Attachment B:

Moffatt & Nichol Feasibility Study for Valero Benicia Terminal

Submitted for consideration for the At Berth Regulation Interim Evaluation

CARB At Berth Study

Valero Benicia Refinery
CARB Feasibility Study

Prepared for:

Valero®

Revision:	Date:	Comments:
0	11/30/2021	Issued for Valero Use
1	07/20/2022	Addition of Risk Analysis

Prepared by:

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Table of Contents

List of Attachments

Table of Figures

List of Tables

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2. Executive Summary

The purpose of this study is to develop the technical background information necessary for Valero to develop a Terminal Plan by December 1, 2021 as required by the California Air Resources Board (CARB) at berth emissions regulation. This new regulation extends at berth emission control requirements to marine oil terminals and tankers in California. The work includes a feasibility study focused on the terminal side compliance options including shore power, barge-based capture and control, shore-based capture and control, and innovative concepts. This study is focused on the existing marine oil terminal that serves the Valero Benicia Refinery in Benicia, CA.

The CARB Approved Emission Control Strategy (CAECS) must accommodate tankers at berth ranging from 400 ft to 987 ft length overall all (LOA). Based on 2018 and 2019 vessel call data at the terminal, it is estimated that Valero will require a CAECS at berth approximately 27% of the time. This analysis estimates that approximately 20% of the time a non-CARB regulated vessel is at berth and approximately 53% of the time the berth is vacant.

The following terminal side compliance options were studied based on the CARB Final Environmental Analysis (August 25, 2020) summarizing the environmental impact of several reasonably foreseeable compliance methods for vessels and terminals:

- Shore Power
- Barge-Based Capture and Control
- Shore-Based Capture and Control

Note that there is currently no commercially available solution for CARB compliance that is demonstrated safe for use on oil tankers.

Shore power is the least favorable from a cost and implementation schedule perspective. It is estimated shore power will cost approximately $55M to implement, with an annual operations cost of approximately $4.5M. This does not fully capture the costs required to make the system intrinsically safe. Furthermore, this study does not capture the cost or feasibility of the necessary vessel improvements that would be required. The estimated date for the shore power system to be operational is August 2029, which is more than 2.5 years after the CARB compliance deadline.

Shore-based capture and control is not a favorable option from a cost and implementation schedule perspective. It is estimated to cost approximately $54M to implement, with an annual operations cost of approximately $5M for an intrinsically safe shore-based capture and control system. To increase the terminal throughput from 32,500 barrels per hour to 65,000 barrels per hour an additional capital investment cost of $3M would be required, and the annual operations cost would increase by ~$1M. The estimated date for shore-based capture and control system to be operational is August 2029, which is more than 2.5 years after the CARB compliance deadline.

Barge-based capture and control appears to be the most favorable option from a cost and implementation schedule perspective. However, there are unresolved risks that require further study which may increase the cost or lengthen the implementation schedule of this option and make it more comparable to the other options. There are several options to utilize this control strategy ranging from purchase of a system to entering into service agreements with barge vendors. For example, it is estimated to cost approximately $18M to purchase a barge with an approximate annual operations cost of $3.5M. Note that this is for a non-intrinsically safe equipment; if an intrinsically safe barge is required, it is estimated to cost approximately $20M with an annual operations cost of $4.2M. For this study, intrinsically safe equipment is that which can safely operate within the vessel and terminal hazardous area. To increase the terminal throughput from 32,500 barrels per hour to 65,000 barrels

per hour an additional capital investment cost of $3M would be required, and the annual operations cost would increase by ~$0.5M. The estimated date for a barge-based capture and control system to be operational is October 2027, which is 10 months after the CARB compliance deadline. Note that additional capital investment and schedule would be needed if new overwater structures are required to safely secure the barge for safe operation at the site. This additional cost and schedule to permit permanent overwater structures is not included in the study at this time.

Valero has indicated its business is dependent upon the spot availability of tankers on the open market. Therefore, until such experimental technology is reviewed, and safe best practices are globally adopted most tankship owners are unlikely to implement unvetted experimental technology for use at the Benicia Refinery. This is particularly relevant to international standards for shore power, the interface of shore-based capture and control devices as well as safety standards for capture and control barges within the explosive zone of marine oil terminals. This perspective is shared by many of the oil terminal operators in California. Valero has indicated that they cannot select a compliance strategy nor commit to a compliance deadline until the required technology and service is commercially available and demonstrated safe for use on oil tankers.

The scope of this study does not include identifying or evaluating innovative concept options. However, it is recommended that Valero submit an innovative concept application as part of the December 1, 2021, CARB Terminal Compliance Plan to reserve the right to use an innovative concept if one is identified for use in the future.

3. Risk Analysis and Opportunities

The risk analysis was developed during a workshop with Moffatt and Nichol (M&N) and Valero staff. The workshop occurred on July 12th, 2022, with Ian Dillingham (Valero), Lisa Hodges (Valero), Martin Stocksick (Valero), Melissa Fimbres (Valero), Captain Sanjeet Kamat (Valero),Taryn Wier (Valero), Ui An (Valero), Matt Trowbridge (M&N), and Wice Ibrahimi (M&N).

In conducting the risk analysis industry standards were followed. The goals of the risk analysis workshop were only to identify risks. Identifying risk mitigations were not a part of the exercise. However, for future discussion it was noted that the consequences of an event cannot be mitigated to lower the risk, but the frequency of the event could be mitigated to reduce the risk.

Sections 3.1, 3.2, and 3.3 include the risk analysis and opportunities for each CAECS option considered in this study.

3.1. Shore Power

The following opportunities should be taken into consideration when evaluating shore power:

- Compared to the capture and control options, shore power has been more widely implemented in ports and marine terminals.
- Does not rely on third party operators at the terminal for compliance.
- Is a simpler passive system to operate.

The following risks should be taken into consideration while evaluating the shore power option:

- This option relies on vessel owners to make costly improvements to their vessel. The terminal has little leverage over the tanker fleet to force vessel improvements by the compliance date. This may significantly limit the pool of available vessels. Alternatively, this may put the terminal at risk of needing to accept a vessel that is not shore power capable and risk non-compliance with the regulation.

  The consequence of this event is a retrofitted vessel cannot be found, but funds have been utilized on terminal improvements. This consequence presents a potential high business impact. This presents an unacceptable risk for terminal operations.

- The terminal will only be able to accept vessels with shore power improvements within the swing radius of the shore power cable crane. There is a risk that a vessel with shore power improvements would not be able to have a successful connection.

  This risk is already covered by the previous item.

- There is no cable handling system or crane currently available in the market that can safely operate as needed to supply power cables to the range of design vessels at the Benicia Refinery. Until a solution becomes commercially available and is demonstrated safe for use on oil tankers, Valero has indicated this compliance option is not feasible.

  The consequence of this event is a commercially available crane is not available by the regulation deadline. This consequence has medium to high repercussions. This presents an unacceptable risk for terminal operations.

- The frequency and voltage between the shore power and shipboard electricity may not be compatible with each other. This will need to be addressed as part of the shore power system design and during the vessel nomination and vetting process.

The outcome of this event is a retrofitted vessel cannot be found, but funds have been utilized on terminal improvements. This outcome presents a potential high business impact. This presents an unacceptable risk for terminal operations.

- The accidental or unexpected power loss of shore power may impact the safety and cargo operation.

  The consequence of this event may be a loss of power during loading or unloading. Furthermore, power may be lost on the vessel only, on the shore only, or on both the vessel and the shore. This presents safety and community risks, mainly due to spill, fire, and explosion risks during loading. During unloading the risk is to the community and environment, mainly due to spill. In either case, any loss of power during cargo operation has medium to high repercussions and is an unacceptable risk for terminal operations.

- Due to the site geometry and required location of the shore power platform, the platform may be within the vessel hazardous area for some vessels.

  The risk for this event was not addressed because it is not a credible event or a high risk.

- An international standard exists through the International Electrotechnical Commission (IEC) for shore power systems at container and cruise terminals. However, the committee progressing this standard has not started the chapter pertaining to shore power connections for oil tankers. We are not aware of a national or international standard for shore power connections to oil tankers. A standard will need to be developed before shore power can be safely implemented at many terminals.

  The consequence of this event is a compatible vessel cannot be found, but funds have been utilized on terminal improvements. This consequence presents a potential high business impact. This presents an unacceptable risk for terminal operations.

- The shore power system must not inhibit the vessel's ability to get underway within 30 minutes in an emergency scenario. This risk will need to be studied in more detail if this option is further pursued.

  The outcome of this event is the vessel becomes uncompliant because it is unable to get underway within 30 minutes during an emergency, such as a fire, earthquake, or tsunami. This outcome presents a potential elevated impact, but the frequency cannot be speculated by Moffatt and Nichol or Valero staff at this moment. More research needs to be developed to define this event's repercussions.

- Although not studied here, the energy grid may need upgrades in capacity and reliability for shore power to be a reliable compliance method. The reliability and cost of service is out of the terminal's control.

  The risk for this event is already covered by the previously mentioned compatibility issue.

- May rely on third party operators at the terminal for compliance or may require additional staff at the marine terminal.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff.

- Valero reports reliability issues with the existing electrical feed to the marine terminal and refinery. According to Valero's records, a total of 9 power interruption or loss incidents have occurred in 2021 through September in 2021. A total of 6 similar incidents were reported in 2020, and 15 similar incidents reported in 2019 year.

The risk for this event is already covered by the previously mentioned accidental or unexpected power loss of shore power item.

- The flight path for the Travis Airforce Base needs to be studied in more detail with the City of Benicia to confirm height or lighting restrictions that may prevent the installation of proposed shore power improvements.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff at this moment.

3.2. Barge-Based Capture and Control

The following opportunities should be taken into consideration while evaluating the barge-based capture and control option:

- There are options to purchase a barge and have it dedicated to the terminal. There are options to enter into a service agreement with a barge vendor. The barge vendors may offer revenue or profit-sharing options to use the barge on other facilities when not in operation at the terminal.
- There may be multiple barge vendors available on the market which may lead to lower cost of service.

The following risks should be taken into consideration while evaluating the barge-based capture and control option:

- Relies on third party operators at the terminal for compliance.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff.

- There may be some vessels that cannot be accepted during the vessel vetting process due to geometry or location of vessel stacks that are not compatible with the capture hood system.

  The outcome of a vessel failing during the vetting process presents a potential elevated business impact. This presents an unacceptable risk for terminal operations.

- Some vessels at the terminal may have a missed connection due to incompatibility between the vessel stacks and the capture hood and/or the barge operator or terminal may elect not to attempt a connection for safety reasons.

  The consequence of a vessel failing after the vetting process or at dock presents a potential elevated business impact. This presents an unacceptable risk for terminal operations.

- The capture and control system must not inhibit the vessel's ability to get underway within 30 minutes in an emergency scenario. This risk will need to be studied in more detail if this option is further pursued.

  The outcome of this event is the vessel becomes uncompliant because it is unable to get underway within 30 minutes during an emergency, such as a fire, earthquake, or tsunami. This outcome presents a potential elevated impact, but the frequency cannot be speculated by Moffatt and Nichol or Valero staff at this moment. More research needs to be developed to define this event's repercussions.

- There is a risk that the schedule to procure and commission a barge is delayed due to high demand.

This event is a supply and demand and supply chain issue. The consequence of this event has medium to high impacts. This presents an unacceptable risk for terminal operations.

- Unless a barge is purchased or a long-term service agreement is in place, there is a risk that the service is not available when required.

  This event is a supply and demand and supply chain issue. The consequence of this event has medium to high impacts. This presents an unacceptable risk for terminal operations.

- There is a risk that a barge vendor goes out of business.

  The risk for this event was not analyzed. This event cannot be speculated by Moffatt and Nichol or Valero staff.

- There is a risk the barge vendor does not develop a barge solution that is acceptable for safe operation on oil tankers.

  This event is similar to a previous item where a long term or permanent barge would be required to avoid availability issues, however this event is more focused on technology. Assuming it takes longer to develop the solution that is accepted within the timeline then the schedule for compliance cannot be achieved. This consequence has medium to high repercussions. This presents an unacceptable risk for terminal operations.

- There is a risk the barge vendor does not develop a barge solution that achieves CARB approval.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff.

- Additional time may be required in the vessel turnaround due to the time to position the barge into place upon vessel arrival and the move the barge prior to vessel departure.

  The outcome of this event has low repercussions. This presents an acceptable risk.

- There is a risk that the barge based mechanical equipment experiences downtime.

  The result of this event presents a potential elevated impact. This presents an unacceptable risk for terminal operations.

- The CARB regulation may change in the future requiring upgrades or modifications to the barge treatment system.

  The risk for this event was not analyzed because the event cannot be speculated by Moffatt and Nichol or Valero staff.

- The site has unique and challenging Metocean conditions including strong currents. A site specific Metocean data collection program is needed to verify the local conditions. Any barge system will need to be adequately designed and tested to confirm it can safely operate in these conditions.

  The result of this event presents a potential elevated business repercussion. This presents an unacceptable risk for terminal operations.

- Further study is required to evaluate the risk of self-propelled barges including loss of power or an underpowered propulsion system. There is a risk that a self-propelled barge may not be acceptable at this location and tug assist is required for all barge movement operations.

The outcome of this event presents a potential high business repercussion. This presents an unacceptable risk for terminal operations.

- The flight path for the Travis Airforce Base needs to be studied in more detail with the City of Benicia to confirm height or lighting restrictions that may prevent the installation of proposed shore power improvements.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff at this moment.

- Further studies are required to confirm if the geotechnical conditions at the site are adequate for barge operation. The geotechnical conditions do not appear adequate to support a jack-up barge. A spud barge will likely require anchors or mooring lines to a fixed structure to provide adequate support during operations. A spud barge with anchors will require further study to evaluate risk of anchor line conflicts with tankers, vessel traffic, and Benicia-Martinez bridge maintenance and repair activities. If an anchor system is not acceptable, options to moor the barge to an existing structure (dolphin or platform) should be evaluated and may require the installation of additional permanent overwater structures.

  The consequence of this event presents a potential high business impact. This presents an unacceptable risk for terminal operations.

- There is a risk that a barge cannot move off berth due to spud binding and/or mechanical failure / downtime.

  The outcome of this event presents a potential medium to high business repercussion. This presents an unacceptable risk for terminal operations.

- A spud barge may not be acceptable as a more fixed working platform may be required for safe connection of capture system to the vessel stacks.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff at this moment.

3.3. Shore-Based Capture and Control

The following opportunities should be taken into evaluation when evaluating the shore-based capture and control option:

- Compared to the barge-based option, vessel cycle time at berth is reduced.

The following risks should be taken into consideration while evaluating the shore-based capture and control option:

- Due to the site geometry and required location of the capture and control platform, the platform may be within the vessel hazardous area for some vessels.

  This event is associated with capital cost to ensure intrinsic safety. The outcome has medium to high impacts. This presents an unacceptable risk for terminal operations.

- The capture and control system must not inhibit the vessel's ability to get underway within 30 minutes in an emergency scenario. This risk will need to be studied in more detail if this option is further pursued.

  The outcome of this event is the vessel becomes uncompliant because it is unable to get underway within 30 minutes during an emergency, such as a fire, earthquake, or tsunami. This

outcome presents a potential elevated impact, but the frequency cannot be speculated by Moffatt and Nichol or Valero staff at this moment. More research needs to be developed to define this event's repercussions.

- May rely on third party operators at the terminal for compliance or may require additional staff at the marine terminal.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff at this moment.

- There may be some vessels that cannot be accepted during the vessel vetting process due to geometry or location of vessel stacks that are not compatible with the capture hood system.

  The result of a vessel failing during the vetting process presents a potential elevated business impact. This presents an unacceptable risk for terminal operations.

- Some vessels at the terminal may have a missed connection due to incompatibility between the vessel stacks and the capture hood and/or the operator or terminal may elect not to attempt a connection for safety reasons.

  The consequence of a vessel failing after the vetting process or at dock presents a potential elevated business impact. This presents an unacceptable risk for terminal operations.

- The CARB regulation may change in the future requiring upgrades or modifications to the treatment system.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff at this moment.

- The flight path for the Travis Airforce Base needs to be studied in more detail with the City of Benicia to confirm height or lighting restrictions that may prevent the installation of proposed shore power improvements.

  The risk for this event was not analyzed because it cannot be speculated by Moffatt and Nichol or Valero staff at this moment.

4. CARB At Berth Emission Regulation Background

4.1. CARB Control Measure for Ocean-Going Vessels At Berth

California Code of Regulations (CCR), Title 17, Division 3, Chapter 1, Subchapter 7.5, Sections 93130 to 93130.22, also known as the Control Measure for Ocean-Going Vessels At Berth, became effective on January 1, 2021. The Control Measure, enacted by CARB, extends an existing at berth regulation for container, cruise, and refrigerated cargo vessels to tanker and roll-on/roll-off (RORO) vessels. The purpose of the Control Measure is to reduce emissions of oxides of nitrogen (NOx), reactive organic gases (ROG), particulate matter (PM), diesel particulate matter (DPM), and greenhouse gas (GHG) from ocean-going vessels while docked at berth in California ports. The Control Measure also ensures that ocean-going vessels do not create excess visible emissions. The Control Measure requires that tanker vessels comply with the regulation by January 1, 2027, for tankers visiting terminals not in the Ports of Los Angeles or Long Beach. A terminal that receives less than 20 vessel visits a year is exempt from the regulation. The regulation defines an ocean-going vessel as a commercial, government, or military vessel, excluding articulated tug barges (ATBs), meeting any of these criteria:

- A vessel greater than or equal to 400 ft in length overall;
- A vessel greater than or equal to 10,000 gross tons; or
- A vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters.

ATBs are defined as a tanker barge that is mechanically linked with a paired tug that functions as one vessel. Based on the regulation, ATBs are excluded, and based on Valero's interpretation, all other non-ATB barges are excluded as they are not "ocean-going."

The intent of the Control Measure is to ensure that emissions from ocean-going vessels are reduced using a CAECS to control PM, NOx, and ROG emissions at berth without increasing overall GHG emissions and that every ocean-going vessel meets visible emission standards at berth and at anchor. All parties necessary to achieving emission reductions from ocean-going vessels at berth have responsibilities and requirements under the Control Measure, including, but not limited to, vessel operators, terminal operators, ports, and operators of a CAECS. The Control Measure requires that the Operator begin controlling emissions with shore power or another CAECS within two hours after "Ready to Work" and cease controlling emissions no sooner than one hour before "Pilot on Board."

4.2. Emission Requirements

To receive CARB approval, the emission control strategy must demonstrate and achieve emission rates of NOx ≤ 2.8 g/kW-hr, PM 2.5 ≤ 0.03 g/kW-hr, and ROG ≤ 0.1 g/kW-hr for auxiliary engines. Additionally, GHG emissions must be grid-neutral using the grid emission rate for the year the technology is granted an Executive Order. Default emission rates of auxiliary engines on ocean-going vessels are 13.8 g/kW-hr for NOx, 0.17 g/kW-hr for PM 2.5, and 0.11 g/kW-hr for ROG.

4.3. CARB Approved Emission Control Strategy (CAECS) Options

CARB issued a Final Environmental Analysis on August 25, 2020 summarizing the environmental impact of several reasonably foreseeable compliance methods for vessels and terminals including the following CAECS options:

- Shore Power
- Capture and Control
    - Barge-based

  - Shore-based
- On-board Technology
  - Selective Catalytic Reduction (SCR)
  - Scrubbers
  - Water/Fuel Emulsion
  - Distributed Generation
- Alternative Fuels
- Vessel Incident Events (VIE) and Terminal Incident Events (TIE)
- Remediation Fund
- Innovative Concept

The final regulation order states that the Control Measure has shared responsibilities between all parties involved in reducing emissions from ocean-going vessels (see Figure 1).

Table 7: Summary of Responsibilities (Continued)		
Circumstances that will be evaluated for non-compliance		
Circumstances		Responsible Parties
Berth	Vessel	
Has shore power	Does not have shore power	Vessel
No shore power, but has other CAECS	Has shore power	Terminal, Port
No shore power, but has other CAECS	Does not have shore power	Terminal, Port, Vessel
Has other CAECS	No shore power, but doesn't allow CAECS	Vessel

Figure 1: CARB Final Regulation Order – Summary of Responsibilities

4.4. Innovative Concept Compliance Option

In lieu of establishing a CAECS or to provide time for a CAECS to be implemented, the regulation allows the use of an "Innovative Concept." The innovative concept reduces emissions from sources in and around the regulated port or marine terminal at a level equivalent or greater to what would be achieved using a CAECS. One or more innovative concepts can be implemented, provided the innovative concepts result in emission reductions of PM 2.5, NOx, and ROG that are at least equivalent to the emission reductions that would have occurred using a CAECS, while not increasing GHG. The reductions must be at the same port or marine terminal, within adjacent communities, or overwater within three nautical miles of the port or marine terminal. The proposed innovative concept must not increase emissions at other ports or marine terminals. No innovative concept shall have a compliance period greater than five years.

An application seeking approval for proposed innovative concepts must be submitted to CARB by December 1, 2021 and include, at a minimum, the following information:

- Company name, address, and contact information.
- Description of proposal, including an overview of the source and scope of emission reductions, and a project site plan and location map.
- Estimate of vessel emissions planned to be covered for each pollutant NOx, PM 2.5, and ROG.

- The proposed recordkeeping, reporting, monitoring, and testing procedures.
- A Memorandum of Understanding between the applicant, any funding partners, owners, and operators of controlled equipment.
- The proposed length of time during which the innovative concept would be used and the number and duration of any anticipated time extension requests.
- A summary of all governmental approvals necessary to develop the innovative concept.
- A discussion regarding any environmental review requirements that may apply to the proposed innovative concept, including identification of which agency would serve as the lead agency for environmental review purposes.
- Any information necessary to demonstrate that the proposed innovative concept meets all eligibility and applicability requirements.

4.5. CARB Terminal Compliance Plans

The Control Measure requires Operators to submit a terminal plan by December 1, 2021 with the most likely control strategy and submit a revised plan on February 1, 2024 reflecting any changes to the plan. The terminal plan shall include discussion of necessary infrastructure modifications needed to comply with the regulation. For each strategy implemented, the plan shall include the following:

- Identification and description of all necessary equipment, including whether it will be located on the vessel, wharf, shore, or elsewhere.
- Number of vessels expected to visit the terminal using the strategy.
- List of each berth with geographic boundary coordinates.
- Identify berth(s) where equipment will be used.
- Terminal/port specific berthing restrictions.
- Schedule for installing equipment.
- Division of responsibilities between the terminal operator and the port, including contractual limitations applicable to the terminal relevant to enacting the infrastructure required by each terminal's plan.
- A terminal operator claiming that a physical and/or operational constraint will delay its ability to implement its CAECS must also submit a technical feasibility study evaluating if there are any other emission control options that could be implemented more quickly at the terminal.

CARB staff will assess the progress made in adopting control technologies for use with tanker vessels, as well as the status of landside infrastructure improvements that may be needed to support emission reductions at tanker terminals. CARB staff will evaluate the information provided by the port and terminal plans required by this Control Measure. CARB staff will also consider other public information provided to CARB, including terminal specific engineering evaluations, logistical considerations, public engagement, and independent studies that inform the implementation timeline. By December 1, 2022, CARB will publish an analysis and findings in a report and make it available for public review at least 30 calendar days prior to presenting the report to the Board at a public meeting. If CARB finds that the compliance deadlines for tanker vessels need to be adjusted forward or backward in time, the report will include recommendations to initiate staff's development of potential formal regulatory amendments.

5. Existing Terminal Description

The Valero Benicia Marine Oil Terminal, constructed in 1968, is located along the north shore of the Carquinez Strait. This geography exposes the dock to both the flood tide current from the San Francisco Bay as well as the ebb tide current from the delta. Currents for the navigation channel in the Strait (located approximately 800 yards south of dock) during ebb tides can routinely approach 3 knots. The marine terminal serves the Valero Benicia Refinery and is used for both the loading and unloading of petroleum products from tankers and barges.

The reinforced concrete crude dock measures approximately 350 feet long by 50 feet wide. The crude dock is supported by 16-inch diameter by 0.625-in thick epoxy coated concrete filled steel piles. Access to the dock is provided by a 10-foot wide concrete trestle. The pile caps supporting the trestle extend an additional 18 feet east to support terminal piping. The trestle and pipeline supports consist of 16-inch diameter by 0.625-in thick epoxy coated concrete filled steel piles.

The fendering system along the south side of the dock is supported by steel 12-inch H-bearing piles and 16-inch diameter steel pipe piles. The piles support a fender frame structure fabricated out of structural steel sections.

There are four mooring dolphins each 30 feet long by 30 feet wide platforms supported by 16-inch diameter by 0.625-in thick epoxy coated concrete filled steel piles. All dolphins are accessed by 3-foot-wide catwalks. At the eastern end of the site is a protective fender dolphin which was installed to protect the adjacent Benicia Bridge (Protective Dolphin PF-1). All dolphins are connected by 3-foot wide catwalks.

The Valero Benicia marine terminal is regulated by the California State Lands Commission (CSLC) for compliance to the California Building Code (CBC) Chapter 31F: Marine Oil Terminals also known as the Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS).

Refer to Attachment A for an as-built drawing of the existing marine terminal.

6. CARB Design Basis

6.1. Functional Requirements

The following functional requirements are required for the CARB compliance options:

- The CAECS system must be capable of complying with the minimum requirements in the CARB regulation and the system must be certifiable by CARB.
- The CAECS must be located landside of the pierhead line (PHL) or it must receive all required approvals to operate waterside of the PHL so as not to impact the navigable waterway.
- The CAECS must be clear of all mooring lines for the range of vessels anticipated at the terminal.
- The CAECS must be clear of all product transfer systems such as not to interrupt or impact safe transfer operations.
- The CAECS must be intrinsically safe and/or it must be operated outside the vessel hazardous classification area.
- The CAECS must be independent of the vessel such that it does not impart motion or forces to the moored vessel at berth and reduce the terminal operating limits.
- The CAECS must not inhibit the vessel's ability to get underway within 30 minutes in an emergency scenario. This is based on CCR / Title 2 Administration / Division 3 State Property Operations / Chapter 1 State Land Commission / Section 2340 Marine Terminals Inspection and Monitoring: CCR § 2340 (28).
- An overwater platform is required for the shore power and shore-based capture and control options. This platform must be located toward the aft of the vessel. If the terminal anticipates both port-side-to and starboard-side-to operations, an additional platform is required.
- The maximum assumed total power demand for a tanker at berth using shore power is 7 MW. The shore power system must be able to accommodate a power demand of 10 MW.
- New systems including, but not limited to, a shore power system crane and capture and control booms need to be rated for a hazardous environment or operate completely out of the hazardous area for all proposed vessels.
- The shore power system must be able to bring a shore power cable from a landside platform to the vessel. Therefore, the shore-based power system must have a crane size that can accommodate the range of vessels anticipated at the terminal. The crane sizing must allow for variances in the location where a vessel installs the vessel-side improvements to facilitate connecting to shore power.
- The barge-based capture and control barge must be sized to be adequate for the minimum and maximum reach (envelope) anticipated based on the range of vessels that call on the terminal. The barge must be designed to be stable for all operational modes and reaches during the anticipated Metocean and loading conditions at the terminal.
- The shore-based capture and control crane and the shore power crane must be sized to be adequate for the minimum and maximum reach (envelope) anticipated based on the range of vessels that call on the terminal. The cranes must be designed to operate for all reaches during the same Metocean conditions as a vessel will be transferring product at the terminal.
- The capture and control system must have the flexibility in system design to service multiple types, sizes, quantity, and locations of vessel stacks.
- A capture and control system must be designed to accommodate the emissions generated for a range of product unloading rates from 700 to 32,500 barrels per hour. The maximum

unloading rate of 32,500 barrels per hour is based on the use of a single marine loading arm. In the future, a second arm may be added, increasing the maximum product unloading rate to 65,000 barrels per hour. The capture and control system must be able to accommodate 32,500 barrels per hour with the option to increase capacity to 65,000 barrels per hour sometime in the future.

- The capture and control barge must operate such that it does not inhibit vessel movement and operations in channel and in the vicinity of the terminal.
- The terminal is near the Martinez-Benicia highway bridge. Per correspondence with Caltrans (see Attachment B), a barge system must stay clear of the bridge right-of-way. Additionally, the barge is not permitted to moor or anchor to the bridge piers. Barge operations must not inhibit the ability for Caltrans to perform inspection and maintenance work on the bridge. Details on barge spudding and/or anchoring will need to be shared with Caltrans for review and approval.

6.2. Tidal Elevations

Tidal elevations were taken from the nearest tidal gage at the NOAA Martinez-Amorco Station located approximately 0.6 miles south of the terminal across the Carquinez Strait. The tidal elevation are as follows:

Table 1: Tidal Datum (Martinez-Amorco, CA, Station 9415102) Epoch: 1983-2001

Description	Datum	Water Level (ft, MLLW)	Water Level (ft NAVD88)
Highest Observed Water Level	Maximum (1/12/2017)	+7.69	+8.19
Highest Astronomical Tide	HAT (12/30/1986)	+6.46	+6.96
Mean Higher High Water	MHHW	+5.38	+5.88
Mean High Water	MHW	+4.86	+5.36
Mean Sea Level	MSL	+2.87	+3.37
Mean Low Water	MLW	+0.88	+1.38
Mean Lower Low Water	MLLW	0.00	+0.50
North American Vertical Datum of 1988	NAVD88	-0.50	0
Lowest Observed Water Level	Minimum (12/5/2017)	-1.02	-0.52
Lowest Astronomical Tide	LAT (12/3/1990)	-1.54	-1.04

6.3. Current Data

Tidal currents in the Carquinez Strait are strong with maximum near-surface ebb and flood current speeds larger than two knots in most locations along the strait. Strong seasonally variable flows of the San Joaquin and Sacramento rivers can produce stronger ebb and weaker flood currents in the Carquinez Strait at the Valero Benicia terminal. Based on the Valero Benicia Terminal Metocean Study Report Revision C by Moffatt & Nichol dated January 31, 2020, the design current velocities are shown in Table 2.

Table 2: Design currents established as part of the MOTEMS Initial Audit (M&N 2008).

Tide Phase	Design Speed (knots)	Design Direction To (° N)	Design Direction (° from face of berth)
Ebb	2.4	238 ↔ 218	+10 ↔ -10
Flood	1.6	38 ↔ 58	+10 ↔ -10

6.4. Tsunami

Tsunami run-up values and current speeds for Benicia are provided in Table 31F-3-6 of Chapter 31F of the California Building Code (also known as MOTEMS) as 2.0 feet of maximum water level run-up and 0.6 knots (1.0 feet/sec) of current velocity.

6.5. Wind-Waves

Local winds can generate fetch-limited waves over the Carquinez Strait. The primary direction of wave exposure (longest fetch of approximately 9.4 miles) is due 44 - 53° from north, as shown in Figure 2. Based on the Valero Benicia Terminal Metocean Study Report Revision C by Moffatt & Nichol dated January 31, 2020, estimated extreme waves for 1-, 5-, 10-, 25-, and 50-yr return period events are shown in Table 3.

Table 3: Extreme Waves at the Valero pier estimated using ACES (USACE 2006)

Return Period (years)	Significant Wave Height, Hs (ft)	Peak Wave Period, Tp (sec)
1	1.5	2.6
5	1.8	2.8
10	2.0	3.0
25	2.3	3.2
50	2.6	3.4

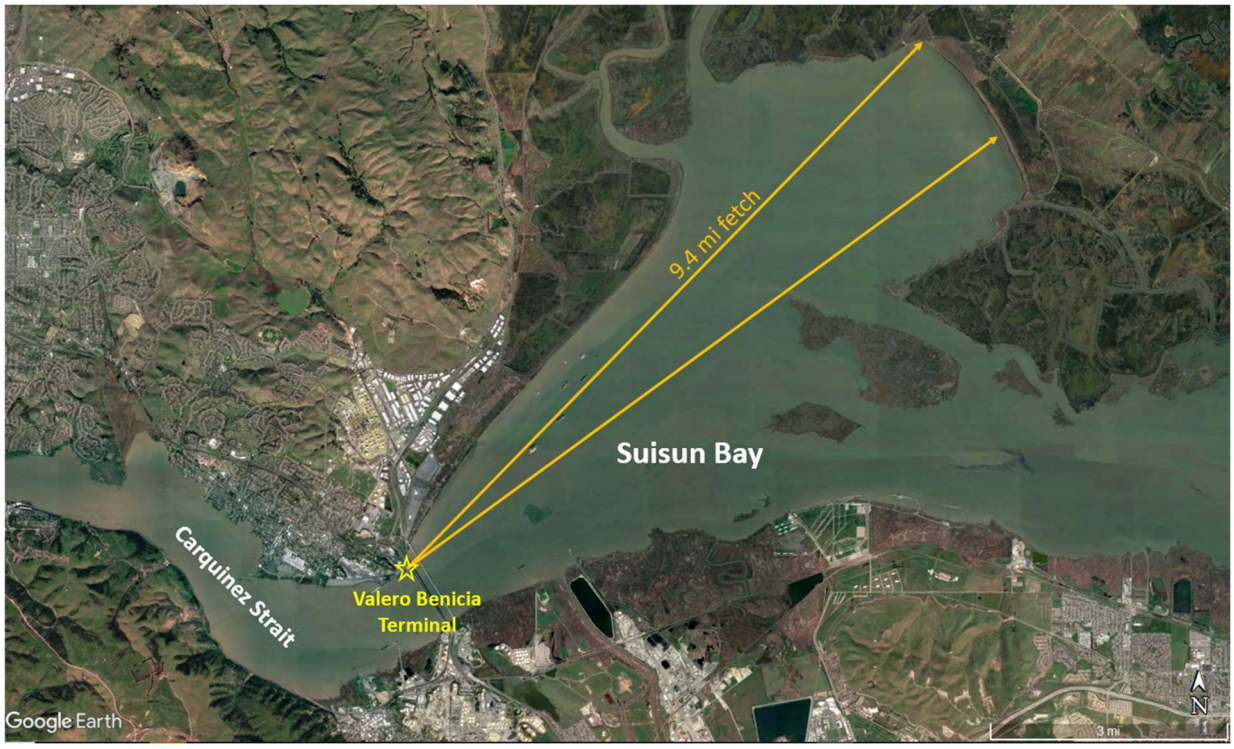

Figure 2: Longest Fetch for the Valero Benicia Terminal over Suisun Bay

6.6. Wind on Vessel

Based on the Valero Benicia Terminal Metocean Study Report Revision C by Moffatt & Nichol dated January 31, 2020, wind data from NOAA Station 9415144 Port Chicago, CA is used. The Port Chicago data record is sufficiently long to support projects of extreme wind speeds and appears to be

reasonably representative of the northeasterly and southwesterly wind exposure at the terminal. Refer to Table 4 for extreme wind speeds for various return periods.

Table 4: Extreme Wind Speeds at Port of Chicago, CA (NOAA Station 9415144)

Wind Direction (from)	Wind Speed (mph, one-hour average)				
	1-year	5-year	10-year	25-year	50-year
N	25.0	30.3	32.2	34.5	36.2
NE	20.9	23.6	25.0	27.5	29.8
E	17.4	21.3	23.0	25.3	27.0
SE	15.0	19.7	21.4	23.5	25.0
S	19.3	22.3	23.6	25.3	26.6
SW	25.4	27.2	27.8	28.7	29.1
W	27.2	29.5	30.4	31.4	32.1
NW	20.0	23.6	24.6	26.0	26.8

6.7. Bathymetry

The berth is maintained to an approximate 40 ft water depth at MLLW. Refer to Attachment C for available bathymetric surveys at the site.

6.8. Geotechnical Considerations

The elevation of the soil at the face of the wharf is maintained at -40 feet MLLW. The soil below the front of the pier is very soft to medium stiff silt and clay with organics (Bay Mud). The Bay Mud is underlaid by bedrock (sandstone, siltstone and shale) varying from -55 feet to -120 feet in the area of proposed infrastructure. Refer to Attachment D for selected geotechnical information at the site.

6.9. Design Vessels

The final regulation order defines an “ocean-going vessel” as a commercial, government, or military vessel, excluding ATBs, meeting any of the following criteria:

- A vessel greater than or equal to 400 ft in length overall as defined in 50 CFR § 679.2, as adopted June 19,1996.
- A vessel greater than or equal to 10,000 gross tons under the convention measurement (international system) as defined in 46 CFR § 69.51-.61, as adopted September 12, 1989; or
- A vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters.

Based on Valero’s interpretation of the regulation, only tanker vessels calling at the terminal will be regulated by CARB. ATBs are explicitly excluded, and all other non-ATBs are not “ocean-going” so, therefore, are excluded from the regulation.

The smallest tanker to call at the Benicia Terminal in 2019/20 is the SEA PANTHER (IMO 9322138) with overall length = 421.6 ft, beam = 66.9 ft, draft = 28.6 ft and gross tonnage = 13,026 MT. However, it is possible a smaller tanker may call on the facility in the future. Therefore, the ANUKET AMBER (IMO 9395733) with overall length = 401 ft, beam = 63 ft, draft = 23 ft and gross tonnage = 6,952 MT is assumed to be the minimum design vessel as it is closest to the regulation’s 400 ft limit. The other design vessels are from A January 2020 update to the Valero Benicia Statement of Terminal Operating Limits (see Attachment E). See Table 5 for design vessels.

Table 5: Benicia Terminal Design Vessels for CARB Regulation

Vessel	DWT (mt)	LOA (ft)	Beam (ft)	Arrival Draft (ft)	Arrival Displacement (mt)
211k DWT Tanker	≤ 211,470	987	166	38.0	137,480
160k DWT Tanker	≤ 160,000	900	158	39.0	123,547
139k DWT Tanker	≤ 139,501	895	152	38.0	106,855
120k DWT Tanker	≤ 120,000	887	151	38.0	105,136
100k DWT Tanker	≤ 104,875	799	138	38.0	93,805
80k DWT Tanker	≤ 78,658	719	125	38.0	78,574
70k DWT Tanker	≤ 72,631	750	106	38.0	70,030
40k DWT Tanker	≤ 40,000	625	96	37.1	49,943
39k DWT Tanker	≤ 39,081	601	90	38.0	45,295
10k DWT Tanker	10,000	400	63	23.0	12,931

6.10. CARB Regulated Vessel Berth Utilization

Based on 2019 and 2020 vessel call data provided by Valero, refer to Table 6 for approximate throughput and vessel calls in 2019 and 2020 for the Valero Benicia Terminal.

Table 6: Approximate Throughput & Vessel Calls at Valero Benicia Terminal (2019-20)

	Throughput (BBLs)			Vessel Calls		
Year	Load	Unload	Total	Barge	Tanker	Total
2019	3,203,057	30,899,169	34,102,226	92	100	192
2020	2,763,786	32,634,532	35,398,318	54	93	147
Average	2,983,422	31,766,851	34,750,272	73	97*	170*

*Numbers are rounded up

A statistical analysis was completed to determine the anticipated percent of time that a CARB regulated vessel will call at the Valero Benicia Terminal. The statistical analysis uses vessel call data provided by Valero for the years 2019 and 2020 and assumes that it will be representative of future vessel calls. The analysis evaluates the percentage of both CARB regulated and unregulated vessel calls anticipated at the terminal using the design criteria above. Refer to Table 7 for a summary table and Attachment F for the details of the analysis.

Table 7: CARB Regulated* Vessel Berth Utilization

Year	Regulated Vessel at Berth (hours) – (% per year)	Unregulated Vessel at Berth (hours) – (% per year)	No Vessel at Berth (hours) – (% per year)
2019	2260 hours – 25.8%	2439 hours – 27.8%	4061 hours – 46.4%
2020	2471 hours – 28.1%	1146 hours – 13.0%	5167 hours – 58.9%

*Regulated Vessel is a vessel that requires a CAECS when at berth per the regulation
**Note: 2020 had 366 days

7. CARB Compliance Options

The following terminal side compliance options were studied:

- **Shore Power**
  - Connect the vessel to an electrical plug while at berth.
  - Vessel power at berth will be provided by the shore power system.
  - Requires additional electrical supply be provided by the utility to the site.
  - Requires an overwater platform and cable handling system or crane to provide the power cable to the vessel.
  - Requires an overwater platform for the substation, switch gears and transformer due to lack of available land at the marine terminal; and
  - Requires vessel improvements to be shore power capable.
- **Barge-Based Capture and Control**
  - Capture and treat the vessel emissions while the vessel is at berth; and
  - Capture and treatment system is located on a barge that can relocate and reposition.
- **Shore-Based Capture and Control**
  - Capture and treat the vessel emissions while the vessel is at berth; and
  - Capture and treatment system is located onshore and/or on an overwater platform.
- **Innovative Concept**
  - Reduce emissions from sources in and around the regulated marine terminal to a level equivalent or greater than what would be use achieved using a CAECS while not increasing GHG emissions.
  - One or more innovative concepts can be implemented.
  - Must be at same port or marine terminal, within adjacent communities, or overwater within three nautical miles of the port or marine terminal; and
  - Compliance period of 5 years or less.

Refer to Attachment G for sketches of the conceptual options.

8. Required Reach Capability for CAECS Options

Required design reaches were calculated for the three compliance options. The location for the platforms for both the shore power and shore-based capture and control options was determined based on the design vessels and the required dimensions for the platforms. Both platforms were located to avoid conflicts with vessel mooring lines. It is not feasible to locate the shore power or capture and control infrastructure onshore due to unreasonable long reaches and due to onshore site constraints. A sketch of the selected locations for overwater platforms are shown in Figure 3 and Figure 4.

