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PRELIMINARY ENGINEERING REPORT

To
Economic Development Administration

For
Terminal 2 Development Infrastructure
EDA Grant Application

Dated
May 11, 2022

Project Number
2180364.13

MACKENZIE
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RiverEast Center | 1515 SE Water Avenue, Suite 100, Portland, OR 97214
PO Box 14310, Portland, OR 97293 | T 503.224.9560 | www.mcknze.com

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I. PROJECT OVERVIEW

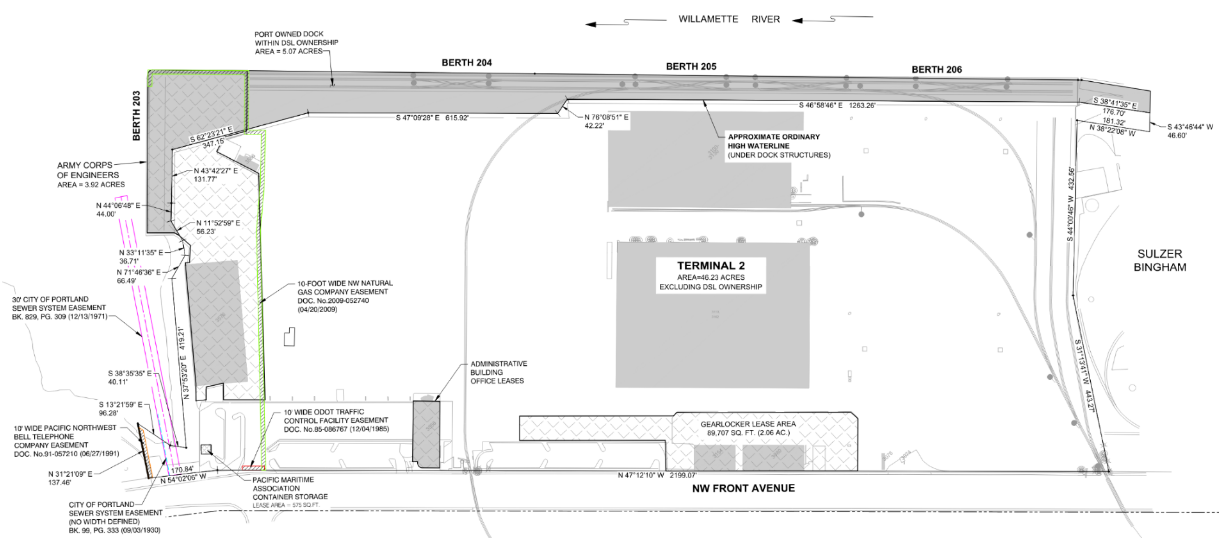
The Port of Portland is proposing to redevelop the underutilized Terminal 2 marine facility located in North Portland, Oregon. The eventual development goals for this site include construction of three (3) facilities and associated site and utility needs, including:

- Mass Timber Manufacturing Facility
- Mass Timber Workforce Training Center
- Oregon Acoustics Research Laboratory

In support of this development opportunity, the Oregon Mass Timber Coalition is applying for a grant through the Build Back Better program through the U.S. Economic Development Administration (EDA). The proposal under this grant application includes construction of subsurface soil improvements to support the eventual planned development of the Terminal 2 site.

The vicinity map below shows the project area in relation to adjacent development.

Figure 1: Terminal 2 Vicinity Map



Existing Conditions

The Terminal 2 property consists of seven (7) parcels comprising approximately 51.5 acres. The site is zoned Heavy Industrial (I-H) and is located within the Guild's Lake Industrial Sanctuary district in Northwest Portland. Terminal 2 includes five (5) buildings, marine terminal cranes, rail spurs, and paved berth areas. The site is bounded to the west by NW Front Avenue, south by industrial development, and east and north by the Willamette River. Two (2) buildings located in the northern portion of the site are used as offices; the remaining structures are currently vacant.

