Port of Alaska Modernization Program Terminal 2 Preliminary Design Narrative

Prepared for

Municipality of Anchorage/Port of Alaska

2000 Anchorage Port Road
Anchorage, Alaska 99501

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Anchorage, Alaska

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Revisions					
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Acronyms and Abbreviations

PAMP	Port of Alaska Modernization Program
ASCE 7-10	*Minimum Design Loads for Buildings and Other Structures*
ASCE 7-5	*Minimum Design Loads for Buildings and Other Structures* (earlier version)
ASCE	American Society of Civil Engineers
ASCE/COPRI 61-14	*Seismic Design of Piers and Wharves*
AWWU	Anchorage Water and Wastewater Utility
CH2M	CH2M HILL Engineers, Inc.
CLE	contingency level earthquake
COPRI	Coasts, Oceans, Ports, and Rivers Institute
DE	design earthquake
DOR	Designer of Record
g	gravity
GAC	Geotechnical Advisory Commission
MCE	maximum considered earthquake
MLLW	mean lower low water
MOA	Municipality of Anchorage
OLE	operational level earthquake
PGA	peak ground acceleration
POA	Port of Alaska
RO-RO	roll-on/roll-off
SDM	*PAMP Seismic Design Manual*
T1	Terminal 1
T2	Terminal 2
T3	Terminal 3
TOTE	Totem Ocean Trailer Express
U.S.	United States
UHMW	ultra-high molecular weight
USGS	U.S. Geological Survey

SECTION 1

Introduction

1.1 Overview and Objective

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

Terminal 2 will primarily support proprietary roll-on/roll-off cargo operations. Currently, these operations are performed by TOTE Maritime. In order to comply with recommendations from the Municipality of Anchorage (MOA) Geotechnical Advisory Commission (GAC), the design of the new Terminal 2 (T2) will include a higher level of performance than the one typically required for similar structures designed to meet the current codes. The reasoning behind the GAC recommendation is that the Port is currently the entryway for the vast majority of all goods and supplies coming into the state of Alaska, and if the Port were to be shut down for more than 7 days, there would potentially be food and recovery supply shortages that would be far-reaching. Therefore, T2 has been identified by POA and the GAC as an essential facility that is critical to the region's post-earthquake response.

The objective of this Preliminary Design Narrative is to provide an overview of the engineering and related technical information necessary to advance the program's efforts toward procuring Final (100 percent) Design services from the Designer of Record (DOR).

1.2 Seismic Performance Requirements

The seismic performance requirements for the PAMP are presented in the *Port of Alaska Modernization Program Seismic Design Manual* (SDM) (CH2M, 2019). The SDM describes the many different aspects of structural and seismic design for the program. The following section presents a brief summary of the seismic performance requirements related to pile-supported wharves and trestles, and the design preference. For more detailed discussions, refer to the SDM.

POA and GAC have identified the recently published American Society of Civil Engineers (ASCE) *Seismic Design of Piers and Wharves* document (ASCE/COPRI 61-14) as the primary basis of seismic design for pile-supported piers and wharves for APMP. ASCE/COPRI 61-14 defines three different seismic hazard levels for the design of pile-supported piers and wharves, as follows:

1. **Operational Level Earthquake (OLE)**: OLE corresponds to a ground motion with a probability of exceedance of 50 percent in 50 years, or a 72-year return period.
2. **Contingency Level Earthquake (CLE)**: CLE corresponds to a ground motion with a probability of exceedance of 10 percent in 50 years, or a 475-year return period.
3. **Design Earthquake (DE)**: The level of ground motion for the DE is that defined in ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*. ASCE 7-10 DE corresponds to ground motions equal to two-thirds of that of a maximum considered earthquake (MCE). The MCE has a probability of exceedance of 2 percent in 50 years, or a 2,475-year return period. The DE corresponds roughly to a ground motion of a 1,000-year return period.

Table 1-1 shows the corresponding peak ground acceleration (PGA) for two different sites at the Port for each of the three seismic hazard levels. For comparison, Table 1-1 also shows the estimated PGA for the 1964 Alaska Earthquake in the areas around Anchorage. Note the PGA for the 1964 Alaska Earthquake is less than the PGA of the PAMP CLE.