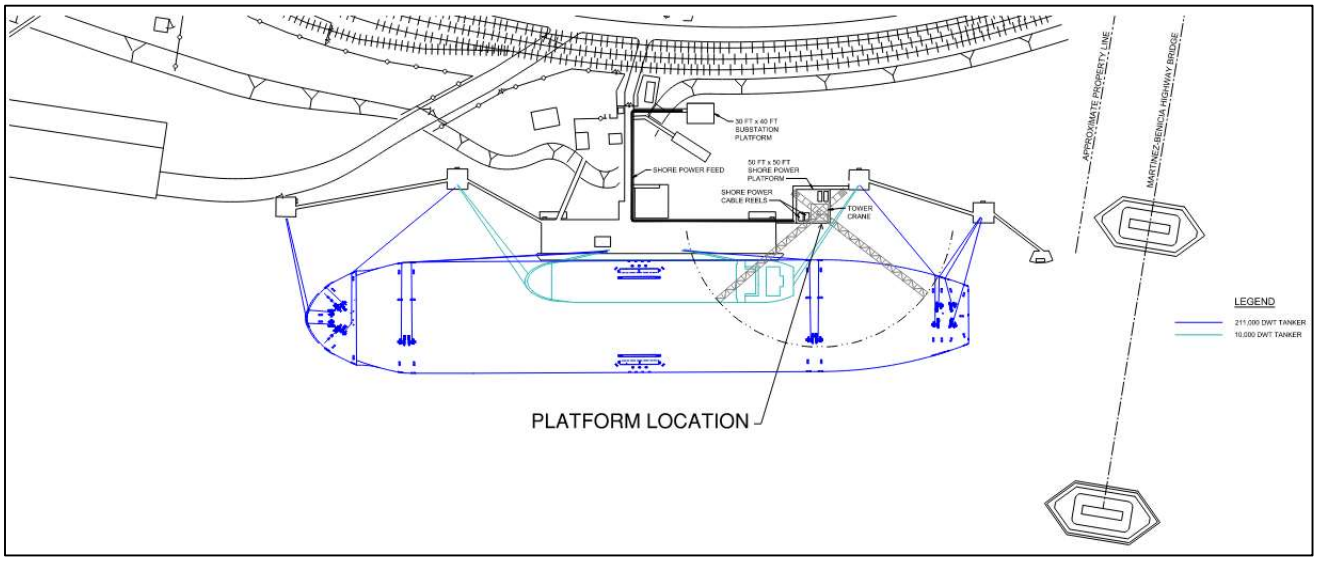

Figure 3: Overwater Platform Location for Shore Power

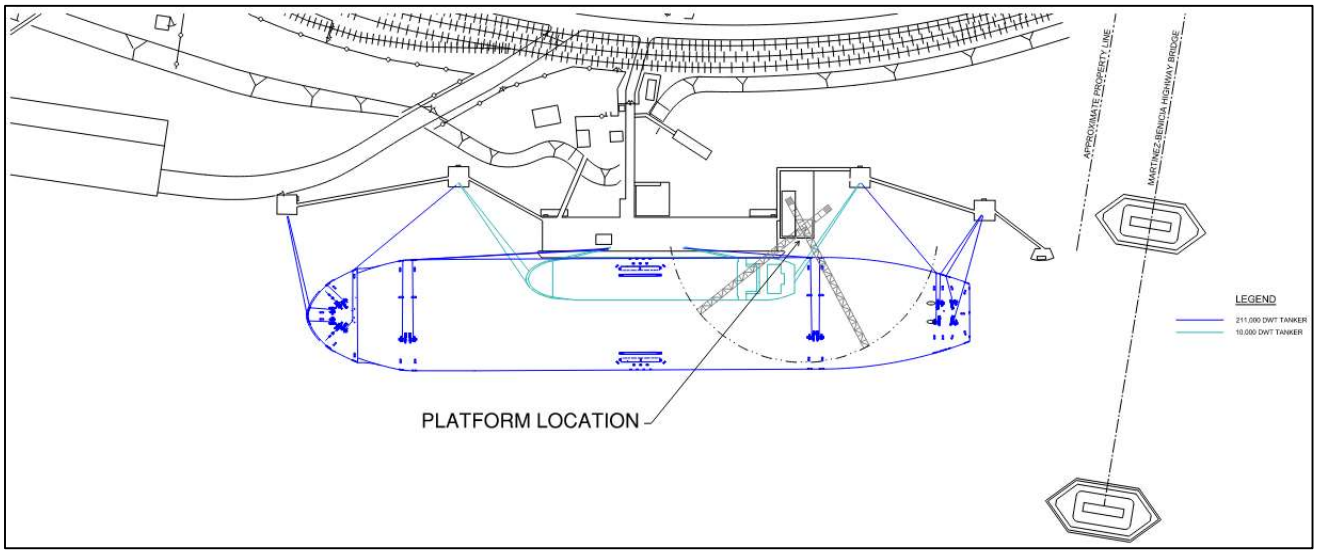

Figure 4: Overwater Platform Location for Shore-Based Capture and Control

Based on the platform locations, a rough analysis was completed to determine the required reach capabilities for each CAECS option for the range of design vessels. The stack locations on the design vessels vary in plan location and elevation. Note that this analysis is at a preliminary feasibility level and a more detailed analysis will be required to properly size the preferred solution prior to implementation.

For the shore power option, the required reach is calculated from the center of the proposed platform (50 ft x 50 ft) to the vessel deck at the center of the vessel stacks. The elevation of the platform is assumed to be +15 ft MLLW.

For the barge-based capture and control option, two scenarios are considered, one with the barge approaching from the starboard-side and one approaching from the stern of the vessel. The required reach is calculated from the center of the barge (50 ft x 100 ft) to the center of the vessel stacks with the barge deck elevation assumed to be +2 ft MLLW. It is assumed the barge will need to be a minimum of 15 ft clear of the tanker during operations.

For the shore-based capture and control option, the required reach is calculated from the center of the proposed platform (50 ft x 100 ft) to the center of the vessel stacks with the platform deck elevation assumed to be +15 ft MLLW.

The tables below show the required reaches for each option. The X distance is parallel to the berth, Y distance is perpendicular to the berth, and the Z distance is in the vertical direction.

Table 8: Reaches for Shore Power Option

Vessel	X Distance (ft)	Y Distance (ft)	Z Distance (ft)	Total Distance (ft)
211,000 DWT	110	95	45	155
10,000 DWT	105	65	-5	125

Table 9: Reaches for Barge-Based Capture and Control Option (Stern)

Vessel	X Distance (ft)	Y Distance (ft)	Z Distance (ft)	Total Distance (ft)
211,000 DWT	125	50	155	205
10,000 DWT	55	20	30	70

Table 10: Reaches for Shore-Based Capture and Control Option

Vessel	X Distance (ft)	Y Distance (ft)	Z Distance (ft)	Total Distance (ft)
211,000 DWT	185	155	140	280
10,000 DWT	40	70	20	85

9. Shore Power

Valero has indicated its business is dependent upon the spot availability of tankers on the open market. Therefore, until such experimental technology is reviewed, and safe best practices are globally adopted most tankship owners are unlikely to implement unvetted experimental technology for use at the Valero Benicia Terminal. This is particularly relevant to international standards for shore power, the interface of shore-based capture and control devices as well as safety standards for capture and control barges within the explosive zone of marine oil terminals. This perspective is shared by many of the oil terminal operators in California.

9.1. Regulation Background

As defined in the Regulation, “shore power” refers to electrical power being provided by either the local utility or by distributed generation to a vessel at berth. Shore power is considered a CAECS. If distributed generation is used to supply shore power, the electricity generated must meet the following emissions standards:

- NOx emissions no greater than 0.03 g/kW-hr.
- PM emissions equivalent to the combustion of natural gas with a fuel sulfur content of no more than 1 grain per 100 standard cubic foot.
- Distributed generation GHG emissions must be grid-neutral; and
- Ammonia emissions no greater than 5 ppmdv if SCR is used.

Vessel operators with shore power vessels shall plug in to shore power on each and every visit to a terminal where the port or terminal has commissioned the vessel’s shore power equipment, or the port or terminal has deemed the vessel to be compatible based on the vessel’s previous commissioning to another berth.

The use of shore power requires the terminal to begin controlling emissions within two hours after “Ready to Work” and cease controlling emissions no sooner than one hour before “Pilot on Board.”

Terminal operators or ports with berths equipped to receive shore power vessels must connect these vessels to shore power when visited by a commissioned shore power vessel. The port or terminal operator is responsible for commissioning vessels equipped with shore power that is installed on the side of the vessel facing the wharf when berthed. If the commissioned shore power vessel is berthed in a way that prevents it from connecting to shore power, the terminal may use a TIE or must provide an alternative CAECS compatible with the vessel.

Terminal operators shall complete the following items in this checklist to ensure compliance under the Control Measure:

- Ensure shore power equipped vessels are commissioned for shore power at the terminal they are visiting or notify vessel operator if commissioning is required.
- Position vessel appropriately to enable use of shore power.
- Record power meter reading at the time of shore power connection; and
- Record power meter reading immediately after disconnecting from shore power.

9.2. Shore Power System Description

Using shore power, the vessel is connected to shoreside electrical power while its main and auxiliary engines are shut down. The shoreside electrical power is usually provided by vaults installed on the existing marine structure(s). The proposed terminal does not have adequate overwater structures to accommodate the required shore power infrastructure and, therefore, a new platform is required. The proposed platform is preliminarily sized at 50 ft x 50 ft to accommodate two vaults, a cable reel, a cable handling crane, and the operator.

Some market-ready cable reel options utilize a crane or a telescopic arm to increase the maximum reeling range and reaching capacities. Unfortunately, these cable reel options do not meet the minimum reach requirements shown in Table 8. Therefore, a custom crane system will need to be designed and installed to facilitate delivery of the shore power cables to the vessels.

To provide the required electrical service to the vessel, a new electrical service will need to be run from Pacific Gas & Electric (PG&E). At the site, a 40 ft x 30 ft area will be needed to locate the substation and primary and secondary switchgears. Since there is not adequate onshore space for this improvement, it is assumed an overwater platform will be required. In addition, each vessel will require improvements to accept the power and tie it into the vessel systems.

Refer to Figure 5 for a plan view of the shore power concept at the terminal.

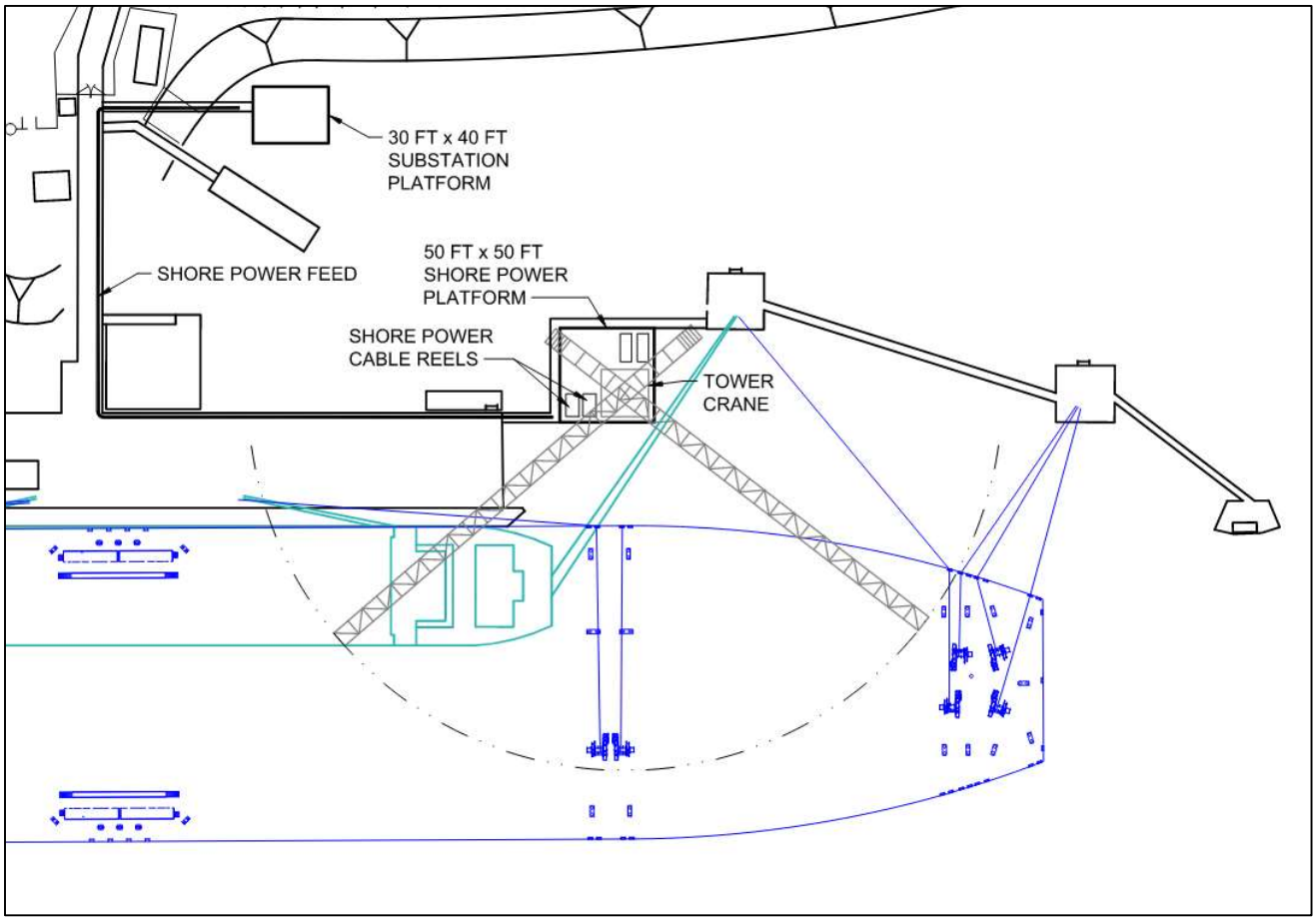

Figure 5: Plan View of Shore Power Option

9.3. Vessel Improvements

All vessels expected to call at a terminal with shore power must have modifications installed on the vessel to facilitate the shore power connection. The improvements are to receive the shore power cables and tie the power into the vessel systems. These improvements include, but are not limited to:

- Shore connection switchboard with protection equipment to connect shore side cables, including socket which needs to match the plug;
- Quick-release physical mechanism and signal system if deemed necessary;
- Control interface between shore and a ship;
- Main switchboard and protection equipment including synchronization and paralleling equipment to give a bump-less closed transfer to/from shore power;
- Safety circuits;
- Automatic Voltage Regulator (AVR) tuning or upgrade for auxiliary generators, for example, ABB Unitrol;
- Governor tuning or upgrade for auxiliary engines;
- Power management system with integrated shore power system;
- Step-down transformer, where applicable, to match shore voltage with ship voltage; and
- Graphic panel-based human-machine interface (HMI) to operate the shore power system.

Details on the type and cost of the required vessel improvements will vary on a vessel-to-vessel basis and, therefore, are not included in this study.

Any state or federally mandated technology intended to be introduced onto a tank ship or into the interface of any portion of a tankship and marine oil terminal must be approved by international consensus on best practices. These safety standards are developed and promulgated by entities such as Oil Companies International Marine Forum (OCIMF), The International Association of Independent Tanker Owners (INTERTANKO) and the International Maritime Organization (IMO).

Per Valero, their business is dependent upon the spot availability of tankers on the open market. Therefore, until such experimental technology is reviewed, and safe best practices are globally adopted most tankship owners are unlikely to implement unvetted experimental technology for use at the Valero Benicia Terminal. This is particularly relevant to international standards for shore power, the interface of shore-based capture and control devices as well as safety standards for capture and control barges within the explosive zone of marine oil terminals.

9.4. Electrical Improvements

The electrical improvements would need to include a new 35 kV electrical service from Pacific Gas & Electric (PG&E), onsite substation, underground and overhead distribution infrastructure, conduits, cabling, shore power vaults and cable management system. Refer to Attachment H for a single line diagram of the existing terminal and Figure 6 for a single line diagram of the proposed system.

9.4.1. PG&E Power Distribution Service

The terminal will initiate a power distribution project with PG&E to plan, engineer, permit, and construct a new 35 kV electrical service.

The shore power system must be designed to accommodate vessels with a maximum peak power consumption of 7 MW. This study assumes a maximum power requirement of 10 MW, which is conservative for a one vessel terminal ships up to 220k DWT. PG&E will provide power that will support the proposed Shore Power Substation (SPS) load of 10 MW. PG&E will require an 18-month advanced notice to upgrade the Valero Benicia service to full power requirements.

The details of the new electrical service will be planned and designed by PG&E engineering staff; however, it is anticipated the service will include a new 35kV meter and circuit breaker main cabinet installed in close proximity to the terminal. A new duct bank system and/or overhead line will be required to facilitate transfer of power from this location to the marine terminal area, where a new 35kV-6.6kV substation will be installed to support the new shore power system.

9.4.2. Shore Power Substation

One 10 MVA, 35kV-6.6kV liquid filled transformer with 110% oil volume capacity containment dike will supply power to the SPS. The containment dike will be equipped with oil/water separation features to allow the safe drainage of rainwater but block the flow of oil. The SPS metal-clad/metal-enclosed switchgear will, in general, include (1) 6.6kV main draw out power circuit breaker and (2) HVL load break interrupter switches with corresponding ground switch to serve two Shore Power Outlet (SPO) vaults. Provisions for future bus extension will be provided at the switchgear. The substation 6.6kV secondary will be provided with a low resistance neutral-ground resistor (NGR). The short-circuit contribution from the SPS 6.6kV shore system shall be limited to less than 16kA rms. The shore side protection system will include protective features in accordance with IEE/IEC 80005-1 international shore power standards in addition to any special protection that's required by the power supply utility.

The HVL/ground switch lineup will distribute power to one SPO vault at any given time. Each 6.6kV HVL switch shall be Kirk-Key interlocked to the SPO and ground switch to allow closure only when both the shore power receptacles in one SPO are plugged in, and the ground switch is open. The HVL switch is Kirk-Key interlocked with the SPS 6.6kV main circuit breaker to allow closure only when the Ship-to-shore cable is connected, the ground switch is open and HVL is closed. The paralleling of the ship's electrical system with the shore system occurs on the ship and is controlled by the ship. The ship side paralleling system will include automatic synchronization features with preset time limit of maximum 120 seconds to establish closed transfer.

9.4.3. Shore Power Outlet Vault

Two SPO vaults with two push-pull receptacles each will be provided on the shore power platform. Receptacles shall be mechanically and electrically interlocked by the Kirk-Key interlock system and ground check relay. Each receptacle will be rated for 350A, 7200V continuous operation and will be rated to withstand the thermal and mechanical effects of a maximum fault current of 16kAIC RMS and a peak fault current of 40kA.

SPO vaults will include conduit provisions for 600V rated control cable and a future fiber optic cable. A space heater shall be provided at the SPO vault.

The shore power outlet vault will be located in a non-hazardous classified area or alternatively it will need to be rated for operation in the hazardous classification area.

9.4.4. Grounding System

A substation ground loop will be installed consisting of copper clad ground rods and bare copper cables of sufficient size to carry the available ground fault current. The ground loop will be tied into the existing ground system in the vicinity of the SPS. All electrical equipment, structures, system neutral

grounds, receptacles and switchgear grounds shall be connected to the ground loop. The ground loop shall meet the requirements of American National Standards Institute / Institute of Electrical and Electronics Engineers (ANSI / IEEE) standard 80 “IEEE Guide for Safety in AC Substation Grounding.” Bare conductors shall be installed 18” below grade.

The 6.6kV transformer secondary wye-connected neutral will be connected to the grounding system through an NGR to limit ground fault current to 50 amperes or less. Ground fault relaying will be provided to sense current returning through the NGR of the transformer. The NGR shall have a minimum rating of 50A, 60 seconds. The NGR shall have multiple taps to allow 10A-50A of current flow.

Equipment Grounding: All 35kV power circuits, 6.6kV power circuits, 480V power circuits, and 120V or 208V power or branch circuits will have an NEC-sized insulated equipment grounding conductor routed in the raceway or duct or multi-conductor cable with the circuit phase conductors. The circuit equipment grounding conductor will be bonded to the originating circuit panel equipment ground bus. The other end of the equipment grounding conductor will be connected to the equipment enclosure, case, or frame.

Medium voltage cable shields will be grounded at all locations where terminated or spliced. Individual cable shields will be strapped together and connected to the switchgear ground bus before entering ground sensing zero sequence current transformers.

9.4.5. General Electrical Requirements

All electrical distribution equipment will be located outdoors and shall be provided with suitable enclosures. All switchgear will be housed in a weatherproof, ventilated enclosure. The 6.6kV switchgear assembly shall be a walk-in type enclosure.

Electrical equipment will generally be installed in non-hazardous classified areas or alternatively it will need to be rated for operation in the hazardous classification area.

Electrical equipment, raceways, or cables which interfere with the installation of the new equipment shall be rerouted to locations acceptable to the Operator. All relocated equipment or services shall be fully tested and placed back into service.

The new electrical distribution system shall be designed with a level of redundancy and reliability that exceeds that of the mechanical equipment it supports.

- Electrical design of the AC distribution system will be demonstrated by engineering calculations to ensure adequate performance prior to final selection of equipment. Calculations will include all input data and design bases required to duplicate the results. This design will coordinate selection of switchgear interrupting ratings, voltage ratios, and impedances of transformers.
- Switchgear and circuit interrupting devices at all voltage levels will have adequate interrupting and close-latch capability for the calculated available three phase and line-ground fault currents. Calculations shall be in accordance with ANSI C37 series standards and C57 series standards.
- The switchgear will be sized to maintain at least a 105% short circuit margin for the worst case bolted three phase fault. All fault calculations shall be performed according to the IEEE standards. All fault currents shall be determined at 100% pre-fault voltage. For fault calculations, a 7.5% impedance tolerance for two-winding transformers shall be used unless the actual impedance from a test report is available.

Protective Device Coordination: Protective system coordination study will be performed to establish instrument transformer and protective relay and overcurrent device ratings. Protective device coordination study will be prepared by the Engineer-of-Record for review and approval by the Operator. Any special protection requirements imposed by the power supply utility may also require utility review and approval.

Raceways: Raceways will be designed for a level of reliability equal to or exceeding that of the cables they contain. All conduit and other raceways shall conform to the California Electrical Code (CEC) and Underwriters Laboratories (UL) Standards with regard to the materials and installation.

- Conduits will be installed as a complete system and will be securely fastened in place. All underground raceways will be schedule 40 PVC. The on-terminal duct bank risers to above ground level will be rigid galvanized elbows. The design will include a minimum 25% spare capacity of empty conduits for future use.
- All above grade exposed raceway in the on-terminal substations will be PVC coated rigid steel conduit.
- All fittings and materials used for connection to electrical enclosures shall be selected to maintain the National Electrical Manufacturers Association (NEMA) classification of the enclosure. All materials shall be listed by UL or a Nationally Recognized Testing Laboratory (NRTL) acceptable to the local jurisdiction. Conduit terminations to equipment subject to vibration will be made with liquid tight flexible steel conduit. All rigid steel conduits will be provided with grounding bushings and bonded per CEC requirements.
- Underground on-shore duct lines of individual conduits will be encased in a red cement slurry. The slurry encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3-inches of cover. Separate conduits using plastic spacers. Tops of underground conduit banks shall be a minimum of 3’-0” below finished surface.

On-Terminal Cables and Conductors: Cables will be sized to carry the required operating current and voltage ranges. Protective devices shall be set such that the maximum bolted fault current at the load shall not result in thermal damage to the conductor and/or the equipment. Ampacities and derating factors shall be in accordance with the Latest NEC & CEC Adapted Edition. Cable construction and insulation shall be appropriate for the environment and voltage in which it is applied.

- All medium voltage cable ampacities will be 105ºC rated. However, depending on the cable size and the temperature rating of the device on which the cable is terminated, raceway temperature rating, the allowable ampacity may be less than the 105ºC rating. Power cables shall be UL labeled and color-coded in accordance with the NEC requirements.
- All low voltage cable ampacities will be 90ºC rated. However, depending on the cable size and the temperature rating of the device on which the cable is terminated, the allowable ampacity may be less than the 90ºC rating. Power cables shall be UL labeled and color-coded in accordance with the NEC requirements.

Special Design Elements: All necessary equipment and appurtenances required to provide reliable power to all electrical functions such as shore power stations will be provided conforming to applicable codes.

- Transformers, switchgear, distribution panels, etc., shall be suitable for a marine environment and will be installed on concrete pads.
- Electrical equipment and appurtenances will be sized and located to be contained within the designated SPS and substation areas and to provide minimum interference with terminal operations.

- SPS locations will be selected to minimize impacts to facility operations and to provide cost effective requirements for conduit and wiring.
- Wherever possible, existing spare conduits will be used for the shore power electrical system.

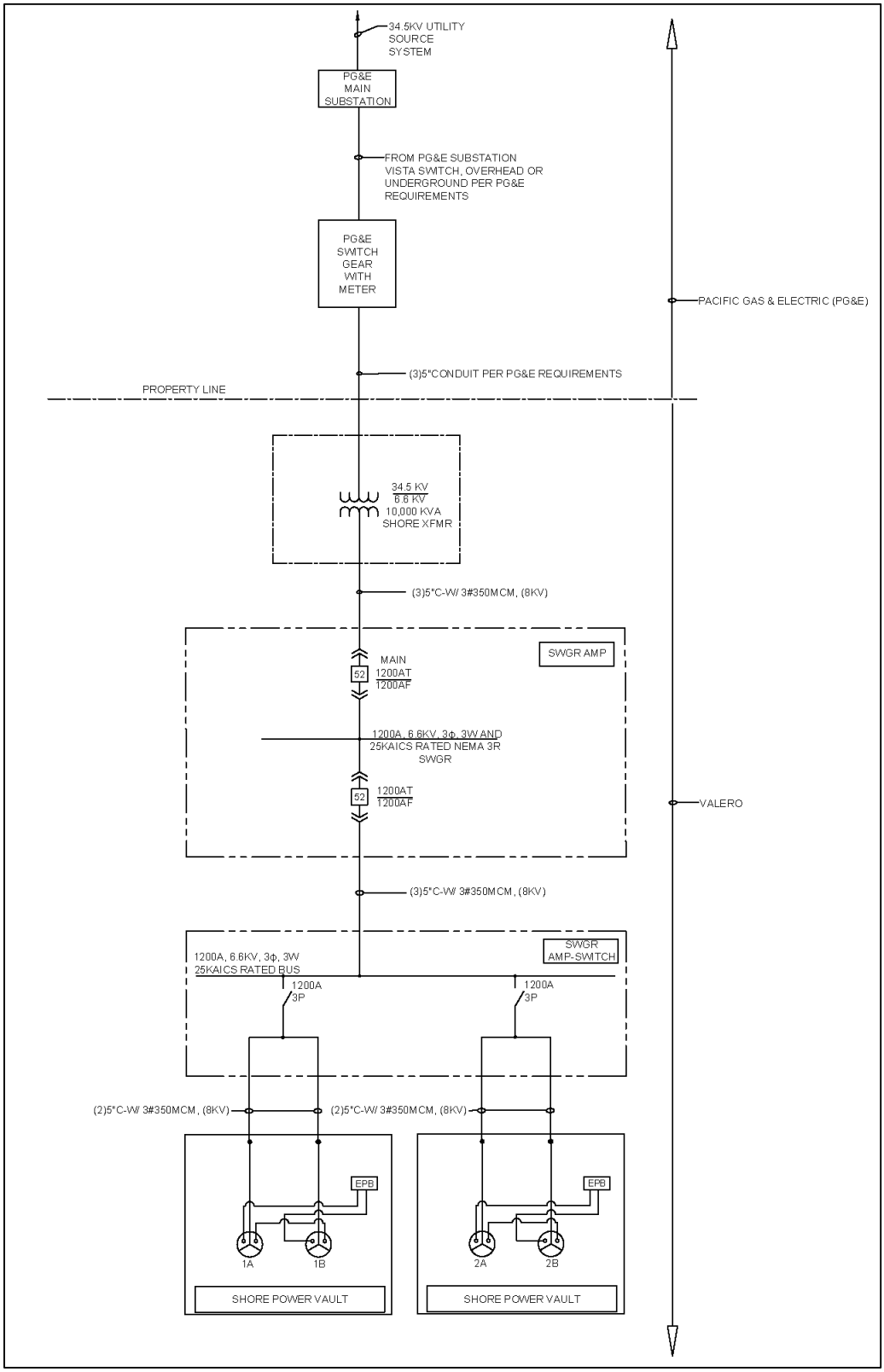

Figure 6: Shore Power Option - Single Line Diagram

9.5. Shore Power Platform

A new 50 ft x 50 ft overwater platform is required to support the shore power system. The platform consists of a steel pile supported concrete deck system with safety railing. A pedestrian walkway is provided back to shore. Due to existing and proposed onshore improvements, the location of the platform will not facilitate vehicular access from shore. Therefore, any maintenance activities will require the use of a barge.

The platform is assumed to fall under the jurisdiction of the California State Lands Commission and therefore must comply with CBC Chapter 31F: Marine Oil Terminals commonly referred to as MOTEMS.

9.6. Cable Handling Crane and Cable Reel

A crane is used to lift the shore power cables and deliver them to the vessel for connection. It is assumed that up to three cables are required (positive, negative, ground). A cable reel will be located on the shore power platform with enough cable length to accommodate the range of vessels at the terminal. Based on the reach requirements in Table 8, all commercially available shore power cable handling systems are not adequate. Therefore, a specialty crane needs to be designed. The following assumptions were made to size the crane:

- Lift 3 cables that each weigh up to 10 lb/ft.
- Minimum acceptable cable bending radius of 5 ft.
- Maximum wind speed for operations equal to 30 knots (30-sec duration averaging speed).
- Cables must remain on the crane hook once attached to the vessel to help minimize cable sag and to maintain required bend radius; and
- Cables must remain at a minimum elevation of +15 ft (MLLW) to provide a 10 ft clearance to the water at high tide.

Reputable crane manufacturers including Liebherr, Terex, Konecranes, and Manitowoc were contacted to discuss the viability of their crane products for this application. The only solution that made it beyond the initial screening for reach requirements was a tower crane (see Figure 7). Although a tower crane can provide the overhead clearance and reach required to provide the shore power cables to the range of vessels at site, it is not designed for this type of application. A tower crane does not have the capability to accommodate the horizontal load induced by the self-weight of the shore power cable. Nor does it have the safety systems installed to advise the operator of a horizontal overload. Since the market for this type of tower crane solution is not large, it is unlikely that a crane vendor will take on the cost of engineering to create a long reach shore power cable handling crane solution as there are not enough projects to spread the research and development cost.

Since there is no cable handling system commercially available and no indications that crane vendors are developing a crane solution for the required use, Valero has indicated this is not a feasible option for compliance at the terminal. However, for the purpose of this study, and to provide an estimated cost of compliance, a ballpark cost of $5M is assumed to procure, deliver, erect and commission a tower crane onsite that would conceptually be able transfer shore power cables to the vessel. The viability, design, and safety of this concept have not been studied and would need to be fully vetted and engineered by a reputable crane manufacturer before this option can be further considered.

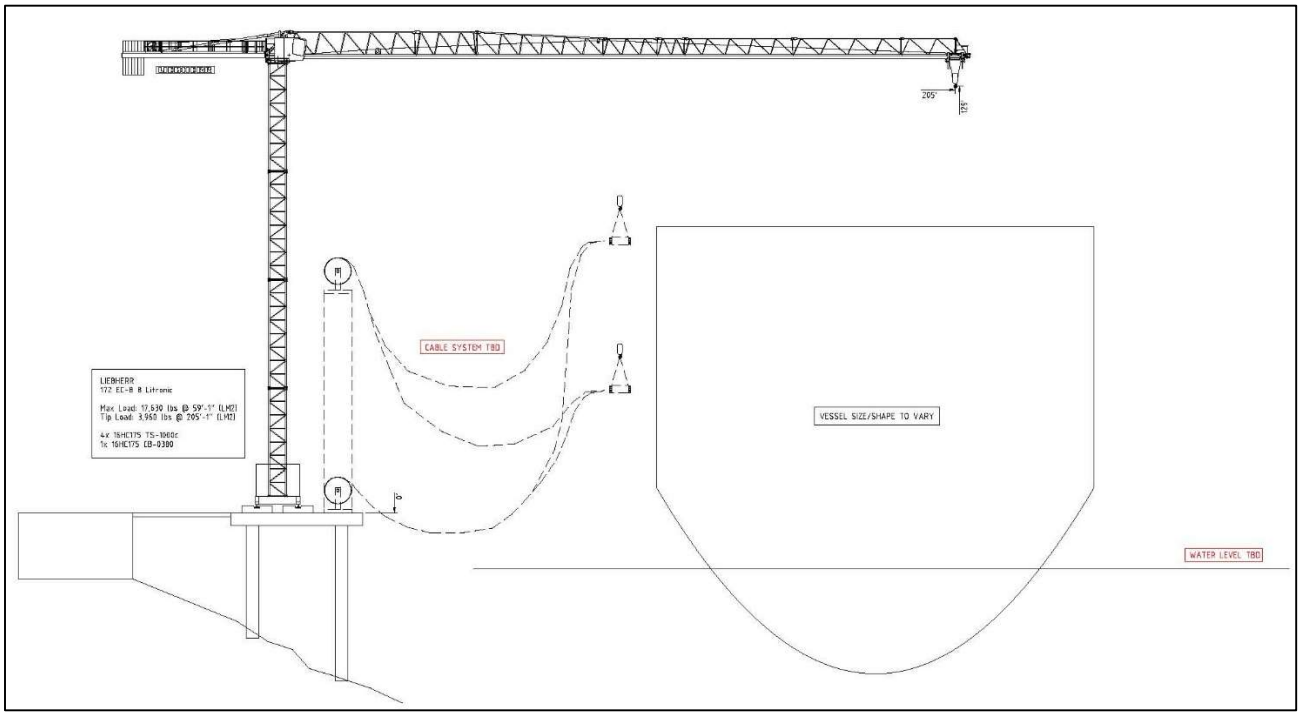

Figure 7: Shore Power Option – Tower Crane

*Note: tower crane shown schematically with approximate boom length required to reach all vessels

10. Barge-Based Capture and Control

Valero has indicated its business is dependent upon the spot availability of tankers on the open market. Therefore, until such experimental technology is reviewed, and safe best practices are globally adopted most tankship owners are unlikely to implement unvetted experimental technology for use at the terminal. This is particularly relevant to international standards for shore power, the interface of shore-based capture and control devices as well as safety standards for capture and control barges within the explosive zone of marine oil terminals. This perspective is shared by many of the oil terminal operators in California.

10.1. Regulation Background

Barge-based capture and control involves installing capture and control infrastructure on a barge and is considered a CAECS. For any CAECS besides shore power to receive CARB approval, a company must demonstrate that the emission controls strategy achieves emission rates less than 2.8 g/kW-hr for NOx, 0.03 g/kW-hr for PM 2.5, and 0.1 g/kW-hr for ROG for auxiliary engines. Additionally, for strategies approved after 2020, GHG emissions from the strategy must be grid-neutral using the grid emission rate for the year that the technology is granted an Executive Order. Default emission rates of auxiliary engines on ocean-going vessels are 13.8 g/kW-hr for NOx, 0.17 g/kW-hr for PM 2.5, and 0.52 g/kW-hr for ROG. For tanker vessels with steam driven pumps, unless the tanker is using shore power to reduce emissions from auxiliary engines, a company must demonstrate that the CAECS achieves emission rates less than 0.4 g/kWhr for NOx, 0.03 g/kW-hr for PM 2.5, and 0.02 g/kW-hr for ROG for tanker auxiliary boilers. Default emission rates of tanker auxiliary boilers on ocean-going vessels are 2.0 g/kW-hr for NOx, 0.17 g/kW-hr for PM 2.5, and 0.11 g/kW-hr for ROG.

The manufacturer of each emission control strategy shall warrant the system for 10 years when a unit is purchased that the strategy is designed, built, and equipped to conform, at the time of sale, with the regulation. The manufacturer shall also warrant that the system is free from defects in materials and workmanship which cause the failure of a warranted part to no longer be identical in all material respects to that part as described in the manufacturer's application for certification. The applicant of the emission control strategy system shall provide the end user with maintenance practices set forth by the manufacturer.

When a company sells or leases a unit, the company must conduct in-use compliance testing of the strategy to demonstrate that the expected percentage of emissions reductions is being achieved. The company must report the results to CARB within 30 calendar days. If testing shows the unit does not meet the emission requirements, the unit cannot be used to satisfy the emission requirements of the regulation.

At a minimum, emission control technologies shall be tested annually to demonstrate that the expected percentage of emissions reductions are being achieved. The applicant shall provide the results of such testing to the Executive Officer by December 31, annually. The Executive Officer may modify the testing frequency as he or she deems appropriate. The Executive Officer may request that the owner or operator of a CAECS conduct periodic emission source testing or other types of monitoring to verify the proper operation of alternative control technologies or distributed generation equipment, or to verify the emission rate of an auxiliary engine.

The use of a CAECS requires the terminal to begin controlling emissions within two hours after “Ready to Work” and cease controlling emissions no sooner than one hour before “Pilot on Board.”

Terminals that receive a vessel at a berth without shore power are responsible for arranging a CAECS for each visit by vessels with requirements for auxiliary engines or tanker auxiliary boilers. If neither

the vessel nor the terminal has shore power, then it is the shared responsibility of both parties to arrange a CAECS for this visit.

Terminal operators shall complete the following items in this checklist to ensure compliance under the Control Measure:

- Record inlet and outlet levels of emissions during the visit; and
- Ensure vessels are operating on CARB compliant distillate marine fuel.

10.2. Barge-Based System Description

The system consists of a capture system and a control/treatment system both located on a movable barge that is maneuvered astern a vessel at berth to reduce emissions from the vessel while it continues to operate its auxiliary engines and boilers. The current generation of barge-based technologies is designed to control emissions from the vessel's auxiliary engines. Current barge-based technologies are dependent on an external tugboat to move the barge alongside the vessel. Although there is the potential for self-propelled barges to eliminate the need for a tugboat, this technology has not yet been implemented or demonstrated on oil tankers especially for bay area terminals.

The capture system is comprised of the capture hood, which is placed on the stack from which the exhaust is being captured, and the transfer duct, which transports the captured exhaust from the hood to the treatment system. A placement boom or crane is used to support and position the capture hood and transfer duct.

The treatment system consists of a filter system to remove the targeted particulates / pollutants and to produce a dry powdered non-hazardous waste product. The system will need to continuously monitor both the inlet and outlet of the treatment system to demonstrate compliance to CARB through reporting required by the regulation. A process flow diagram of the treatment system for the barge vendor, Clean Air Engineering – Maritime (CAEM) is shown in Figure 8.

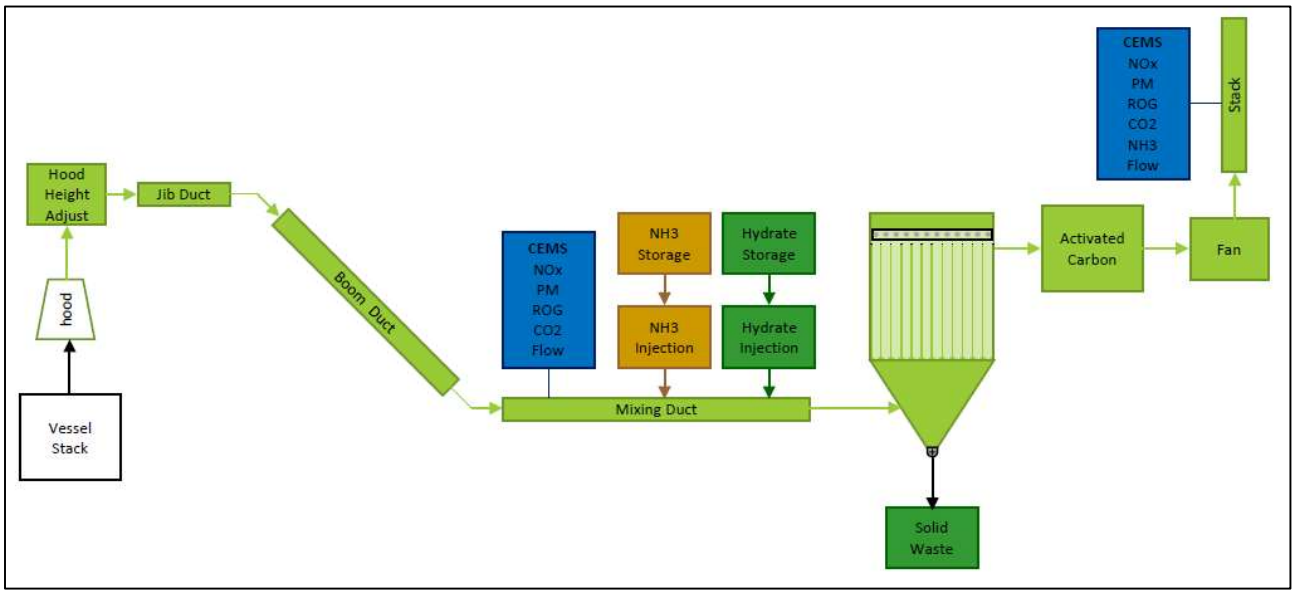

Figure 8: Process Flow Diagram of Treatment System (CAEM)

Barge-based systems are currently owned and operated by third-party vendors. The third-party vendor provides their own staff to operate the barge. This technology is only feasible in locations where a

terminal has adequate clearance to operate at the vessel stern or near the stern on the starboard or port side of the vessel. The barge must not inhibit safe terminal operations, vessel navigation in the channel, or operations at adjacent terminals.

At unsheltered sites in the bay area, a specialized barge design would be needed to safely operate in the challenging metocean conditions. The options include a spud barge or a jack-up barge.

10.3. San Francisco Bar Pilot Feedback

A meeting was held between the San Francisco Bar Pilots (SFBP), Valero, and Moffatt & Nichol (M&N) on October 13 to discuss barge-based capture and control at the Valero Benicia terminal. Attendees included the following:

- SFBP: Captain Carlier, Captain Manes, Captain McIntyre
- Valero: Capt Marchant, Capt Kamat, Tia Youk, Bob Chou, Melissa Manke Fimbres
- M&N: Matheus Miranda, Matt Trowbridge, Xiuying Xing

The following items were discussed:

- Other bay area terminals are discussing the use of a spud barge for capture and control with the SFBP.
- The SFBP view the proposed barge-based operation as high-risk.
- The barge cannot be in the vicinity of the terminal during vessel arrival due to the metocean conditions.
- Any delays experienced due to barge to vessel connection could reduce berth availability and increase berth downtime.
- A self-propelled barge system would require an adequate propulsion system to safely maneuver in the site metocean conditions.
- Any mechanical downtime or issues in the capture and control boom system may impact the ability for the vessel to depart the berth safely in an emergency departure scenario. Further study is required to assess the feasibility of attaching / detaching the capture system from the vessel, especially in an emergency departure scenario.
- The barge would need to be operated in close proximity to the tanker, marine terminal, and bridge. Any loss of power or challenges maneuvering the barge in the metocean conditions may risk an impact with an adjacent vessel or structure.
- The geotechnical site conditions need to be studied spud barge or jack-up barge to confirm the soil is adequate for the proposed use and loads. The study should include evaluation of repeated use of the barge in the same location and any reduction in soil capacity over time due to use.
- Further study is required to confirm the proposed operation is acceptable from an environmental permitting and approvals perspective.
- The SFBP are not aware of any self-propelled barges in the bay area. The SFBP expressed concerns that any self-propelled barges would be underpowered. If a tug is required, it is likely a dedicated tug would be required and therefore would need to be on standby near the terminal during normal operations. If tugs are required for this operation additional tugs would be needed in the bay area to service this industry.
- The SFBP typically see spud barges, anchor barges, and spud/anchor barges in the bay area. It was noted that CS Marine has a flexi-float jack-up barge in their Vallejo yard. Otherwise, otherwise all parties were not aware of jack-up barges operating in the bay area.
- The SFBP do not expect anchor barges will be acceptable due to excess movement.

- The SFBP view shore power as slightly more favorable compared to capture and control. The SFBP view shore-based capture and control as more favorable compared to barge-based capture and control.

10.4. Preliminary Barge Evaluation

A spud barge uses long steel members dropped into the seabed to maintain the barge position. A spud barge rides up and down with the tide and the barge hull is subject to current and wave forces. Preliminary analysis indicates the site geotechnical conditions are not adequate to support a spud barge in high current conditions and that anchor lines would be required. This is consistent with standard practice in the construction industry in the Bay Area. In high current areas, Contractors use spud barges with anchor lines to maintain barge position. For anchor lines to be effective they need to be set at a reasonable angle (minimum 3H:1V to ideally 7H:1V) which requires significant space in 40 – 50 ft of water depth. This may not be acceptable due to risk of anchor and anchor lines interfering with safe vessel operations, terminal operations, and Caltrans inspection and maintenance operations at the bridge. The other option for spud barges is to moor them to permanent structures such as the existing mooring dolphins or a new structure that is purpose built such as barge breasting monopiles or dolphins. Further study is required to evaluate the adequacy of the spud barge solution. In addition, further innovation is required to design a capture system that has the capability to safely reposition and adjust in elevation while the barge moves in the vertical plane due to tide and wave. For this reason, a jack-up barge was considered. Refer to Figure 9 for a picture of a spud barge.

A jack-up barge uses long steel members founded on the seabed to raise the barge above the water surface to provide a stable working platform. Prior to the barge jacking up, the legs are pre-loaded and tested to confirm the soil is adequate to support the load. Stability calculations are required to verify the barge can safely operate at the site based on the proposed loading, site specific metocean conditions, and site-specific geotechnical conditions. The process to jack-up and jack-down is very slow. A capture and control jack-up barge would not be able to disconnect, jack down, and depart the berth within the 30-minute emergency departure scenario. Therefore, the jack-up barge would need to be positioned in a location that would facilitate safe departure of the tanker without relocation of the barge. Preliminary analysis indicates the site geotechnical conditions are not adequate to support a theoretical jack-up barge as the axial capacity required for barge stability would require unreasonable leg embedment into the bay mud soils. For this reason, a jack-up barge is not further considered at this time. Refer to Figure 9 for a picture of a jack-up barge.

