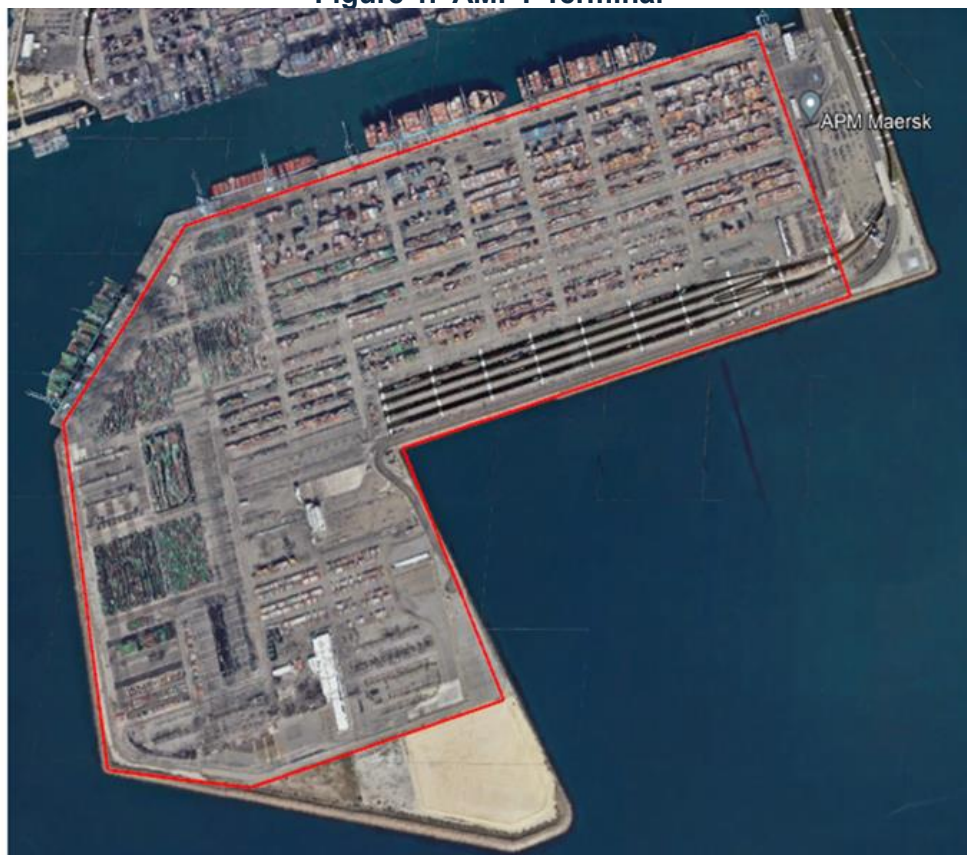


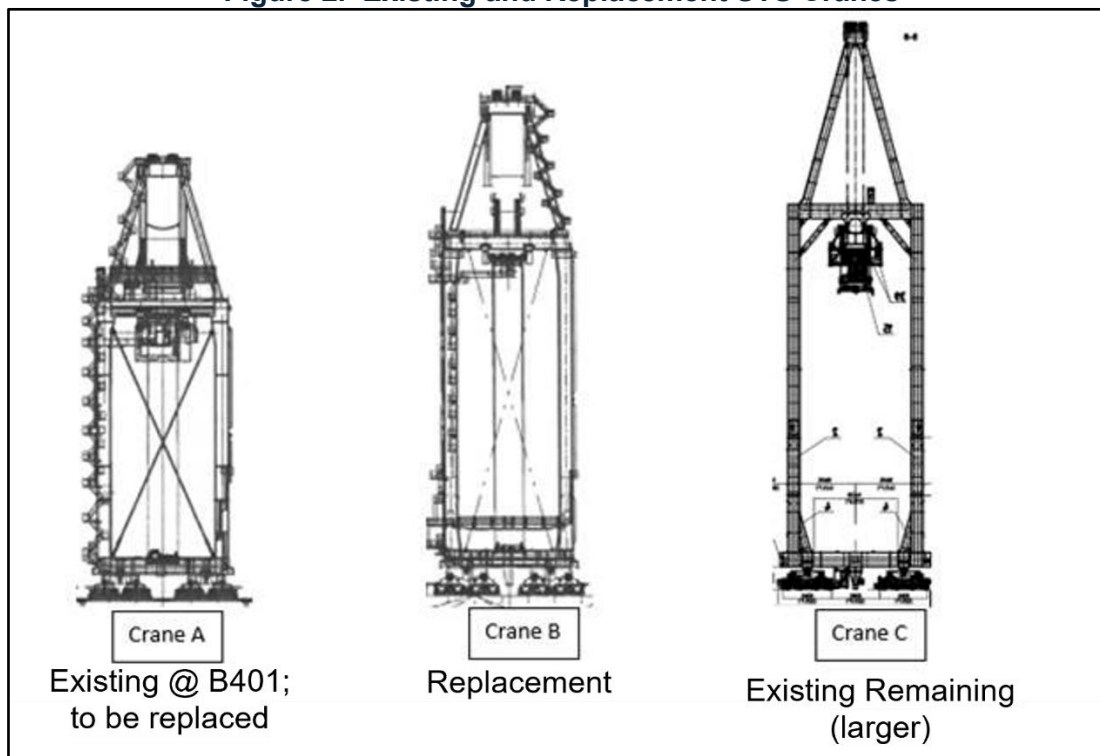
**Current Operational Constraint**

The APMT currently operates the entire terminal wharf with 19 ship-to-shore (STS) cranes. The three (3) STS cranes proposed for replacement are currently located at berth 401 (easternmost berth within the entire AMPT wharf; see Figure 1). Figure 2 illustrates the cranes proposed for replacement and existing cranes to remain.

**Figure 1. AMPT Terminal**



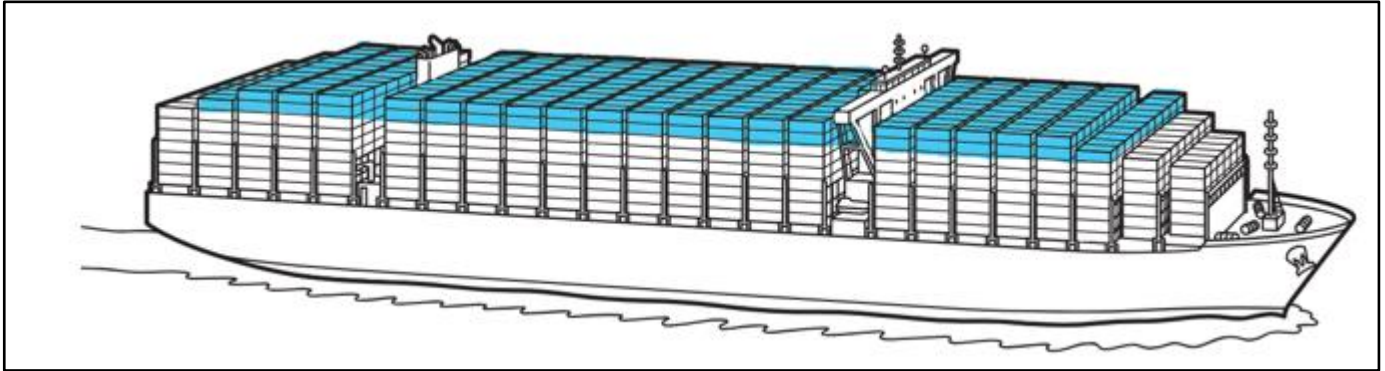
**Figure 2. Existing and Replacement STS Cranes**



## APMT CRANE REPLACEMENT CAPACITY/OPERATIONAL ANALYSIS

Due to height and horizontal reach limitations, these three cranes cannot serve the top two to three tiers (vertical levels) of stacked containers on 10,000-13,500 twenty-foot equivalent units (TEU) size container ships. For these sized vessels, when the vessel is ready to unload at berth 401, AMPT currently first deploys two directly adjacent larger cranes to remove the top two-three tiers first (on average 1,060 containers), after which four additional cranes are deployed (including the three smaller cranes proposed to be replaced) for container unloading. The reverse operation is done for container loading (export and empty containers). Figure 3 simplistically illustrates these vessel tiers. Typically, for container loading (outbound vessels), empty containers exceed export containers by 2:1. Consequently, outbound vessels sit higher in the water for loading, and thus this crane constraint is more severe for loading the vessel. The constraint is further exacerbated with a high tide as well.