Proposed Conditions

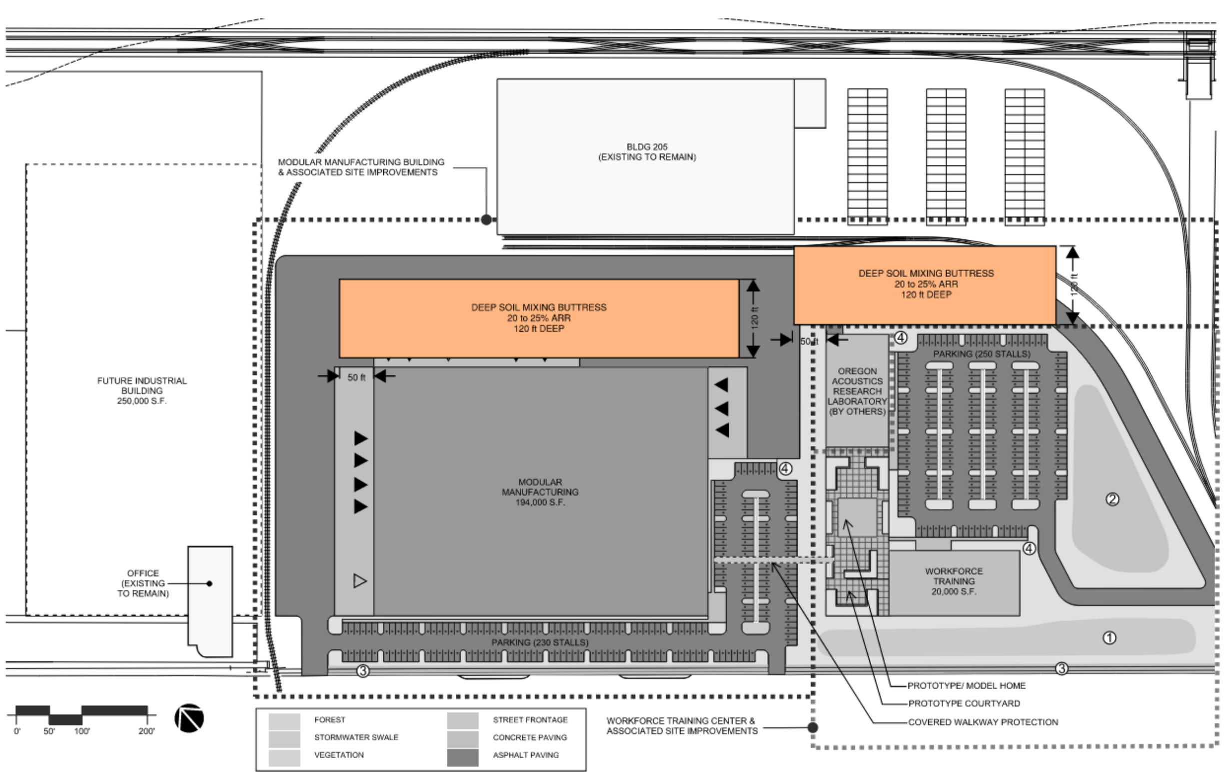
The proposal under this grant application is to construct a campus focused on the manufacture of mass timber housing products, including modular housing and prefabricated panels. The manufactured timber products are expected to focus on cross-laminated timber (CLT) and similar mass timber construction materials. The overall campus will include a manufacturing facility, workforce training facility, and acoustics research laboratory.

As noted in the Preliminary Engineering Reports prepared for the specific Oregon Mass Timber Coalition buildings, the Terminal 2 site is susceptible to lateral spreading in the event of a design-level earthquake. The proposed solution to stabilize the site soils involves a Deep Soil Mixing (DSM) buttress constructed on the river side of the proposed buildings, to support the upland soils from shifting. Refer to the attached geotechnical report for details of the proposed subsurface improvements.

This Preliminary Engineering Report is focused on the subsurface soil improvements to support the planned developments.

The following figure summarizes the approximate proposed subsurface improvements footprint, based on the concept Mass Timber Coalition building layout. Additional details of the proposed improvements are provided in the following sections of this report.

Figure 2: Overall DSM Buttress Site Plan



II. COMPLIANCE WITH EDA INVESTMENT GOALS

This grant requests construction assistance for subsurface soil improvements to support future development of the Terminal 2 site. The proposed improvements are designed to reduce the risk of seismic impacts to the Terminal 2 property, which were identified as a significant obstacle to redevelopment. The risk of lateral spread during an earthquake is common among sites along waterways such as the Willamette River, and the proposed DSM buttress has been used in several local examples as a successful approach to stabilizing sites and reducing risk.