Figure 9: Spud Barge (left) and Jack-up Barge (Right) (Source: Weeks Marine)

Due to the site geotechnical conditions, a jack-up barge is not considered further. Therefore, a spud barge with anchors or moored to existing structures is considered in this study. This finding is consistent with the marine construction industry in the Bay Area. There are many types of construction spud and anchor barges in use but no known use of construction jack-up barges. Based on conversations with Bay Area marine contractors, they expressed concern with the use of jack-up barges due to soil capacity and stability concerns.

It is proposed that the spud barge operate in the non-hazardous area of the tanker. However, if it is determined that the barge may operate in the hazardous area or if it is determined an intrinsically safe barge is required the barge equipment could be modified to be intrinsically safe. This would result in increased capital and operational costs.

As Valero is considering increasing the maximum throughput at the terminal from 32,500 barrels per hour to 65,000 barrels per hour sometime in the future, the barge design must be able to accommodate this future increase. The increased throughput would produce additional vessel emissions requiring treatment and would therefore require an upgrade to the barge treatment system. This upgrade in capacity would require an additional capture boom and additional treatment system filter housings. The original barge design would be sized and designed to accommodate this additional equipment; however, the additional equipment would not be installed until the terminal throughput is increased.

10.5. Barge Vendors

There are several existing and potential barge vendors that may be able to provide a capture and control service for oil tanker vessels at the terminal. Note that currently there is no commercially available barge service for oil tankers. However, at least one of the vendors listed below is offering to enter into service agreements with operators to provide a service based on a barge system in construction that is intended to be demonstrated for oil tanker use in 2022. In addition, the following risks should be taken into consideration for the barge vendors:

- There is a risk that a barge vendor goes out of business.
- There is a risk the barge vendor does not develop a barge solution that is acceptable for safe operation on oil tankers.
- There is a risk the barge vendor does not develop a barge solution that achieves CARB approval.
- There is a risk that barge systems cannot be safely operated at this site due to metocean and/or geotechnical conditions.

Clean Air Engineering – Maritime (CAEM) has a CARB approved barge-based system and a CARB approved shore-based system for container vessels. CAEM's barge-based system (see Figure 10) started operating on container vessels in 2015 and currently services container vessels in the Port of Los Angeles (POLA) and the Port of Long Beach (POLB). However, the existing barge-based and shore-based systems are not adequate for tanker use. Furthermore, the barge is not adequate for bay area use. CAEM is currently constructing two new barges that are designed and intended for use on tanker, container, and RO-RO vessels. One barge will be deployed to POLA/POLB and one barge will be deployed to the Port of Oakland. These barges include self-propulsion systems and spuds to maintain position at berth without tying to the vessel. Per CAEM, the capture boom can be disconnected to allow safe tanker departure within 30 minutes in an emergency scenario. CAEM participated in an industry risk analysis study led by the Western State Petroleum Association (WSPA) and Det Norske Veritas Germanischer Lloyd USA, Inc. Maritime (DNV GL) and is currently incorporating mitigation measures into their barge design and operating procedures based on the risks identified in the WSPA / DNV GL study. CAEM intends to construct a fleet of barges to provide capture

and control service for tankers, ROROs, and container vessels at both southern and northern California terminals for CARB compliance. Operators can enter a long-term service agreement with CAEM for the service which would be used as collateral for CAEM to construct a barge. Alternatively, an Operator could fund the design and construction of a barge operated by CAEM with exclusive and/or priority use at the Operator's terminal. A terminal specific study for a barge-based service by CAEM is provided in Attachment I.

Other Barge Vendors: It is possible that additional barge vendors may enter the market and compete to provide barge-based capture and control service or sell barge-based capture and control systems to Operators. ***Stax Engineering (STAX)*** in partnership with South Coast AQMD was recently awarded a CARB grant for $10M to demonstrate a barge-based capture and control system for oil tankers. STAX intends to develop a commercial barge-based service for the container industry in 2022. ***Advanced Environmental Group (AEG)*** previously had CARB authorization for a barge-based system operating in the Port of Long Beach on container vessels; however, AEG received a cease-and-desist letter from CARB for this system on November 5, 2020. The letter stated that AEG's system was noncompliant with the Regulation for equipment failure, mandatory reporting of continuous emission monitoring data, and visits where controls were terminated or had insufficient control efficiencies. It is unknown if AEG intends to develop a barge solution that could be demonstrated for safe use on oil tankers and unknown if they would receive CARB approval to operate.

Figure 10: Barge-Based Capture and Control System for Container Vessels (CAEM)

11. Shore-Based Capture and Control

Valero has indicated its business is dependent upon the spot availability of tankers on the open market. Therefore, until such experimental technology is reviewed, and safe best practices are globally adopted most tankship owners are unlikely to implement unvetted experimental technology for use at the terminal. This is particularly relevant to international standards for shore power, the interface of shore-based capture and control devices as well as safety standards for capture and control barges within the explosive zone of marine oil terminals. This perspective is shared by many of the oil terminal operators in California.

11.1. Regulation Background

Shore-based capture and control is considered a CAECS and involves installing capture and control infrastructure at the terminal on a fixed marine platform, wharf, or onshore. For any CAECS besides shore power, to receive CARB approval, a company must demonstrate that the emission controls strategy achieves emission rates less than 2.8 g/kW-hr for NOx,0.03 g/kW-hr for PM 2.5, and 0.1 g/kW-hr for ROG for auxiliary engines. Additionally, for strategies approved after 2020, GHG emissions from the strategy must be grid-neutral using the grid emission rate for the year that the technology is granted an Executive Order. Default emission rates of auxiliary engines on ocean-going vessels are 13.8 g/kW-hr for NOx, 0.17 g/kW-hr for PM 2.5, and 0.52 g/kW-hr for ROG. For tanker vessels with steam driven pumps, unless the tanker is using shore power to reduce emissions from auxiliary engines, a company must demonstrate that the CAECS achieves emission rates less than 0.4 g/kWhr for NOx, 0.03 g/kW-hr for PM 2.5, and 0.02 g/kW-hr for ROG for tanker auxiliary boilers. Default emission rates of tanker auxiliary boilers on ocean-going vessels are 2.0 g/kW-hr for NOx, 0.17 g/kW-hr for PM 2.5, and 0.11 g/kW-hr for ROG.

The manufacturer of each emission control strategy shall warrant the system for 10 years when a unit is purchased that the strategy is designed, built, and equipped to conform, at the time of sale, with the regulation. The manufacturer shall also warrant that the system is free from defects in materials and workmanship which cause the failure of a warranted part to no longer be identical in all material respects to that part as described in the manufacturer's application for certification. The applicant of the emission control strategy system shall provide the end user with maintenance practices set forth by the manufacturer.

When a company sells or leases a unit, the company must conduct in-use compliance testing of the strategy to demonstrate that the expected percentage of emissions reductions is being achieved. The company must report the results to the Executive Officer within 30 calendar days. If testing shows the unit does not meet the emission requirements, the unit cannot be used to satisfy the emission requirements of the regulation.

At a minimum, emission control technologies shall be tested annually to demonstrate that the expected percentage of emissions reductions are being achieved. The applicant shall provide the results of such testing to the Executive Officer by December 31, annually. The Executive Officer may modify the testing frequency as he or she deems appropriate. The Executive Officer may request that the owner or operator of a CAECS conduct periodic emission source testing or other types of monitoring to verify the proper operation of alternative control technologies or distributed generation equipment, or to verify the emission rate of an auxiliary engine.

The use of a CAECS requires the terminal to begin controlling emissions within two hours after “Ready to Work” and cease controlling emissions no sooner than one hour before “Pilot on Board.”

Terminals that receive a vessel at a berth without shore power are responsible for arranging a CAECS for each visit by vessels with requirements for auxiliary engines or tanker auxiliary boilers. If neither

the vessel nor the terminal has shore power, then it is the shared responsibility of both parties to arrange a CAECS for this visit.

Terminal operators shall record inlet and outlet levels of emissions during the visit.

11.2. Shore-Based System Description

Land-based capture and control systems are essentially land-based versions of the barge-based systems described in the section above. The hood and transfer duct on a land-based system is supported and positioned by a shore-based mobile or fixed crane. The treatment system can be permanently installed onshore, on an overwater marine structure, or mounted to a mobile chassis for repositioning. A process flow diagram of the treatment system from the treatment vendor, CAEM is shown in Figure 8.

11.3. Treatment System Vendors

Per discussions with CAEM and STAX, they can offer to supply a capture and control system that could be incorporated into a shore-based system. The same treatment technology used on the barge-based system could be used in a shore-based system. It is also possible that additional treatment system vendors may enter the market.

11.4. Capture and Control Platform

A new 100 ft x 50 ft overwater platform is required to support the capture and control system. The platform consists of a steel pile supported concrete deck system with safety railing. A pedestrian walkway is provided back to shore. Due to existing site infrastructure, the location of the platform will not facilitate vehicular access from shore. Therefore, any maintenance activities and resupply will require the use of a barge.

The platform is assumed to fall under the jurisdiction of the California State Lands Commission and therefore must comply with CBC Chapter 31F: Marine Oil Terminals commonly referred to as MOTEMS.

11.5. Capture System Crane

A crane is used to locate the capture system hood over the vessel stacks. Based on the reach requirements in Table 8, there are no commercially available crane systems that are designed for this use and reach. A custom crane and capture system will need to be designed and constructed. It is possible an articulating boom crane mounted to a tower could be purchased from a crane vendor similar to what is proposed on the CAEM barges under construction (see Figure 11).

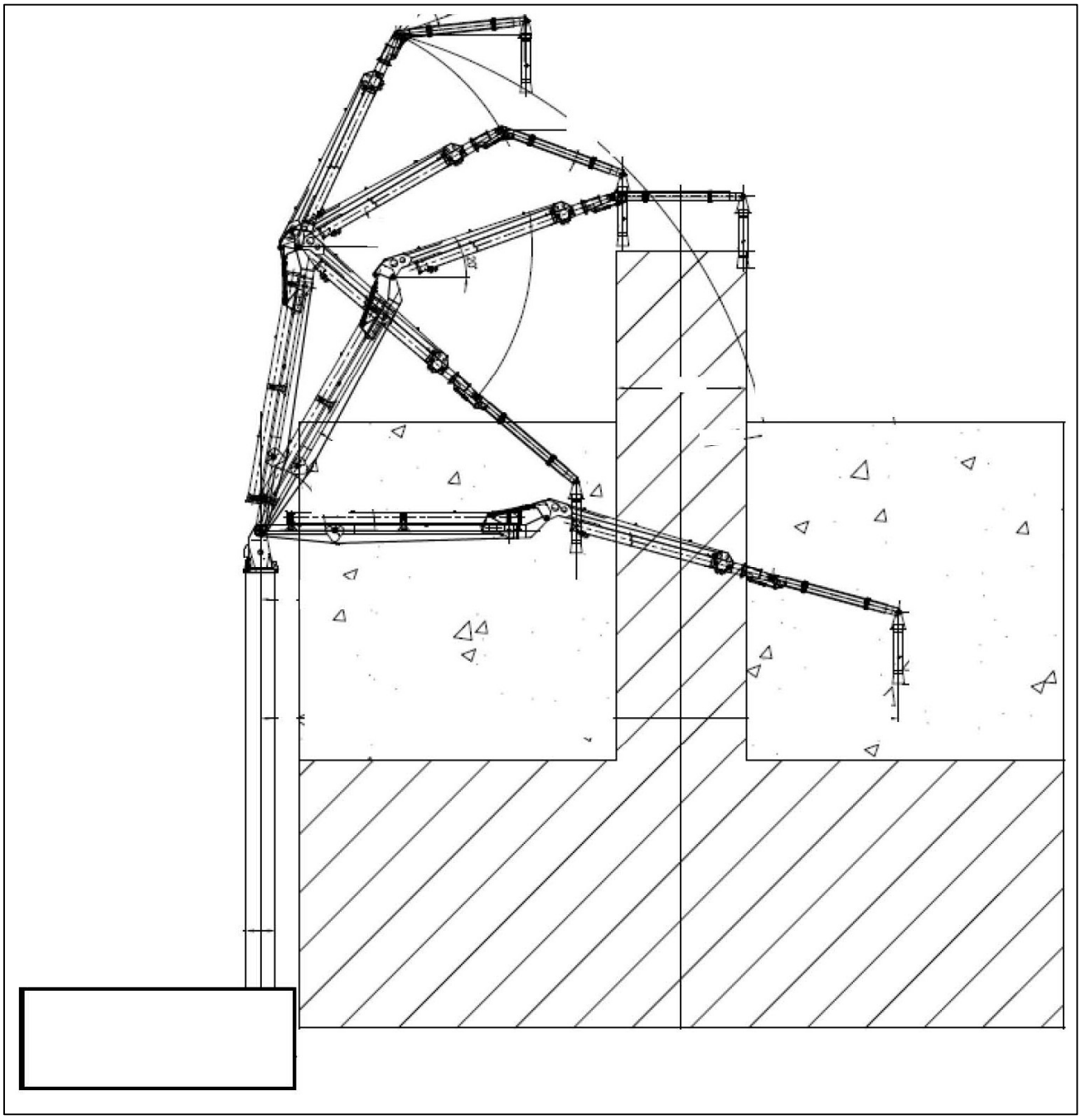

Figure 11: Articulating Crane Boom System (CAEM)

12. Innovative Concepts Discussion

In lieu of establishing a CAECS or to provide time for a CAECS to be implemented, the regulation allows the use of an “Innovative Concept.” The innovative concept reduces emissions from sources in and around the regulated port or marine terminal at a level equivalent or greater to what would be achieved using a CAECS. One or more innovative concepts can be implemented, provided the innovative concepts result in emission reductions of PM 2.5, NOx, and ROG that are at least equivalent to the emission reductions that would have occurred using a CAECS, while not increasing GHG. The reductions must be at the same port or marine terminal, within adjacent communities, or overwater within three nautical miles of the port or marine terminal. The proposed innovative concept must not increase emissions at other ports or marine terminals. No innovative concept shall have a compliance period greater than five years. An application seeking approval for proposed innovative concepts must be submitted to CARB by December 1, 2021.

The scope of this study does not include identifying or evaluating innovative concept options. However, it is recommended that Valero submit an innovative concept application as part of the December 1, 2021 CARB Terminal Compliance Plan to reserve the right to use an innovative concept if one is identified for use in the future. Example language is suggested below:

Valero reserves the right to evaluate all innovative compliance options that are or may become available as the terminal continues to plan for CARB compliance.

13. Cost Estimate

13.1. Summary

To support planning and selection of the most likely control strategy as part of the Terminal Compliance Plan due to CARB December 1, 2021, a cost estimate was developed for the CARB compliance options. Due to the high-level nature of the study, the cost estimate was developed to an AACE International Class 5 level with an accuracy range of -30% / +50%. This level of estimate is typical for conceptual planning and budgetary purposes.

The costs have been developed based on historical and current data using in-house sources, information from previous studies, as well as budget quotations solicited from suppliers, vendors, and contractors. Costs for the marine structures were based on other similar projects at marine oil terminals in the Bay Area and at Wilmington. Costs for the barge-based system, treatment system, and shore power infrastructure are based on budgetary estimates received from qualified vendors. Note that the estimate assumes the barge system can operate with anchors or by mooring to existing structures. If this is not acceptable, the cost would increase. Refer to Table 11 for a summary of the cost estimate and Attachment J for detailed cost estimate back-up including assumptions. Note that the options present an upfront capital cost and an estimated annual operational cost for the first year of operations.

Table 11: Cost Estimate Summary (Accuracy Range -30% to +50%)

No	Item	Total Upfront Cost	Approx. Annual Operation Cost	Total Cost at Year 10
1	Shore Power	$55,320,000	$4,510,000	$100,420,000
2	Capture and Control – Barge Based			
2a	Purchase (non-IS)	$23,199,000	$3,420,000	$57,399,000
2b	Long-Term Service Agreement (non-IS)	$1,000,000	$6,580,000	$66,800,000
2c	Purchase (IS)	$25,399,000	$4,210,000	$67,499,000
2d	Long-Term Service Agreement (IS)	$1,000,000	$7,360,000	$74,600,000
2e	Purchase (non-IS & 65k bbl/hr)	$26,499,000	$4,210,000	$68,599,000
2f	Long-Term Agreement (non-IS & 65k bbl/hr)	$1,000,000	$7,760,000	$78,600,000
2g	Purchase (IS & 65k bbl/hr)	$28,699,000	$5,000,000	$78,699,000
2h	Long-Term Agreement (IS & 65k bbl/hr)	$1,000,000	$8,550,000	$86,500,000
3	Capture and Control – Shore Based			
3a	Non-IS System	$51,684,000	$4,470,000	$96,384,000
3b	IS System	$54,084,000	$5,260,000	$106,684,000
3c	Non-IS System (65k bbl/hr)	$55,284,000	$6,180,000	$117,084,000
3d	IS System (65k bbl/hr)	$57,684,000	$6,970,000	$127,384,000

Notes:

1. Estimates presented do not include any costs to upgrade or retrofit vessels as may be required
2. IS = intrinsically safe if required, a non-IS safe system may be acceptable to some terminals and operators if operations can be demonstrated to occur outside the hazardous area
3. Purchase = Valero own the equipment and pay a barge vendor to operate it
4. Long-Term Agreement Service = Valero enters into a long-term agreement (+/- 10 year) with a barge vendor, Valero has first priority on use of equipment, equipment could earn revenue when not used at Valero Benicia (estimate conservatively assumes no revenue is realized)
5. 65k bbl/hr options show the added capital and operating cost to upgrade the treatment system for a 65,000 barrel per hour capacity.

13.2. Limitations

The cost estimate is an 'Opinion of Probable Cost' (OPC) made by a consultant. In providing opinions of construction cost, it is recognized that the consultant has no control over the cost of labor, equipment, and materials or over the vendor or contractor's means and methods of determining constructability, pricing, or schedule. The opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that the contractor's bids, negotiated prices, or actual execution of the work will not vary from the OPC.

This report was prepared by Moffatt & Nichol for Valero, for a specific purpose and specific project using the standard of care prevailing at the time the work was done and is provided for information only. The material contained within it reflects Moffatt & Nichol's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third-parties. Moffatt & Nichol accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

14. Implementation Schedule

A high-level project implementation schedule was developed for each option. The schedule makes the following assumptions:

- No in-water work is permitted from September to November due to delta smelt season.
- The risks and technical challenges presented in this report are resolved within the proposed schedule. Any unmitigated risks or technical challenges that prevent a compliance option from moving into development and implementation may extend the schedule from what is shown here.
- Valero will not select a CAECS until after an adequate review of CARB's analysis and findings scheduled to be published by December 1, 2022. It is assumed this process will occur over a 6-month period prior to determining a preferred compliance option and initiating a project.
- Valero will not make a final funding decision until all permits and approvals are received.

Based on these assumptions, none of the compliance options can be reasonably implemented before the CARB compliance deadline of January 1, 2027.

Refer to Attachment K for a matrix of the required permits and approvals and Attachment L for a detailed project implementation schedule of the options.

Attachment A – Marine Terminal As-Built Drawing

2922-134-CD-1	VICINITY MAP & GENERAL NOTES
2922-134-CD-2	DREDGING PLAN
2922-134-CD-3	DREDGING CROSS SECTIONS SHT #1
2922-134-CD-4	DREDGING CROSS SECTIONS SHT #2
2922-134-CD-5	CRUDE PIER PLOT PLAN

N

N 3285.89
E 5764.83

70' RIGHT-OF-WAY

N 3158.75
E 5742.08

N 3162.71
E 5827.04

N 3154.78
E 5749.12

36" MOV

36" CRUDE LINE

N 3045.09
E 5799.24

N 2947.00
E 5829.33

N 3024.38 G27
E 5879.99

N 2915.49
E 5759.64

EXISTING RAILROADS

S 74° 01' 20" W 992.79'

N 2873.41 G27A
E 5101.70

ELECTRICAL POWER CENTER

CRUSHED ROCK PAVING

FIRE WATER PUMP START BUTTON

11' ROADWAY INCLUDING 6" CURB EACH SIDE

18' PIPEWAY

22'

HYDRANT

PUMPER CONN'S

N 2773.98
E 5490.11

MOORING DOLPHIN CMD-2

LADDER

POWER CAPSTAN

4000 GALLON PORTABLE TANK

CATWALK

2-100 TON CAPACITY QUICK RELEASE MOORING HOOKS

N 2751.82
E 5566.46

DOCK EQUIPMENT STORAGE

FIRE WATER PUMP W/INLET BUTTON

FIRE MONITOR

FIRE HYDRANT

REMOTE CONTROL 36" MOV

GANGWAY OPERATING STRUCTURE

6" CONCRETE CURB ALL AROUND

3000 GAL SUMP & SUMP PUMP

6" CONC CURB ALL AROUND

OIL SPILL CLEANUP EQUIPMENT STORAGE

500' OIL SPILL CONTAINMENT BOOMS

CRUDE PIER

N 2795.11
E 6049.44

POWER CAPSTAN BOLLARDS TO BE PURGED

FLEXIBLE FENDER SYSTEM DESIGNED FOR TANKER IMPACT

N 2745.98
E 5881.24

3 LOADING ARMS ALL OTHERS FUTURE

OPERATORS SHELTER

POWER CAPSTAN

N 2696.97
E 5713.74

N 2668.62
E 5620.10

PIER

MANIFOLD

N 73° 33' 49" E FACE OF PIER

CRUDE TANKER
191,000 DWT
55' BEAM
1055' LONG

34' BULBOUS BOW

500'

555'

CARQUINEZ STRAIT

FLOOD

EBB

4" VACUUM SYSTEM FOR OIL SPILL CLEANUP

2-PILE CATWALK SUPPORT (TYP)

N 2678.30
E 5338.15

WHARF LEASE BOUNDARY LINE

N 82° 13' 49" E 484.59'

4-100 TON CAPACITY QUICK RELEASE MOORING HOOKS

N 2526.09
E 5395.35

EXISTING WHARF

FACE OF EXISTING WHARF

PIERHEAD LINE

N 2609.11
E 5100.56

SURVEY POINT "A" SPIKE & WASHER IN DECK

N 2609.068
E 5159.684

N 2611.85
E 5204.69

POINT "A" IS NAIL AND SHINER CIRCLED AND LABELED
POINT G-27 AND G-27A ARE 1/2" ø IRON PIPE WITH LABELED GUARD STAKES

MOORING DOLPHIN - CMD-3

LADDER

POWER CAPSTAN

CATWALK

2-100 TON CAPACITY QUICK RELEASE MOORING HOOKS

N 2921.60
E 6147.45

LADDER

MOORING DOLPHIN - CMD-4

POWER CAPSTAN 2-100 TON CAPACITY QUICK RELEASE MOORING HOOKS

POWER CAPSTAN

3 PILE CATWALK SUPPORT

BOLLARD

N 2925.98
E 6334.04

PROTECTIVE FENDER DOLPHIN - PFD-1

N 2903.35
E 6435.58
4" PILE

N 2899.95
E 6424.09
4" PILE

185'

175'

85'

55'

BENICIA-MARTINEZ BRIDGE

BRIDGE FOOTING & FENDER SYSTEM FOR PIER No. 4

GENERAL ARRANGEMENT PLAN
SCALE 1" = 50'

REV	DATE	DESCRIPTION	APPRO
7	5-23-73	ADDED OIL CONTAINMENT EQUIPMENT	RDM
6	1/29/68	ADDED ELECTRICAL POWER CENTER	RAH
5	11-22-67	SURGE TANK AREA DELETED, FIRE WATER SYSTEM REVISED, 4 MOORING HOOKS ON CMD-1 WAS 3 HOOKS	RAH
4	8-15-67	COORD. REVISED @ POINT "A" DIMENSION FROM POINT "A" TO POINT G27A CHANGED	RAH
3	5/25/67	CURB ADDED ALL AROUND, POWER CAPSTAN RELOCATED	RAH
2	4/7/67	ISSUED FOR CONSTRUCTION	RAH
1	2/8/67	REDRAWN, RELOCATED FACE OF PIER, REISSUED	RAH
0	12/7/66	ISSUED FOR REVIEW	RAH

ISSUED FOR CONSTRUCTION
BY R.G. Hubbard CE #8942 DATE 4/7/67

DESIGNED	DRAWN	REVIEWED	APPROVED
J&M TTN	T. NAFIUS	J&M	RAH

FOR HUMBLE OIL & REFINING COMPANY
AT BENICIA CALIFORNIA

BENICIA REFINERY
MARINE FACILITIES — CIVIL
CRUDE PIER
GENERAL ARRANGEMENT PLAN

ALHAMBRA **C F BRAUN & CO** CALIFORNI

SCALE	DRAWING NUMBER	RE
1" = 50'	2922-134-CD-6	
DATE 12-7-66		

Attachment B – Caltrans Correspondence

Trowbridge, Matthew

Subject: Benicia-Martinez Bridge Contact Request

From: Mantravadi, Surya 'Sunny' N@DOT <surya.n.mantravadi@dot.ca.gov> **On Behalf Of** D4Permits@DOT
Sent: Thursday, September 30, 2021 12:00 AM
To: Dekker, Garrett <gdekker@moffattnichol.com>; D4Permits@DOT <D4Permits@dot.ca.gov>
Subject: RE: Benicia-Martinez Bridge Contact Request

Hello Garrett,

I have contacted Caltrans Structure Maintenance & Investigation Group. Here is the input I received:

They have stated they do not have any restrictions. However, they will need space around the piers to do the inspections using small boats.

Nothing should be moored to the piers or fender systems.

Caltrans Structure Maintenance asked for the information how the barges will be anchored or spudded so that they know what to avoid when they do perform inspections or maintenance work on the piers.

The Coast Guard may have other restrictions.

Thank you contacting us.

Surya “Sunny” Mantravadi, CE, TE
Senior Permit Engineer
Caltrans/D4/Traffic Ops/Encroachment Permits
510-286-4424 Work
510-304-3885 Cell

From: Dekker, Garrett <gdekker@moffattnichol.com>
Sent: Wednesday, September 29, 2021 8:55 AM
To: D4Permits@DOT <D4Permits@dot.ca.gov>
Subject: Benicia-Martinez Bridge Contact Request

Good Morning,

I am reaching out because my firm is working with Valero Benicia to evaluate berthing options at their facility on the north side of the Carquinez Straight. One option being evaluated would require a capture and control barge to be staged close to the George Miller Jr. Benicia-Martinez Bridge, see the attached illustrations. As the attached “Feasibility Study” pdf shows, we would **not** be staging the barge within State ROW, and therefore I do not believe we would need to go through an encroachment permit process. However, we would like to determine if there are any restrictions that may

apply to vessels staged close to the State's toll bridge (albeit out of the State ROW). In other words, is this proposal a non-starter? Given my assumption that an encroachment permit is not needed, what is our best course of action to obtain input from Caltrans? The Google Maps link below shows the location in question.

https://www.google.com/maps/@38.0455979,-122.1287295,426m/data=!3m1!1e3

Thank you in advance for your help, and don't hesitate to reach out with questions.

Garrett Dekker, PE
Moffatt & Nichol
2185 N. California Blvd., Suite 500
Walnut Creek, California 94596
Main (925) 944-5411 | Direct (925) 956-4947 | gdekker@moffattnichol.com

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www.moffattnichol.com

Trowbridge, Matthew

Subject: Benicia-Martinez Bridge Contact Request

From: Woods, Mark P@DOT <mark.woods@dot.ca.gov>
Sent: Wednesday, September 29, 2021 3:01 PM
To: Dekker, Garrett <gdekker@moffattnichol.com>; Thometz, Edward J@DOT <edward.thometz@dot.ca.gov>
Subject: RE: Benicia-Martinez Bridge Contact Request

Hi Garrett,

I sent a response similar to Ed's to our Maintenance folks who were responding to Permits. Nothing should be moored to our piers or fender systems. It would be good to know how the barges will be anchored or spudded so that we know what to avoid when we do perform our inspections or maintenance work on the piers.

Mark Woods
Senior Bridge Engineer
California Department of Transportation
HQ Division of Maintenance
Structure Maintenance & Investigations- Toll Bridges
Cell (916) 765-3187

From: Dekker, Garrett <gdekker@moffattnichol.com>
Sent: Wednesday, September 29, 2021 2:40 PM
To: Thometz, Edward J@DOT <edward.thometz@dot.ca.gov>
Cc: Woods, Mark P@DOT <mark.woods@dot.ca.gov>
Subject: RE: Benicia-Martinez Bridge Contact Request

Hi Ed,

Thanks for the quick response and input! My family is doing well. The kids are growing up fast, both in school now. Last year was a bit tricky with COVID, but they are in-person again and things are more/less normal for them.

Mark – It is good to be introduced to you. I did submit my inquiry to the D4 Permits office, but if you need any additional information from me on this request, please let me know. We certainly want to steer clear of any proposals that would ultimately be disallowed by SM&I.

Regards,

Garrett Dekker
Moffatt & Nichol

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From: Thometz, Edward J@DOT <edward.thometz@dot.ca.gov>
Sent: Wednesday, September 29, 2021 12:14 PM
To: Dekker, Garrett <gdekker@moffattnichol.com>

Cc: Woods, Mark P@DOT <mark.woods@dot.ca.gov>
Subject: FW: Benicia-Martinez Bridge Contact Request

Hi Garrett,

Great to hear from you!

Unless you are mooring from one of the bridge piers, which is not the case, as well as not even being within State ROW, as you stated, I believe that you probably only need to get marine clearance with the Coast Guard. But I am not 100% sure of that.
The Bridge Senior for the Benicia-Martinez is Mark Woods (CC'd on this email). He would be the key contact for inquiries for said bridge. And yes, I concur that you get in touch with our D4 Permits office as well.

Hope you and the family are well?!

Kind Regards, Ed

****

Edward J. Thometz, P.E.
Senior Bridge Engineer, Toll Bridge Investigations - South Branch
Structure Maintenance & Investigations, Toll Bridges
Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Cell: (510) 529-1743
edward.thometz@dot.ca.gov

"The most difficult thing is the decision to act. The rest is merely tenacity."
-- Amelia Earhart, aviator

From: Dekker, Garrett <gdekker@moffattnichol.com>
Sent: Wednesday, September 29, 2021 8:50
To: Thometz, Edward J@DOT <edward.thometz@dot.ca.gov>
Subject: FW: Benicia-Martinez Bridge Contact Request

Hi Ed,

It's been a long while, I hope you are well!

I am reaching out because my firm is working with Valero Benicia to evaluate berthing options at their facility on the north side of the Carquinez Straight. One option being evaluated would require a capture and control barge to be staged close to the George Miller Jr. Benicia-Martinez Bridge, see the attached illustration. We would **not** be staging the barge within State ROW, and therefore I do not believe we would need to go through an encroachment permit process. However, we would like to determine if there are any restrictions that may apply to vessels staged close to the State's toll bridge (albeit out of the State ROW). In other words, is this proposal a non-starter? I will also reach out to the District 4 Permit Office, but I understand this is ultimately an SM&I question, so I'm wondering if you might know the appropriate contact. The Google Maps link below shows the location in question.

https://www.google.com/maps/@38.0455979,-122.1287295,426m/data=!3m1!1e3

Thank you in advance for your help!

Garrett Dekker, PE
Moffatt & Nichol
2185 N. California Blvd., Suite 500
Walnut Creek, California 94596
Main (925) 944-5411 | Direct (925) 956-4947 | gdekker@moffattnichol.com

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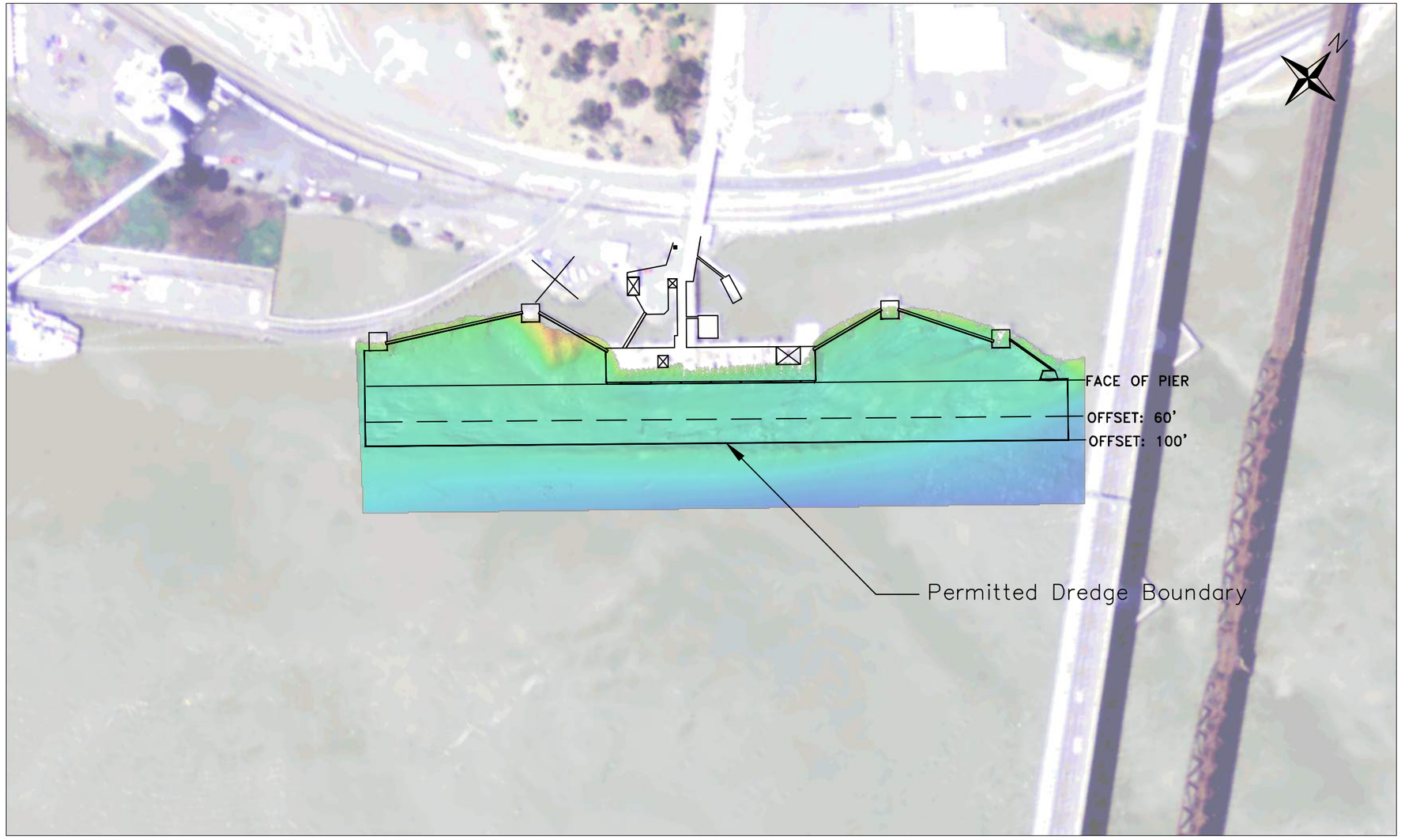
Attachment C – Available Bathymetric Surveys

BENICIA REFINERY

VALERO

HYDROGRAPHIC SURVEY

Overview



not to scale

SHEET INDEX:

GENERAL NOTES:

1. SURVEY DATA COLLECTED ON AUGUST 26, 2021
2. HORIZONTAL DATUM/PROJECTION: NAD83 (2011) SPCS CALIFORNIA ZONE 03 - U.S. SURVEY FEET
3. HORIZONTAL CONTROL: ETRAC REFERENCE STATION: MARTINEZ 38°01'24.75685" N, 122°08'12.23358" W
4. VERTICAL DATUM: MLLW, U.S. SURVEY FEET
5. THIS SURVEY REPRESENTS GENERAL CONDITIONS AT THE TIME OF THE SURVEY.
6. POSITIONING AND MOTION DATA WAS COLLECTED USING AN APPLANIX POS MV V5.
7. SOUNDINGS WERE COLLECTED USING AN R2SONIC 2020 OPERATING AT 400 KHZ.

Valero
Benicia Refinery
3400 East 2nd Street
Benicia, CA 94510
United States
707.745.7011
valero.com

eTrac
eTrac Inc.
637 LINDARO STREET
SUITE 100
SAN RAFAEL, CA 94901
415.462.0421
eTracInc.com

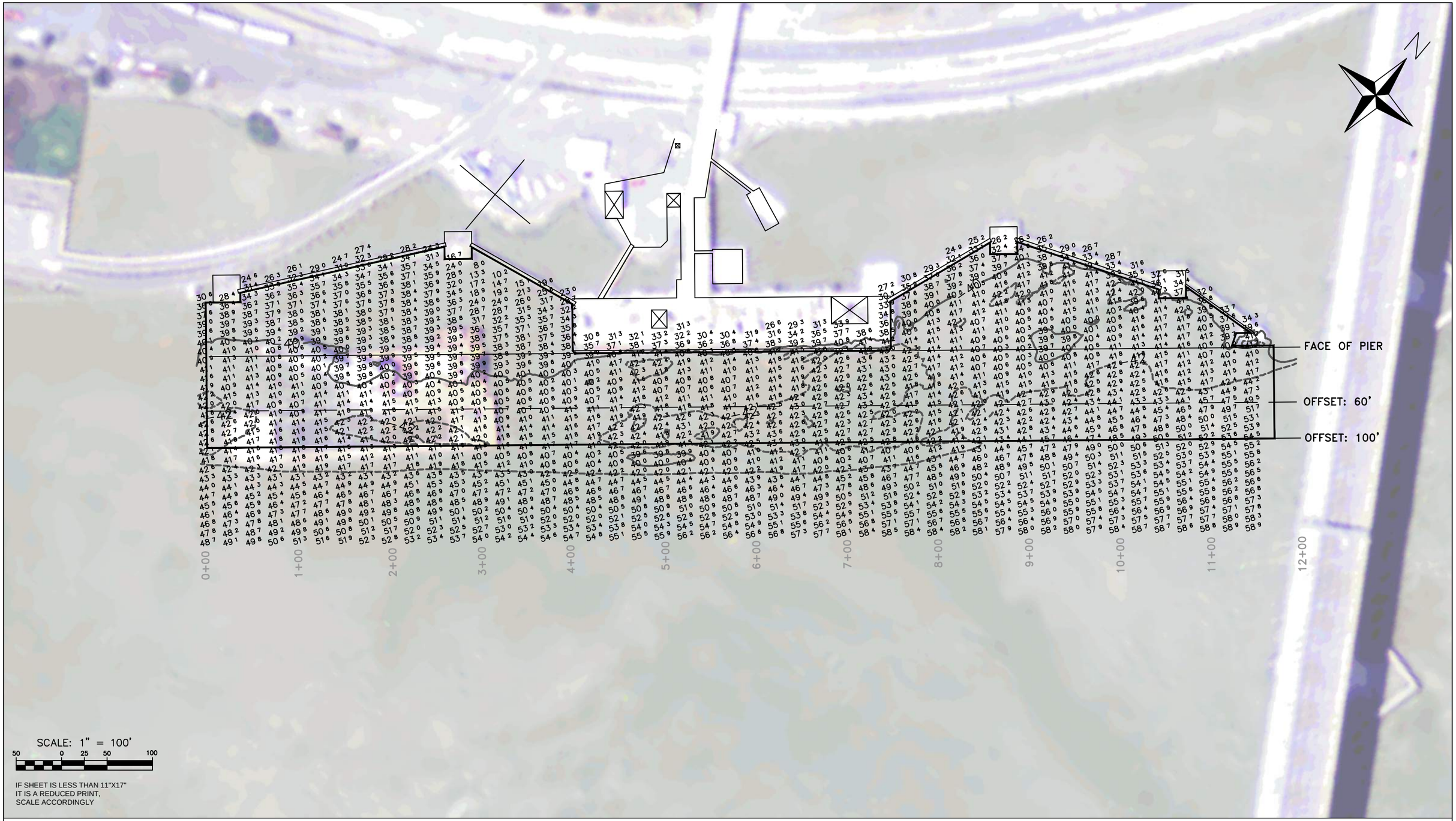
SURVEY DATE: AUGUST 26, 2021	PLOT DATE: August 26, 2021
DESIGNED BY: DRN	CHECKED BY: JAK
REVISION #	
FILE NAME: VALE_20210826_BeniciaRefinery.dwg	

BENICIA REFINERY
VALERO
HYDROGRAPHIC SURVEY

PROJECT INFORMATION

Reference Number:

S1



Benicia Refinery
3400 East 2nd Street
Benicia, CA 94510
United States
707.745.7011
valero.com

eTrac Inc.
637 LINDARO STREET
SUITE 100
SAN RAFAEL, CA 94901
415.462.0421
eTracInc.com

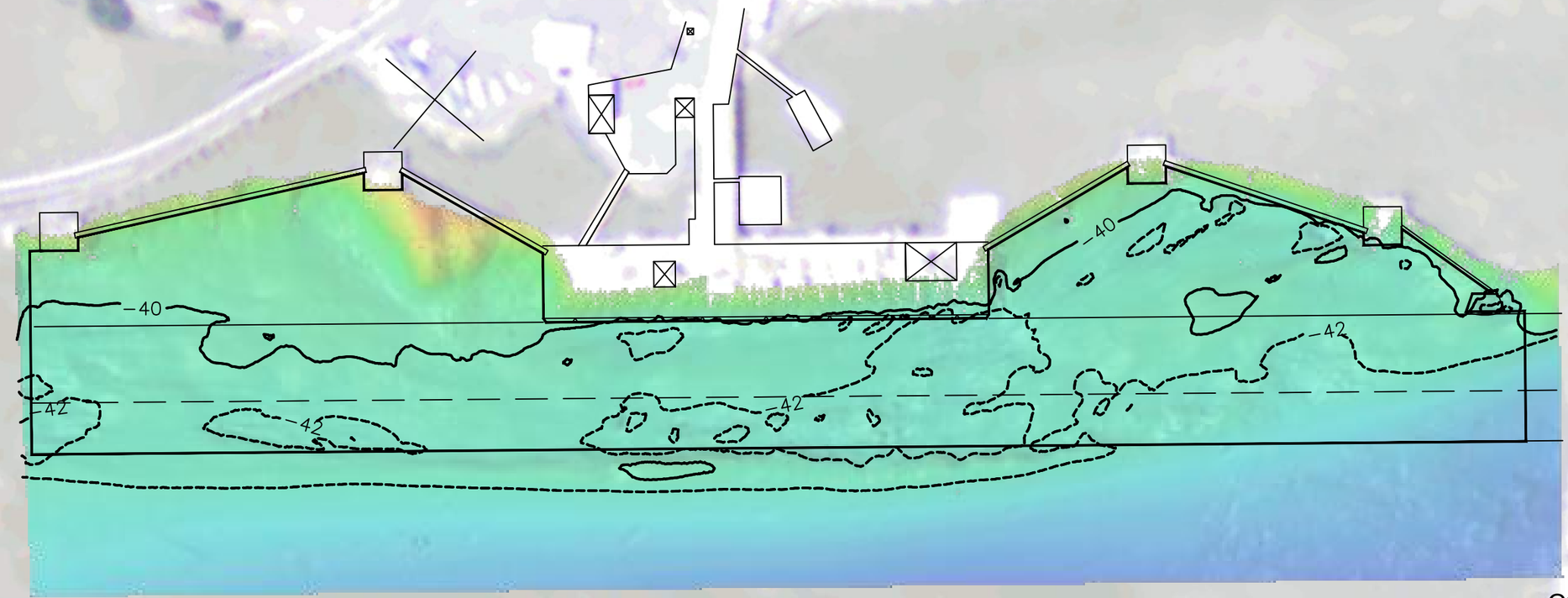
SURVEY DATE: AUGUST 26, 2021	PLOT DATE: August 26, 2010
DESIGNED BY: DRN	CHECKED BY: JAK
REVISION #	
FILE NAME: VALE_20210826_BeniciaRefinery.dwg	