Table 1-1. Peak Ground Acceleration
Port of Alaska Modernization Program

Location	Seismic Hazard Level	Return Period (years)	PGA (g)
Landside Ground Surface	OLE	72	0.14
	CLE	475	0.31
	DE	1,000 [a]	0.32
Waterside Mudline	OLE	72	0.21
	CLE	475	0.29
	DE	1,000 [a]	0.43
1964 Alaska Earthquake (areas around Anchorage)		-	0.18-0.24[b]

[a] DE corresponds to two-thirds of the MCE and corresponds to a ground motion of an approximate 1,000-year return period.

[b] Recorded PGA around Anchorage area (USGS, 2008).

- = not applicable

g = gravity

Correspondingly, ASCE/COPRI 61-14 defines the following three performance levels for pile-supported piers and wharves:

1. ***Life Safety Protection****: A structure shall be classified as providing "life safety protection" when (a) the post-earthquake damage state is such that the structure continues to support gravity loads, (b) damage that does occur does not prevent egress, and (c) there is no loss of containment of materials in a manner that would pose a public hazard.*
2. ***Controlled and Repairable Damage****: A structure shall be classified as having achieved "controlled and repairable damage" when (a) the structure responds in a controlled and ductile manner, experiencing limited inelastic deformations at locations where repair is possible, (b) the required repairs result in a loss of serviceability for no more than several months, and (c) there is no loss of containment of materials in a manner that would pose a public hazard.*
3. ***Minimal Damage****: A structure shall be classified as having achieved "minimal damage" when (a) it exhibits near-elastic structural response with minor or no residual deformation, (b) there is no loss of serviceability of the structure, and (c) there is no loss of containment of materials in a manner that would pose a public hazard.*

Figure 1-1 illustrates the damage states at a concrete pile corresponding to the preceding performance-level definitions. For a typical pile-supported wharf similar to the proposed new wharves at the Port, the required earthquake performance levels under different earthquake hazards, as required by ASCE/COPRI 61-14, are as follows:

- **Minimal Damage** performance level under **OLE** ground motion
- **Controlled and Repairable Damage** performance level under **CLE** ground motion
- **Life Safety Protection** performance level under **DE** ground motion

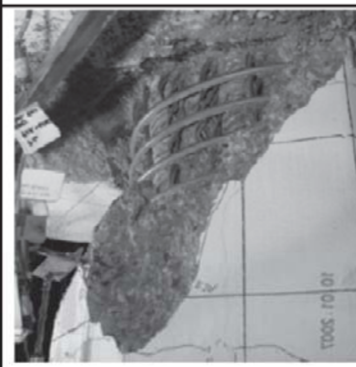
Minimal Damage OLE	Controlled and Repairable Damage CLE	Life Safety Protection DE
		
Initial cracking and spalling of the pile and/or deck	Substantial spalling of the pile and the deck in the vicinity of the pile thereby exposing reinforcement in the pile and the deck	Broken connection from either spalling into the core, fractured dowel bars or buckled strand.

Figure 1-1. Photos of Concrete Pile Damage States Corresponding to Performance Levels (ASCE/COPRI 61-14)

1.2.1 Geotechnical Advisory Commission Recommendations

In a letter addressed to POA on September 23, 2014, the GAC put forth the following recommended seismic performance requirements for the APMP:

- *At a minimum, one container dock and one POL dock should be designed for minimal damage at the CLE ground motions, and controlled and repairable damage at the DE ground motions. These structures are referred to as the seismic berths.*
- *The seismic berths are considered to be essential for post-earthquake response and for continued support of the other communities it serves throughout the state. The controlled and repairable damage performance level by code definition implies there could be loss of serviceability for several months. That time frame is likely to be too long to supply 80 to 90 percent of the goods for the entire state, particularly in winter conditions. GAC advises that the definition of controlled and repairable damage should be adjusted to mean damage that is feasibly repairable within several days to 1 week of the seismic event, and contingencies, plans and materials for repair to be included in the design to reduce response time. The GAC also recommends that the performance of the new port elements should consider the effects on repair or reconstruction schedules if a major earthquake occurs during the winter.*

The seismic performance requirements recommended by the GAC for the seismic berths are significantly more stringent than the requirements in ASCE/CORPI 61-14. After a careful evaluation of the original 15 percent conceptual design, it was determined that, without modification, the proposed design for T2, while meeting or exceeding all requirements in ASCE/CORPI 61-14, will only partially meet the GAC-recommended performance requirements (Table 1-2). Notably, the baseline design of the access trestles will not be able to achieve controlled and repairable damage performance level at the DE. Nor would the repair necessary to restore cargo offloading capabilities within several days to a week of a major event be feasible. Hence, several different design approaches were explored to increase the seismic resilience of the T2 structures to meet the more stringent seismic performance requirements.