The proposed improvements are key to redevelopment of the Terminal 2 site, which is expected to feature three (3) new buildings and generate manufacturing capacity for mass timber products geared toward the affordable housing sector. This facility will support local employment, regional forestry suppliers, and housing production while redeveloping an under-utilized industrial property.

Subsurface improvements like those proposed in this application are strong candidates for EDA investment because they remove barriers to development, thereby making development goals achievable.

The project components described in this engineering report are consistent with the EDA investment project description that is provided in Section B.2 of Form ED-900.

III. SOIL IMPROVEMENTS DETAILS AND LAYOUT

The proposed soil stabilization method employs a DSM buttress, which is an in situ soil treatment in which native soils or fills are blended with binding materials such as cement to strengthen the soils. Soil mixing is accomplished with vertical drilling and mixing augers which simultaneously drill, mix, and pump cement slurry into the native soil. Specific equipment varies, but most applications utilize crane-mounted rotary drilling heads which are advanced to the design depth and then withdrawn while mixing the soils with injected binders.

The proposed DSM buttress is expected to extend the length of the new Terminal 2 buildings at a width of approximately 120 feet perpendicular to the river and approximately 120 feet deep. Based on the initial site layouts for the Mass Timber buildings, the DSM buttress will need to be approximately 1,000 feet long. The buttress soil replacement volume is calculated based on the area replacement ratio:

$$Volume_{DSM} = Area \times Depth \times Ratio = (120' \times 1{,}000') \times 120' \times \left(\frac{1\,cy}{27\,cf}\right) \times 25\% = 133{,}333\,cy$$

The DSM buttress construction is a very intensive and disruptive construction process, and the ground surface within and nearby the DSM buttress footprint will be demolished to provide access to the subsurface soils. Following construction of the proposed Terminal 2 subsurface improvements, the disturbed area will be reconstructed to provide a stable, paved ground surface to accommodate the future final development. Approximately 120,000 SF of site is expected to require surface restoration following the DSM buttress construction.

The proposed DSM construct may disrupt existing infrastructure within the buttress footprint, including drainage and sewer utilities. These utilities will be reconstructed to maintain service to the existing Terminal facilities.

The proposed DSM buttress will be located along the land side of the existing Warehouse 205 building at Terminal 2, and will be constructed to protect the structure and foundation of the warehouse building. The building is currently vacant, so disruption to the Terminal 2 site will not affect any ongoing operations at the building.

IV. CONSTRUCTION COST ESTIMATE

Construction costs for the proposed Terminal 2 subsurface improvements are based on the conceptual Oregon Mass Timber Coalition buildings layout shown in Figure 2 of this report. The following summarizes the schematic construction costs estimated in year 2025 costs.

Table 2: Estimated Terminal 2 Subsurface Improvements Construction Cost (Year 2025)

Construction Classification	Subsurface Improvements Cost
Mobilization and Demolition	$1,217,000
Deep Soil Mixing Buttress	$20,000,000
Surface Paving Restoration	$540,000
Utility Reconnection Allowance	$50,000
Total Estimated Cost	$21,808,500
Soft Costs[1]	$4,361,700
15% Contingency	$3,271,300
Total Construction Cost	**$29,441,500**

[1] Soft costs are estimated at 20% of construction costs and include design fees, permit fees, testing and inspection fees, and other owner fees.

Contracts for construction of the proposed subsurface improvements are expected to be awarded through sealed competitive bids administered and issued by Port of Portland. The Port has extensive experience managing similar infrastructure projects throughout the region.

V. REQUIRED PERMITS

The proposed subsurface improvement is allowed within the IH-Heavy Industrial zone, so no land use review or entitlement approvals are necessary prior to permitting. While intended to support the eventual development goals at Terminal 2, the proposed improvements can be designed and permitted independent of the eventual development since the DSM buttress stabilizes the overall site rather than a specific building or foundation. The local Authority Having Jurisdiction is City of Portland.