BENICIA REFINERY
VALERO
HYDROGRAPHIC SURVEY

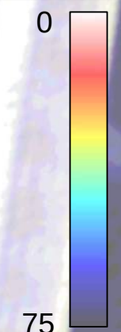
SOUNDINGS

Reference Number:

S2



COLOR BAR
(FT BELOW MLLW)



SCALE: 1" = 100'

50 0 25 50 100

IF SHEET IS LESS THAN 11"X17"
IT IS A REDUCED PRINT,
SCALE ACCORDINGLY

Benicia Refinery
3400 East 2nd Street
Benicia, CA 94510
United States
707.745.7011
valero.com

eTrac Inc.
637 LINDARO STREET
SUITE 100
SAN RAFAEL, CA 94901
415.462.0421
eTracInc.com

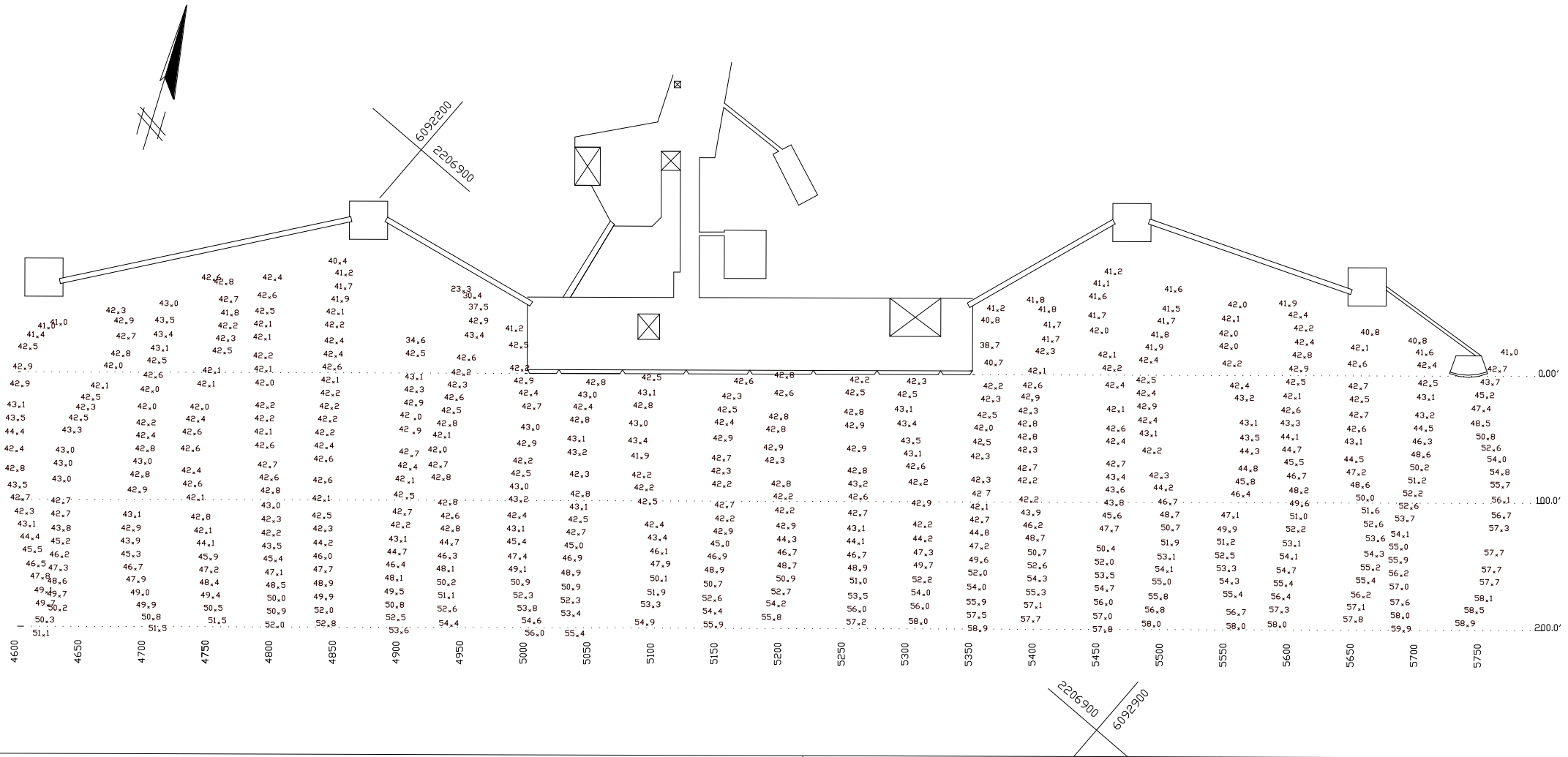
SURVEY DATE: AUGUST 26, 2021	PLOT DATE: August 26, 2021
DESIGNED BY: DRN	CHECKED BY: JAK
REVISION #	
FILE NAME: VALE_20210826_BeniciaRefinery.dwg	

BENICIA REFINERY
VALERO
HYDROGRAPHIC SURVEY

COLORED DEM

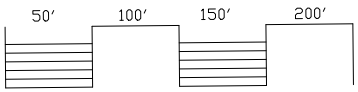
Reference Number:

S3



NOTES:

1. *NUMBERS SHOWN REPRESENT DEPTHS AT 0.0' TIDE (MLLW DATUM).*
2. *DEPTHS ARE IN FEET AND TENTHS OF A FOOT.*
3. *THE DECIMAL POINT IS THE LOCATION OF THE DEPTH READING.*
4. *DATUM USED IS N.O.S. B.M. 5111D (ELEV.=10.19 M.L.L.W.)*
5. *HORIZONTAL DATUM IS CALIF. CO-ORDINATE SYSTEM. NAD 83, ZONE III.*
6. *EQUIPMENT USED: STARLINK DGPS, ODOM DF3200 FATHOMETER W/ 3 DEGREE TRANSDUCER, HYPACK "MAX" SOFTWARE.*
7. *SEAFLOOR MATERIAL IS "BAY MUD".*

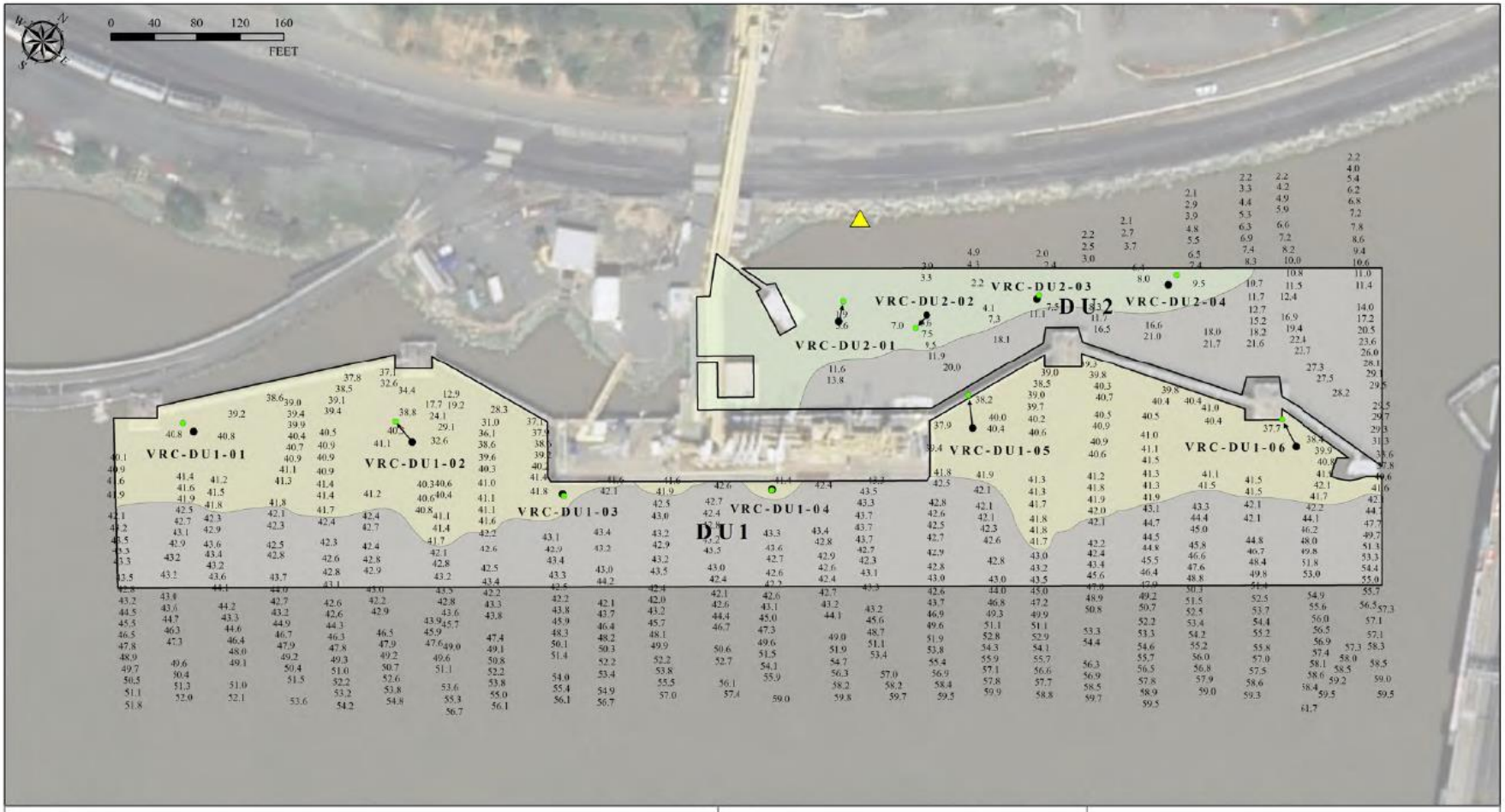


SURVEYED BY:
HERMAN HOLDENER HYDROGRAPHIC
350 MAGNOLIA AVE.
VACAVILLE, CA. 95688
Ph. (707) 486-8434

Hydrographic Survey
Valero Crude Wharf
Benicia, Calif.

SURVEYED: 06-10-2019

SCALE: 1"=60'



LEGEND

- ACTUAL SAMPLE LOCATIONS
- PROPOSED SAMPLE LOCATIONS
- STORMWATER OUTFALL
- PERMITTED DREDGE BOUNDARY *5.8 Acres*
- DU1: DREDGE FOOTPRINT *2.1 Acres, Dredge Depth -42 + 2ft Overdepth*
- DU2: DREDGE FOOTPRINT *0.7 Acres, Dredge Depth -10 + 1ft Overdepth*

NOTES

1. HORIZONTAL DATUM/PROJECTION: NAD83/SPCS CA ZONE 3.
2. SURVEY DATA COLLECTED BY HERMAN HOLDENER HYDROGRAPHIC 10/10/2019.
3. NUMBERS SHOWN REPRESENT DEPTHS AT 0.0' TIDE (MLLW DATUM).
4. DATUM USED IS N.O.S. B.M. 5111D (ELEV. = 10.19 M.L.L.W.).
5. EQUIPMENT USED: STARLINK DGPS, ODOM DF3200 FATHOMETER W/ 3 DEGREE TRANSDUCER, HYPACK "MAX" SOFTWARE
6. SEAFLOOR MATERIAL IS "BAY MUD."
7. MAP CREATED BY PACIFIC ECORISK 02/19/20.

FIGURE 2-1.

SITE MAP: VALERO REFINING COMPANY
PROPOSED AND ACTUAL SAMPLE LOCATIONS

PACIFIC ECORISK | ENVIRONMENTAL CONSULTING & TESTING

Attachment D – Site Geotechnical Information

SELECTED PAGES FROM:

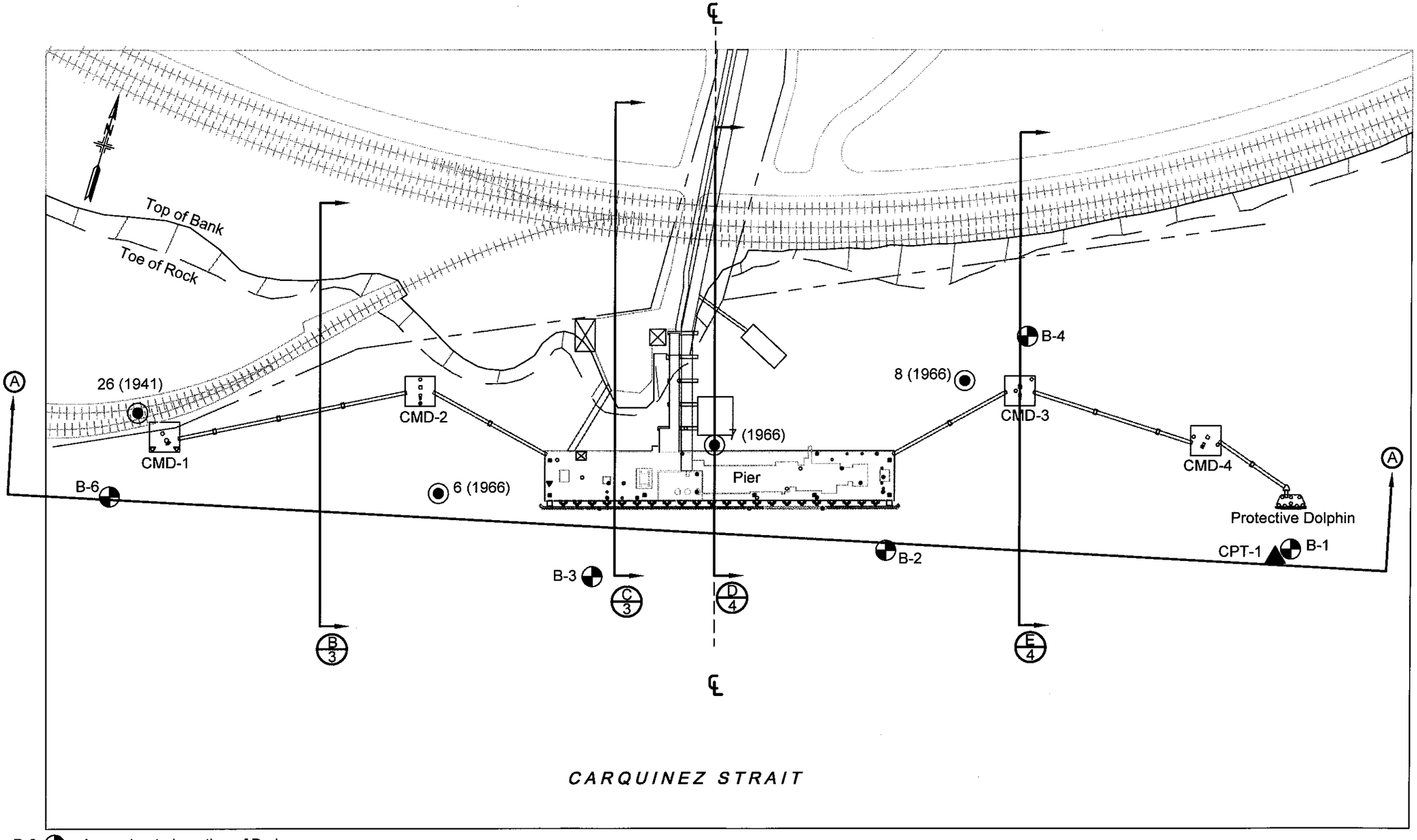
GEOTECHNICAL INVESTIGATION

CRUDE OIL TERMINAL
VALERO REFINERY
BENICIA, CALIFORNIA

Project No. 672.03
April 8, 2008

Prepared by

Hultgren – Tillis Engineers



B-6 Approximate Location of Boring

8 (1966) Approximate Location Previous Boring (year drilled)

CPT-1 Approximate Location of CPT

B/3 Cross Section*

* Section lines were selected from "Crude Pier Dredging Plan, C. F. Braun & Co., 2922-134-CD-2, Rev. 3, 8-15-67"

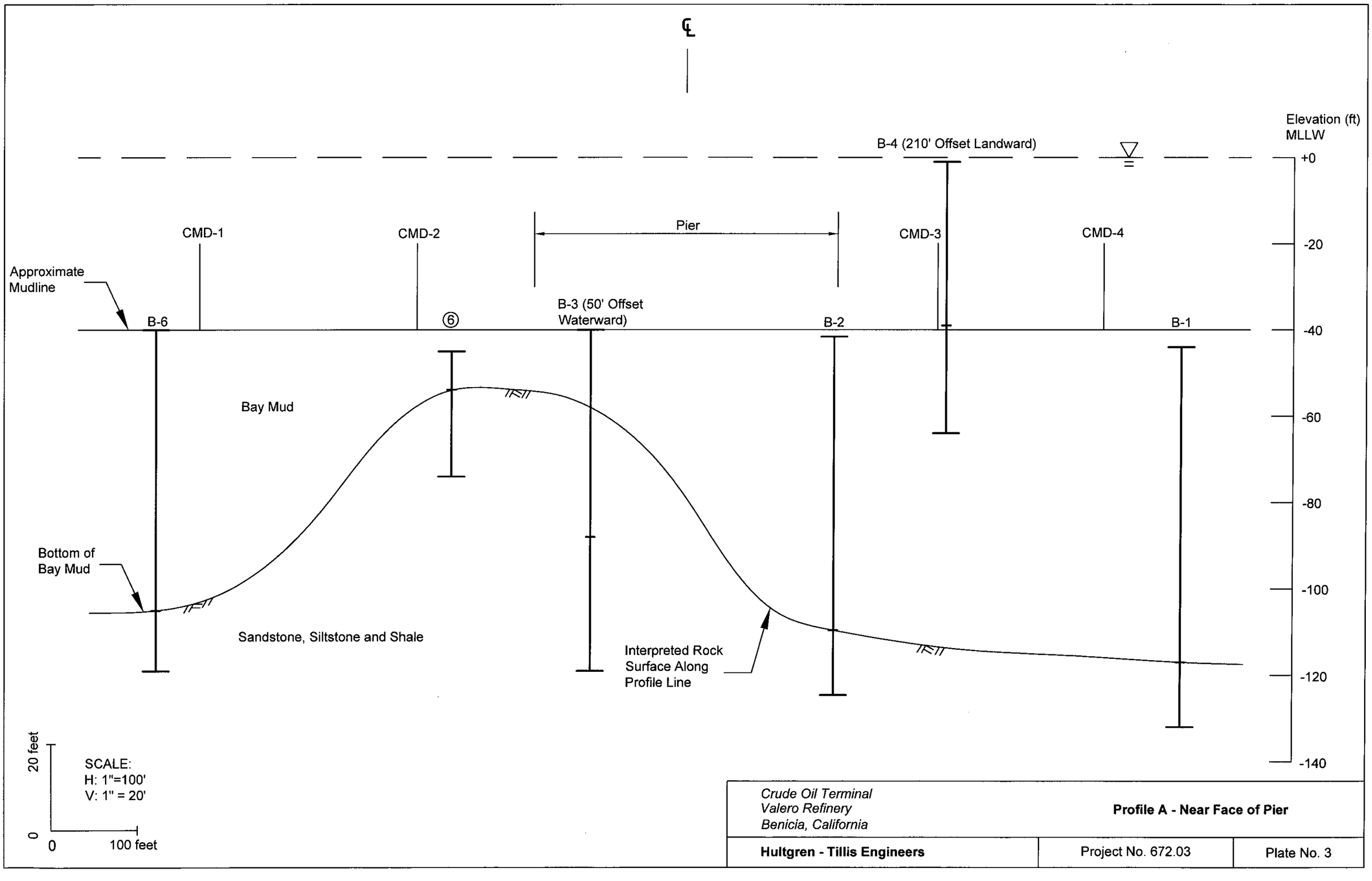
0 100 feet

SCALE: 1" = 100'

Crude Oil Terminal
Valero Refinery
Benicia, California

Site Plan

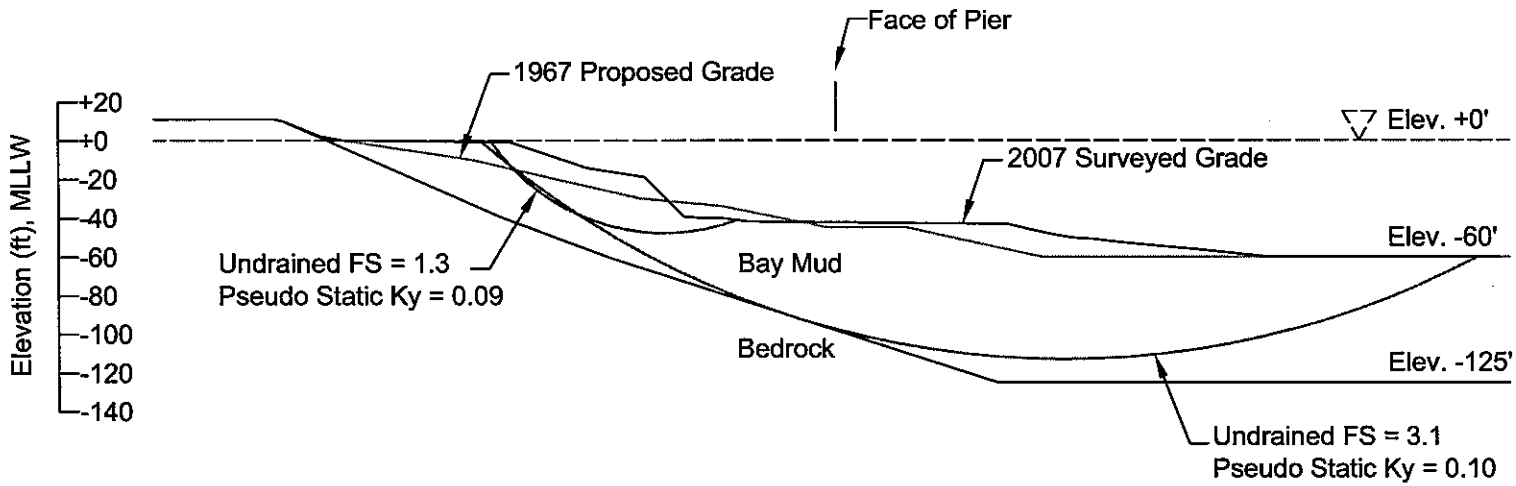
Hultgren - Tillis Engineers	Project No. 672.03	Plate No. 2



Crude Oil Terminal
Valero Refinery
Benicia, California

Profile A - Near Face of Pier

Hultgren - Tillis Engineers	Project No. 672.03	Plate No. 3



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength	
		Cohesion (psf)	Friction Angle (°)
Bay Mud	90	60+6H	0
Bedrock	130	5000	0

SCALE

0 100 feet

1 inch = 100 feet

Crude Oil Terminal
Valero Refinery
Benicia, California

Cross-Section E/4
Existing Condition

Hultgren - Tillis Engineers

Project No. 672.03

Plate No. 15

Boring Log 1

Hultgren-Tillis Engineers

LOG OF BORING 1

Date Drilled : December 17, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +7 NAVD (+6.1 MLLW)
Northing : 2207282
Easting : 6092979

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B1

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
0					▼	Deck of Barge					
						Water					
5											
10											
15											
20											
25											
30											

Hultgren-Tillis Engineers

LOG OF BORING 1

Date Drilled : December 17, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +7 NAVD (+6.1 MLLW)
Northing : 2207282
Easting : 6092979

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B2

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
30						Water					
35											
40											
45											
50						Light Gray Elastic Silt (MH), very soft, wet, with fine micaceous sand lenses					
55				MH					80	52	TxUU=143 psf (see Appendix E)
60											

Hultgren-Tillis Engineers

LOG OF BORING 1

Date Drilled : December 17, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +7 NAVD (+6.1 MLLW)
Northing : 2207282
Easting : 6092979

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B3

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
60						Light Gray Elastic Silt (MH), very soft, wet, with fine micaceous sand lenses	0.1		79	53	TxUU=193 psf (see Appendix E)
65		0									
70						lower plasticity			77	53	LL=68, PI=34 (not oven dried) LL=55, PI=24 (oven dried) TxUU=142 psf (see Appendix E)
75				MH			0.05				
80		0					0.05		87	50	TxUU=136 psf (see Appendix E)
85							0.05				
90				MH		Gray Elastic Silt (MH) with silty sand lenses, soft, wet	0.25		95	47	TxUU=548 psf (see Appendix E)

Hultgren-Tillis Engineers

LOG OF BORING 1

Date Drilled : December 17, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +7 NAVD (+6.1 MLLW)
Northing : 2207282
Easting : 6092979

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B4

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
90						Gray Elastic Silt (MH) with silty sand lenses, soft, wet	0.15				
95							0.23				
100				MH		becoming medium stiff	0.25		96	46	TxUU=701 psf (see Appendix E)
105											
110							0.25				
				SM		Gray Silty Sand (SM), loose, wet	0.35				
		0				Gray Fat Clay (CH) with sand lenses, soft, wet	0.2				
115				CH							
		0									LL=57 PI=31
120											

Hultgren-Tillis Engineers

LOG OF BORING 1

Date Drilled : December 17, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +7 NAVD (+6.1 MLLW)
Northing : 2207282
Easting : 6092979

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B5

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
120				CH		Gray Fat Clay (CH) with sand lenses, soft, wet					
				SM		Gray Silty Sand (SM), medium dense, wet, medium grained					
		24									Sieve Analysis (see Appendix E)
125		102/ 4"				Gray Sandstone, weak to moderately strong, low hardness to moderately hard, intensely fractured					
130											
		67/ 5"				becoming low hardness, friable					
135											
		67/ 4"									
140						Bottom of boring at 139.3 feet					
145											
150											

Boring Log 2

Hultgren-Tillis Engineers

LOG OF BORING 2

Date Drilled : December 19, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +6.1 NAVD (+5.2 MLLW)
Northing : 2207011
Easting : 6092667

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B6

Sampler Type
SPT
2.5-inch
3.0-inch
Shelby Tube

Water Levels
During Drilling
After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
0					▼	Deck of Barge					
						Water					
5											
10											
15											
20											
25											
30											

Hultgren-Tillis Engineers

LOG OF BORING 2

Date Drilled : December 19, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +6.1 NAVD (+5.2 MLLW)
Northing : 2207011
Easting : 6092667

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B7

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
30						Water					
35											
40											
45											
50						Gray Elastic Silt (MH), very soft, wet					
55				MH			0.1		85	49	TxUU=141psf (see Appendix E)
60											

Hultgren-Tillis Engineers

LOG OF BORING 2

Date Drilled : December 19, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +6.1 NAVD (+5.2 MLLW)
Northing : 2207011
Easting : 6092667

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B8

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
60						Gray Elastic Silt (MH), soft, wet	0.1		83	57	TxUU=254 psf (see Appendix E)
65						with sand lenses	0.05				
70							0.05		68	58	TxUU=226 psf (see Appendix E)
75				MH		becoming very soft to soft	0.1		66	59	TxUU=231 psf (see Appendix E)
80							0.2		95	46	TxUU=472 psf (see Appendix E)
85							0.15				
90											

Hultgren-Tillis Engineers

LOG OF BORING 2

Date Drilled : December 19, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +6.1 NAVD (+5.2 MLLW)
Northing : 2207011
Easting : 6092667

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B9

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
90						Gray Elastic Silt (MH), very soft to soft, wet					
						becoming medium stiff	0.2		90	49	TxUU=662 psf (see Appendix E)
95				MH							
						increasing sand	0.25				
100		2					0.15				
105		13				Gray Silty Sand (SM), medium dense, wet					Sieve Analysis (see Appendix E)
		23									Sieve Analysis (see Appendix E)
110				SM							
		19				increasing silt content					Sieve Analysis (see Appendix E)
115		53									
						Gray Siltstone, moderate weathering, low hardness to moderately hard, intensely fractured					
120											

Hultgren-Tillis Engineers

LOG OF BORING 2

Date Drilled : December 19, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +6.1 NAVD (+5.2 MLLW)
Northing : 2207011
Easting : 6092667

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B10

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
120											
		67/ 4"				Gray Siltstone, moderate weathering, low hardness to moderately hard, intensely fractured					
125											
130		67/ 1"				Bottom of boring at 130.7 feet					
135											
140											
145											
150											

Boring Log 4

Hultgren-Tillis Engineers

LOG OF BORING 4

Date Drilled : December 21, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +5.3 NAVD (+4.4 MLLW)
Northing : 2207274
Easting : 6092634

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B16

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube
Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
0					▼	Deck of Barge					
						Water					
5						Gray Elactic Silt (MH), very soft, wet					
10							0		106	43	TxUU=88 psf (see Appendix E)
15				MH		with sand lenses	0				
20						Increasing organic content, lower plasticity	0.05		94	48	LL=78, PI=41 (not oven dried) LL=61, PI=28 (oven dried) TxUU=161 psf (see Appendix E)
25							0.15		94	47	TxUU=170 psf (see Appendix E)
30											

Hultgren-Tillis Engineers

LOG OF BORING 4

Date Drilled : December 21, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +5.3 NAVD (+4.4 MLLW)
Northing : 2207274
Easting : 6092634

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B17

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
30						Gray Elactic Silt (MH), very soft, wet					
						with sand lenses	0.1				
35						higher plasticity	0.15		80	53	TxUU=191 psf (see Appendix E) NOTE: H/D was less than 2
				MH		becoming soft	0.15		83	52	TxUU=341 psf (see Appendix E)
40						increasing sand content					
		52				Gray Sandstone, weak to moderately strong, moderate weathering, closely fractured					
45											
		67/ 5"									
50											
55											
		126									
60											

Hultgren-Tillis Engineers

LOG OF BORING 4

Date Drilled : December 21, 2007
Drilling Method : Rotary Wash
Elevation (Feet) : +5.3 NAVD (+4.4 MLLW)
Northing : 2207274
Easting : 6092634

Valero Crude Oil Terminal
Benicia, California

Project No. 672.03 Plate B18

Sampler Type: SPT; 2.5-inch; 3.0-inch; Shelby Tube

Water Levels: During Drilling; After Completion

Depth in Feet	Samples	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Penetrometer (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
60						Gray Sandstone, weak to moderately strong, moderate weathering, closely fractured					
65		125/11"									
						Bottom of boring at 68.2 feet					
70											
75											
80											
85											
90											

Attachment E – MOTEMS Terminal Operating Limits

Valero Benicia Terminal Operating Limits History

Report Description	Initial Audit, Appendix E (Mooring & Berthing Report)	Response to CSLC Comments : Initial Audit	Berth Deepening Memo	Response to CSLC Comments : Revised Ops Manual & Berth Deepening	70,000 DWT Vessel STOL
Approximate Submittal Date	8/6/2008	1/13/2009	9/22/2009	8/17/2010 (CSLC letter) 1/19/2011 (Valero response)	9/2/2011
Major Changes		1) "Min" and "Max" arrival draft STOLs combined per CSLC comment 2) Significant formatting changes		1) Dredge depth at wharf changes from 37' to 42' 2) Polar Class replaces Alaskan Class at request of Valero 3) 215,000 DWT vessel name is corrected to 211,000 DWT based on Ops Manual & CSLC comment	1) Additional vessel (Overseas Palawan) added to fill gap between 40,000 and 125,000 DWT vessels per CSLC request
STOL Label:	STOL Description				
ES-1	215,000 DWT max (Port)	215,000 DWT (Stbd)	No STOL changes	211,000 DWT (Stbd)	211,000 DWT (Stbd)
ES-2	215,000 DWT max (Stbd)	215,000 DWT (Port)		211,000 DWT (Port)	211,000 DWT (Port)
ES-3	215,000 DWT min (Port)	193,000 DWT (Stbd)		125,000 DWT Stbd	125,000 DWT Stbd
ES-4	215,000 DWT min (Stbd)	193,000 DWT (Port)		125,000 DWT Port	125,000 DWT Port
ES-5	193,000 DWT max (Port)	40,000 DWT (Stbd)		40,000 DWT Stbd	40,000 DWT Stbd
ES-6	193,000 DWT max (Stbd)	40,000 DWT (Port)		40,000 DWT Port	40,000 DWT Port
ES-7	193,000 DWT min (Port)	10,000 DWT barge (Port)		10,000 DWT barge (Port)	10,000 DWT barge (Port)
ES-8	193,000 DWT min (Stbd)	-		-	70,000 DWT Stbd
ES-9	40,000 DWT max (Port)	-		-	70,000 DWT Port
ES-10	40,000 DWT max (Stbd)	-		-	-
ES-11	40,000 DWT min (Port)	-		-	-
ES-12	40,000 DWT min (Stbd)	-		-	-
ES-13	-	-		-	-
ES-14	-	-		-	-
ES-15	-	-		-	-
M&N Project #	6287	6287	6850-04	6850-06	6850-09

KEY:

New analysis was run
Superseded
Reformatted Only

Valero Benicia Terminal Operating Limits History

Report Description	STOL Format Changes	39,000 DWT Renewable Biodiesel Vessel STOL	100,000 DWT Vessel STOL	160,000 DWT Vessel STOL	160,000 DWT Vessel STOL
Approximate Submittal Date	8/20/2012	8/1/2016	8/1/2016	6/25/2016	6/25/2016
Major Changes	1) 211,000 DWT vessel re-analyzed with 4 spring lines total (instead of 3) 2) Significant formatting changes	1) 39,000 DWT Renewable Diesel Vessel	1) 100,000 DWT Vessel	1) 160,000 DWT Vessel per Valero Request	1) 120,000 DWT Vessel and 80,000 DWT Vessel per Valero Request 2) Reformatting per Valero Request
STOL Label:					
ES-1	211,000 DWT (Stbd)	211,000 DWT (Stbd)	211,000 DWT (Stbd)	211,000 DWT (Stbd)	211,000 DWT (Stbd)
ES-2	211,000 DWT (Port)	211,000 DWT (Port)	211,000 DWT (Port)	211,000 DWT (Port)	211,000 DWT (Port)
ES-3	125,000 DWT Stbd	125,000 DWT Stbd	125,000 DWT Stbd	125,000 DWT Stbd	-
ES-4	125,000 DWT Port	125,000 DWT Port	125,000 DWT Port	125,000 DWT Port	-
ES-5	40,000 DWT Stbd	40,000 DWT Stbd	40,000 DWT Stbd	40,000 DWT Stbd	40,000 DWT Stbd
ES-6	40,000 DWT Port	40,000 DWT Port	40,000 DWT Port	40,000 DWT Port	40,000 DWT Port
ES-7	10,000 DWT barge (Port)	10,000 DWT barge (Port)	10,000 DWT barge (Port)	10,000 DWT barge (Port)	10,000 DWT barge (Port)
ES-8	70,000 DWT Stbd	70,000 DWT Stbd	70,000 DWT Stbd	70,000 DWT Stbd	-
ES-9	70,000 DWT Port	70,000 DWT Port	70,000 DWT Port	70,000 DWT Port	-
ES-10	-	39,000 DWT Stbd	39,000 DWT Stbd	39,000 DWT Stbd	39,000 DWT Stbd
ES-11	-	-	Not used - saved for 39,000 Port	-	-
ES-12	-	-	100,000 DWT Stbd	100,000 DWT Stbd	-
ES-13	-	-	-	160,000 DWT Stbd	160,000 DWT Stbd
ES-14	-	-	-	-	120,000 DWT Stbd
ES-15	-	-	-	-	80,000 DWT Stbd
M&N Project #	6850-13	6850-15	6850-18	9348-02	9348-02

KEY:

New analysis was run
Superseded
Reformatted Only

Valero Benicia Terminal Operating Limits History

Report Description	2016 MOTEMS Subsequent Audit Submission	160,000 DWT Vessel STOL Rev	CSLC comments Dec 2018	CSLC comments March 2019	CSLC comments July 2019
Approximate Submittal Date	9/30/2016	7/16/2018	1/31/2019	4/23/2019	7/10/2019
Major Changes	Resubmit as part of Audit	1) Revised 160,000 DWT Vessel per CSLC comment	1) 211,000 DWT vessel favorable berthing (0.26ft/s) 2) Polar endeaver change title 125,000 to 139,500 DWT 3) 39,000 DWT update 38ft limited draft	1) Edits to 120,000 DWT Vessel and 80,000 DWT Vessel TOL and analysis per CSLC comments	1) Edits to 120,000 DWT Vessel and 80,000 DWT Vessel TOL and analysis per CSLC comments
STOL Label:					
ES-1	211,000 DWT (Stbd) Rev 1	-	211,000 DWT (Stbd) Rev 3	-	-
ES-2	211,000 DWT (Port) Rev 1	-	211,000 DWT (Port) Rev 3	-	-
ES-3	125,000 DWT Stbd Rev 2	-	139,500 DWT (Stbd) Rev 2	-	-
ES-4	125,000 DWT Port Rev 2	-	139,500 DWT (Port) Rev 2	-	-
ES-5	40,000 DWT Stbd Rev 1	-	-	-	-
ES-6	40,000 DWT Port Rev 1	-	-	-	-
ES-7	10,000 DWT barge (Port) Rev 1	-	-	-	-
ES-8	70,000 DWT Stbd Rev 1	-	-	-	-
ES-9	70,000 DWT Port Rev 1	-	-	-	-
ES-10	39,000 DWT Stbd Rev 3	-	39,000 DWT Stbd Rev 5	-	-
ES-11	-	-	-	-	-
ES-12	100,000 DWT Stbd Rev 1	-	-	-	-
ES-13	-	160,000 DWT Stbd Rev 1	-	-	-
ES-14	-		-	120,000 DWT Stbd Rev 1	120,000 DWT Stbd Rev 2
ES-15	-		-	80,000 DWT Stbd Rev 1	80,000 DWT Stbd Rev 2
M&N Project #			9348-04	9348-04	9348-04

KEY:

New analysis was run
Superseded
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Valero Benicia Terminal Operating Limits History

Report Description	CSLC comments July 2019	CSLC comments Jan 2020
Approximate Submittal Date	7/23/2019	1/15/2020
Major Changes	1) Edits to 120,000 DWT Vessel and 80,000 DWT Vessel TOL and analysis per CSLC comments	1) Edits to 211,000 DWT Vessel and 139,500 DWT Vessel TOL and analysis per CSLC comments
STOL Label:		
ES-1	-	211,000 DWT (Stbd) Rev 4
ES-2	-	211,000 DWT (Port) Rev 4
ES-3	-	139,500 DWT (Stbd) Rev 3
ES-4	-	139,500 DWT (Port) Rev 3
ES-5	-	-
ES-6	-	-
ES-7	-	-
ES-8	-	-
ES-9	-	-
ES-10	-	-
ES-11	-	-
ES-12	-	-
ES-13	-	-
ES-14	120,000 DWT Stbd Rev 3	-
ES-15	80,000 DWT Stbd Rev 3	-
M&N Project #	9348-04	9348-06

KEY:	
	New analysis was run
	Superseded
	Reformatted Only

FIGURE ES1

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

211,000 DWT Vessel Starboard-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

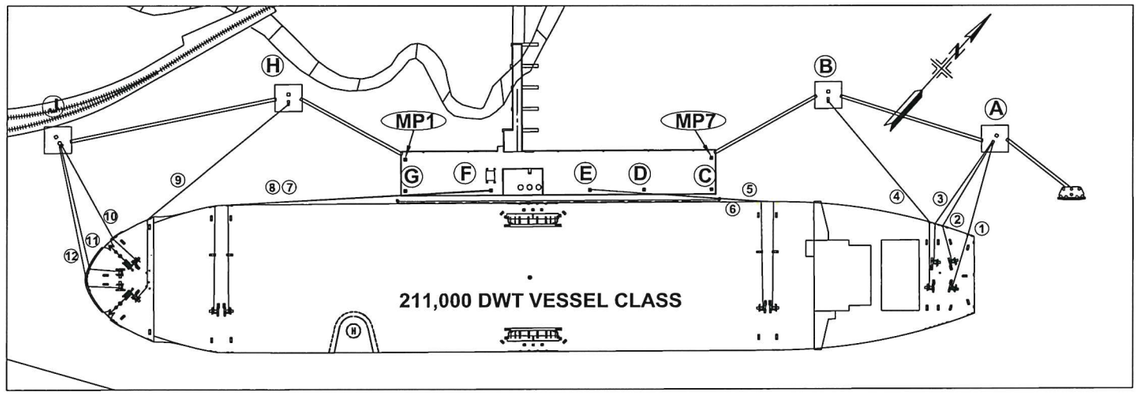
1. MEMORANDUM TO CSLC ON STOL FORMAT CHANGES / RKI / AUG 20, 2012
2. ADDENDUM TO 2008 INITIAL AUDIT MOORING & BERTHING REPORT/ RKI / JAN 19, 2011
3. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016

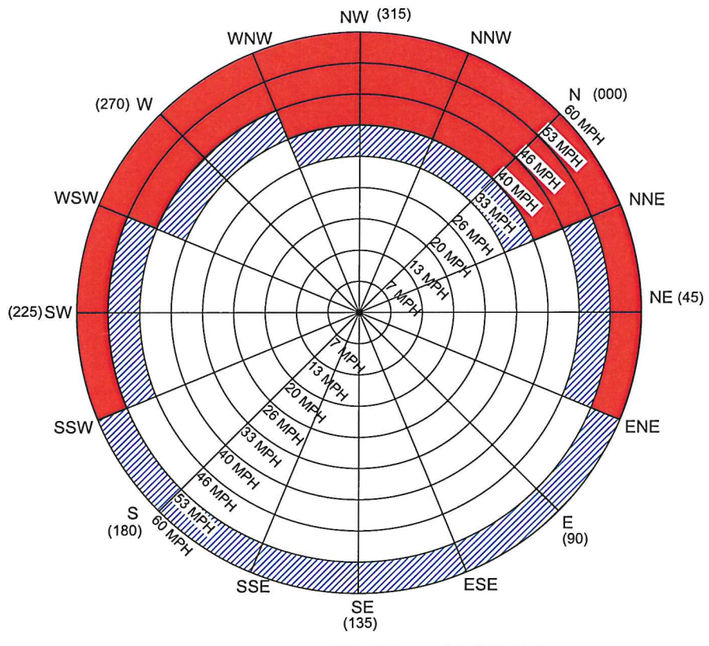
ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE





WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
MARC I. PERCHER
C68072
Expires 6/30/21
CIVIL
STATE OF CALIFORNIA

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	211,470 DWT
MAXIMUM ARRIVAL DISPLACEMENT	135,309 LT
MAXIMUM DRAFT (FULLY LOADED)	64.6 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	25 FT
LOA	987 FT
LBP	945 FT
BEAM	166 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH) OR CURRENT GREATER THAN 2 KNOTS
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	127 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 4, JAN, 2020

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMORANDUM TO CSLC ON STOL FORMAT CHANGES / RKI / AUG 20, 2012
2. ADDENDUM TO 2008 INITIAL AUDIT MOORING & BERTHING REPORT/ RKI / JAN 19, 2011
3. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016.