These approaches are discussed in the document *Evaluation of Design Alternatives to Satisfy the Municipality of Anchorage Geotechnical Advisory Commission's Recommended Seismic Performance Requirements* (CH2M, 2015b).

Table 1-2. Seismic Design Performance
Port of Alaska Modernization Program

Structure	Design Classification	Seismic Hazard Level	Concept D Baseline Design Seismic Performance Level	GAC-recommended Performance
New T2 wharf and approach trestles	Seismic Berth	OLE	Minimal damage	Minimal damage
	Seismic Berth	CLE	Minimal damage[a.]	Minimal damage[a.]
	Seismic Berth	DE	Life safety protection	Minimal damage[b.] / Controlled and repairable damage[c.]

Notes:

DE level is equivalent to two-thirds of MCE in accordance with ASCE 7-10. Ground motions from ASCE 7-10 exceed those from ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures*, specified in ASCE/COPRI 61-14.

[a.] Seismic performance level exceeds that required by ASCE/COPRI 61-14.

[b.] For wharf. Seismic performance level exceeds that required by ASCE/COPRI 61-14.

[c.] Controlled and repairable damage defined as being operable within 7 days.

1.3 Design Approaches

T2 consists of a pile-supported wharf and connecting pile-supported access trestles. Pile-supported wharves located in high-seismic areas are typically designed as ductile systems, meaning the structure is designed to yield under high earthquake demands and will undergo significant inelastic action before failure. This is considered more desirable than the sudden, brittle failure at the maximum load of a nonductile system. The inelastic action is typically carefully controlled by design to occur only at designated ductile elements in the structure, where careful detailing limits the damage caused by inelastic action to ductile elements, and preserves the gravity load carrying capacity and the integrity of the rest of the structure.

For most of the pile-supported wharves, the ductile elements are the vertical (plumb) piles, where inelastic action (plastic hinging) is usually designed to occur at the top of the pile where the pile connects to the pile cap, as well as in the part of the pile embedded underground. The superstructure of the wharf (deck and pile cap) are typically designed to remain elastic by providing them with strength greater than that corresponding to the development of maximum feasible strength in the potential plastic hinge regions. This design philosophy is usually referred to as capacity design or capacity protection (the term used in ASCE/CORPI 61-14), and is widely accepted as the state-of-practice for seismic design in high-seismic regions.

ASCE/COPRI 61-14 recommends the use of a displacement-based design approach for pile-supported wharves in high-seismic regions, like the Port. This approach is based on the assumption that the sizing and configuration of primary structural members has been previously defined considering service loads. Once the sizing and configuration of the structural elements have been defined, the analysis and design for seismic loads are performed for each seismic hazard and performance level. For each of these levels, the calculated displacement capacity will exceed the calculated displacement demand.

The displacement demand is dependent on the characteristics of the structure, such as mass and stiffness, as well as earthquake load in the form of ground motions. Higher earthquake hazard levels typically translate into higher ground motions and would lead to higher displacement demands. The displacement capacity of the structure is dependent on the ability of the structure to develop elastic and inelastic deformation, and is linked to performance levels through strain limits, as discussed in Section 3.9 of ASCE/COPRI 61-14 and Section 4.5.2 of the SDM. The higher the strain limits, the more inelastic deformation can be developed in ductile pile elements; thus, resulting in higher displacement capacity.

To meet the GAC-recommended seismic performance of terminals repairable within several days to 1 week of a DE level seismic event, and service to the terminal restored within the same time frame, the design approach for T2 is for the wharf to remain elastic and to accept that the trestles piles may suffer repairable damage during the DE. For the preliminary design, two rapidly deployable emergency trestle structures will be used to provide contingency operations for essential offloading capabilities while repairs are made at the permanent trestle. These emergency trestles will also serve a second purpose: to provide temporary access for the Totem Ocean Trailer Express (TOTE) vessels during the interim construction stage before all the permanent trestles can be constructed. The temporary emergency trestles will consist of prefabricated steel bridge superstructures, supported on permanent pile and pile caps.

