4.0	0.0	18.4	62	9	7.9ppw 104	
13	-299.0	-12.0	0.0	18.4	62	9	7.9ppw 104	
14	279.9	-28.0	6.9	24.9	62	9	7.9ppw 104	
15	274.6	-31.0	6.9	24.9	62	9	7.9ppw 104	

Codes for Types of Line:
ppw: polypropylene wet (broken-in)

END OF MANUAL