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE

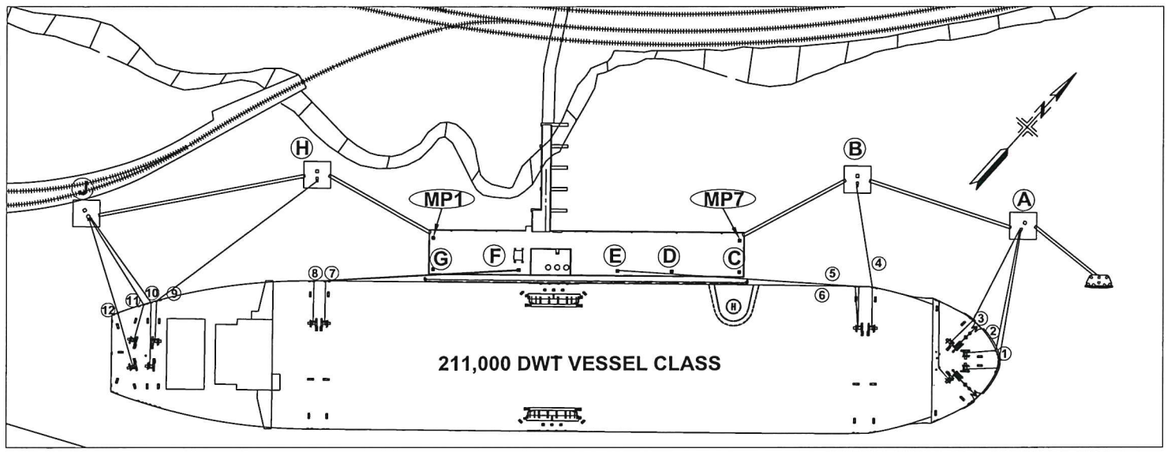
FIGURE ES2

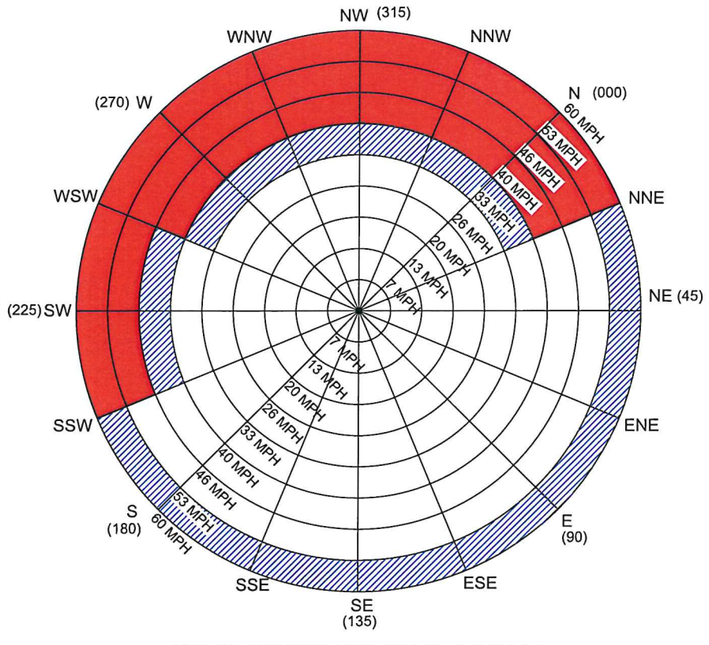
STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

211,000 DWT Vessel Port-Side-to





WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
MARC I. PERCHER
C68072
Expires 6/30/21
CIVIL
STATE OF CALIFORNIA

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) AREA OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	211,470 DWT
MAXIMUM ARRIVAL DISPLACEMENT	135,309 LT
MAXIMUM DRAFT (FULLY LOADED)	64.6 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	25 FT
LOA	987 FT
LBP	945 FT
BEAM	166 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH) OR CURRENT GREATER THAN 2 KNOTS.
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	127 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 4, JAN 2020

FIGURE ES3

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

139,500 DWT Vessel Starboard-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

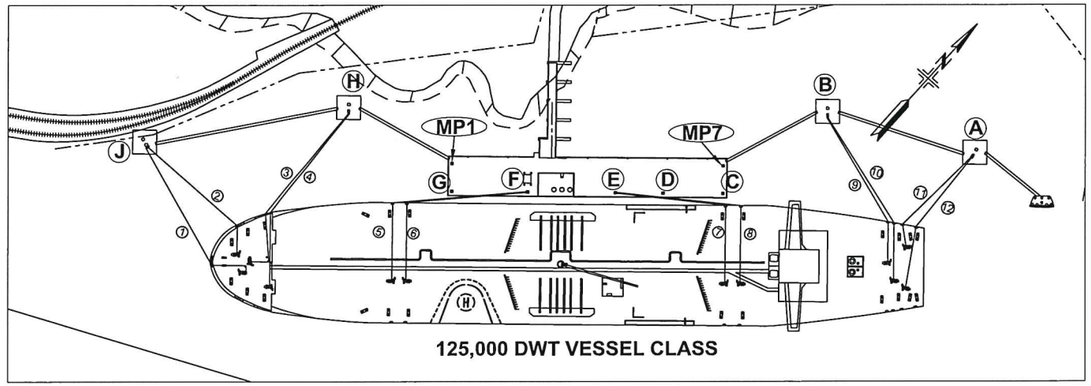
1. ADDENDUM TO 2008 INITIAL AUDIT MOORING & BERTHING REPORT/ RKI / JAN 19, 2011
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016.

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE



125,000 DWT VESSEL CLASS

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) AREA OUT-OF-SERVICE FOR PRODUCT TRANSFER.

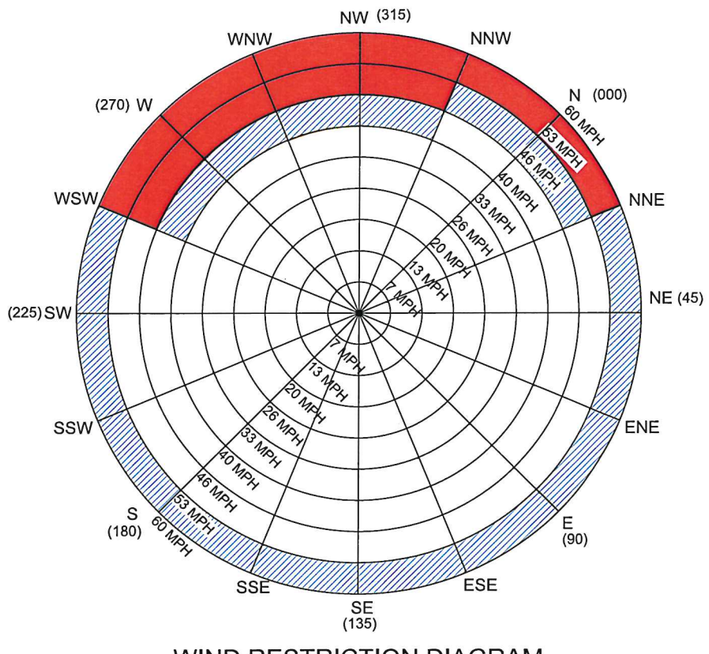
VESSEL DESCRIPTION:

DWT	139,501 DWT
MAXIMUM ARRIVAL DISPLACEMENT	105,167 LT
MAXIMUM DRAFT (FULLY LOADED)	57.5 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	32.8 FT
LOA	895 FT
LBP	845 FT
BEAM	152 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
MARC I. PERCHER
C68072
Expires 6/30/21
CIVIL
STATE OF CALIFORNIA

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	124 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 3, JAN, 2020

FIGURE ES4

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

139,500 DWT Vessel Port-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

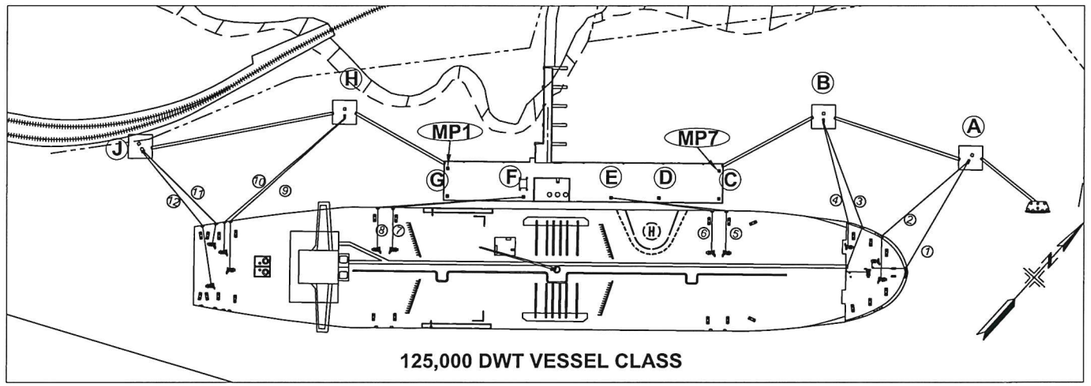
1. ADDENDUM TO 2008 INITIAL AUDIT MOORING & BERTHING REPORT/ RKI / JAN 19, 2011.
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016.

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE



125,000 DWT VESSEL CLASS

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) AREA OUT-OF-SERVICE FOR PRODUCT TRANSFER.

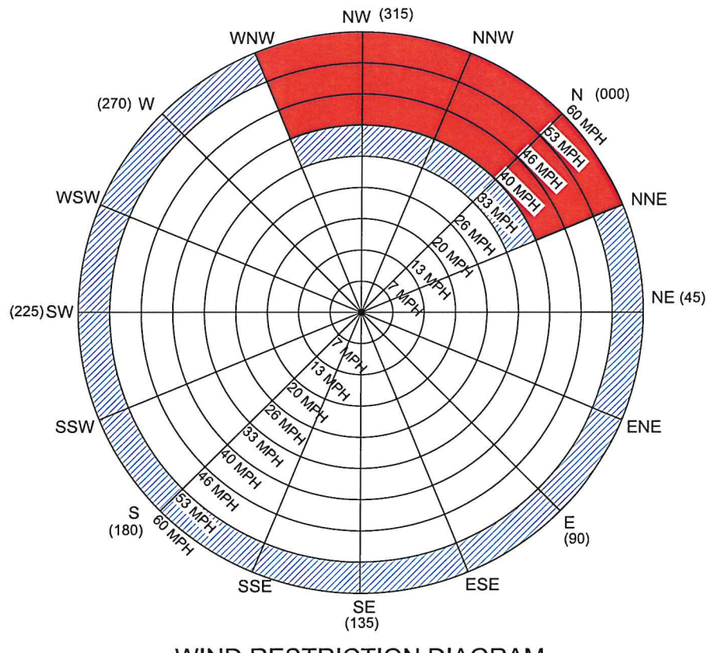
VESSEL DESCRIPTION:

DWT	139,501 DWT
MAXIMUM ARRIVAL DISPLACEMENT	105,167 LT
MAXIMUM DRAFT (FULLY LOADED)	57.5 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	32.8 FT
LOA	895 FT
LBP	845 FT
BEAM	152 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
MARC I. PERCHER
C68072
Expires 6/30/21
CIVIL
STATE OF CALIFORNIA

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	124 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 3, JAN, 2020

FIGURE ES5

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

40,000 DWT Vessel Starboard-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

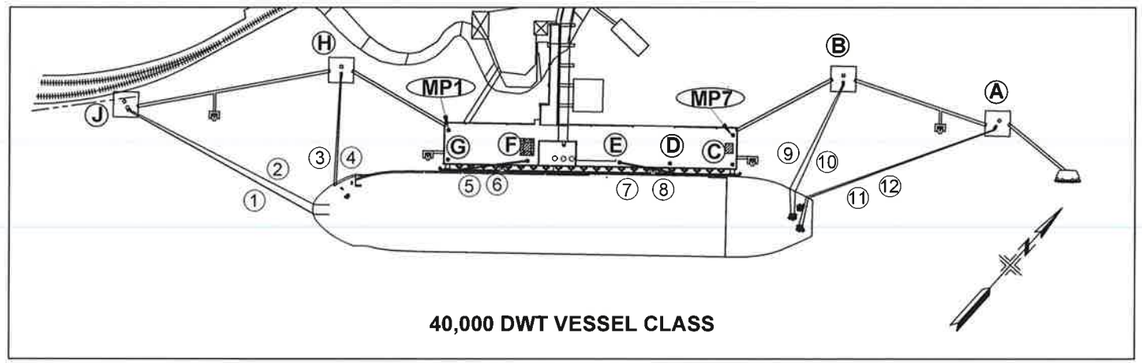
1. ADDENDUM TO 2008 INITIAL AUDIT MOORING & BERTHING REPORT/ RKI / JAN 19, 2011.
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE



40,000 DWT VESSEL CLASS

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:

1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) AREA OUT-OF-SERVICE FOR PRODUCT TRANSFER.

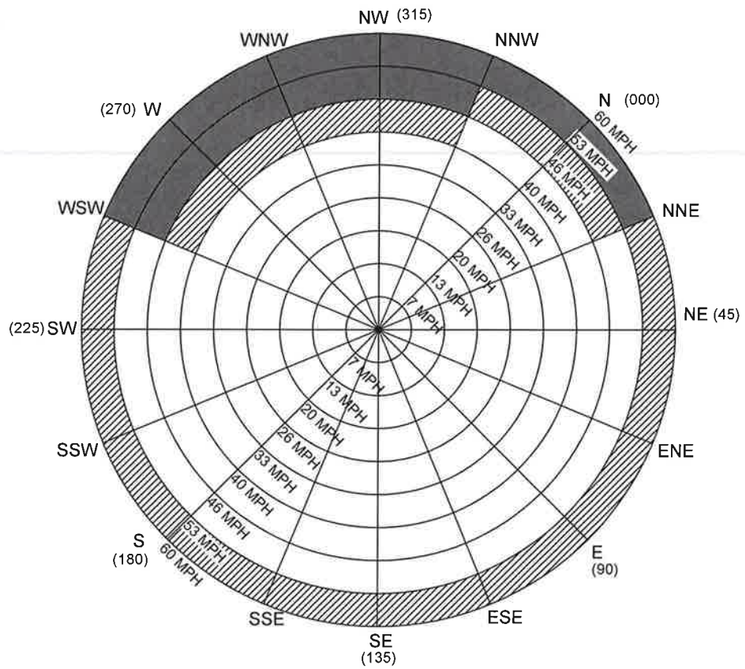
VESSEL DESCRIPTION:

DWT	40,000 DWT
MAXIMUM ARRIVAL DISPLACEMENT	49,154 LT
MAXIMUM DRAFT (FULLY LOADED)	37.1 FT
MAXIMUM ARRIVAL DRAFT	37.1 FT
MINIMUM ARRIVAL DRAFT*	24 FT
LOA	651 FT
LBP	625 FT
BEAM	96 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

REGISTERED PROFESSIONAL ENGINEER
ROD K. IWASHITA
No. C 51581
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA

9/9/16

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY 0.59 FPS
2. MAXIMUM APPROACH ANGLE 8 DEGREES
3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	67 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 1, SEP 30, 2016

FIGURE ES6

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

40,000 DWT Vessel Port-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

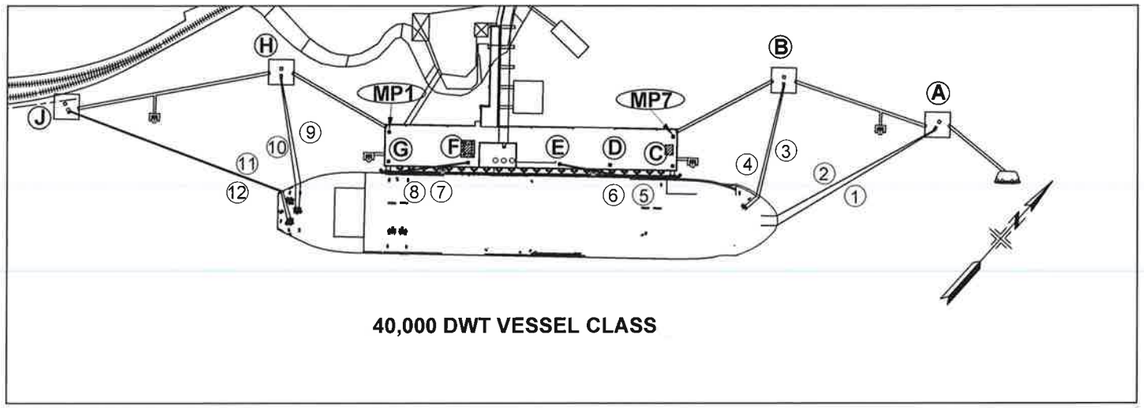
1. ADDENDUM TO 2008 INITIAL AUDIT MOORING & BERTHING REPORT/ RKI / JAN 19, 2011
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016.

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE



40,000 DWT VESSEL CLASS

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

ESSEL DESCRIPTION:

DWT	40,000 DWT
MAXIMUM ARRIVAL DISPLACEMENT	49,154 LT
MAXIMUM DRAFT (FULLY LOADED)	37.1 FT
MAXIMUM ARRIVAL DRAFT	37.1 FT
MINIMUM ARRIVAL DRAFT*	24 FT
LOA	651 FT
LBP	625 FT
BEAM	96 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.59 FPS
2. MAXIMUM APPROACH ANGLE	8 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
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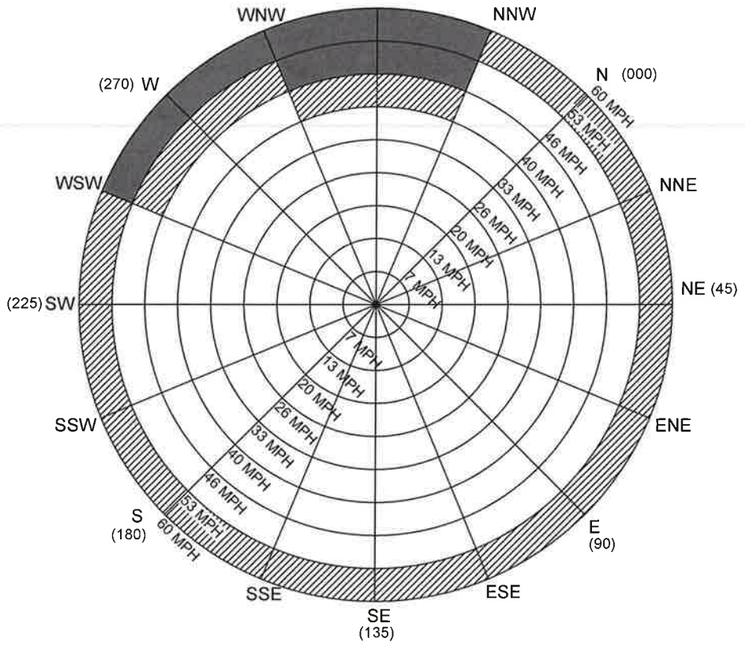
MINIMUM BREAKING LOAD, MBL	67 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
ROD K. IWASHITA
No. C 51581
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA
9/9/16

REV 1, SEP 30, 2016

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MOTEMS INITIAL AUDIT: MOORING & BERTHING REPORT/ RKI / AUG 6, 2008
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016.

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (3,4,5,6) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE

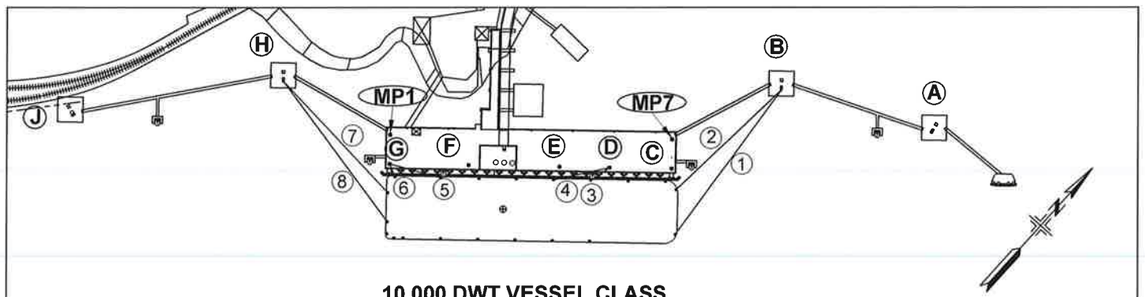
FIGURE ES7

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

10,000 DWT Vessel Port-Side-to



10,000 DWT VESSEL CLASS

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	10,000 DWT
MAXIMUM ARRIVAL DISPLACEMENT	12,040 LT
MAXIMUM DRAFT (FULLY LOADED)	17.81 FT
MAXIMUM ARRIVAL DRAFT	17.81 FT
MINIMUM ARRIVAL DRAFT	3.25 FT
LOA	350 FT
LBP	350 FT
BEAM	76 FT

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	0 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY 1.31 FPS
2. MAXIMUM APPROACH ANGLE 15 DEGREES
3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

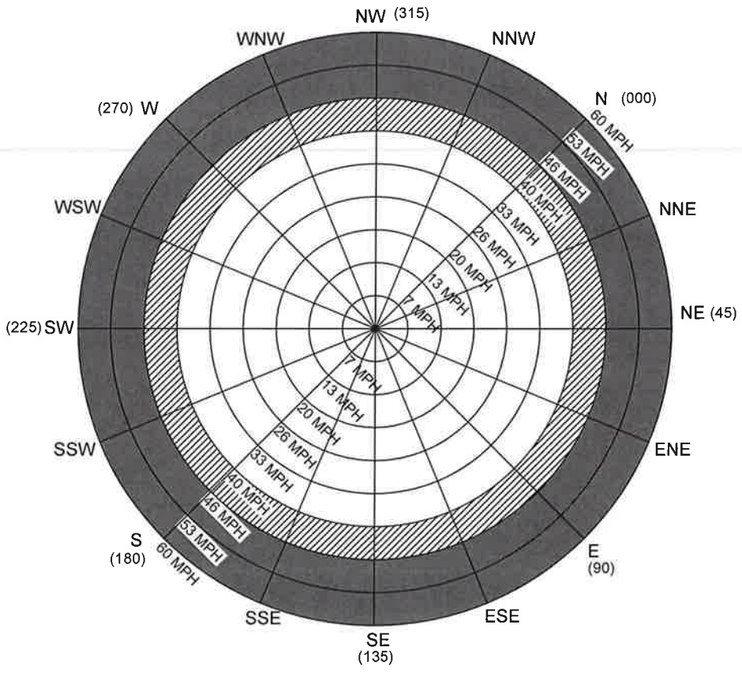
MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	8
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	33 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
ROD K. IWASHITA
No. C 51581
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA
9/9/16

REV 1, SEP 30, 2016

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMO: STOL FOR 70K DWT VESSEL/ RKI / SEPT 2, 2011.
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016.

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE

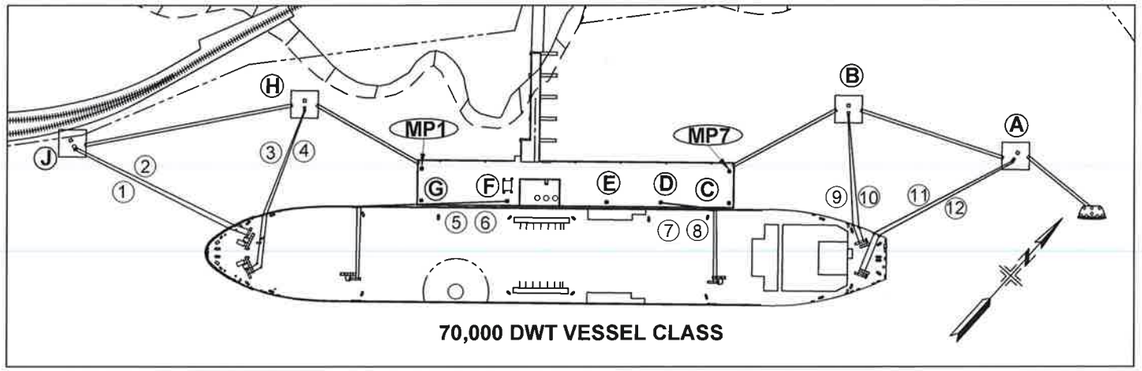
FIGURE ES8

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

70,000 DWT Vessel Starboard-Side-to



70,000 DWT VESSEL CLASS

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP2 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

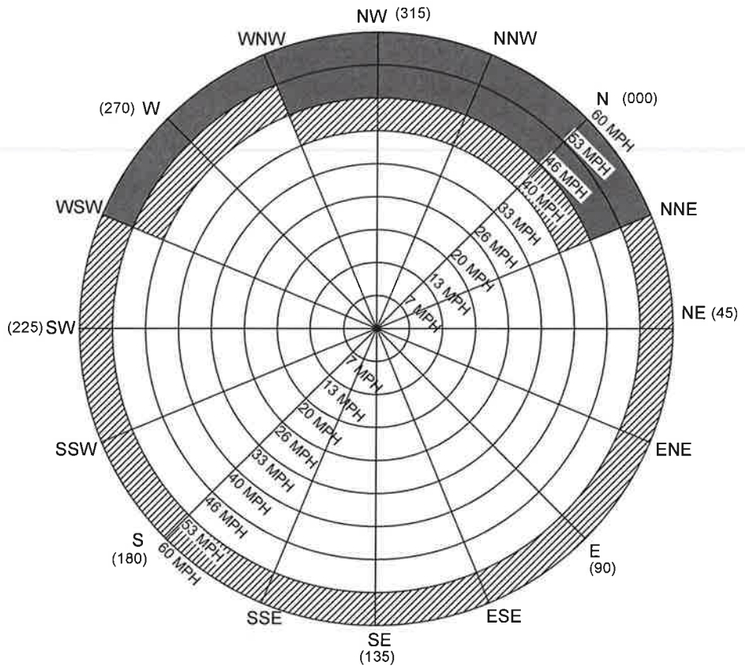
VESSEL DESCRIPTION:

DWT	72,631 DWT
MAXIMUM ARRIVAL DISPLACEMENT	68,924 LT
MAXIMUM DRAFT (FULLY LOADED)	47.6 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	22.6 FT
LOA	750 FT
LBP	721 FT
BEAM	106 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

REGISTERED PROFESSIONAL ENGINEER
ROD K. IWASHITA
No. C 51581
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA
9/9/16

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY 0.47 FPS
2. MAXIMUM APPROACH ANGLE 6 DEGREES
3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	82 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 1, SEP 30, 2016

TO BE SUPERSEDED BY 80,000 DWT

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMO: STOL FOR 70K DWT VESSEL/ RKI / SEPT 2, 2011.
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE

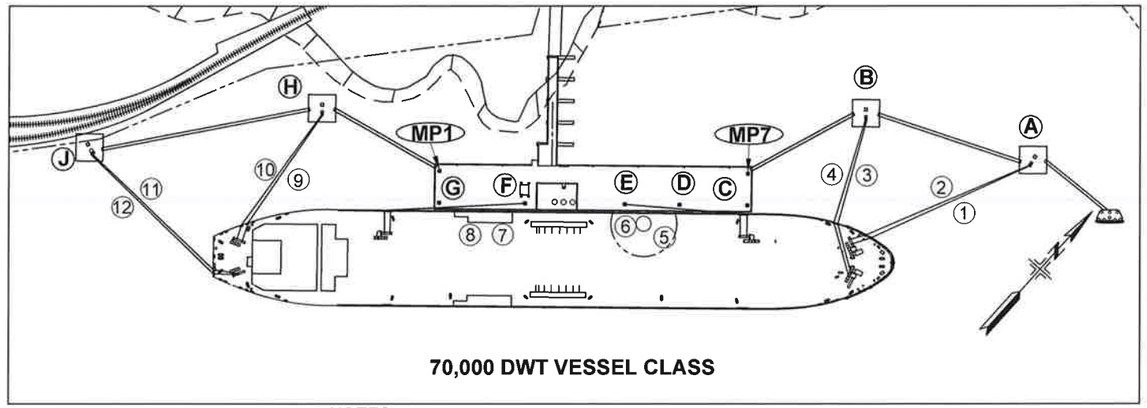
FIGURE ES9

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

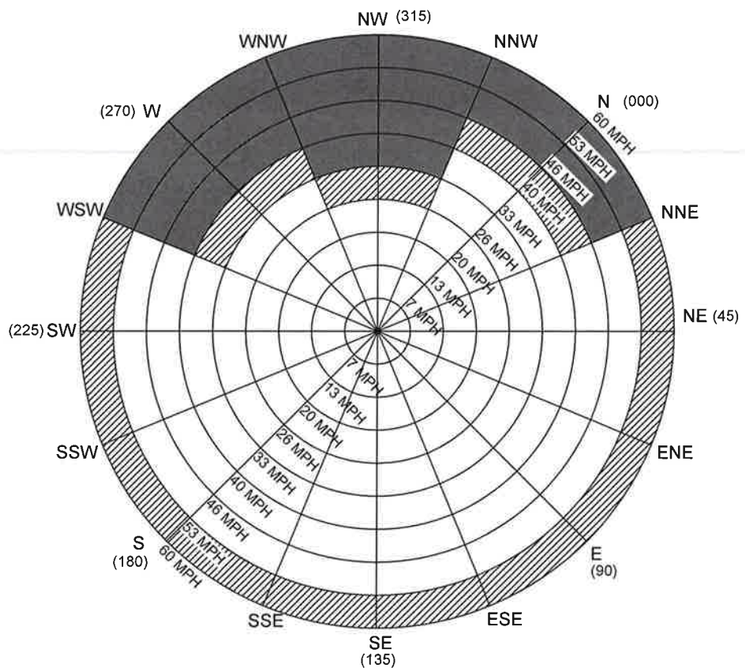
70,000 DWT Vessel Port-Side-to



70,000 DWT VESSEL CLASS

NOTES:

1. MOORING LINES (5, 6, 7, 8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

REGISTERED PROFESSIONAL ENGINEER
ROD K. IWASHITA
No. C 51581
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA
9/9/16

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY OF 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHRAF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	72,631 DWT
MAXIMUM ARRIVAL DISPLACEMENT	68,924 LT
MAXIMUM DRAFT (FULLY LOADED)	47.6 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	22.6 FT
LOA	750 FT
LBP	721 FT
BEAM	106 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.47 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	82 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED

REV 1, SEP 30, 2016

TO BE SUPERSEDED BY 80,000 DWT

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMO - STATEMENT OF TERMINAL OPERATING LIMITS FOR 39,000 DWT RENEWABLE DIESEL VESSEL, DATED MAY 29, 2014.
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (6,7,8,9) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE

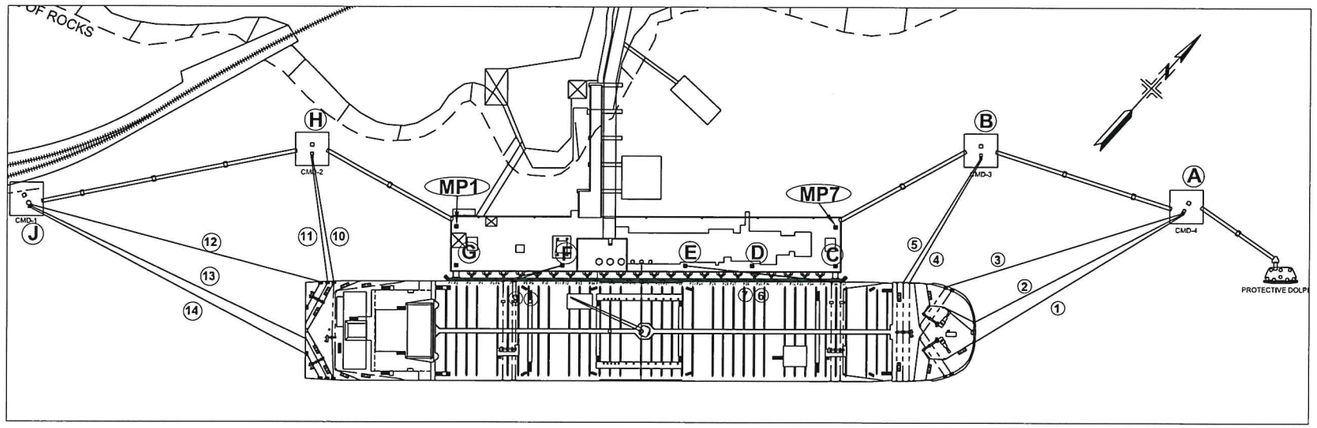
FIGURE ES10

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

39,000 DWT Vessel Port-Side-to



MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) AREA OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	39,081 DWT
MAXIMUM ARRIVAL DISPLACEMENT	44,580 LT
MAXIMUM DRAFT (FULLY LOADED)	38.7 FT
MAXIMUM ARRIVAL DRAFT	38.0 FT
MINIMUM ARRIVAL DRAFT	19.7 FT
LOA	601 FT
LBP	577 FT
BEAM	90 FT

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.60 FPS
2. MAXIMUM APPROACH ANGLE	8 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

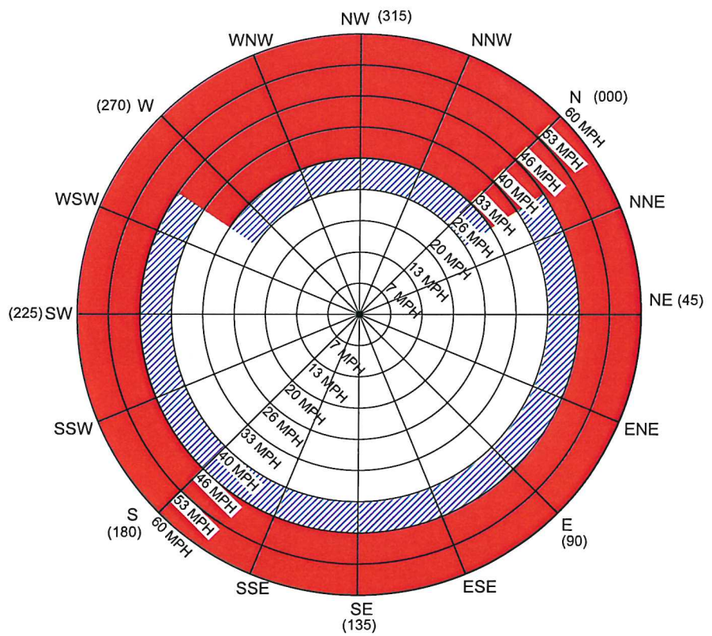
MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
NO. OF HEAD/TAIL LINES	3 FORWARD, 3 AFT
MINIMUM BREAKING LOAD, MBL	88 SHORT TONS
LINE MATERIAL	AMSTEEL BLUE OR EQUIVALENT HMPE
TAIL	5M NYLON
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED TO 10% OF MBL.



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

REGISTERED PROFESSIONAL ENGINEER
MARC I. PERCHER
C68072
Expires 6/30/19
CIVIL
STATE OF CALIFORNIA

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS AT A 30 SEC. WIND SPEED OF 40 MPH.
4. UNLESS OTHERWISE NOTED, VESSELS SHALL DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 46 MPH.
5. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 40 MPH OR DISCONNECT, WHICHEVER IS SOONER.

REV 5, JAN, 2019

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMO - STATEMENT OF TERMINAL OPERATING LIMITS FOR 100,000 DWT VESSEL, DATED MAY 18, 2015.
2. 2015 MOTEMS SECOND SUBSEQUENT AUDIT REPORT REV 1 BERTHING ANALYSIS, AUGUST 1, 2016

ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7,8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE
2. NOT TO SCALE

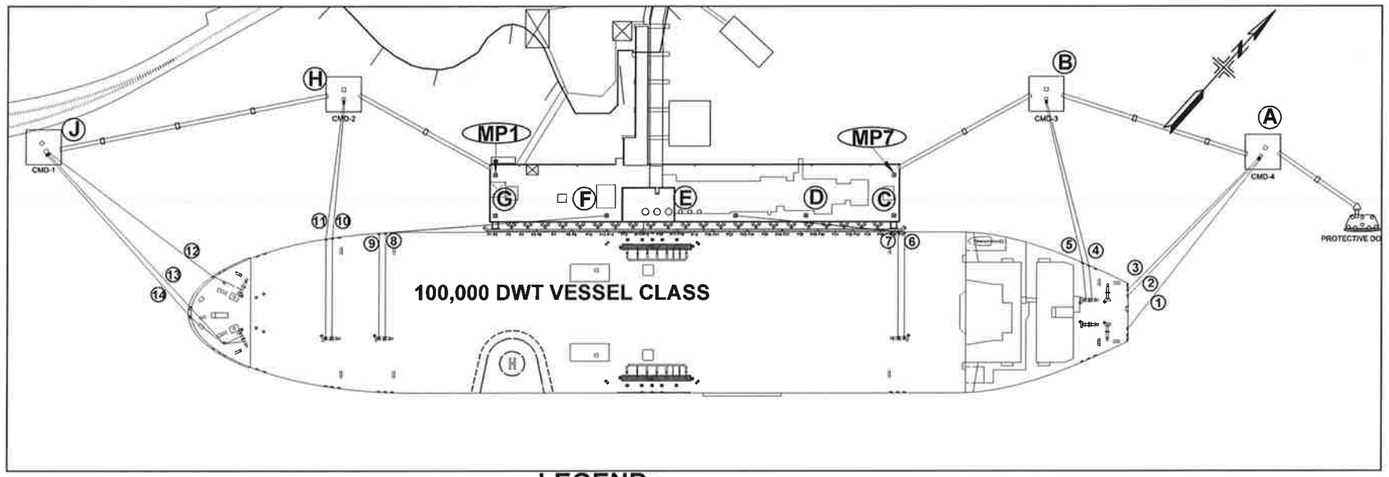
FIGURE ES12

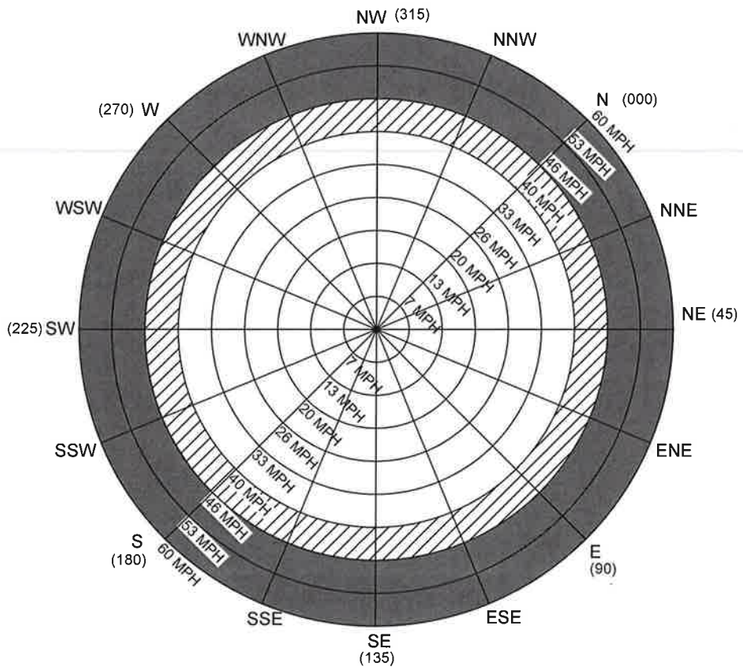
STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

100,000 DWT Vessel Starboard-Side-to





WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 30 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR
   - MAXIMUM EBB CURRENT 2.4 KNOTS AT 10 DEGREES OFFSHORE
   - MAXIMUM FLOOD CURRENT 1.4 KNOTS AT THE BERTH
   - WAVE PERIOD T < 4.0 SECONDS
   - CHANGE IN TIDAL RANGE < 6 FT
2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS AT A 30 SEC. WIND SPEED OF 40 MPH.
4. UNLESS OTHERWISE NOTED, VESSELS SHALL DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 46 MPH.
5. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 40 MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
ROD K. IWASHITA
No. C 51581
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA
9/9/16

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	103,219 DWT LT
MAXIMUM ARRIVAL DISPLACEMENT	92,323 LT
MAXIMUM DRAFT (FULLY LOADED)	46.7 FT
MAXIMUM ARRIVAL DRAFT	38.0 FT
MINIMUM ARRIVAL DRAFT	23.4 FT
LOA	799 FT
LBP	771 FT
BEAM	138 FT

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: +/- 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	14
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
NO. OF HEAD/TAIL LINES	3 FORWARD, 3 AFT
MINIMUM BREAKING LOAD, MBL	103 SHORT TONS
LINE MATERIAL	AMSTEEL BLUE OR EQUIVALENT HMPE
TAIL	11M NYLON
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED

REV 1, SEP 30, 2016

TO BE SUPERSEDED BY 120,000 DWT

FIGURE ES13

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

160,000 DWT Vessel Starboard-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMORANDUM TO CSLC 160,000 DWT STOL, JUNE 25, 2018
2. MEMORANDUM RESPONSE TO CSLC COMMENT, JULY 16, 2018

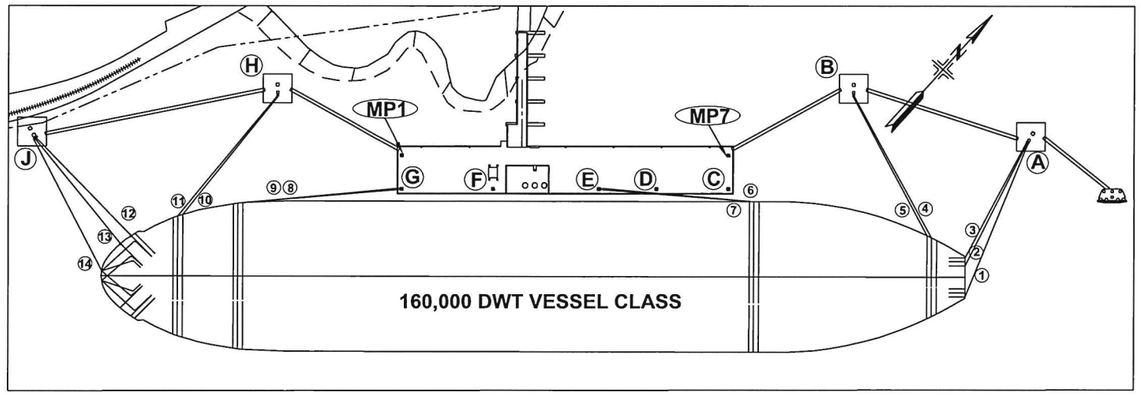
ALTERNATIVES APPROVED:

1. _____
2. _____

NOTES:

1. MOORING LINES (6,7,8, AND 9) ARE TIED BACK TO BOLLARDS ALONG PIER FACE

2. NOT TO SCALE



MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	160,000 DWT
MAXIMUM ARRIVAL DISPLACEMENT	121,596 LT
MAXIMUM DRAFT (FULLY LOADED)	55.9 FT
MAXIMUM ARRIVAL DRAFT	39 FT
MINIMUM ARRIVAL DRAFT*	25 FT
LOA	900 FT
LBP	866 FT
BEAM	158 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	1 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

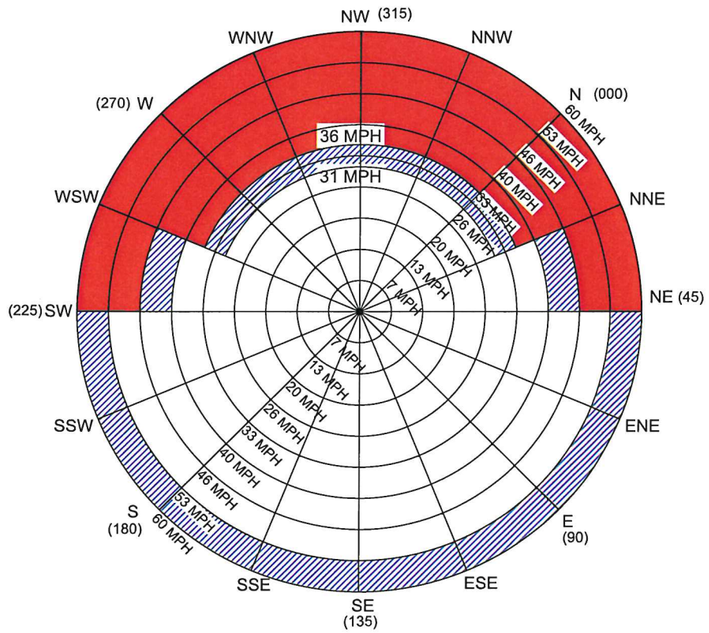
MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 3 FT EITHER DIRECTION FORE/AFT
   SWAY: + 3 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	14
NO. OF HEAD LINES	3
NO. OF STERN LINES	3
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	83 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.



WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 60 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REV 1, JULY 16, 2018

FIGURE ES14

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

118,752 DWT Vessel Starboard-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMORANDUM TO CSLC 80,000 DWT & 120,000 DWT STOLS, AUGUST 8, 2018

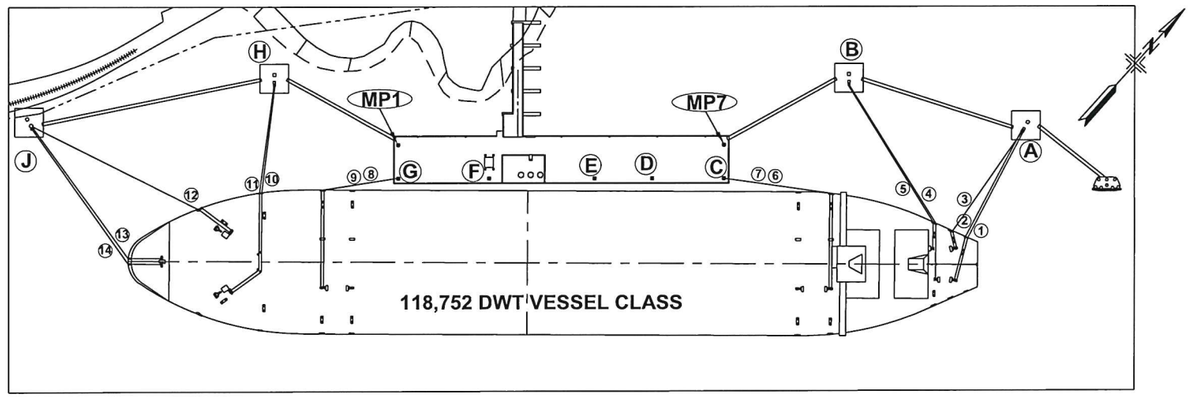
ALTERNATIVES APPROVED:

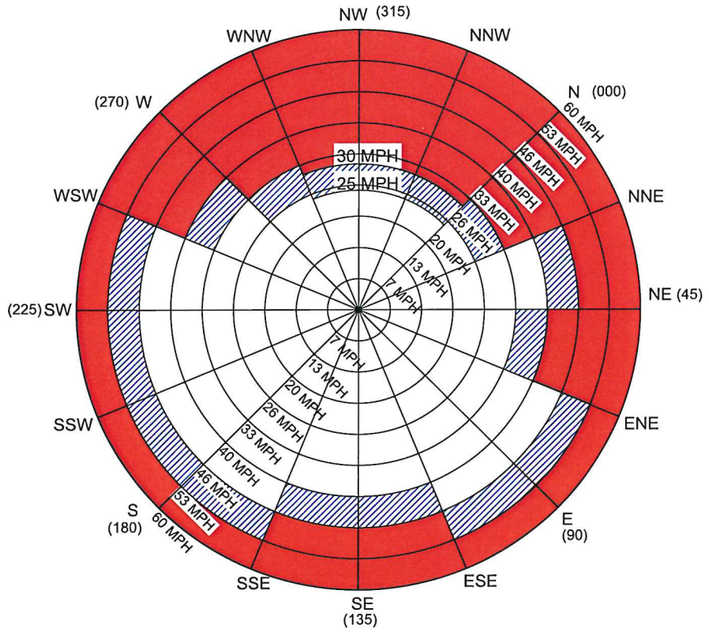
1. _____
2. _____

NOTES:

1. MOORING LINES (6,7,8, AND 9) ARE TIED BACK TO BOLLARDS ALONG PIER FACE

2. NOT TO SCALE





WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 60 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH
3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.
4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	118,752 DWT LT
MAXIMUM ARRIVAL DISPLACEMENT	103,475 LT
MAXIMUM DRAFT (FULLY LOADED)	49.6 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	25 FT
LOA	887 FT
LBP	850 FT
BEAM	151 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.39 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 2 FT EITHER DIRECTION FORE/AFT
   SWAY: + 2 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	14
NO. OF HEAD LINES	3
NO. OF STERN LINES	3
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	68 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 3, JULY 23, 2019

FIGURE ES15

STATEMENT OF TERMINAL OPERATING LIMITS

Valero Benicia Terminal

1501 Bayshore Road, Benicia, CA 94510

78,658 DWT Vessel Starboard-Side-to

GENERAL INFORMATION:

REFERENCE CALCULATION:

1. MEMORANDUM TO CSLC 80,000 DWT & 120,000 DWT STOLS, AUGUST 8, 2018

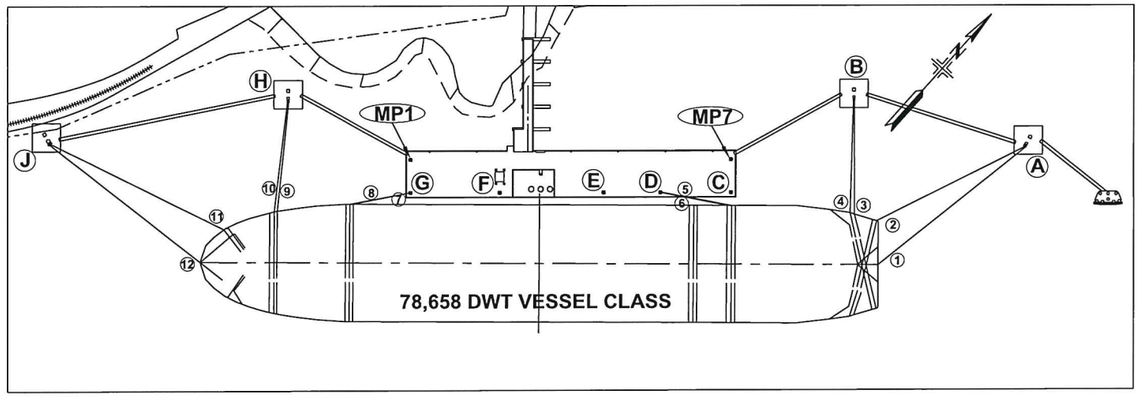
ALTERNATIVES APPROVED:

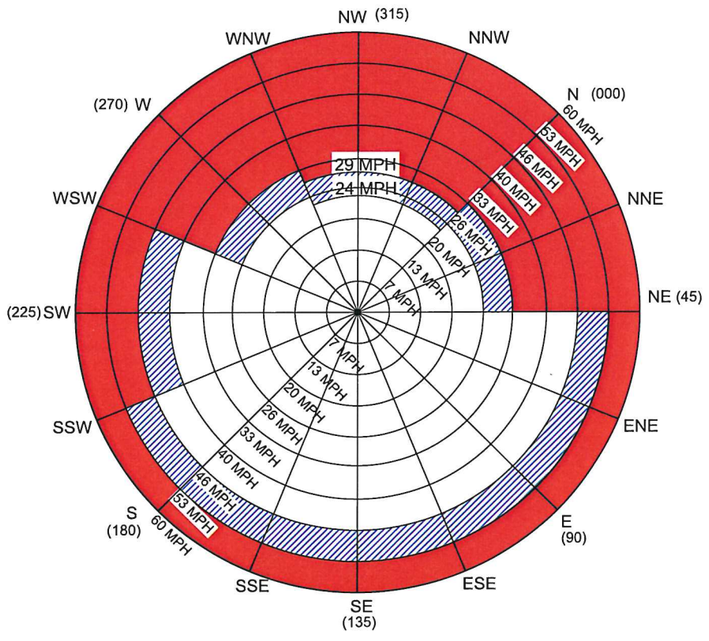
1. _____
2. _____

NOTES:

1. MOORING LINES (5,6,7, AND 8) ARE TIED BACK TO BOLLARDS ALONG PIER FACE

2. NOT TO SCALE





WIND RESTRICTION DIAGRAM

LEGEND:

OPERATIONAL CONDITION LIMIT:
TERMINATE PRODUCT TRANSFER

SURVIVAL CONDITION LIMIT:
DISCONNECT PRODUCT LINES & DEPART BERTH

- WIND DIRECTION FROM
- 60 SECOND WIND SPEED

ENVIRONMENTAL CONDITION LIMITS:

1. WIND RESTRICTION DIAGRAM IS APPLICABLE FOR

- MAXIMUM EBB CURRENT	2.4 KNOTS AT 10 DEGREES OFFSHORE
- MAXIMUM FLOOD CURRENT	1.4 KNOTS AT THE BERTH
- WAVE PERIOD	T < 4.0 SECONDS
- CHANGE IN TIDAL RANGE	< 6 FT

2. ANALYSES WERE NOT CARRIED OUT FOR WIND SPEEDS GREATER THAN 60 MPH

3. UNLESS OTHERWISE NOTED, VESSELS SHALL STOP TRANSFER OPERATIONS & DISCONNECT LOADING ARMS AT A 30 SEC. WIND SPEED OF 60 MPH.

4. VESSEL CAPTAIN SHALL DECIDE IF WEATHER CONDITIONS REQUIRE VESSEL DEPARTURE AFTER 60MPH OR DISCONNECT, WHICHEVER IS SOONER.

REGISTERED PROFESSIONAL ENGINEER
MARC I. PERCHER
C68072
Expires 6/30/21
CIVIL
STATE OF CALIFORNIA

MOORING DEVICE INFORMATION		
MOORING POINT	DEVICE TYPE	CAPACITY (SHORT TONS)
A	TRIPLE HOOK	300 (100 PER HOOK)
B	DOUBLE HOOK	200 (100 PER HOOK)
C	BOLLARD (MP6)	100
D	BOLLARD (MP5)	100
E	BOLLARD (MP4)	100
F	BOLLARD (MP3)	100
G	BOLLARD (MP2)	100
H	DOUBLE HOOK	200 (100 PER HOOK)
J	TRIPLE HOOK	300 (100 PER HOOK)

NOTE:
1. ALLOWABLE CAPACITY IS 90% OF RATED CAPACITY BASED ON 2016 CONDITION.
2. MP1 AND MP7 (BACK SIDE OF WHARF) ARE OUT-OF-SERVICE FOR PRODUCT TRANSFER.

VESSEL DESCRIPTION:

DWT	78,658 DWT LT
MAXIMUM ARRIVAL DISPLACEMENT	77,333 LT
MAXIMUM DRAFT (FULLY LOADED)	45.3 FT
MAXIMUM ARRIVAL DRAFT	38 FT
MINIMUM ARRIVAL DRAFT*	25 FT
LOA	719 FT
LBP	699 FT
BEAM	125 FT

* DUE TO LOADING ARM HEIGHT RESTRICTIONS

BERTH DESCRIPTION:

WATER DEPTH	40 FT @ MLLW
MINIMUM UNDERKEEL CLEARANCE	2 FT

BERTHING NOTES:

1. MAXIMUM BERTHING VELOCITY	0.45 FPS
2. MAXIMUM APPROACH ANGLE	6 DEGREES

3. NO BERTHING OPERATION WILL TAKE PLACE WITH WIND VELOCITIES GREATER THAN 38 KNOTS (44 MPH)
4. WATER DEPTH STATED IS PERMITTED DEPTH OF BERTH. ACTUAL WATER DEPTH MAY VARY. REGULARLY VERIFY WATER DEPTH AND RESTRICT VESSEL DRAFT AS NEEDED.
5. BERTHING FIRST CONTACT CORNER FENDER ONLY.

MOORING NOTES:

1. THE FACILITY IS NOT VULNERABLE TO PASSING VESSEL EFFECTS, AND THEREFORE NO RESTRICTIONS ARE REQUIRED DUE TO PASSING VESSEL FORCES.
2. DO NOT EXCEED ONE LINE PER HOOK.
3. MAXIMUM ALLOWED:
   SURGE: +/- 2 FT EITHER DIRECTION FORE/AFT
   SWAY: + 2 FT (ZERO-TO-PEAK)

MOORING LINE DESCRIPTION:

MINIMUM NO. OF LINES	12
NO. OF HEAD LINES	2
NO. OF STERN LINES	2
NO. OF BREAST LINES	2 FORWARD, 2 AFT
NO. OF SPRING LINES	2 FORWARD, 2 AFT
MINIMUM BREAKING LOAD, MBL	68 SHORT TONS
ACTUAL LINE LOADS NOT TO EXCEED	50 % MBL

ALL MOORING LINES SHALL BE PRE-TENSIONED.

REV 3, JULY 23, 2019

Attachment F – Berth Utilization Statistical Analysis

moffatt & nichol	Client:	Valero	Job No.	211925		
	Project:	Benicia CARB Feasibility Study	Sheet:	1	of	3
	Designed for:	At Berth Vessel Statistics	Designer:	N. Gross	Date:	10/21/2021
		Regulated Vessels	Checker:	M. Miranda	Date:	10/21/2021

Regulated Vessels			2019		2020	
Vessel Name	**LOA (m)**	**LOA (FT)**	**Quantity of Vessel Calls**	**Hours at Berth**	**Quantity of Vessel Calls**	**Hours at Berth**
Advantage Atom	248.97	817	1	27	0	0
Alaskan Explorer	286.87	941	0	0	1	20.47
Alaskan Legend	287	942	0	0	1	22.6
Alaskan Navigator	289.5	950	0	0	1	20.3
Alyarmouk	248.96	817	1	18.1	0	0
Aqualeader	248.97	817	0	0	2	87.4
Aqualegend	248.97	817	0	0	1	29.4
Aqualoyalty	248.97	817	0	0	2	63.1
Aquapuelche	244	801	0	0	1	18.4
Aquatravesia	244	801	1	31.3	2	44.1
Aristoklis	249.9	820	1	34.8	0	0
Banda Sea	238	781	0	0	1	25.7
Brazos	274.39	900	0	0	2	90.6
BW Cougar	183	600	0	0	1	68.0
Cabo San Antonio	228	748	0	0	2	45.9
California	251	824	2	32.43	6	142.8
Cap Charles	274.2	900	0	0	1	46.4
Chemtrans Sea	229	751	1	19	0	0
Companion	228	748	1	30.3	0	0
Despina	228	748	1	26.2	0	0
Eagle Barcelona	250	820	0	0	1	25.5
Elandra Osprey	227.17	745	0	0	1	29.6
Pelican State	183	600	1	68.3	0	0
Emerald Spirit	243	797	0	0	2	58.6
Garnet Express	183.17	601	0	0	1	101.3
Gulf Muttrah	183	600	0	0	1	28.7
Gulf Pearl	228	748	1	12.0	0	0
Hellspoint Promise	228.6	750	0	0	1	29.5
Henrique Dias	274.3	900	1	28.7	0	0
LR1 Carrier	228	748	2	114.3	0	0
Madison	183	600	2	58.7	0	0
Marcilio Dias	274.2	900	1	29.0	0	0
Nord Tulip	228.6	750	1	27.0	0	0
Overseas Los Angeles	183.2	601	1	28.4	0	0
PAG	183	600	0	0	1	72.0
Paramount Hydra	249.9	820	24	510.4	11	257.1
Pichincha	244	801	1	18.8	1	27.3
Polar Adventure	272.69	895	3	39.7	4	66.4
Polar Discovery	272.69	895	10	144.4	6	116.6
Polar Endeavour	272.69	895	10	139.3	2	27.3
Polar Enterprise	272.69	895	6	98.9	6	81.6
Polar Resolution	272.61	894	7	94.7	6	85.0
RS Aurora	274.2	900	0	0	1	41.4
Salamina	228.13	748	0	0	1	48.4
SCF Progress	228.5	750	1	18.5	0	0
Sea Panther	128.6	422	0	0	2	59.6
Seaways Goldmar	228	748	2	77.8	0	0

moffatt & nichol	Client:	Valero	Job No.	211925		
	Project:	Benicia CARB Feasibility Study	Sheet:	2	of	3
	Designed for:	At Berth Vessel Statistics	Designer:	N. Gross	Date:	10/21/2021
		Regulated Vessels	Checker:	M. Miranda	Date:	10/21/2021

Regulated Vessels			2019		2020	
Vessel Name	**LOA (m)**	**LOA (FT)**	**Quantity of Vessel Calls**	**Hours at Berth**	**Quantity of Vessel Calls**	**Hours at Berth**
Seaways Jademar	228	748	1	45.7	0	0
Seaways Rubymar	228	748	3	100.5	2	59.7
Seaways Silvermar	228	748	1	25.5	1	46.8
Seaways Yellowstone	250	820	0	0	1	49.0
Selecao	227.63	747	2	67.8	0	0
Sigma Triumph	244	801	1	25.5	0	0
Sofia	274.19	900	0	0	2	69.7
Statia	274.2	900	1	32.5	0	0
Stella	274.19	900	0	0	1	48.7
Stena Sunrise	274	899	0	0	1	28.8
Suez Rajan	274.33	900	0	0	1	27.4
Torm Alexandra	183.2	601	1	40.3	0	0
Washington	251	824	3	51.8	11	227.9
Wisdom Venture	237	778	1	63.4	0	0
Muhut Silver	183.06	601	1	16.6	0	0
World Harmony	228.13	748	1	25.8	0	0
Zaruma	238	781	1	36.5	1	32.3
Total Number of Hours at Berth				**2260.0**		**2471.3**
	Berth Utilization			**25.8%**		**28.1%**
	Number of Vessel Calls		**100**		**93**	
Average Duration of Vessel Call (hr)				**22.6**		**26.6**

moffatt & nichol	Client:	Valero		Job No.	211925		
	Project:	Benicia CARB Feasibility Study		Sheet:	3	of	3
	Designed for:	At Berth Vessel Statistics		Designer:	N. Gross	Date:	10/21/2021
		Unregulated Vessels		Checker:	M. Miranda	Date:	10/21/2021

Unregulated Vessels		**2019**		**2020**	
Vessel Name	**Vessel Type**	**Quantity of Vessel Calls**	**Hours at Berth**	**Quantity of Vessel Calls**	**Hours at Berth**
550-1	Barge	45	1492.4	14	481.1
All aboard for a cure	Barge	2	52.8	4	52.8
FDH 35-2	Barge	2	19.5	0	0.0
FDH32-5	Barge	0	0.0	5	51.2
Dr Robert Beall	Barge	1	25.8	0	0.0
Lovel Briere	Barge	3	77.1	5	75.4
OSG 204	Barge	0	0.0	1	57.3
Webb Moffett	Barge	3	32.4	11	131.8
65 Roses	Barge	7	125.4	0	0
Commencement Bay	Barge	1	18.4	0	0
Bernie Briere	Barge	12	128.3	0	0
DS-802	Barge	12	305.9	14	296.5
Olympic Spirit	Barge	4	160.7	0	0
Total Number of Hours at Berth			**2438.6**		**1146.1**
Berth Utilization			**27.8%**		**13.0%**
Number of Vessel Calls		**92**		**54**	
Average Duration of Vessel Call (hr)			**26.5**		**21.2**

Attachment G – Conceptual Option Sketches

VALERO BENICIA REFINERY
CARB AT BERTH FEASIBILITY STUDY

SHEET LIST	
SHEET NO.	TITLE
1	TITLE SHEET
2	SITE PLAN
3	MOORING ARRANGEMENTS
4	SHORE POWER PLAN
5	SHORE POWER SECTION
6	BARGE BASED CAPTURE AND CONTROL PLAN
7	BARGE BASED CAPTURE AND CONTROL SECTION
8	SHORE BASED CAPTURE AND CONTROL PLAN
9	SHORE BASED CAPTURE AND CONTROL SECTION 1
10	SHORE BASED CAPTURE AND CONTROL SECTION 2

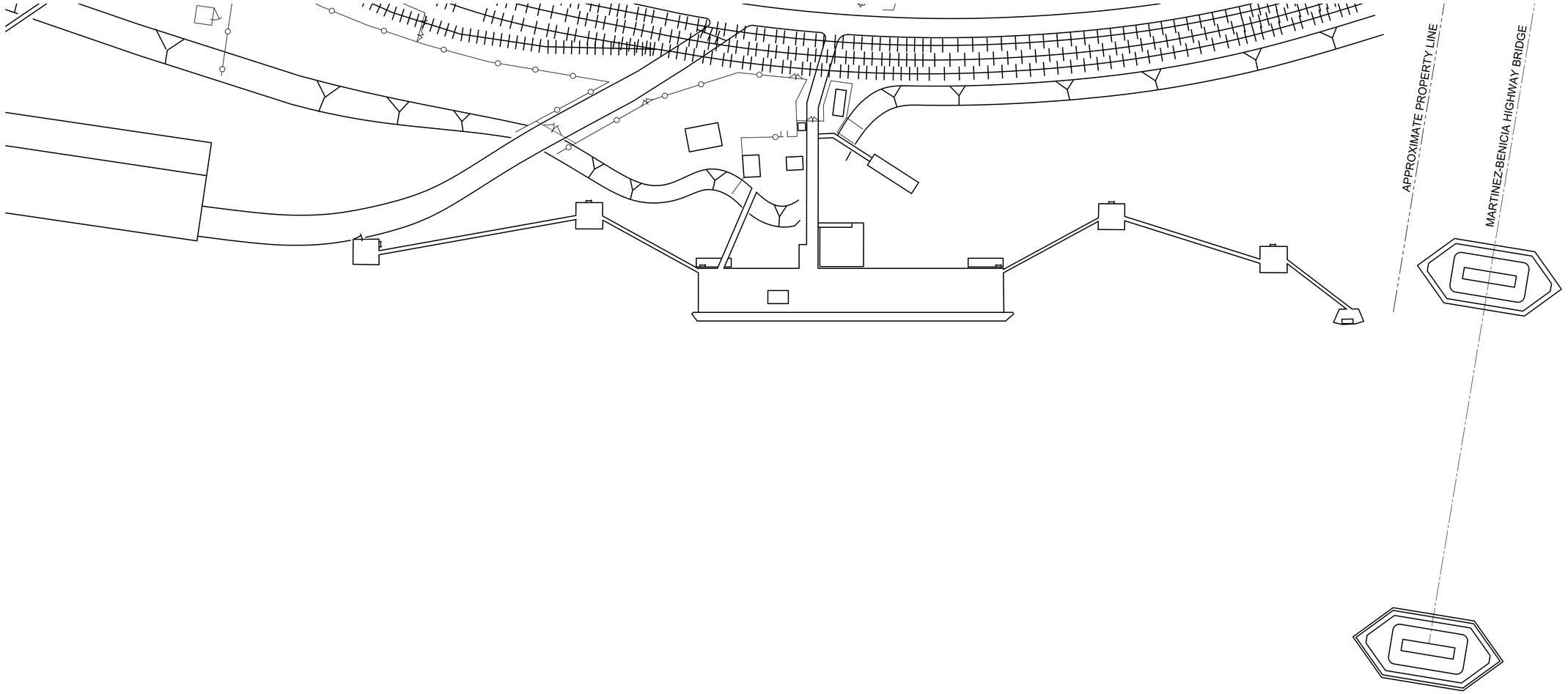
moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

Valero®

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	VALERO BENICIA TERMINAL CARB AT BERTH STUDY TITLE SHEET
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	ORIGINAL PROJECT NO. WC_0002114
SCALE:		DRAWING NO. SHEET 1 / REV. –



SITE PLAN

1"=60'

N

60' 0' 60' 120'

SCALE: 1"=60'

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

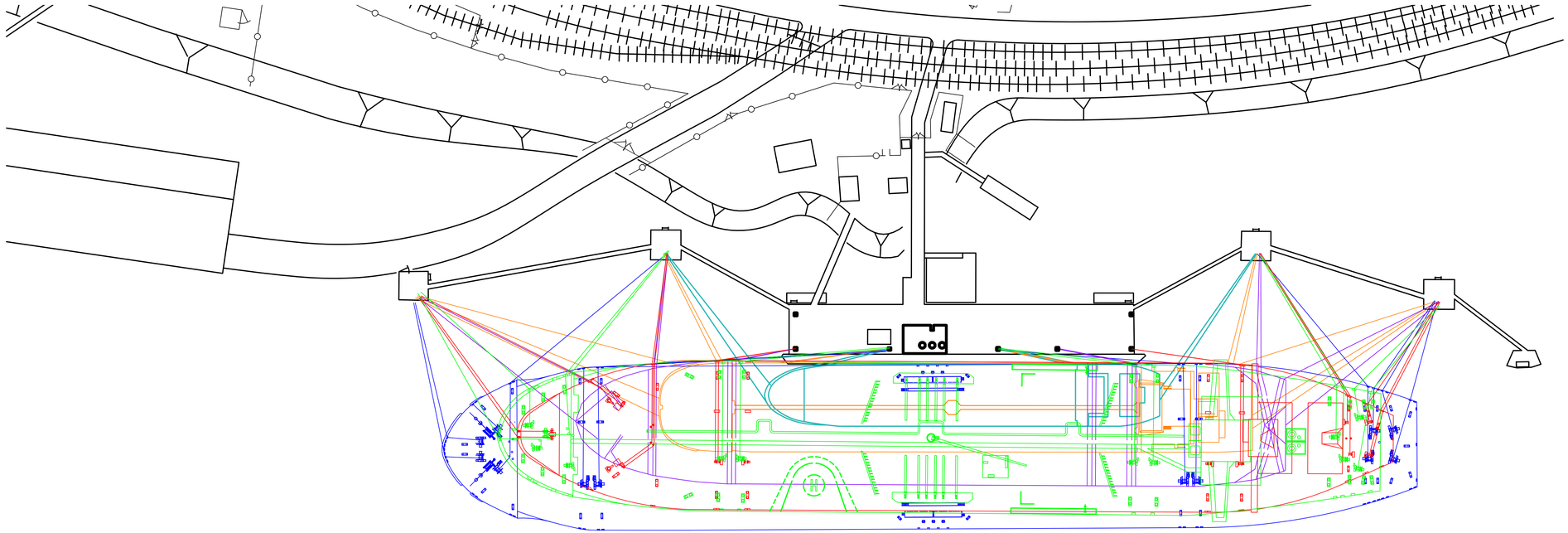
Valero®

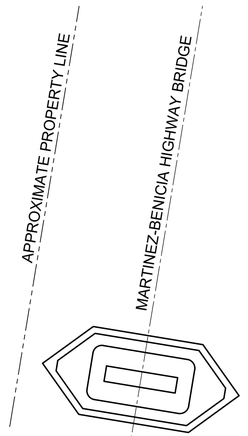
PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1"=60'		

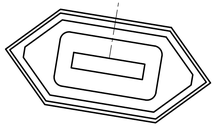
VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
SITE PLAN

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 2 REV. –







LEGEND

- 211,000 DWT TANKER
- 139,000 DWT TANKER
- 120,000 DWT TANKER
- 80,000 DWT TANKER
- 39.000 DWT TANKER
- 10,000 DWT TANKER

NOTE:

1. THE PURPOSE OF THIS SKETCH IS TO SHOW THE MOORING LINE LOCATIONS FOR THE CARB REGULATED DESIGN VESSELS.

MOORING ARRANGEMENTS

1"=60'

60' 0' 60' 120'

SCALE: 1"=60'

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

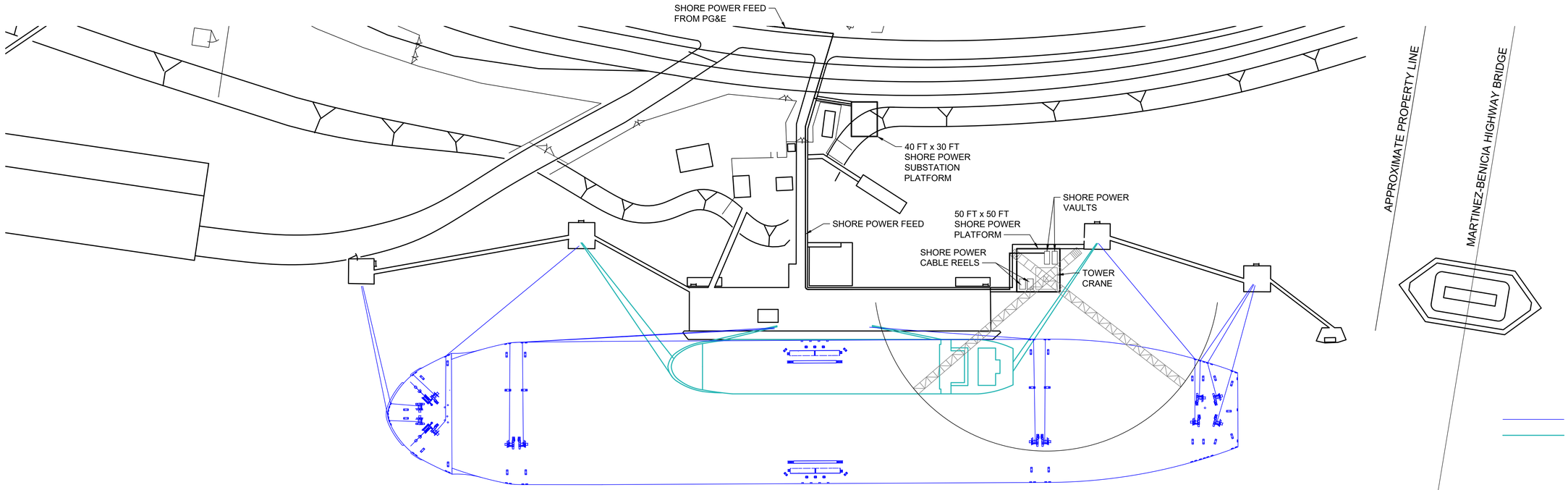
Valero®

PROJECT LOCATION: BENICIA REFINERY	
DRAWN BY: B.VETROVEC	DATE: 10/20/2021
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021
APPROVED:	DATE:
SCALE: 1"=60'	

VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
MOORING ARRANGEMENTS

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 3 REV. –



LEGEND

211,000 DWT TANKER

10,000 DWT TANKER

SHORE POWER PLAN

1"=60'

N

60' 0' 60' 120'

SCALE: 1"=60'

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

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CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1"=60'		

VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
SHORE POWER PLAN

ORIGINAL PROJECT NO. WC_0002114

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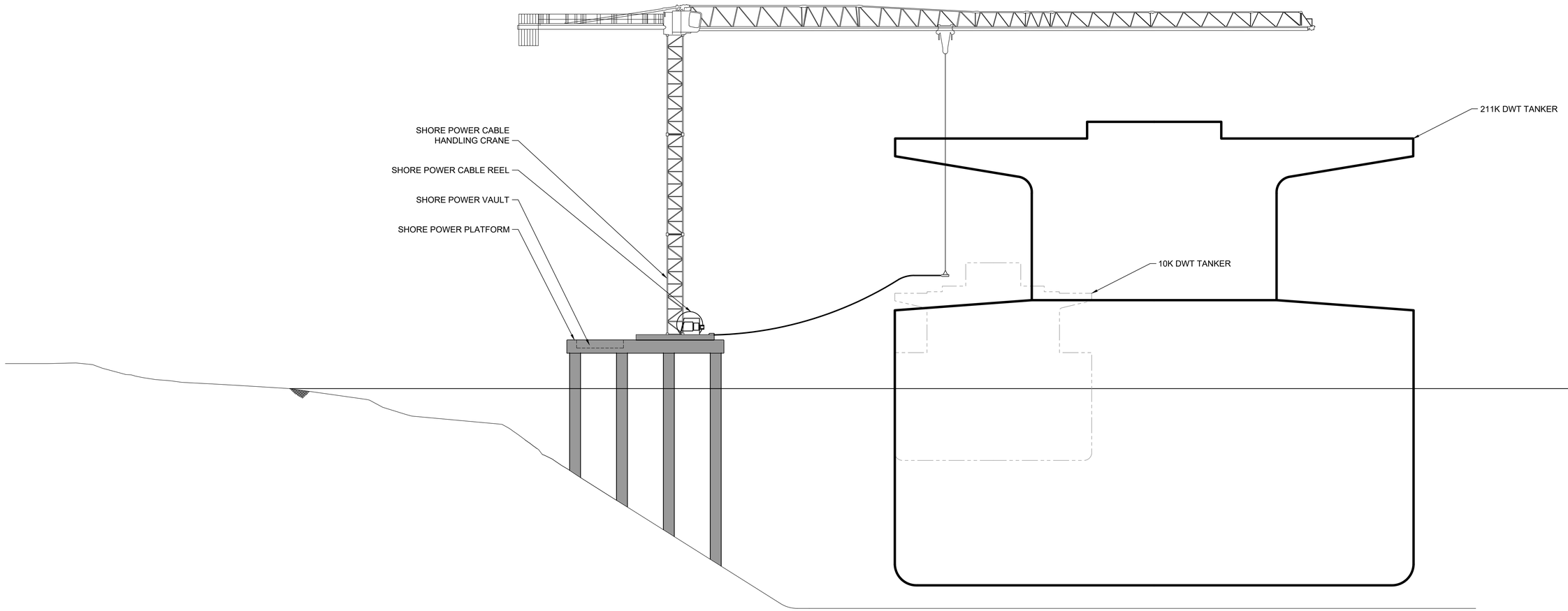

SHORE POWER SECTION

16'-0" 0'-0" 16'-0" 32'-0"

SCALE: 1/16"=1'-0"

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

Valero®

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1/16"=1'-0"		

VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
SHORE POWER SECTION

ORIGINAL PROJECT NO. WC_0002114

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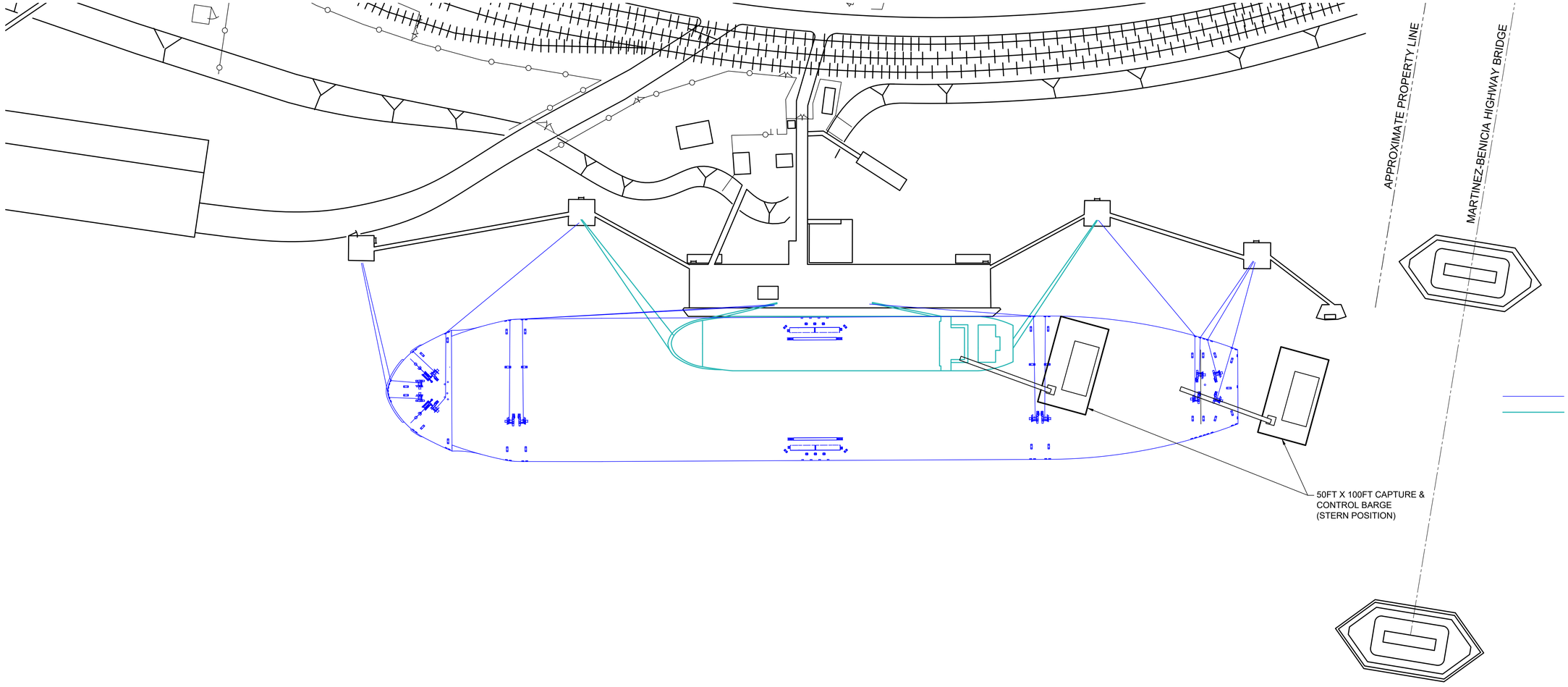


BARGE BASED CAPTURE AND CONTROL PLAN

1"=60'

N

60' 0' 60' 120'

SCALE: 1"=60'

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

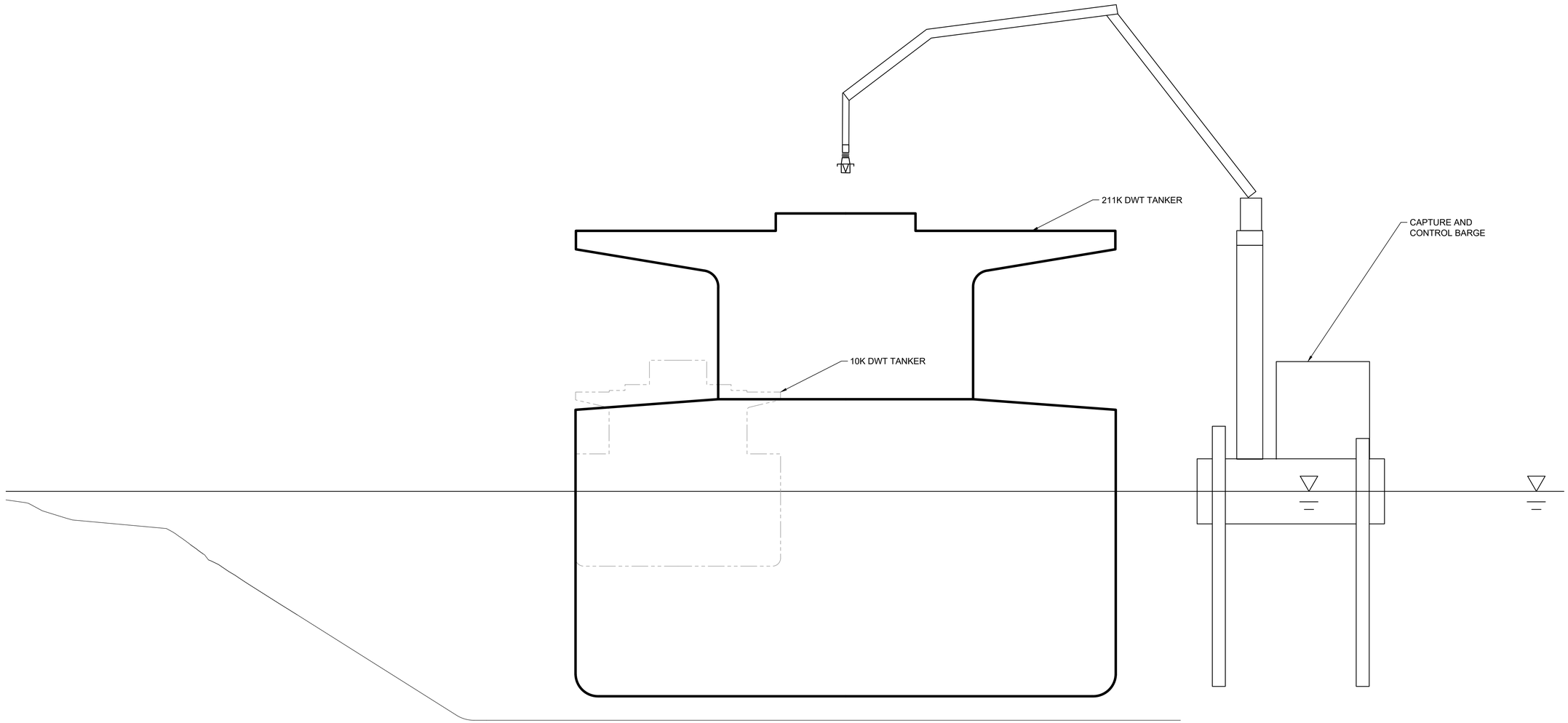
NO.	REVISION	BY	DATE	CHK	APR

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1"=60'		

VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
BARGE BASED CAPTURE AND CONTROL PLAN

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 6 REV. –



BARGE BASED CAPTURE AND CONTROL SECTON

16'-0" 0'-0" 16'-0" 32'-0"

SCALE: 1/16"=1'-0"

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

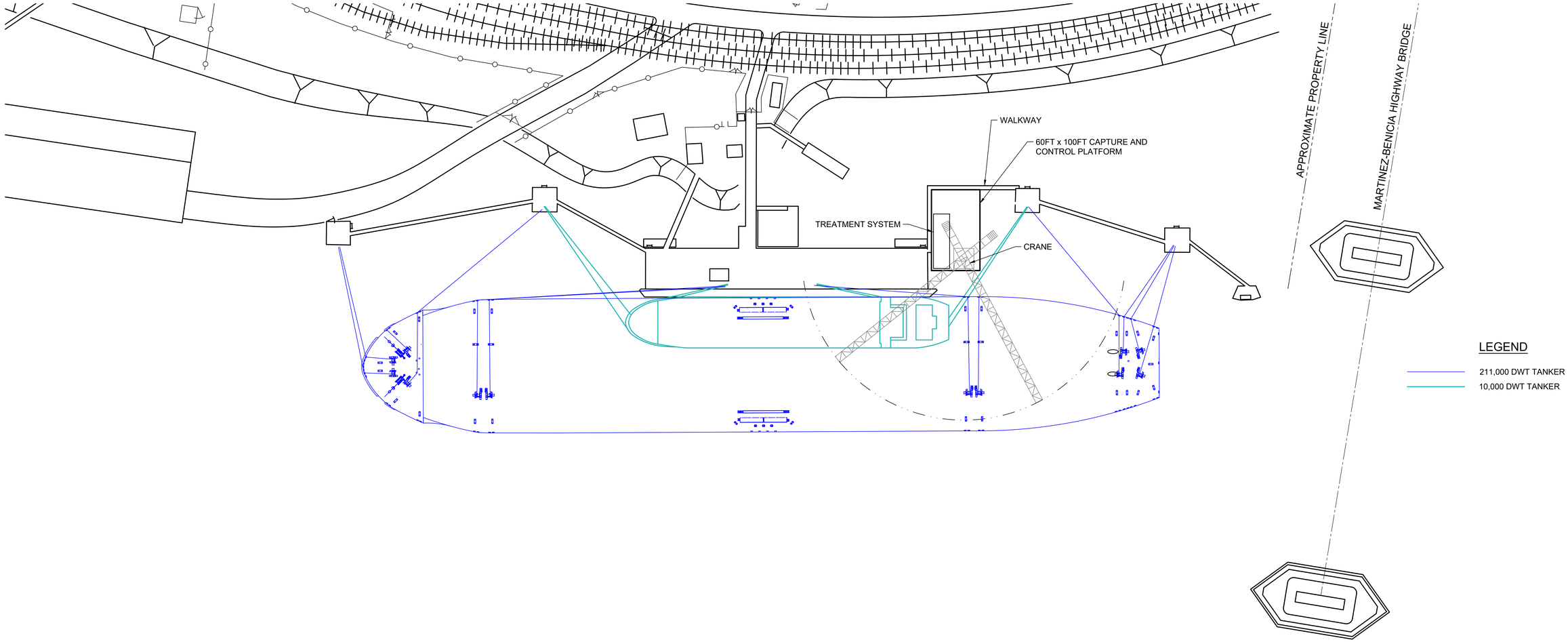
Valero®

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1/16"=1'-0"		

VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
BARGE BASED CAPTURE AND CONTROL SECTON

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 7 REV. –



SHORE BASED CAPTURE AND CONTROL PLAN

1"=60'

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

Valero

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1"=60'		

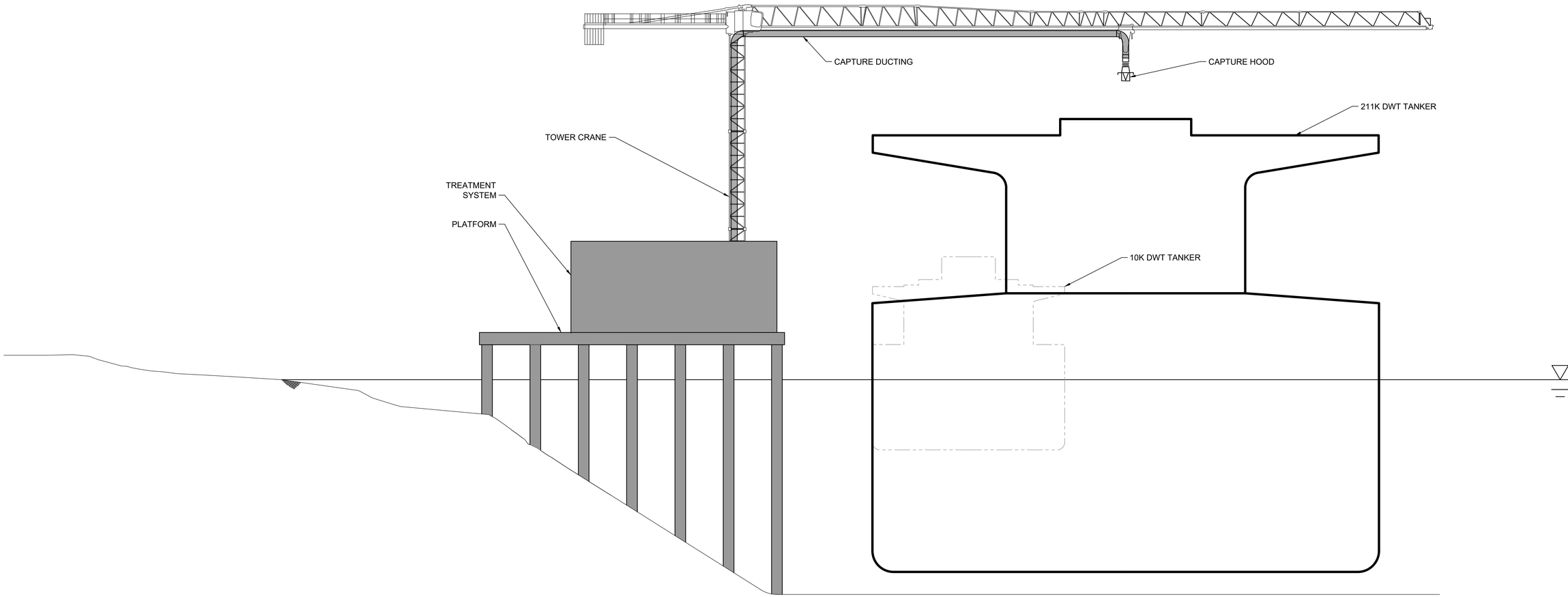
VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
SHORE BASED CAPTURE AND CONTROL PLAN

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 8 | REV. –

NOTE:

A TOWER CRANE SYSTEM CAN PROVIDE THE ADEQUATE REACH BUT MAY NOT BE FEASIBLE TO MODIFY THE CRANE FOR THE CAPTURE SYSTEM. CHALLENGES TO OVERCOME INCLUDE CONTROL OF THE CAPTURE HOOD FOR MULTIPLE STACKS AND DESIGNING A CAPTURE DUCT THAT CAN ALLOW THE HOOD TO TRAVEL ALONG THE BOOM SUCH AS A TELESCOPING SYSTEM. THIS MAY NOT BE FEASIBLE. ANOTHER CHALLENGE TO OVERCOME USING THE TOWER CRANE APPROACH IS ACCOMMODATING STACKS OF DIFFERENT ELEVATIONS.