After the construction of T2 is fully complete, the superstructure of the temporary emergency trestles will be disassembled and stored at the Port. In the event of a large earthquake that causes damage to the permanent trestles, the superstructure can be re-deployed within days of the earthquake. The temporary emergency trestle structure will need to be designed to meet appropriate post-earthquake service requirements in terms of loading and performance, and will also need to be able to withstand aftershocks during the time before the permanent structure can be repaired and returned to service.

When the final design is started the DOR should evaluate the feasibility of using ground improvements to stabilize the backlands behind the trestle as was done for the Petroleum Cement Terminal. This would allow the trestles to be restored to service within 1 week of the DE seismic event. The DOR would also need to investigate whether the project could be phased without the use of the temporary trestles.

SECTION 2

Structural Design Narrative

This section discusses the engineering and technical information related to the preliminary structural design of T2. The seismic performance requirements, overall design approach, as well as full range of the design loadings for T2 are described in more detail within the SDM (CH2M, 2019) and Section 1 of this document.

The following design elements are discussed in detail in this section, including:

- Pile-supported wharf
- Pile-supported access trestles
- Mooring dolphin
- Fender system
- Mooring system
- Corrosion protection systems

2.1 Pile-supported Wharf

2.1.1 Deck

The deck of the pile-supported wharf will consist of precast, pretensioned concrete deck panels supported on precast or cast-in-place pile caps. Using precast panels will greatly reduce costly over-the-water work during construction and could shorten the construction period considerably. As discussed in Section 1.3, the deck will be designed to remain elastic under the DE event and is expected to suffer little or no damage.

The precast deck panels will span in the longitudinal (approximately north-south) direction of the wharf. In the longitudinal direction, the deck panels will be connected at the joints over the pile caps, using cast-in-place closure pours to form a full composite action with the pile caps. The deck panels will also be connected to adjacent panels in the transverse direction with cast-in-place joints. The deck panels and connection joints will be designed to resist the over-strength plastic hinging forces elastically while suffering little or no damage.

The typical haunched, precast panels have a maximum depth of approximately 2 feet, and a minimum depth of approximately 1 foot, 3 inches. Where additional resistance is required, such as at the wharf section designated for the operation of heavy lift cranes, as well as at the end of the wharf, uniform depth precast deck panels will be used. The precast deck panels will be topped with a reinforced concrete overlay to help distribute concentrated loads and provide proper drainage on the deck.

2.1.2 Pile Caps

Typical interior pile caps will be 7-8 feet wide to accommodate pile installation tolerances. Similar to the deck, the pile caps will be designed to remain elastic during a DE event. The depth of the pile cap will be 4 feet, and they will run in the transverse direction of the wharf (approximately east-west direction) only. Two longitudinal edge beams are provided along the western and eastern edge of the wharf to accommodate mooring and fendering hardware.

The default pile cap design will use cast-in-place concrete because of its superior ability to accommodate pile installation tolerances. Precast pile caps could be an alternative to cast-in-place caps if an accelerated construction schedule were desired; like precast panels, they would reduce the duration of over-the-water work.

2.1.3 Piles

To support the wharf, 48-inch-diameter steel and concrete hybrid piles were selected. Each pile will comprise one or two segments. Depending on design loading, the top segment, from the soffit of the pile cap to about 10-12 feet below the pile cap, will consist of reinforced concrete pile within the steel pile. The steel pile below the reinforced section will remain hollow to the pile tip. Alternatively, the design loads may justify filling the entire pile with reinforced concrete. It will be the DOR's responsibility to perform the analysis and determine the most efficient design..

As discussed in Section 1.3, piles are the only ductile elements in the pile-supported wharf system. The performance of the wharf during an earthquake is mainly controlled by the ability of the pile to deform under seismic load. The wharf piles were designed to achieve minimal damage performance requirements under the DE and smaller earthquake events.

2.1.4 Link Slab and Expansion Joint

A concrete link slab and expansion joint will be provided between T2 and Terminal 1 (T1), as well as between T2 wharf and access trestles. The expansion joint is designed to accommodate thermal expansion and contraction of the wharves, as well as to accommodate movement of the T2 wharf during vessel berthing. The link slab is designed to accommodate the differential seismic displacement between the two terminals. The design takes into account two opposite situations. The first situation is where the two terminals are moving away from each other, and the design provides sufficient support length for the link slab, and no danger will be posed to life safety. In the second situation, where the two terminals are moving towards each other, the design eliminates hard contact (pounding) between the two structures. The link slab may suffer minor damage during a DE event, but should be easily repairable.