**Figure 3. Sample Depiction of Vessel Tiers**



### **Purpose/Benefit/Result of Removing Constraint**

Removing this constraint enables more efficient and safer operations on the wharf as a whole (Berths 401-406), by enabling unencumbered vessel planning and assignment, and less delay for vessels at the wharf as a whole. The detailed analysis discussed below demonstrates that the crane replacement **will not increase overall berth and terminal capacity** (maximum possible containers that can be handled at the wharf as a whole; has not been attained to date). **Hence, the same number of containers will be handled by the STS crane operators with the crane replacement.**

### **Operational/Capacity Analysis**

The Harbor Department commissioned AECOM to conduct a detailed operational and capacity analysis of the entire AMPT wharf to assess the effect of replacing three cranes. The modeling conducted for replacing cranes was conducted under capacity (maximum possible volume) conditions, with 19 STS cranes, and not with current volumes that are less. For all POLA (and POLB) environmental assessments, the effect of physical changes are always evaluated under maximum volume capability (capacity) conditions. Also, when analyzing the effect of physical infrastructure changes, the entire wharf must be analyzed. A proprietary simulation model (termed BERTHA) developed by AECOM was used. The BERTHA model has been used for both the Ports of Los Angeles and Long Beach for about 20 years, and also for many other port authorities and terminal operators around the world.

The BERTHA model quantifies the annual wharf capacity of a terminal. The model simulates an entire year of vessel movements to/from a wharf. Due to statistical variations in vessel arrival patterns (due to weather, delays at a previous call, etc.), vessel arrival times cannot be perfectly planned, which sometimes results in vessels arriving off-schedule. This vessel on-time arrival performance (probabilities for vessel arrival delays) is included in the simulation model. As part of the capacity output, total vessel hours required at berth are computed, which is determined based on the following variables: vessel tie-up and untie time; total number of STS cranes, total containers to be loaded/unloaded per vessel; STS crane assignment (accounts for crane size for vessel assignments to appropriate berths); crane productivity (lifts per hour per crane); and physical geometry (wharf length, vessel length, and vessel water draft).

The following briefly summarizes the modeling parameters:

## APMT CRANE REPLACEMENT CAPACITY/OPERATIONAL ANALYSIS

- Two cases (scenarios) – berths 401-406; 19 STS cranes in total for both “No Project” and “Project” entailing 3 STS crane replacements only.
- For No Project: 3 existing cranes at berth 401 (proposed to be replaced) cannot access top two-three tiers (vertical levels of stacked containers) on up to 13,500 TEU container ships.

Through iterative simulations, the model yields the following: a combination of the largest (as envisioned by APMT) and smaller vessels that yields the greatest volume of containers that can be unloaded/loaded across the entire wharf (with 19 STS cranes) over a typical week (most terminals’ vessels operate under a weekly rotation) and year. This represents capacity conditions. The modeling indicated the crane replacement will slightly reduce the overall vessel cumulative times at berth (for unloading/loading) for the wharf as a whole, under capacity conditions. As demonstrated in the simulation modeling, merely reducing the amount of time a vessel is at berth 401 does not enable another vessel to call at the wharf as a whole over the span of a day/week (and year), thus not increasing wharf/terminal capacity. Figure 4 illustrates this outcome from the simulation modeling with a simple time-space diagram of vessels at the wharf over the course of a typical week, under capacity conditions. The modeling is conducted to simulate realistic vessel operations/arrivals (vessel schedules; transit times including within the ports; and tie-up/untie times); i.e., capacity cannot be computed based upon the maximum number of vessels that can simply physically fit at the wharf at one time. As shown, with 19 STS cranes, the following mix of vessels would yield capacity volumes: 16,000 TEU, 13,000 TEU, and 10,000 TEU (or 10,000 TEU) vessels at the wharf at the same time. This mix of vessel sizes are greater than what currently calls at the terminal wharf.

- **Simulation results: replacement cranes will improve operational flexibility, but will not increase overall berth and terminal capacity, i.e., the same number of containers will be handled by the STS crane operators**
  - Net reduction of 253 annual vessel hours at berth (or an average of about 5 fewer vessel hours per week) will not enable an additional vessel call anywhere on the entire wharf; reduces electrical power consumption for shore-side power

**Figure 4. Time-Space Diagram – Vessels at Berth (19 STS cranes at capacity conditions)**