SHORE BASED CAPTURE AND CONTROL SECTION
TOWER CRANE OPTION

16'-0" 0'-0" 16'-0" 32'-0"

SCALE: 1/16"=1'-0"

moffatt & nichol
2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

Valero®

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1/16"=1'-0"		

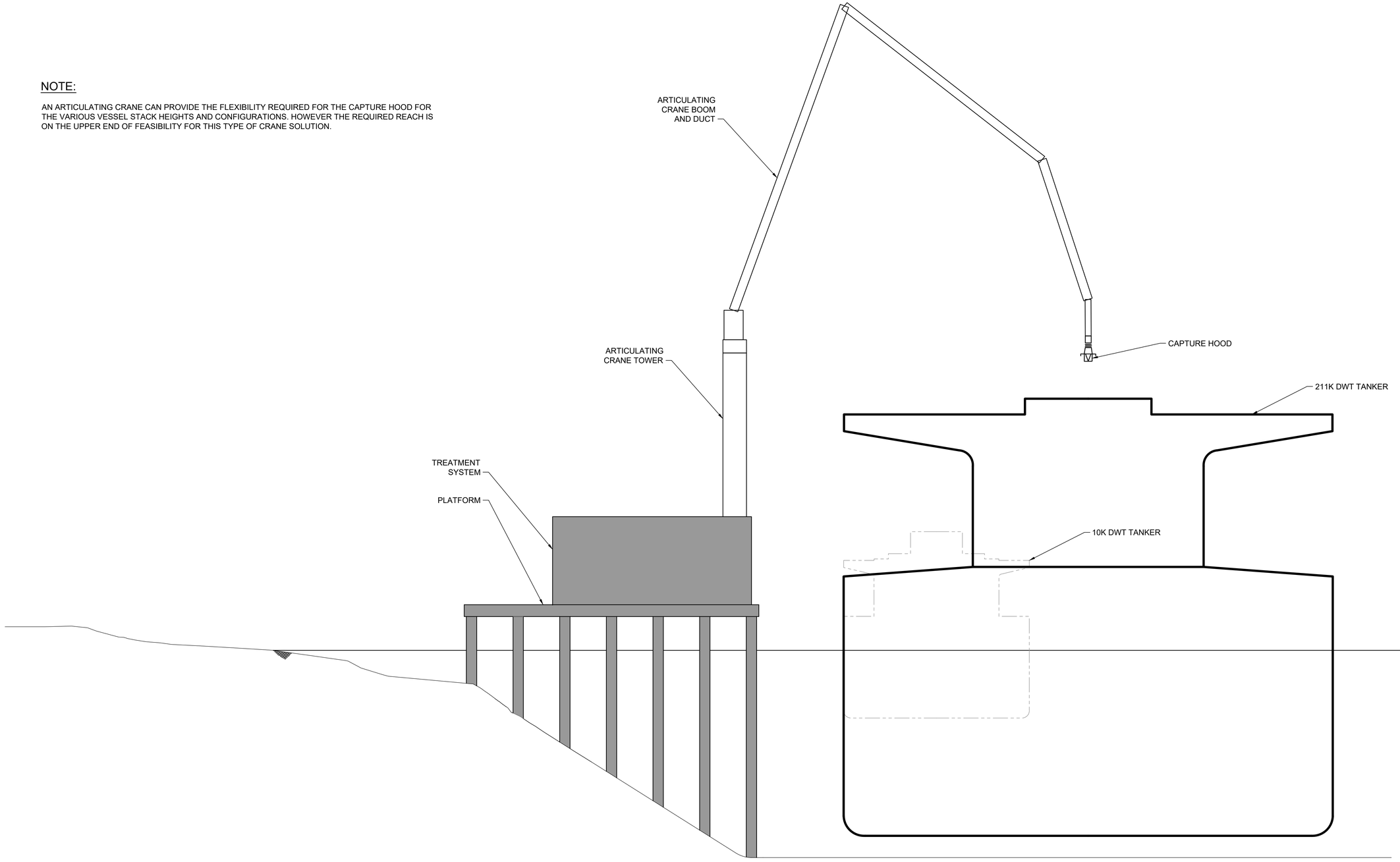
VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
SHORE BASED CAPTURE AND CONTROL SECTION 1

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 9 REV. –

NOTE:

AN ARTICULATING CRANE CAN PROVIDE THE FLEXIBILITY REQUIRED FOR THE CAPTURE HOOD FOR THE VARIOUS VESSEL STACK HEIGHTS AND CONFIGURATIONS. HOWEVER THE REQUIRED REACH IS ON THE UPPER END OF FEASIBILITY FOR THIS TYPE OF CRANE SOLUTION.



SHORE BASED CAPTURE AND CONTROL SECTION
ARTICULATING CRANE OPTION

16'-0" 0'-0" 16'-0" 32'-0"

SCALE: 1/16"=1'-0"

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2185 N. CALIFORNIA BLVD, STE 500
WALNUT CREEK, CA 94596
925-944-5411

REFERENCE DRAWINGS:

NO.	REVISION	BY	DATE	CHK	APR

Valero®

PROJECT LOCATION: BENICIA REFINERY		
DRAWN BY: B.VETROVEC	DATE: 10/20/2021	
CHECKED: M.TROWBRIDGE	DATE: 10/21/2021	
APPROVED:	DATE:	
SCALE: 1/16"=1'-0"		

VALERO BENICIA TERMINAL
CARB AT BERTH STUDY
SHORE BASED CAPTURE AND CONTROL SECTION 2

ORIGINAL PROJECT NO. WC_0002114

DRAWING NO. SHEET 10 REV. –

Attachment H – Existing Terminal Single Line Diagram

DWG NO.	REFERENCE
140-ED-2591	SUBSTATION M & 34, UNDERGROUND
140-ED-2592	SUBSTATION M & 34, BELOW FLOOR CONDUIT PLAN
140-ED-3661	SUBSTATION M & 34, EQUIPMENT LAYOUT
140-ED-3662	SUBSTATION M & 34, ABOVE FLOOR CONDUIT PLAN
134-ED-122	TRANSFORMERS CTA-ELEMENTARY DIAGRAM

NOTES:

1. SEE ELECTRICAL PRACTICE ESY-005 FOR SYMBOLS.
2. PROVIDE AND CONNECT METER SOCKET, FUSE CLIPS, AND MOUNTING BASES FOR CURRENT AND POTENTIAL TRANSFORMERS. PACIFIC GAS & ELECTRIC WILL INSTALL THEIR OWN EQUIPMENT IN THE FIELD.
3. PROVIDE WESTINGHOUSE IQ DATA PLUS MONITORING DEVICES WHERE INDICATED WITH MWH OPTION.
4. KIRK-KEY INTERLOCK ASSOCIATED WITH THE UPS PREVENTS THE MAINTENANCE BYPASS SWITCH ON MCC #34-U1 FROM BEING CLOSED UNLESS THE BYPASS SWITCH ON THE UPS IS FIRST CLOSED.
5. SIZE 480V INCOMING LUGS TO ACCEPT FUTURE (3) 3-750MCM CONDUCTORS.
6. KIRK-KEY INTERLOCK ON THE METERING ENCLOSURE PREVENTS THE PT ACCESS DOOR FROM BEING OPENED UNLESS THE PT DISCONNECT SWITCH IS OPEN AND GROUNDED.
7. BOTH SUBSTATION TRANSFORMERS HAVE INTEGRAL PRIMARY FUSING AND 4-POSITION SWITCHES.

CIRCUIT NUMBER	CABLE SIZE	LENGTH (FEET)	SERVICE	WIRING DIAGRAM
82-1C1	4#14 (2 SPARE)	60	4160V TRANSFORMER SUDDEN PRESSURE & HIGH TEMPERATURE	134-ED-122
82-1C2	4#14 (2 SPARE)	40	4160V TRANSFORMER GROUND C.T.	40-ED-5453
58-2C1	4#14 (2 SPARE)	50	480V TRANSFORMER SUDDEN PRESSURE & HIGH TEMPERATURE	134-ED-122
58-2C2	4#14 (2 SPARE)	50	480V TRANSFORMER GROUND C.T.	40-ED-5442

REV.	DATE	DESCRIPTION	DSN. CKD.	APD. APD.
5	7/22/10	REPLACED 480V & 4160V METERING SYSTEMS	SAR	MSD
4	1/13/10	RETROFIT 19MV615 WITH INTEGRAL STARTER AND ADD STAND-BY GENERATOR, MANUAL TRANSFER SWITCH & CIRCUIT BREAKER	SAR	MSD
3	3/31/92	AS BUILT AR #10575	MCS	AJM JJO

DSN.	RED	1/30/89	FOR INFORMATION - PHONE	AR/WR 10575
DWN.	KEM	7/3/89	MANDHIR DHAMI X-7706	PS 34-12
CKD.	MCS	1-25-91		DDR
APD.				
APD.	JJO	2-13-91		DBASE

VALERO REFINING COMPANY-CALIFORNIA
BENICIA REFINERY

POWER DISTRIBUTION — UNIT 40 ELECTRICAL

4160V/480V

SUB M / SUB 34

SINGLE LINE DIAGRAM

SCALE	DRAWING NO.	REVISION
NONE	140-ED-1312	5
DATE 7/3/89		

40-ED-1312 REV 5.DWG SGN 100722.1121 SAR

Attachment I – Barge-Based System Conceptual Design

CLEAN AIR ENGINEERING MARITIME

VESSEL AT-BERTH EMISSION CAPTURE AND CONTROL SYSTEM

VALERO BENICIA DOCK

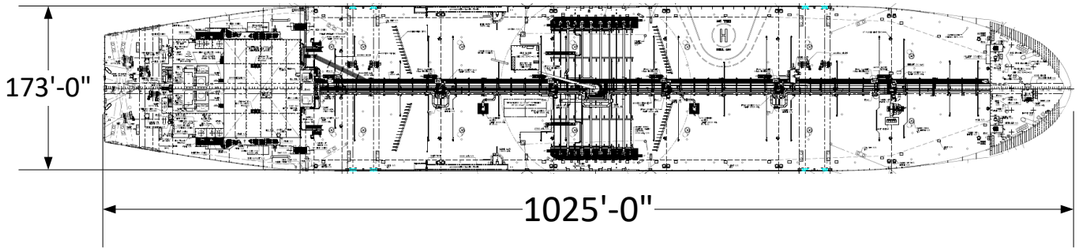
BENICIA, CA

LIQUID BULK TERMINAL

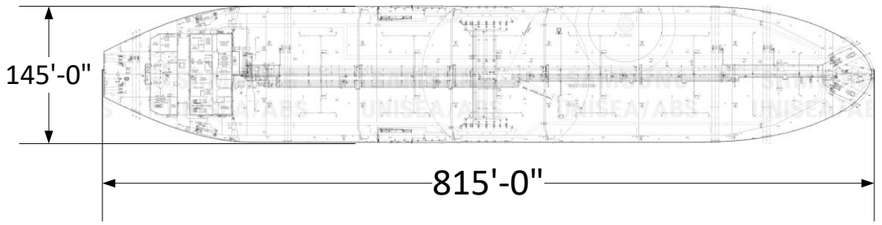
DEVELOPED BY:

ROD GRAVLEY
CAMERON KIANI

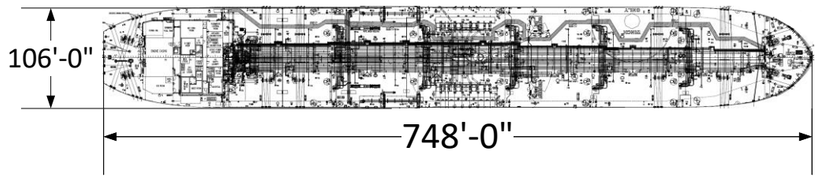
BENICIA DOCK VESSEL SIZES



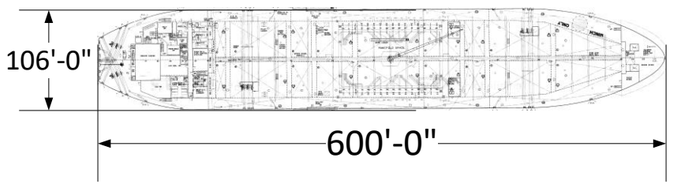
Suezmax – 211,000 DWT



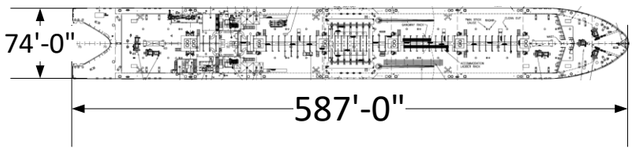
Aframax – 85,000 DWT



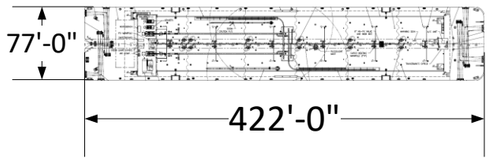
Panamax -75,000 DWT



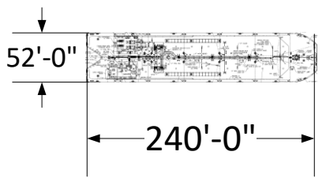
MR – 50,000 DWT



Large Tank Barge (ATB) – 185,000 BBL



Medium Tank Barge – 85,000 BBL



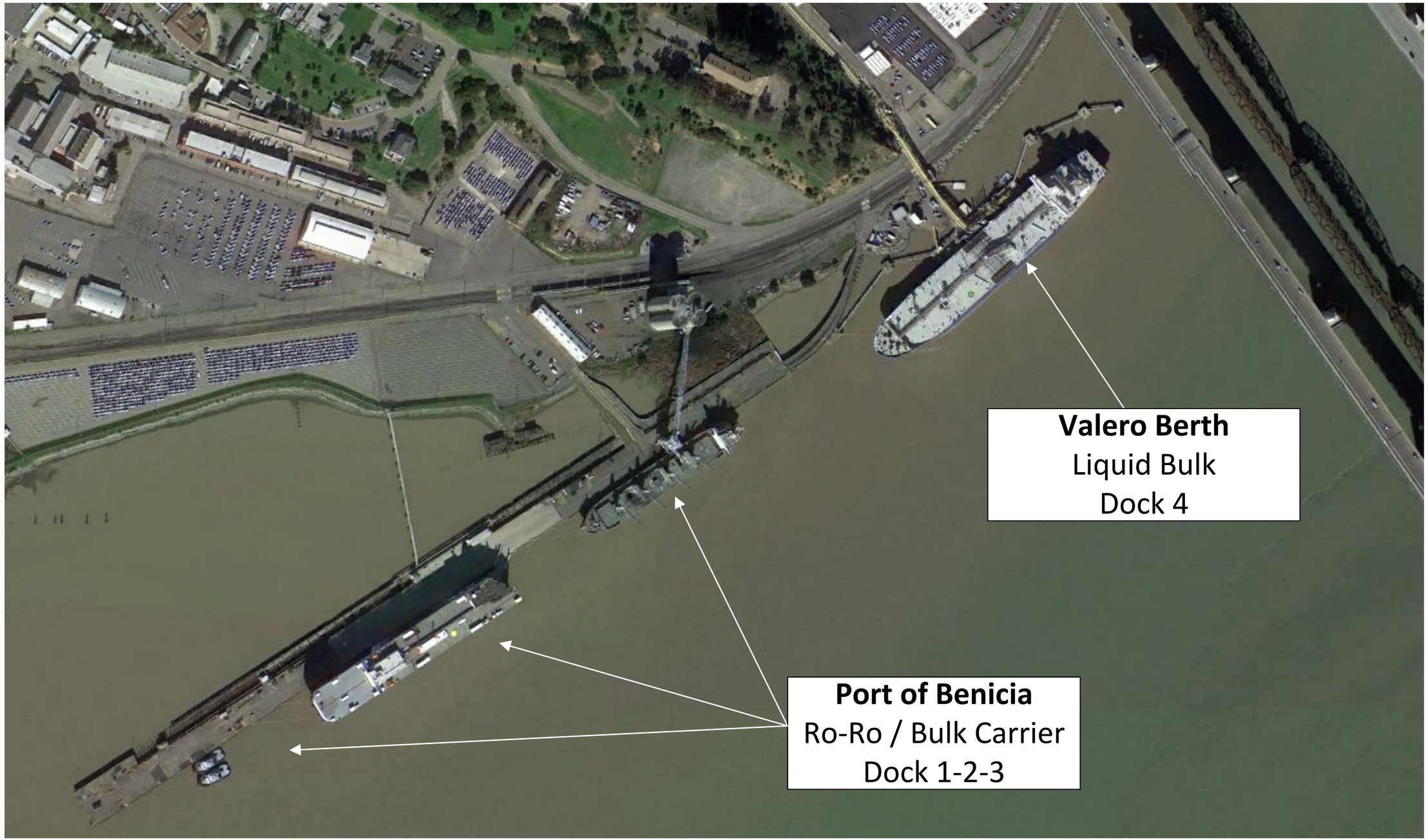
Small Tank Barge – 32,000 BBL

Regulated

Unregulated

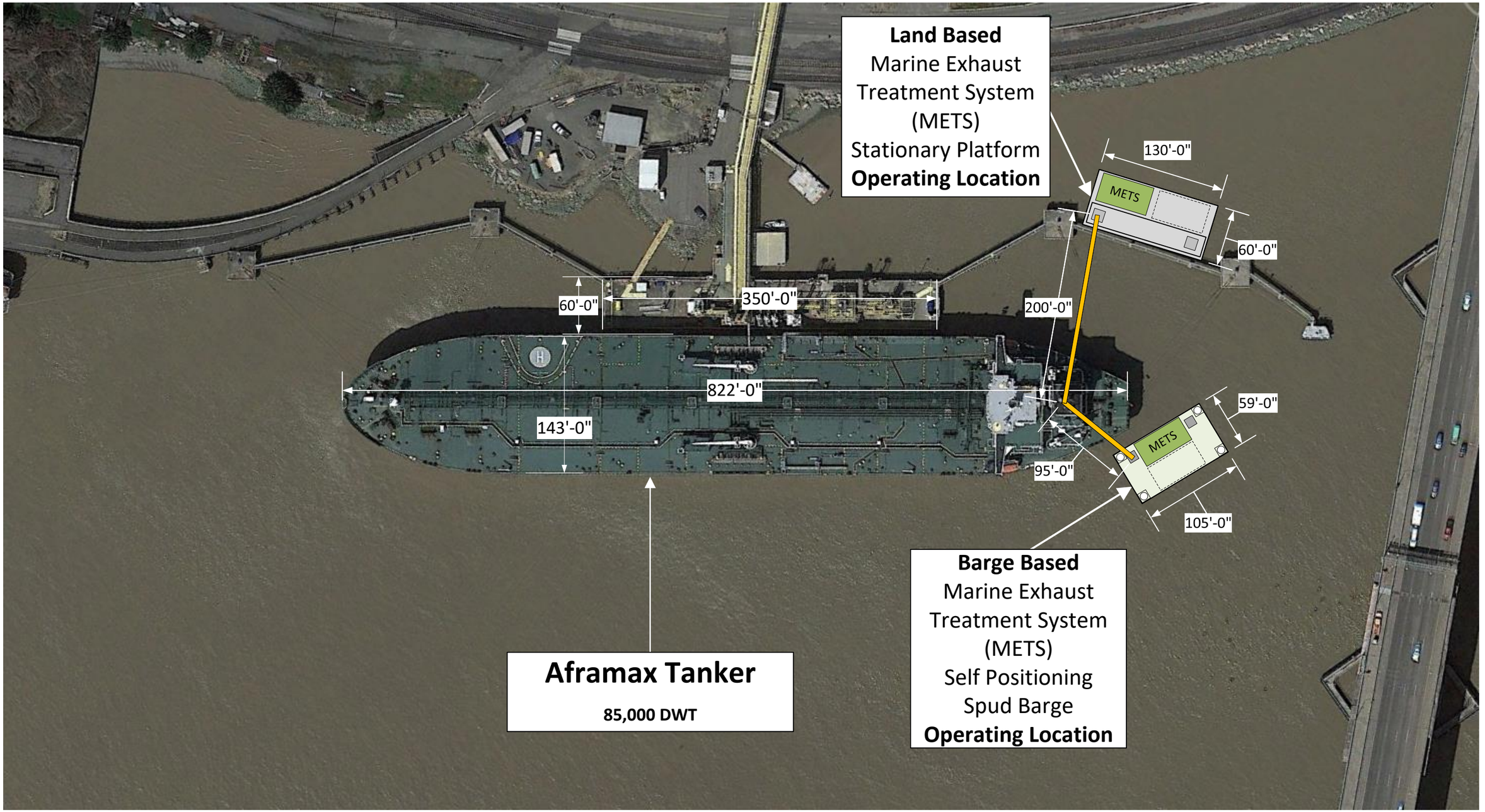
Unit of Measure - ft

Benicia California Marine Terminals



Unit of Measure - ft

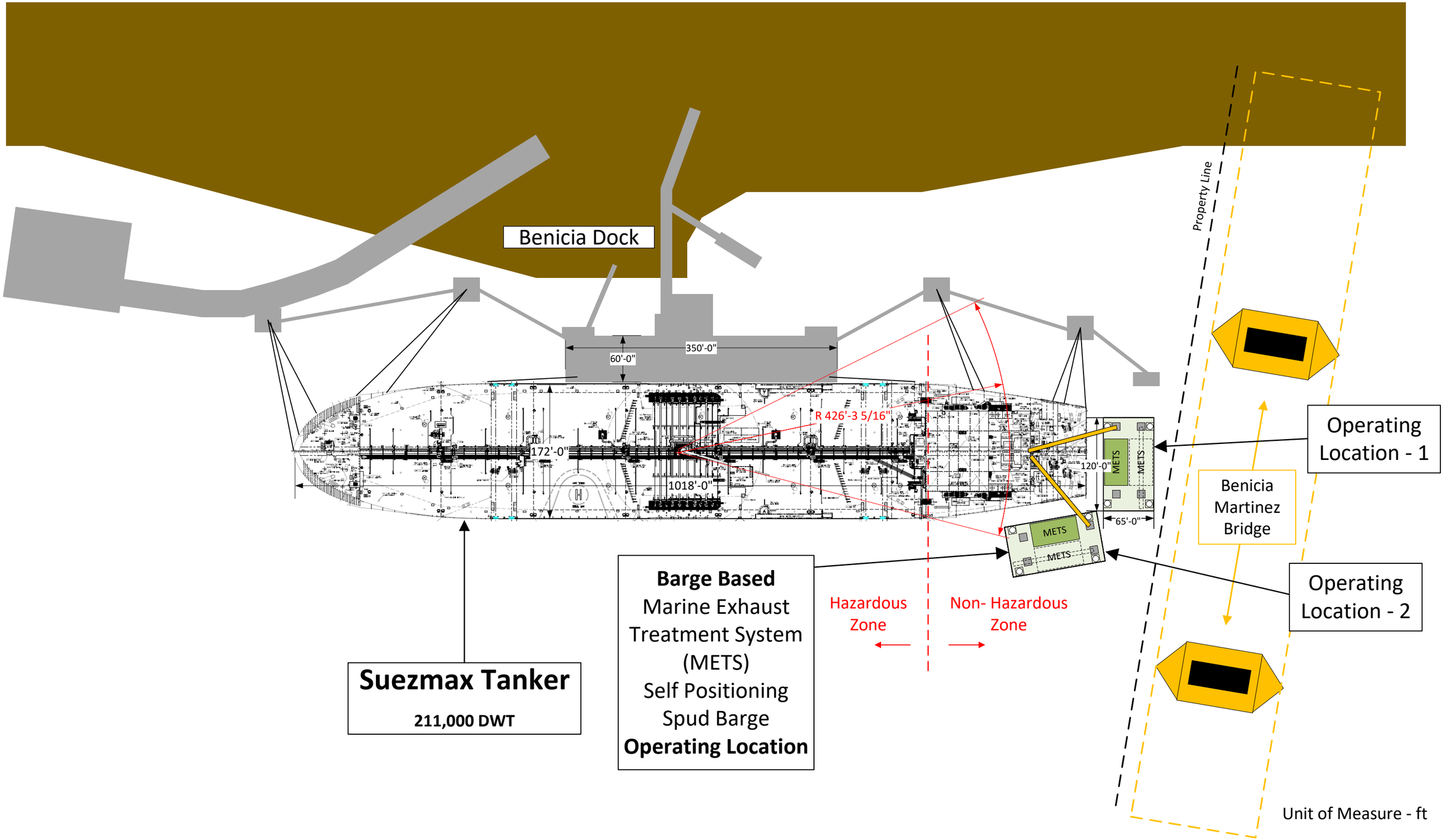
CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS
Land and Barge Based METS



Unit of Measure - ft

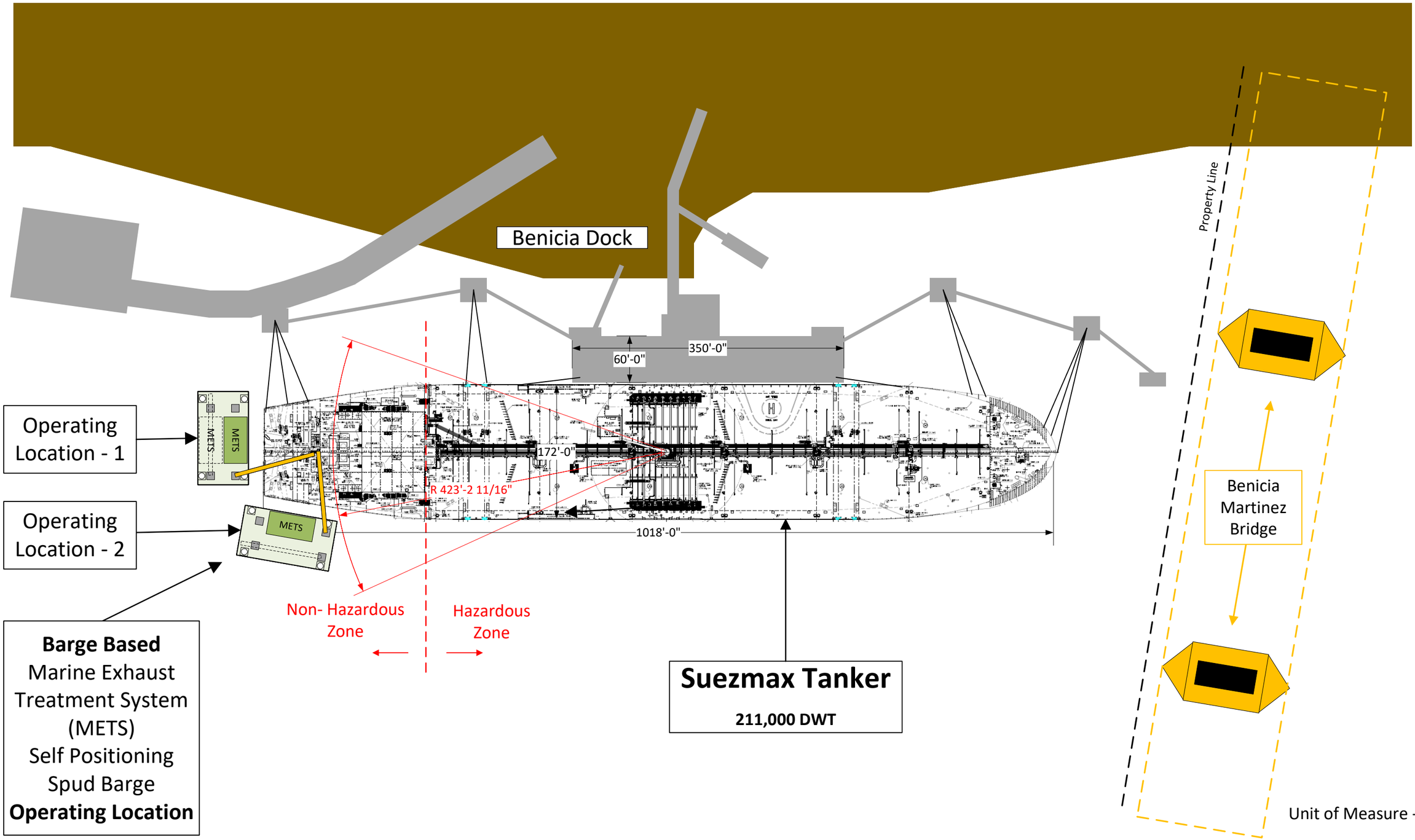
CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS

Barge Based METS – Suezmax Tanker – Starboard Tie



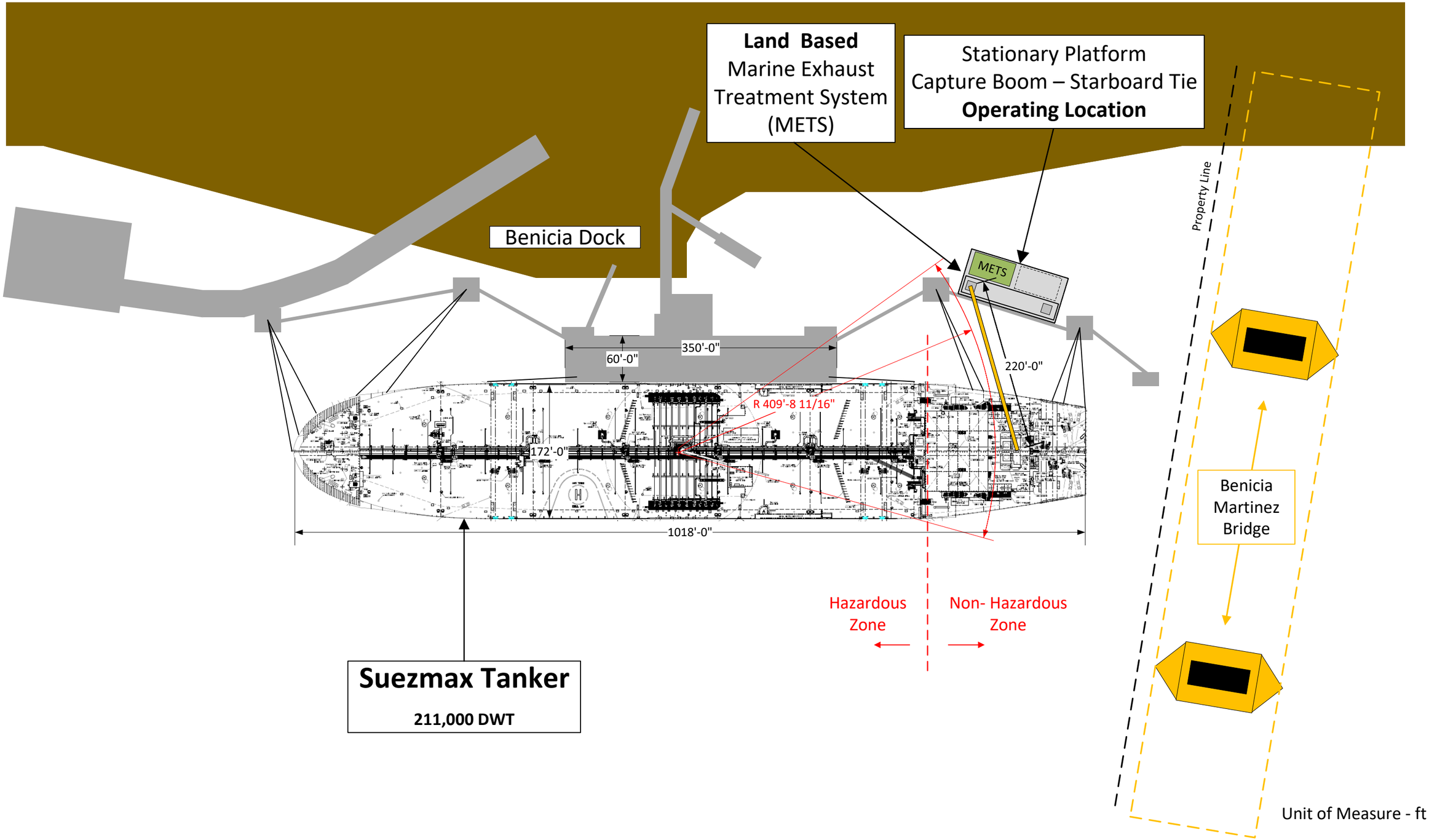
CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS

Barge Based METS - Suezmax Tanker - Port Tie

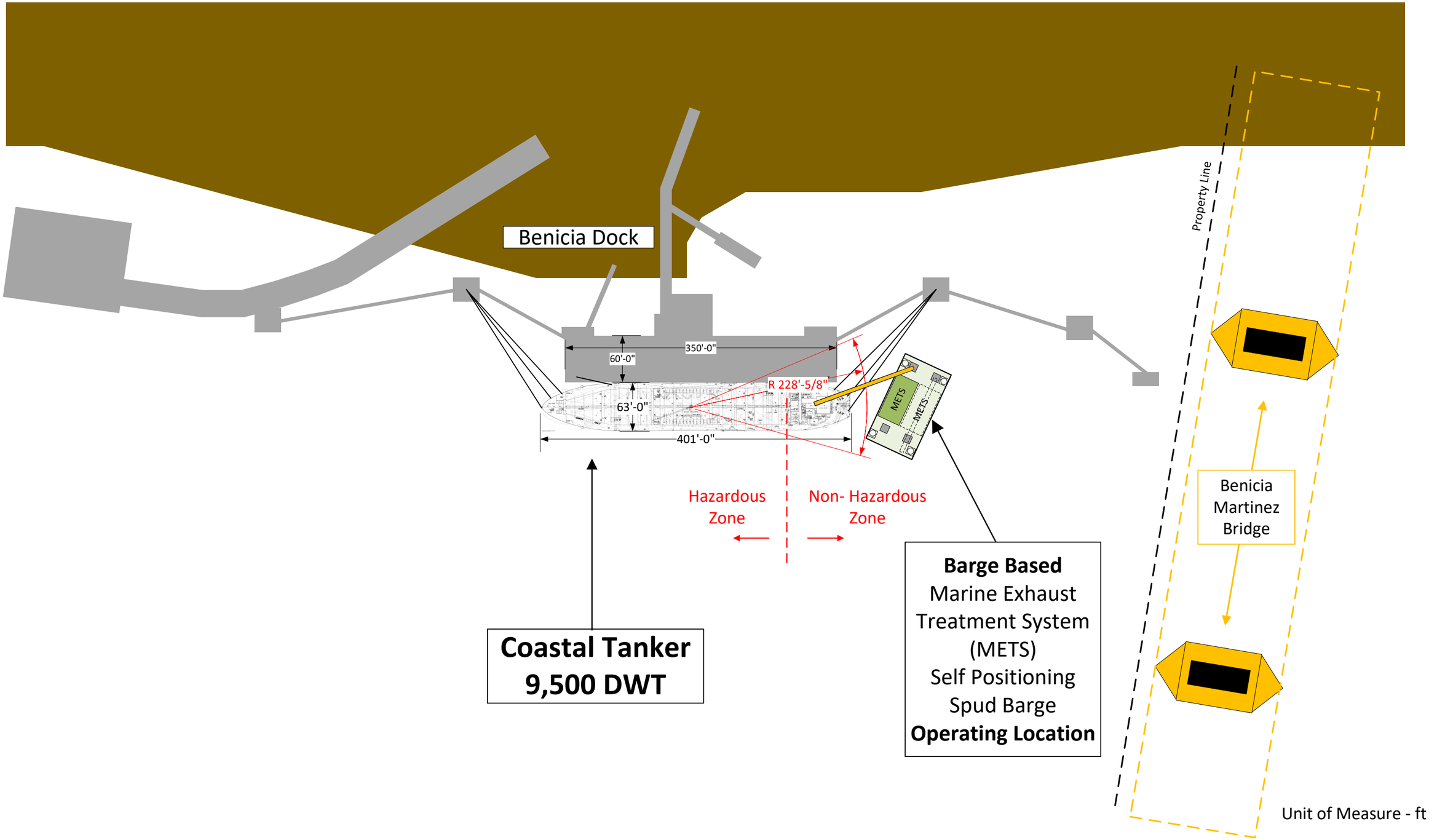


Barge Based Marine Exhaust Treatment System (METS) Self Positioning Spud Barge **Operating Location**

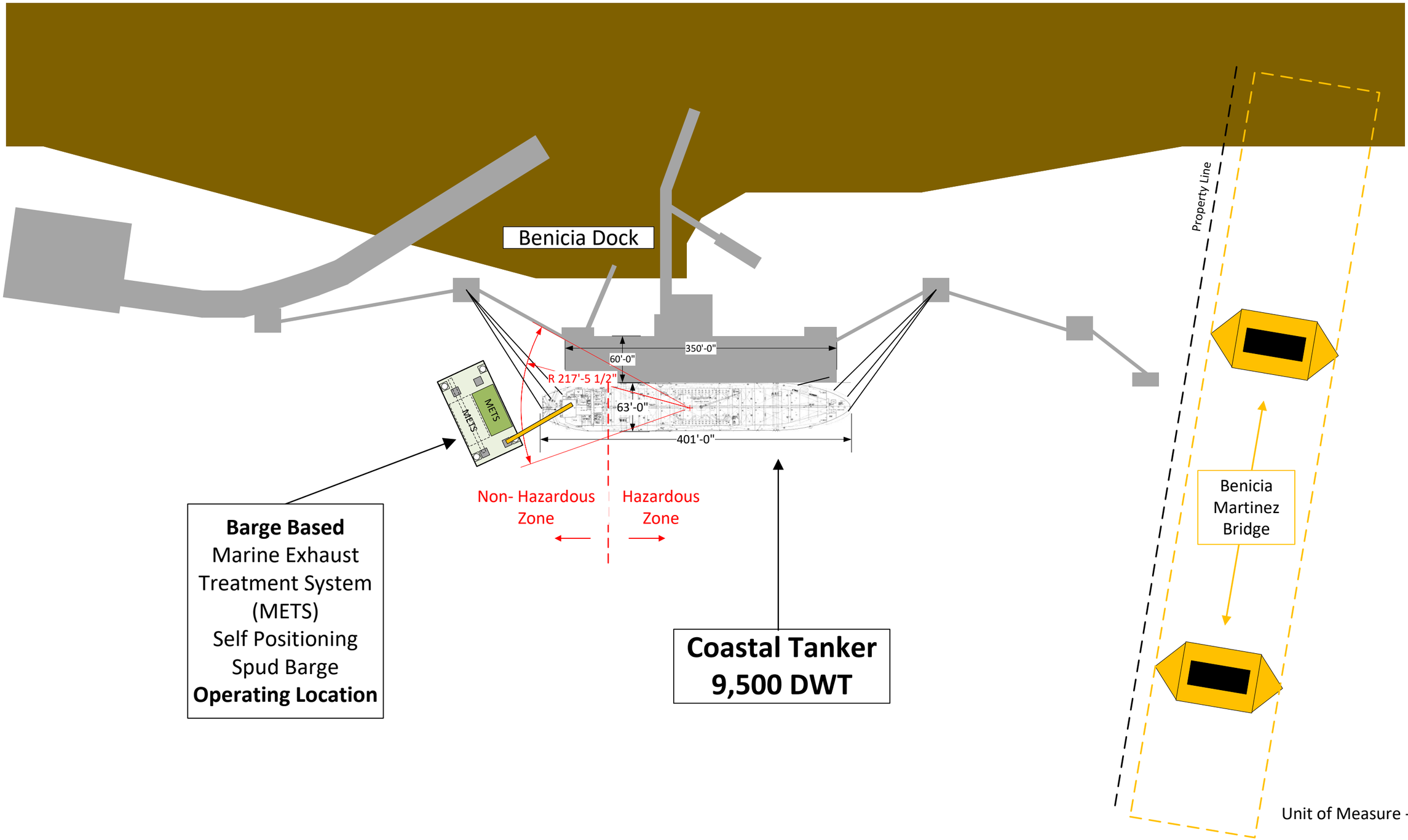
CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS
Land Based METS - Suezmax Tanker – Starboard Tie



CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS
Barge Based METS - Coastal Tanker – Starboard Tie