2.1.5 Construction Staging

The wharf will be constructed in two steps, with Step 1 consisting of the southern 615 feet of the wharf, and Step 2 consisting of the northern 200 feet of the wharf. A construction joint will connect the southern structure to the northern structure. For more detailed discussion about construction staging, see Section 3, Civil Design Narrative.

2.2 Pile-supported Access Trestles

2.2.1 Deck (for the Permanent Trestle)

The deck of the permanent access trestles will consist of similar precast, haunched, and uniform deck panels as the wharf. The typical haunched, precast panels have a maximum depth of approximately 2 feet, and a minimum depth of approximately 1 foot, 3 inches. Where additional resistance is required, uniform depth precast deck panels will be used. The precast deck panels will span in the longitudinal (east-west) direction of the trestle, and will be connected at the joints, over the pile caps, using cast-in-place closure pours to form a full composite action with the pile caps. The deck panels and connection joints will be designed to resist the over-strength plastic hinging forces elastically while suffering little or no damage. The deck will be topped with a reinforced concrete overlay to help distribute concentrated loads and provide proper drainage on the deck.

2.2.2 Piles and Pile Caps (for the Permanent Trestle)

To support the permanent trestle, 48-inch-diameter steel and concrete hybrid piles will be used. The pile details will be similar to that of the wharf piles. Because of the shorter length above the mudline of the trestle piles, their displacement capacities will be significantly less than the wharf piles. As a result, it will not be feasible to design them for minimal damage performance requirements under the DE unless ground improvements are used to reduce the lateral soil loading on the piles. Without the use of ground improvements, the proposed design will accept a level of damage to the piles that is beyond the minimal damage performance, yet still meets life safety protection performance requirements.

Pile cap design for the permanent trestle will include cast-in-place or precast concrete pile caps that vary between 7 and 13 feet in width, and with a typical length of 30 feet. Several 90-foot-long pile caps provide support for the stevedore building located at the middle access trestle. Pile caps will be designed as capacity-protected members.

2.2.3 Link Slabs and Expansion Joints

The permanent access trestles will be divided by expansion joints into three sections: seaside section, landside section, and approach span. The dissimilar structural response due to different water depth at different sections of the trestle necessitates this division. At each expansion joint, a link slab will be provided to accommodate the differential seismic displacement, the design of which is similar to the link slab between T1 and T2 discussed in Section 2.1.4.

2.2.4 Abutments, Approach Slabs, and Z-Pile Retaining Walls

At the landside end of each access trestle, an abutment and approach slab will provide the transition from the trestle to the connecting roadway. Geotechnical analysis has determined that the existing slope and planned upland expansion may experience liquefaction under a large earthquake event and may not be stable (CH2M, 2019). The liquefaction of the slope does not affect the structural performance of the trestles and wharf, nor does it necessarily pose a direct danger to life safety. To mitigate the risk of slope failure, a Z-pile retaining wall or ground improvements may be provided along the shore line to stabilize the slope.

2.2.5 Temporary and Emergency Trestle

The preliminary plan is to use a prefabricated modular bridge (for example, a Bailey bridge) as the superstructure for the temporary emergency trestle. A Bailey bridge consists of modular components that are light enough to be transported by small trucks, and can be assembled with relatively light equipment. These features make it an ideal candidate for a rapid, deployable, interim structure for post-earthquake contingency operations.

The substructure (piles and pile caps) of the temporary emergency trestles will be installed during Step 1 construction. The modular bridge superstructure will then be assembled and installed to provide access to the TOTE vessel during the interim period before Step 2 construction can be completed. After the completion of Step 2 construction, the superstructure will be dissembled and stored by the Port.

After an earthquake event, if it is determined that the permanent access trestle has suffered damage that renders it unserviceable for a prolonged period of time, the prefabricated bridge superstructure could be quickly erected using the existing substructure.

As the Bailey bridge has a longer spanning capability, the steel pile caps for the temporary access trestles will be spaced at 60 feet apart (as opposed to 20 feet apart for the permanent trestles). The pile caps for the temporary trestle will be supported on three piles. The 48-inch-diameter steel and concrete hybrid piles will be used to support the temporary trestles.

2.3 Mooring Dolphin

The mooring dolphin will be supported by batter piles or a monopile to resist mooring loads during normal Port operations, as well as environmental loads. The batter piles supporting the dolphins consist of 48-inch-diameter steel pipe piles with a wall thickness of 1.125 inch. Piles will be connected at the top to a steel pile cap 4 feet in depth, which provides a working platform and supports mooring hardware. A steel catwalk will provide pedestrian access from the main wharf to the dolphin.