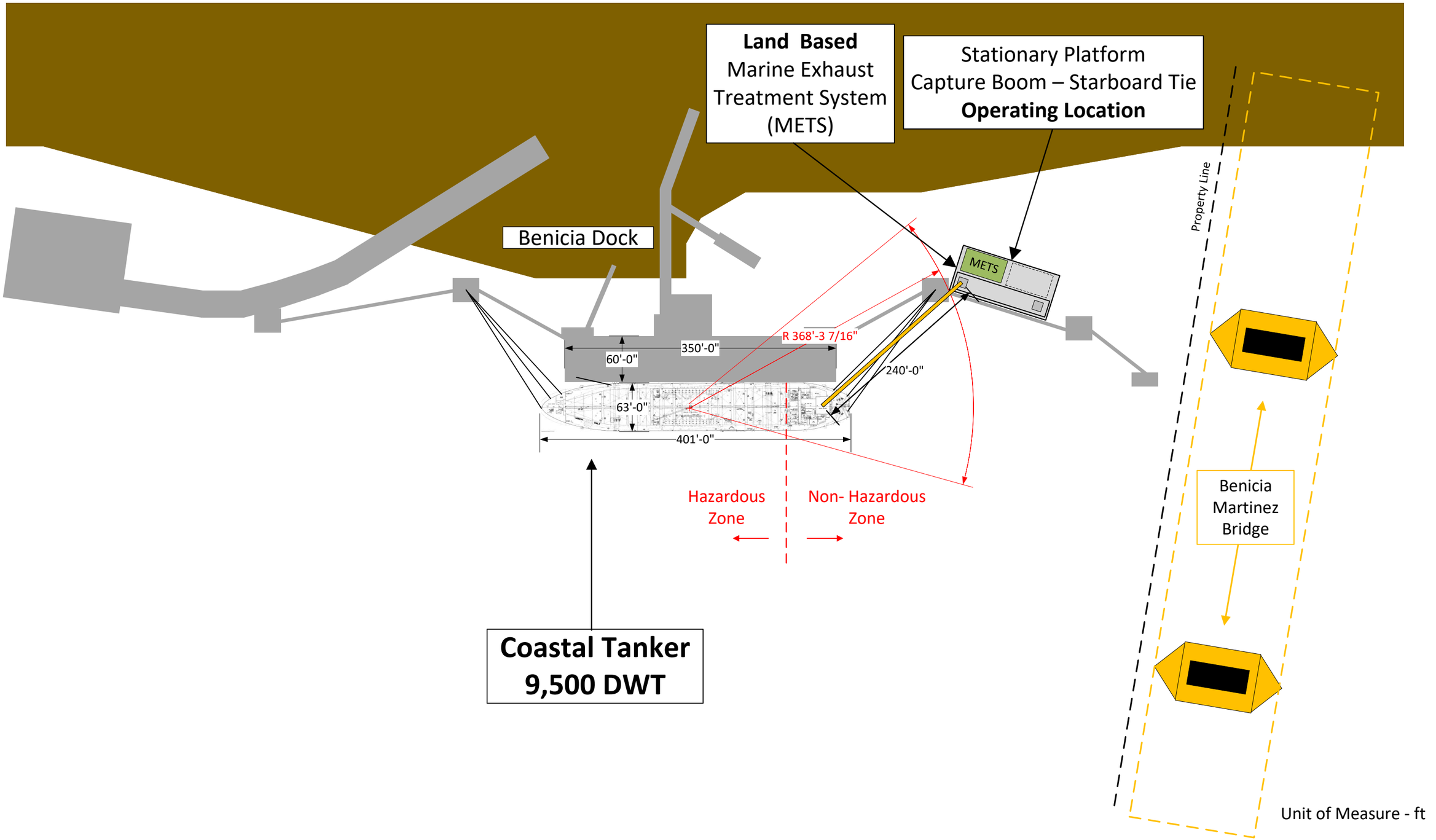
CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS
Barge Based METS - Coastal Tanker – Port Tie



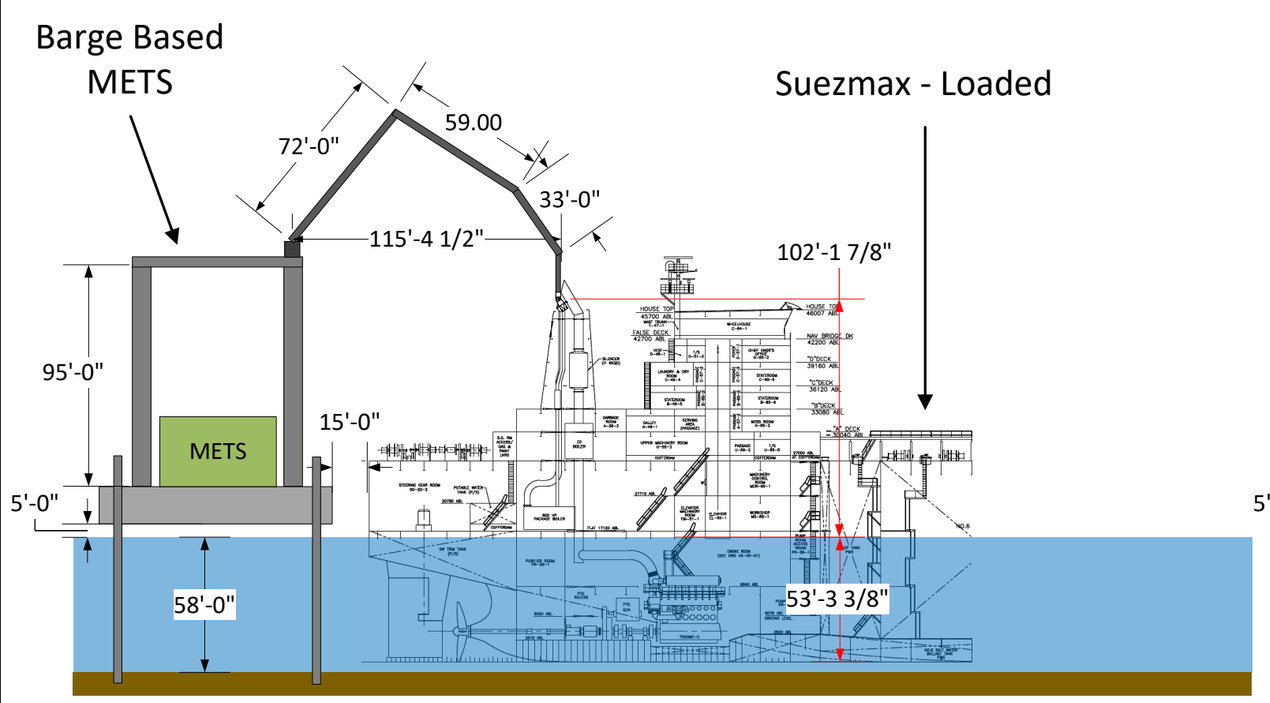
Barge Based
Marine Exhaust Treatment System (METS)
Self Positioning Spud Barge
Operating Location

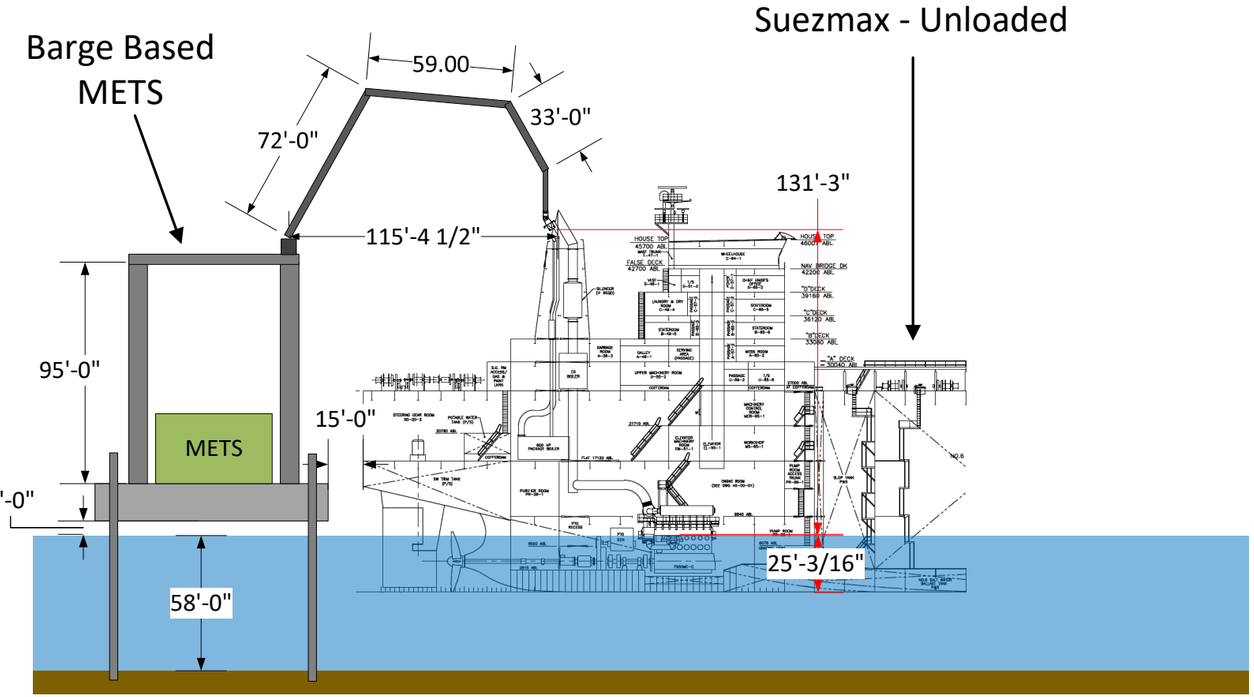
Coastal Tanker 9,500 DWT

CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM OPERATING LOCATIONS
Land Based METS - Coastal Tanker - Starboard Tie



CAPTURE AND CONTROL MARINE EXHAUST TREATMENT SYSTEM
Barge Based METS – Elevation View





View from Water Side

Units of Measure - ft

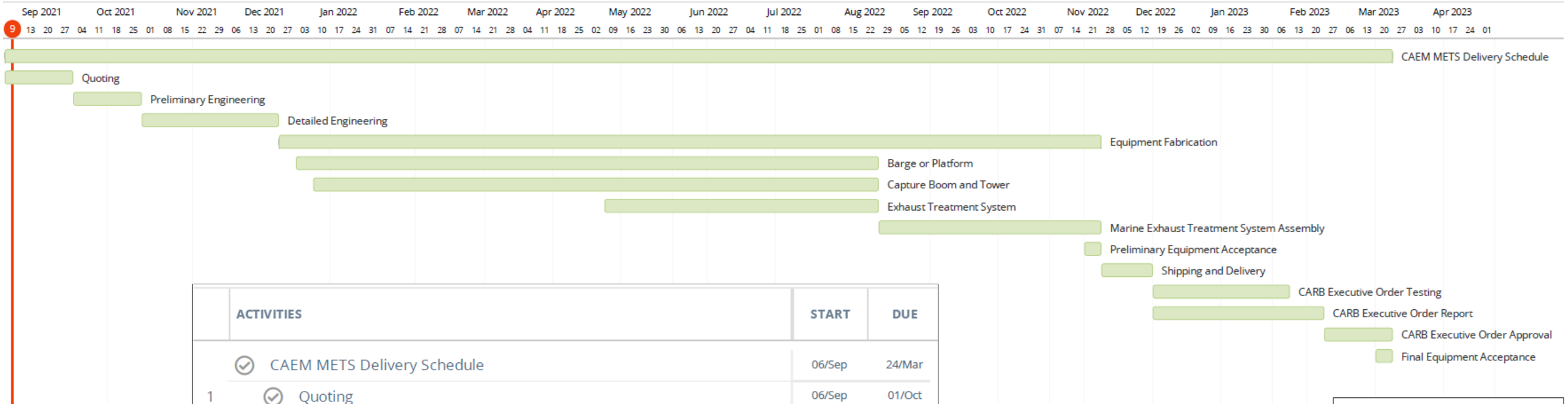
Polar Resolution
Class – Suezmax
Capacity - 141,740 DWT

Vessel Length – 894 ft
Vessel Beam – 152 ft

Anuket Amber
Class – Coastal Tanker
Capacity – 9,500 DWT

Vessel Length – 401 ft
Vessel Beam – 62.5 ft

EQUIPMENT DELIVERY SCHEDULE



	ACTIVITIES	START	DUE
	CAEM METS Delivery Schedule	06/Sep	24/Mar
1	Quoting	06/Sep	01/Oct
2	Preliminary Engineering	04/Oct	29/Oct
3	Detailed Engineering	01/Nov	24/Dec
	Equipment Fabrication	27/Dec	25/Nov
5	Barge or Platform	03/Jan	26/Aug
6	Capture Boom and Tower	10/Jan	26/Aug
7	Exhaust Treatment System	09/May	26/Aug
8	Marine Exhaust Treatment System Assembly	29/Aug	25/Nov
9	Preliminary Equipment Acceptance	21/Nov	25/Nov
10	Shipping and Delivery	28/Nov	16/Dec
11	CARB Executive Order Testing	19/Dec	10/Feb
12	CARB Executive Order Report	19/Dec	24/Feb
13	CARB Executive Order Approval	27/Feb	24/Mar
14	Final Equipment Acceptance	20/Mar	24/Mar

18 MONTH DELIVERY

Attachment J – Cost Estimate

Appendix J.1 - Cost Estimate Summary

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Cost Estimate Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

No	Item	Procure & Construct	Eng & Permit (10%)	Owner Cost & CM / Insp (10%)	Total Upfront Cost	Approx Annual Operation Cost	Total Cost at Year 10
1	**Shore Power**	$46,100,000	$4,610,000	$4,610,000	$55,320,000	$4,510,000	$100,420,000
2	**Capture and Control - Barge Based**						
2a	Purchase (non-IS)	$21,090,000	$0	$2,109,000	$23,199,000	$3,420,000	$57,399,000
2b	Long-Term Service Agreement (non-IS)	$0	$0	$1,000,000	$1,000,000	$6,580,000	$66,800,000
2c	Purchase (IS)	$23,090,000	$0	$2,309,000	$25,399,000	$4,210,000	$67,499,000
2d	Long-Term Service Agreement (IS)	$0	$0	$1,000,000	$1,000,000	$7,360,000	$74,600,000
2e	Purchase (non-IS & 65,000 bbl/hr)	$24,090,000	$0	$2,409,000	$26,499,000	$4,210,000	$68,599,000
2f	Long-Term Service Agreement (non-IS & 65,000 bbl/hr)	$0	$0	$1,000,000	$1,000,000	$7,760,000	$78,600,000
2g	Purchase (IS & 65,000 bbl/hr)	$26,090,000	$0	$2,609,000	$28,699,000	$5,000,000	$78,699,000
2h	Long-Term Service Agreement (IS & 65,000 bbl/hr)	$0	$0	$1,000,000	$1,000,000	$8,550,000	$86,500,000
3	**Capture and Control - Shore Based**						
3a	Non-IS Capture & Treatment System	$43,070,000	$4,307,000	$4,307,000	$51,684,000	$4,470,000	$96,384,000
3b	IS Capture & Treatment System	$45,070,000	$4,507,000	$4,507,000	$54,084,000	$5,260,000	$106,684,000
3c	Non-IS Capture & Treatment System - 65,000 bbl/hr	$46,070,000	$4,607,000	$4,607,000	$55,284,000	$6,180,000	$117,084,000
3d	IS Capture & Treatment System - 65,000bbl/hr	$48,070,000	$4,807,000	$4,807,000	$57,684,000	$6,970,000	$127,384,000

IS = intrinsically safe
Purchase = VLO own the equipment and pay a barge vendor to operate it
Long-Term Agreement Service = VLO enters into a 10 year agreement with barge vendor, VLO have first priority on use of equipment, equipment could earn revenue when not used in the Benicia Refinery (estimate assumes no revenue is realized)
bbl/hr = barrels per hour

1 *Approx Annual Operating Cost assumes normal cost of operation but does not include regular maintenance or repairs that may be required.*

2 *Assumed annual demand for the barge service is 30% of the year (approximately 2630 hours).*

3 *All costs are 2021 USD.*

4 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

5 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

6 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.*

7 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Appendix J.2 - Capital Cost Estimate Summary

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Capital Cost Estimate Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capital Cost Estimate Summary		
No	**Item**	**Total**
1	**Capital Cost Shore Power**	**46,100,000**
2	**Capital Cost Capture and Control - Barge Based**	**21,090,000**
3	**Capital Cost Capture and Control - Shore Based**	**43,070,000**

Capital Cost Shore Power		
No	**Description**	**Extension**
1	**Mobilization & Demobilization**	$500,000
2	**Demolition & Disposal**	$37,500
3	**Shore Power Platform (50ft x 50ft)**	$3,000,000
4	**Shore Power Platform Walkway**	$396,000
5	**Substation Platform (40ft x 30ft)**	$1,440,000
6	**Substation Platform Walkway**	$120,000
7	**Shore Power Substation**	$7,492,900
8	**Shore Power Reel**	$480,000
9	**Tower Crane**	$6,250,000
10	**PG&E 35kV Service Line**	$1,950,000
11	**Allowance for Civil Site Improvements**	$100,000
12	**Allowance for Environmental Mitigation Cost**	$2,000,000
13	**Allowance to Down Time due to Vessel Activity**	$2,500,000
14	**Allowance for Ground Improvement (if required)**	$0
Subtotal		$26,266,400
Contractor Mark-ups (35%)		$9,193,240
Subtotal		$35,459,640
Contingency (30%)		$10,637,892
Total Shore Power		$46,097,532
Total Shore Power (Rounded)		$46,100,000

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Capital Cost Estimate Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capital Cost Capture and Control - Barge Based		
No	**Description**	**Extension**
1	**Barge System**	$16,226,000
Subtotal		$16,226,000
Contingency (30%)		$4,867,800
Subtotal		$21,093,800
Total Barge Based System		$21,093,800
Total Barge Based System (Rounded)		$21,090,000
2	**Allowance for Intrinsically Safe Improvements**	$2,000,000
Total Instrinsically Safe Barge Based System		$23,093,800
Total Instrinsically Safe Barge Based System (Rounded)		$23,090,000
3	**Allowance for Barge System Improvement to 65,000 bbl/hr**	$3,000,000
Total Barge Based System (65,000 bbl/hr)		$24,093,800
Total Barge Based System (65,000 bbl/hr) (Rounded)		$24,090,000
Total Instrinsically Safe Barge Based System (65,000 bbl/hr)		$26,093,800
Total Instrinsically Safe Barge Based System (65,000 bbl/hr) (Rounded)		$26,090,000

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Capital Cost Estimate Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capital Cost Capture and Control - Shore Based		
No	**Description**	**Extension**
1	**Mobilization & Demobilization**	$500,000
2	**Demolition & Disposal**	$37,500
3	**Capture and Control Platform (100ft x 60ft)**	$7,200,000
4	**Capture and Control Platform Walkway**	$456,000
5	**Capture and Control Crane**	$6,250,000
6	**Treatment System**	$5,500,000
7	**Allowance for Civil Site Improvements**	$100,000
8	**Allowance to Down Time due to Vessel Activity**	$2,500,000
9	**Allowance for Environmental Mitigation Cost**	$2,000,000
Subtotal		$24,543,500
Mark-ups (35%)		$8,590,225
Subtotal		$33,133,725
Contingency (30%)		$9,940,118
Total Shore Based System		$43,073,843
Total Shore Based System (Rounded)		$43,070,000
10	**Allowance for Intrinsically Safe Improvements**	$2,000,000
Total Instrinsically Safe Shore Based System		$45,070,000
Total Instrinsically Safe Shore Based System (Rounded)		$45,070,000
11	**Allowance for Barge System Improvement to 65,000 bbl/hr**	$3,000,000
Total Shore Based System (65,000 bbl/hr)		$46,073,843
Total Shore Based System (65,000 bbl/hr) (Rounded)		$46,070,000
Total Instrinsically Safe Shore Based System (65,000 bbl/hr)		$48,073,843
Total Instrinsically Safe Shore Based System (65,000 bbl/hr) (Rounded)		$48,070,000

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Capital Cost Estimate Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

1 *All costs are 2021 USD.*

2 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

3 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

4 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.*

5 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Appendix J.3 - Capital Cost Estimate - Shore Power

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Shore Power Option - Cost Estimate

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capital Cost Shore Power					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
1	**Mobilization & Demobilization**	**1**	**LS**	**$500,000**	**$500,000**
2	**Demolition & Disposal**	**750**	**SF**	**$50**	**$37,500**
3	**Shore Power Platform (50ft x 50ft)**	**2500**	**SF**	**$1,200**	**$3,000,000**
4	**Shore Power Platform Walkway**	**165**	**LF**	**$2,400**	**$396,000**
5	**Substation Platform (40ft x 30ft)**	**1200**	**SF**	**$1,200**	**$1,440,000**
6	**Substation Platform Walkway**	**50**	**LF**	**$2,400**	**$120,000**
7	**Shore Power Substation**	**1**	**LS**	**$7,492,900**	**$7,492,900**
7.1	Transformer 10 MVA	1	LS	$1,705,000	$1,705,000
7.2	Main Switchgear SWGR MS	1	LS	$1,167,000	$1,167,000
7.3	Switchgear SWGR AMP-W	1	LS	$1,077,300	$1,077,300
7.4	Switchgear SWGR AMP-ES	1	LS	$1,077,300	$1,077,300
7.5	AMP OUTLET and Misc.	1	LS	$1,012,500	$1,012,500
7.6	Distribution Panel & Power Link Panels	1	LS	$162,000	$162,000
7.7	5" RGS conduit and Hanger Support	1	LS	$324,000	$324,000
7.8	2" RGS conduit and Hanger Support	1	LS	$121,500	$121,500
7.9	5" PVC conduit	1	LS	$20,500	$20,500
7.10	4" PVC conduit	1	LS	$18,500	$18,500
7.11	#350Kcmil (8KV)	1	LS	$526,500	$526,500
7.12	#1/0 awg, 600V copper	1	LS	$40,500	$40,500
7.13	Hangers and Insulators	1	LS	$36,000	$36,000
7.14	Manhole, 130kip, 8'x8'x8'	1	LS	$27,000	$27,000
7.15	Ductbank Concrete Encasement (Trenching and Backfill)	1	LS	$14,000	$14,000
7.16	Duct Spacers	1	LS	$4,000	$4,000
7.17	Grounding System	1	LS	$10,800	$10,800
7.18	Handhole, 130kip, 4'x4'x4'	1	LS	$27,000	$27,000
7.19	Guard Post	1	LS	$33,750	$33,750
7.2	Concrete Pad and Fencing	1	LS	$40,500	$40,500
7.21	Final Testing	1	LS	$40,500	$40,500
7.22	Lighting	1	LS	$6,750	$6,750
8	**Shore Power Reel**	**1**	**LS**	**$480,000**	**$480,000**
9	**Tower Crane**	**1**	**LS**	**$6,250,000**	**$6,250,000**
9.1	Crane Procurement and Delivery	1	LS	$3,750,000	$3,750,000

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Shore Power Option - Cost Estimate

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capital Cost Shore Power					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
9.2	Engineering & Installation of Crane Modifications	1	LS	$2,500,000	$2,500,000
10	**PG&E 35kV Service Line**	**1**	**LS**	**$1,950,000**	**$1,950,000**
10.1	Drawings, planning, permits, City Approval	1	LS	$450,000	$450,000
10.2	Utility Switchgear SWGR MS/ Meter SUBSTATION including startup & final testing	1	LS	$1,500,000	$1,500,000
11	**Allowance for Civil Site Improvements**	**1**	**LS**	**$100,000**	**$100,000**
12	**Allowance for Environmental Mitigation Cost**	**1**	**LS**	**$2,000,000**	**$2,000,000**
13	**Allowance to Down Time due to Vessel Activity**	**1**	**LS**	**$2,500,000**	**$2,500,000**
14	**Allowance for Ground Improvement (if required)**	**1**	**LS**	**$0**	**$0**
Subtotal					***$26,266,400***
Contractor Mark-ups (Supervision, O&P, Insurance/Bonds)				35%	$9,193,240
Subtotal					***$35,459,640***
Design Contingency				30%	$10,637,892
TOTAL					***$46,097,532***
TOTAL (ROUNDED)					**$46,100,000**

Class 5 Estimate Accuracy	**50%**	**$69,150,000**
	-30%	**$32,270,000**

1 *All costs are 2021 USD.*

2 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

3 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

4 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.*

5 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Appendix J.4 - Capital Cost Estimate - Capture and Control - Shore Based

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Shore Based Capture & Control - Cost Estimate

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capital Cost Capture and Control - Shore Based					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
1	**Mobilization & Demobilization**	**1**	**LS**	**$500,000**	**$500,000**
2	**Demolition & Disposal**	**750**	**SF**	**$50**	**$37,500**
3	**Capture and Control Platform (100ft x 60ft)**	**6000**	**SF**	**$1,200**	**$7,200,000**
4	**Capture and Control Platform Walkway**	**190**	**LF**	**$2,400**	**$456,000**
5	**Capture and Control Crane**	**1**	**LS**	**$6,250,000**	**$6,250,000**
5.1	Crane Procurement and Delivery	1	LS	$3,750,000	$3,750,000
5.2	Crane Engineering & Onsite Erection & Commissioning	1	LS	$2,500,000	$2,500,000
6	**Treatment System**	**1**	**LS**	**$5,500,000**	**$5,500,000**
7	**Allowance for Civil Site Improvements**	**1**	**LS**	**$100,000**	**$100,000**
8	**Allowance to Down Time due to Vessel Activity**	**1**	**LS**	**$2,500,000**	**$2,500,000**
9	**Allowance for Environmental Mitigation Cost**	**1**	**LS**	**$2,000,000**	**$2,000,000**
Subtotal					***$24,543,500***
Contractor Mark-ups (Supervision, O&P, Insurance/Bonds)				35%	$8,590,225
Subtotal					***$33,133,725***
Design Contingency				30%	$9,940,118
TOTAL					***$43,073,843***
TOTAL (ROUNDED)					**$43,070,000**
10	**Allowance for Intrinsically Safe Improvements**				**$2,000,000**
Total Instrinsically Safe Shore Based System					***$45,070,000***
Total Instrinsically Safe Shore Based System (Rounded)					**$45,070,000**

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Shore Based Capture & Control - Cost Estimate

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

11	**Allowance for Barge System Improvement to 65,000 bbl/hr**	**$3,000,000**
Total Shore Based System (65,000 bbl/hr)		***$46,073,843***
Total Shore Based System (65,000 bbl/hr) (Rounded)		**$46,070,000**
Total Instrinsically Safe Shore Based System (65,000 bbl/hr)		***$48,073,843***
Total Instrinsically Safe Shore Based System (65,000 bbl/hr) (Rounded)		**$48,070,000**

Class 5 Estimate Accuracy	**50%**	**$64,605,000**
	-30%	**$30,149,000**

1 *All costs are 2021 USD.*

2 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

3 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

4 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.*

5 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Appendix J.5 - Annual Operation Cost Estimate Summary

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Cost Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Annual Operation Cost Estimate Summary		
No	**Item**	**Total**
1	**Shore Power**	**$4,510,000**
2a	**Capture and Control - Barge Based (Purchase) - non-IS**	**$3,420,000**
2b	**Capture and Control - Barge Based (Long Term Service Agreement) - non-IS**	**$6,580,000**
2c	**Capture and Control - Barge Based (Purchase) - IS**	**$4,210,000**
2d	**Capture and Control - Barge Based (Long Term Service Agreement) - IS**	**$7,360,000**
2e	**Capture and Control - Barge Based (Purchase) - non-IS & 65,000 bbl/hr**	**$4,210,000**
2f	**Capture and Control - Barge Based (Long Term Service Agreement) - non-IS & 65,000 bbl/hr**	**$7,760,000**
2g	**Capture and Control - Barge Based (Purchase) - IS & 65,000 bbl/hr**	**$5,000,000**
2h	**Capture and Control - Barge Based (Long Term Service Agreement) - IS & 65,000 bbl/hr**	**$8,550,000**
3a	**Capture and Control - Shore Based - non-IS**	**$4,470,000**
3b	**Capture and Control - Shore Based - IS**	**$5,260,000**
3c	**Capture and Control - Shore Based - non-IS & 65,000 bbl/hr**	**$6,180,000**
3d	**Capture and Control - Shore Based - IS & 65,000 bbl/hr**	**$6,970,000**

Shore Power		
No	**Description**	**Total**
1	**Electrical Power Annual Cost**	$3,265,934
2	**Labor Annual Cost**	$1,029,000
3	**Electrical Rate Uncertainty (30% Factor on 2008 service rates)**	$214,747
Total Shore Power		$4,509,681
Total Shore Power (Rounded)		$4,510,000

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Cost Summary

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capture and Control - Barge Based (Purchase)		
No	**Description**	**Total**
1	**Operating Cost - non-IS**	$3,419,000
Total Barge Based System (non-IS) (Rounded)		$3,420,000
2	**Operating Cost - IS**	$4,208,000
Total Barge Based System (IS) (Rounded)		$4,210,000
3	**Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - non-IS**	$4,208,000
Total Barge Based System (non-IS) (Rounded)		$4,210,000
4	**Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - IS**	$4,997,000
Total Barge Based System (IS) (Rounded)		$5,000,000

Capture and Control - Barge Based (Long Term Service Agreement)		
No	**Description**	**Total**
1	**Operating Cost - non-IS**	$6,580,000
Total Barge Based System (non-IS)		$6,580,000
2	**Operating Cost - IS**	$7,360,000
Total Barge Based System (IS)		$7,360,000
3	**Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - non-IS**	$7,758,500
Total Barge Based System (non-IS)		$7,760,000
4	**Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - IS**	$8,547,500
Total Barge Based System (IS)		$8,550,000

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Cost Summary

Moffatt & Nichol	
By:	M. Miranda
Checked:	M. Trowbridge
Date:	11/19/2021
Project No:	211925

Capture and Control - Shore Based (Long Term Service Agreement)		
No	**Description**	**Total**
1	**Operating Cost - non-IS**	$4,470,000
Total Shore Based System (non-IS)		$4,470,000
2	**Operating Cost - IS**	$5,260,000
Total Shore Based System (IS)		$5,260,000
3	**Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - non-IS**	$6,180,500
Total Barge Based System (non-IS)		$6,180,000
4	**Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - IS**	$6,969,500
Total Barge Based System (IS)		$6,970,000

1 *Approx Annual Operating Cost assumes normal cost of operation but does not include regular maintenance or repairs that may be required.*

2 *Assumed annual demand for the barge service is 30% of the year (approximately 2630 hours).*

3 *All costs are 2021 USD.*

4 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

5 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

6 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.*

7 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Appendix J.6 - Annual Operation Cost Estimate - Shore Power

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Shore Power

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Shore Power					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
1	**Electrical Power Annual Cost**	**1**	**LS**	**$3,265,934**	**$3,265,934**
1.1	Energy Charge (cost per kWh energy usage)	18410000	kWh	$0.1774	$3,265,934
2	**Labor Annual Cost**	**1**	**LS**	**-**	**$1,029,000**
2.1	Crew for Shore Power Connection and Disconnection	1600	Hours	$150.00	$240,000
2.2	Crew Overseeing Connection	5260	Hours	$150.00	$789,000
Subtotal					***$4,294,934***
Mark-up for rate uncertainty				5%	$214,747
TOTAL					***$4,509,681***
TOTAL (ROUNDED)					**$4,510,000**

Class 5 Estimate Accuracy **50%** **$6,765,000**
-30% **$3,157,000**

Assume $150 / hour for operator labor
Assume 100 vessel visits per year, assume 2 operators required for 4 hours for each connect / disconnect
Assume 2 operators required to oversee crane during full vessel visit (30% = 2630 hours)

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Shore Power

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Calculation Description For:

1 Electrical Power Annual Cost

Power Demand Input	Quantity	Measure	Comment
Tanker Shore Power Load	7.0	MW	Total Demand per Month
Tanker AMP System Power Factor	0.9	-	Assuming automatic power factor correction system used
Tanker Time at Berth	26.3	hours	From statistical analysis
Tanker Visits Per Year	100	-	From statistical analysis
Tanker Total Connection Time	2630	hours	Per year

	Electricity Rates	Quantity	Measure	Price	Extension	Comment
1.1	Energy Charge	18410000	kWh	$0.1774	$3,265,934.00	Cost is per KWh energy usage

1 Approx Annual Operating Cost assumes normal cost of operation but does not include regular maintenance or repairs that may be required.

2 Assumed annual demand for the barge service is 30% of the year (approximately 2630 hours).

3 All costs are 2021 USD.

4 The estimate, including the contingency, is considered accurate to -30% to +50%.

5 This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.

6 The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.

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8 Power cost rates to be confirmed with PG&E

Appendix J.7 - Annual Operation Cost Estimate - Capture and Control - Barge Based (Purchase)

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Barge Based (Purchase)

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capture and Control - Barge Based (Purchase)					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
1	Operating Cost - non-IS	2630	Hours	$1,300	$3,419,000
TOTAL					***$3,419,000***
TOTAL (ROUNDED)					**$3,420,000**
2	Operating Cost - IS	2630	Hours	$1,600	$4,208,000
TOTAL					***$4,208,000***
TOTAL (ROUNDED)					**$4,210,000**
3	Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - non-IS	2630	Hours	$1,600	$4,208,000
FUTURE TOTAL					***$4,208,000***
FUTURE TOTAL (ROUNDED)					**$4,210,000**
4	Future Operating Cost after System Upgrade to meet 65,000 bbl/hr - IS	2630	Hours	$1,900	$4,997,000
FUTURE TOTAL					***$4,997,000***
FUTURE TOTAL (ROUNDED)					**$5,000,000**

Class 5 Estimate Accuracy (Non-IS)	**50%**	**$5,130,000**
	-30%	**$2,394,000**

1 *Approx Annual Operating Cost assumes normal cost of operation but does not include regular maintenance or repairs that may be required.*

2 *Assumed annual demand for the barge service is 30% of the year (approximately 2630 hours).*

3 *All costs are 2021 USD.*

4 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

5 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

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7 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Appendix J.8 - Annual Operation Cost Estimate - Capture and Control - Barge Based (Long Term Service Agreement)

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Barge Based (Long Term Service Agreement)

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capture and Control - Barge Based (Long Term Service Agreement)					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
1	Hourly Rate (paid for each hour the system is used on the contract holders vessels)	2630	Hours	$2,500	$6,575,000
TOTAL - non-IS					***$6,575,000***
TOTAL (ROUNDED)					**$6,580,000**
2	Added Hourly Cost for IS system	2630	Hours	$300	$789,000
TOTAL - IS					***$7,364,000***
TOTAL (ROUNDED)					**$7,360,000**
3	Added Hourly Cost for future upgrade to 65,000 bbl/hr	2630	Hours	$450	$1,183,500
TOTAL - 65,000bbl/hr - non-IS					***$7,758,500***
TOTAL (ROUNDED)					**$7,760,000**
TOTAL - 65,000bbl/hr - IS					***$8,547,500***
TOTAL (ROUNDED)					**$8,550,000**

Class 5 Estimate Accuracy (Non-IS)	**50%**	**$9,870,000**
	-30%	**$4,606,000**

1 *Approx Annual Operating Cost assumes normal cost of operation but does not include regular maintenance or repairs that may be required.*

2 *Assumed annual demand for the barge service is 30% of the year (approximately 2630 hours).*

3 *All costs are 2021 USD.*

4 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

5 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

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Appendix J.9 - Annual Operation Cost Estimate - Capture and Control - Shore Based (Long Term Service Agreement)

CARB At Berth Study
Benicia Refinery
Valero

Feasibility Study - Annual Operations - Shore Based (Long Term Service Agreement)

Moffatt & Nichol
By: M. Miranda
Checked: M. Trowbridge
Date: 11/19/2021
Project No: 211925

Capture and Control - Shore Based					
No	**Description**	**Quantity**	**Measure**	**Price**	**Extension**
1	Operating Cost - non-IS	2630	Hour	$1,700	$4,471,000
TOTAL					***$4,471,000***
TOTAL (ROUNDED)					**$4,470,000**
2	Added Hourly Cost for IS system	2630	Hour	$300	$789,000
TOTAL					***$5,260,000***
TOTAL (ROUNDED)					**$5,260,000**
3	Added Hourly Cost for future upgrade to 65,000 bbl/hr	2630	Hours	$650	$1,709,500
TOTAL - 65,000bbl/hr - non-IS					***$6,180,500***
TOTAL (ROUNDED)					**$6,180,000**
TOTAL - 65,000bbl/hr - IS					***$6,969,500***
TOTAL (ROUNDED)					**$6,970,000**

Class 5 Estimate Accuracy (Non-IS)	**50%**	**$6,705,000**
	-30%	**$3,129,000**

1 *Approx Annual Operating Cost assumes normal cost of operation but does not include regular maintenance or repairs that may be required.*

2 *Assumed annual demand for the barge service is 30% of the year (approximately 2630 hours).*

3 *All costs are 2021 USD.*

4 *The estimate, including the contingency, is considered accurate to -30% to +50%.*

5 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

6 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors.*

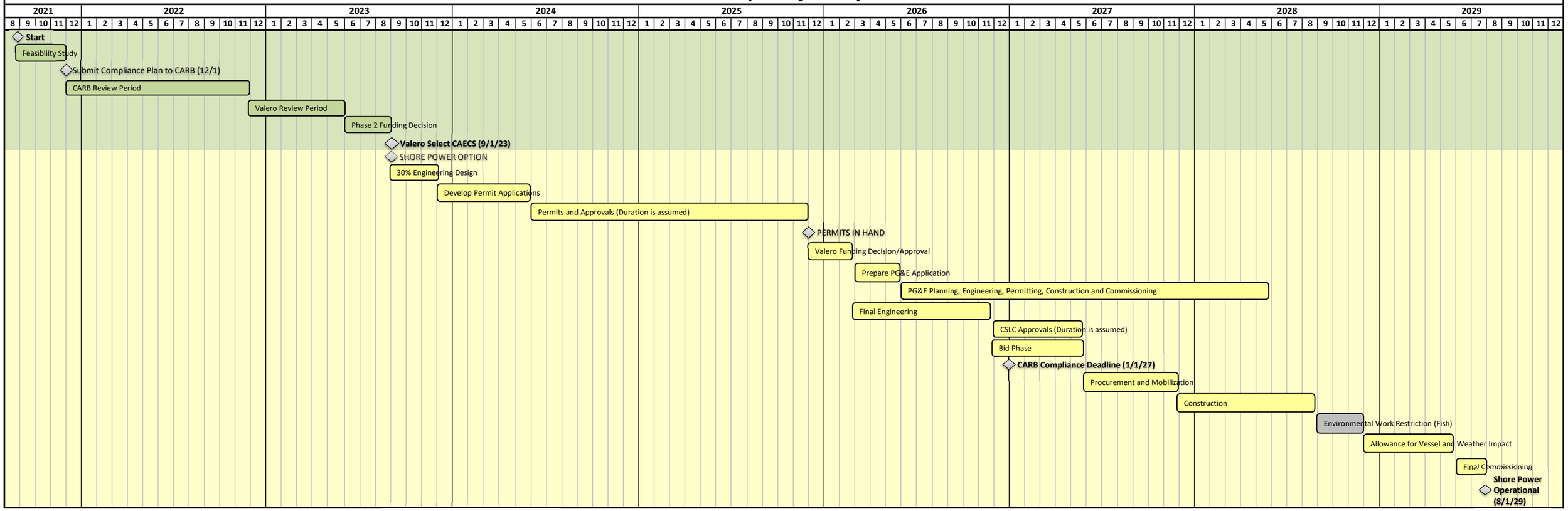
7 *A contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

Attachment K – Permits and Approvals Matrix

Permit/Review	Agency	Trigger	Form/Document/Study	Estimated Timeline
Federal				
Section 10 Rivers and Harbors Act (individual project permit)	US Army Corps of Engineers (USACE)	Construction in or over navigable US waters.	Joint Aquatic Resource Permit Application (JARPA)	Will not issue final approval until CEQA process is complete
Section 408 Impacts to Navigation Channel Evaluation	USACE	Potential impacts to navigation channel	Checklist	<3 months
NEPA	USACE	The requirement for Federal Permits	USACE will use the information provided in the JARPA and CEQA consultation to inform consultation under NEPA	Will rely on results from CEQA
Section 106 Cultural Resources	State Historical Preservation Office (SHPO)	Ground disturbance	Cultural resources survey	3-6 months
Section 7 Endangered Species Act (ESA) Consultation and Biological Opinion (BO)	USACE/US Fish and Wildlife Service (USFWS/ National Oceanic and Atmospheric Administration (NOAA) Fisheries	Work in and over marine aquatic habitat	Biological Evaluation (BE).	6-9 months
			An eelgrass Survey may be required	6-9 months
Marine Mammal Protection Act (MMPA) Incidental Harassment Authorization (IHA) /Incidental Take Authorization (ITA)	National Marine Fisheries Service (NMFS) Protected Resources Division	Work in and over marine aquatic habitat	Letter request for IHA/ITA, if needed, based on construction and operations and potential presence of marine mammals. Marine mammal monitoring plan may be required.	6-9 months
Obstruction Evaluation	Federal Aviation Administration (FAA)	Construction near air traffic (commercial or military)	Online form	3-6 months
Coast Guard Notification	US Coast Guard (USCG)	Work within USCG jurisdiction	Notification	3-6 months
State				
CEQA Initial Study (IS) / Environmental Impact Report (EIR) / Mitigated Negative Declaration (MND)	CEQA	Work in and over marine aquatic habitat in California	CEQA Checklist, IS and EIR or MND	12-15 months for MND, 15-18 months for EIR...sometimes more
Region Waste Discharge Requirements and Section 401 CWA Certification	San Francisco Bay Regional Water Quality Control Board (SF RWQCB)	Work in marine aquatic habitat	JARPA and Notice of Intent, a water quality monitoring plan may also be required.	6 months or less but typically wait to issue until CEQA is done
California Endangered Species Act (CESA) Consistency Determination (CD)/incidental take permit	California Department of Fish and Wildlife	Work potentially impacted CESA listed species	BE, NOAA/NMFS BO and request for consistency review letter.	3-6 months
National Pollution Discharge Elimination System (NPDES) permit for construction	SF RWQCB	Construction of the facility	JARPA and Notice of Intent, a water quality monitoring plan may also be required.	6 months
San Francisco Bay Conservation and Development Commission Management Program for San Francisco Bay (BCDC) and Coastal Zone Management (CZM) CD	BCDC	Work in the San Francisco Bay area	Application form and coordination with BCDC.	3-6 months
MOTEMS Approval	California State Lands Commission (CSLC)	Construction of infrastructure under the jurisdiction of MOTEMS	Final signed/sealed calculations, drawings, specificaitons by Engineer of Record	6-9 months
CALTRANS Approval	California Department of Transportation (CALTRANS)	Work near the Benicia-Martinez Bridge	Encroachment Permit	6-9 months
Local				
Authority to Construct	Bay Area Air Quality Management District (BAAQMD)	New / different emission sources	BAAQMD form, additional information details	12-18 months per Valero
Shoreline/Critical areas Permit	City of Benicia	Work along the shore and in-water/intertidal area	Note: area is in Port District and use will fit with City master plan for Port District	<6 months?
AMPORTS Stakeholder Approval	AMPORTS	Any changes at terminal that may impact AMPORTS operation	Project Stakeholder	TBD
UP Approval	Union Pacific (UP)	Work near the rail line	TBD	TBD
Pipeline Identification / Subsurface Hazard ID	USA Digs	Subsurface improvements	TBD	Also may be some decomissioned / abandoned pipelines
Waste Disposal Approvals	Keller Canyon at Pittsburg	Waste characterization required	Request to dispose (for "non-hazardous" waste from capture and control system)	TBD
Planning Department Approval	City of Benicia	Includes electrical plan check, structural plan check, fire system approval, stormwater, grading, erosion control, SWPPP, etc	Improvements within City limits	9-12 months
Building Department Approval	City of Benicia		Improvements within City limits	9-12 months

Attachment L – Implementation Schedule

Benicia CARB At Berth Study - Project Implementation Schedule



Benicia CARB At Berth Study - Project Implementation Schedule

2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029

- CAPTURE AND CONTROL - BARGE BASED
- 30% Engineering Design
- Develop Permit Applications
- Permits and Approvals (Duration is assumed)
- PERMITS IN HAND
- Valero Funding Decision/Approval
- Bid Phase
- Final Engineering and Fabrication
- Equipment Procurement & Delivery
- Supply Chain Risk (Shipyard Availability)
- **CARB Compliance Deadline (1/1/27)**
- CARB Executive Order Testing & Approval
- **Barge-Based Operational (10/1/27)**
- CAPTURE AND CONTROL - SHORE BASED
- 30% Engineering Design
- Develop Permit Applications
- Permits and Approvals (Duration is assumed)
- PERMITS IN HAND
- Valero Funding Decision/Approval
- Final Engineering
- CSLC Approvals (Duration is assumed)
- Bid Phase
- **CARB Compliance Deadline (1/1/27)**
- Procurement and Mobilization
- Construction
- Environmental Work Restriction (Fish)
- Allowance for Vessel and Weather Impact
- Final Commissioning
- **Shore Based Operational (8/1/29)**