Unlike pile-supported wharf and trestles, the seismic design of the mooring dolphin followed the force-based design approach in accordance with ASCE/CORPI 61-14. The design provides a capacity of all main structural members that exceeds elastic earthquake demand forces. The mooring dolphin will meet the same seismic performance requirements as pile-supported wharf and trestles.

2.4 Fender System

The new fender system will eliminate the pin piles and support the fender panels by hanging them from face of the structure. This is a similar design to that used at Nikiski. The fender panels will be faced with ultra-high molecular weight (UHMW) material and connected by rubber fenders at the top and bottom of the steel fender panel Tripled-ganged fenders, consisting of three typical units connected together with whaler beams, will be provided at locations where frequent ship berthing is expected.

2.5 Mooring System

The mooring loads were evaluated using Tension Technology International's software program OPTIMOOR. The design vessels for T2 included both a container vessel and military roll-on/roll-off (RO-RO) vessel. The full mooring analysis is included in the *APMP Mooring Analysis* (CH2M, 2016c). Quick-release hooks have been specified for the mooring dolphins, along with active line load monitoring. The wharf is provided with mooring bollards.

2.6 Corrosion Protection Systems

2.6.1 Corrosion Protection System (for the Pile-Supported Wharf and Trestles)

The corrosion protection for pile-supported wharf and trestles will consist of active cathodic protection systems that will be designed to be compatible with the other active systems in place at the POA. The piles will also be coated prior to driving to extend their life.. The design life for these pilings is 75 years.

2.6.2 Corrosion Protection System (for Dolphin Piles)

Corrosion protection for dolphin piles is accomplished with active cathodic protection systems that will be designed to be compatible with the other active systems in place at the POA. The piles will also be coated prior to driving to extend their life The design life for these pilings is 50 years.

2.6.3 Corrosion Protection System (for Fender Panels)

For the fender system, active cathodic protection will be used and the panels will be provided with a coating system. The design life for these pilings is 25 years, as fender systems tend to require replacement for maintenance reasons due to wear and tear.

SECTION 3

Civil Design Narrative

This section discusses the approach to the T2 site civil design, which focuses on the following design tasks:

- Traffic control, contractor access, and contractor staging
- General site layout
- Survey control
- Construction sequencing plan
- Demolition and relocations
- Civil elements

3.1 Traffic Control, Contractor Access, and Contractor Staging

Contractor access to the Port requires travel over public roads in the MOA; in such cases, municipal and state load restrictions apply. The Port is a restricted facility, and security clearance is required for contractors to gain access. Traffic control will consist of following existing security protocols in place at the Port at the time of construction. A single haul route is designated over existing roads along Ocean Dock Road. A staging area is designated in the proximity of the construction site near the termini of the T2 trestles. Additional staging of material is anticipated offshore on construction barges.

3.2 General Site Layout

The project will reconstruct the existing bulk cargo terminal (T2) into deeper water. Existing operations at Terminal 3 (T3) will be relocated to the new T2. The existing upland will be modified, and armor stone shore protection will be added to the slope.

The primary role of T2 is to transfer containerized cargo from ship to shore. The T2 layout has been designed in cooperation with TOTE so that their existing and proposed operations will be accommodated at T2. TOTE's RO/RO operations use ramps that are installed on the trestles to transport the containers from ship to shore via tractor-trailers. The terminal will also continue to accommodate other operations, such as military vehicles and equipment, major construction project materials, and cruise ships.

3.3 Survey Control

The horizontal coordinate system is located within the local coordinate system, Anchorage Bowl 2000 Adjustment, and the vertical datum for the project is mean lower low water (MLLW=0). Additional survey requirements can be found in the *APMP Survey Manual* (CH2M, 2015a).

3.4 Construction Sequencing Plan

The proposed sequencing is shown in the plans and is described in this section.

3.4.1 Step 1

At the beginning of Step 1, the majority of existing T2 would be demolished. Most of T2, including utilities and temporary trestles, would be constructed. The amount of berth constructed during this phase would be limited to maintain TOTE operations at existing T3.

3.4.2 Step 2

At the beginning of Step 2, TOTE operations would be relocated to use the northern trestle at new T1 and the temporary trestles at new T2. The remainder of existing T2 and existing T3 would be demolished. The remainder of T2 and the adjacent uplands would be constructed.

3.4.3 Step 3

During Step 3, TOTE operations would be relocated fully to new T2. The temporary trestle superstructures would be removed..

3.5 Demolition and Relocations

The entirety of existing Terminals 2 and 3 will be demolished.

The terminal demolition includes the wharf, trestles, structures, utilities, and all other appurtenances. Existing piles will be cut off at the mudline unless they conflict with the construction of new piles.

The existing wharves support existing stevedore building; these functions will be relocated prior to terminal demolition. Due to the age of the buildings, demolition operations may require specialized abatement measures.

The existing terminals and stevedore building are served by various utilities that will be demolished from the wharf to the uplands. Utility re-routing and infrastructure reconstruction will be required in the uplands to reconnect the utilities to the new terminal.

Salvage of specific existing components within the project area may be required by the Owner's Representative.

3.6 Civil Elements

Construction of T2 will include the following specific civil design elements:

- Water service and fire suppression lines
- Sanitary sewer lines
- Electrical, communication, and security lines
- Upland expansion and shore protection
- Landscaped areas
- Site grading and drainage
- Arctic engineering principles
- Backlands Stability

3.6.1 Water Service and Fire Suppression Lines

New domestic water service and fire suppression lines will be provided at T2. These services would serve the wharf and the stevedore building.

Water lines will be buried with 10 feet of cover where possible, and the fire protection line will be recirculated. Where minimum cover cannot be provided, insulation, heat-trace, or both will be installed to provide freeze protection. Where mounted to the terminal, both sets of water lines will be insulated and heat-traced to provide freeze protection.

3.6.2 Sanitary Sewer Lines

New sanitary sewer service lines will serve the stevedore building at T2. Gravity service would likely be difficult, and the sewer service lines would likely require pressurization to provide positive drainage to the existing sanitary sewer system.

Sewer lines would be buried with 8.5 feet of cover where possible. Where minimum cover could not be provided, insulation, heat-trace, or both would be installed to provide freeze protection. Where mounted to the terminal, sewer lines will be insulated and heat-traced to provide freeze protection. The relationship between sewer and water lines shall meet the requirements of the Anchorage Water and Wastewater Utility (AWWU). The separation requirements of the Alaska Department of Environmental Conservation, are accounted for within AWWU's design criteria.

3.6.3 Electrical, Communication, and Security Lines

New electrical service and lighting, Port security service, and communication lines will be provided at T2.

3.6.4 Upland Expansion and Shore Protection

The existing shoreline has an indentation of approximately 40 feet adjacent to T3. The project will fill in this portion, and the upland paving will be extended to the west to match the typical upland pavement limits in the area. This additional upland area will increase available space at the Port for circulation and storage.

The project will also require uplands reconstruction to accommodate the new infrastructure, including trestle tie-down locations, site circulation, and utilities.

3.6.5 Landscaped Areas

Minimal landscaping will be provided, and generally consists of applying topsoil and seeding to disturbed, unpaved surfaces and slopes.

3.6.6 Site Grading and Drainage

The new upland will be gently graded to provide positive drainage offshore. Existing outfalls in proximity to the expansion fill limits may need to be reconstructed. Stormwater will be discharged to the Cook Inlet in accordance with the Port of Alaska Municipal Separate Storm System (MS4) permit. The existing MS4 permit number is AKS052426 effective through July 31, 2020.

3.6.7 Arctic Engineering Principles

The climate at the Port is subarctic; therefore, Arctic engineering and site-specific principles apply. They influence the design of the civil elements in the following ways:

- Providing nonfrost-susceptible soils for pavement subbase to eliminate the potential for frost heave under paved areas and roadways
- Designating ample areas for snow removal and storage in detailed design
- Insulating and heat-tracing the shallow buried fire protection water, domestic water, and sanitary sewer lines to prevent freezing
- Including oversized culverts provided with thaw pipes to prevent ice damming and glaciation in detailed design

3.6.8 Backlands Stability

The stability of the existing backlands has been preliminarily evaluated, and there is a possibility of slope failure during the DE. The predicted slope failure is not expected to damage the new wharf or new trestles; however, there is a risk that some of the backlands will shift, making them unusable until repaired. The plans show a Z-pile retaining wall alternative or a possible flattening of the slope. Ground improvements could also be considered. These alternatives will need to be evaluated and refined by the DOR.

SECTION 4

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