The following summarizes the expected permits required for the subsurface improvement construction:

- Building Permit (City of Portland Bureau of Development Services) – approximately six (6) month duration to approval
- 1200-C Erosion Control Permit (Oregon Department of Environmental Quality) – two (2) month duration to approval

Applications for these permits will be initiated following acceptance of the EDA grant.

VI. ESTIMATED PROJECT SCHEDULE

The following schedule is anticipated for development of Terminal 2:

- City of Portland Permitting: approximately six (6) months
- Solicitation of Bid and Award: approximately three (3) months
- Construction: approximately 9 months
- Total duration: approximately 26 months

The following figure describes the expected schedule for design, permitting, and construction phases for this development.

Figure 3: Permitting and Construction Schedule

Terminal 2 Subsurface Improvements	Duration	Months After Grant Issuance																							
		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
		Sep 2022	Nov 2022	Jan 2023	Mar 2023	May 2023	Jul 2023	Sep 2023	Nov 2023	Jan 2024	Mar 2024	May 2024	Jul 2024	Sep 2024	Nov 2024	Jan 2025	Mar 2025	May 2025	Jul 2025	Sep 2025	Nov 2025	Jan 2026	Mar 2026	May 2026	Jul 2026
Deep Soil Mixing Buttress Design	6 mo																								
Building Permit Review and Approval	6 mo																								
1200-C Erosion Control Permit	2 mo																								
Bid and Award	3 mo																								
Deep Soil Mixing Buttress Construction	9 mo																								

VII. CONSTRUCTION FEASIBILITY ANALYSIS

The Terminal 2 site is well-suited to support industrial development such as the mass timber manufacturing facility. The availability of transportation and rail systems, adjacent public utilities, and opportunity to re-use existing structures on site are benefits for the proposed site. However, one of the most significant obstacles for the development is the risk of seismic lateral spreading.

The proposed DSM buttress soil improvements proposed in this grant application offer a proven solution to stabilizing the site to facilitate the eventual development. By addressing the soil improvements as a separate project, the Oregon Mass Timber Coalition seeks to prepare the Terminal 2 site for development to make the remaining construction go smoothly.

Construction costs for the proposed soil improvements are expected to be similar to other site improvement projects completed by the development community in the area.

APPENDIX 1

PRELIMINARY GEOTECHNICAL CONSULTATION

GRI
9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
503-641-3478 | www.gri.com

MEMORANDUM

To: Avery Roemen
Port Of Portland
7200 NE Airport Way
Portland, OR 97218

Date: 03-08-2022

GRI Project No.: 6632-14

From: Jason D. Bock, PE; Melissa Preciado

Re: Preliminary Geotechnical Consultation
Port of Portland Terminal 2 (T2) Redevelopment

At your request, GRI is providing preliminary geotechnical consultation during concept development for the Port of Portland (Port) Terminal 2 Redevelopment in Portland, Oregon. GRI and others have completed numerous projects in the area.. Our work included review of existing subsurface information (by GRI and others) and preliminary evaluation of foundation support options and seismic hazards, with mitigation as needed, for the new structure.

SUBSURFACE CONDITIONS

Subsurface materials and conditions at the site were evaluated based on explorations in the vicinity of T2 and GRI's experience and understanding of subsurface conditions at the project site and sites nearby. Published geologic mapping indicates the site is mantled with a variable thickness of artificial fill underlain by recent alluvium consisting of silt and sand, which was deposited by the Willamette River (Madin, 2004). Review of subsurface information for the site, obtained by GRI and others for previous projects in the area indicates significant variations in the subsurface conditions in the project vicinity. We anticipate the project site is mantled with up to 65 ft of sand fill underlain by sandy silt to sand soils that extend to the top of gravel. Explorations within the vicinity of the proposed new structures indicate gravel was encountered at depths of about 115 ft below existing grade. The upper portion of the gravel is likely a Missoula flood deposit and is underlain by relatively coarse-grained sedimentary deposits, locally referred to as the Troutdale Formation.

Due to the close proximity of the Willamette River, we anticipate the groundwater level at the site will rise and fall in response to fluctuations in the river level and rainfall. In general, we anticipate water to be between 15 and 25 ft below existing grade. In addition, perched groundwater conditions may occur in the silt and sand soils that mantle the site during periods of heavy or prolonged precipitation.

PRELIMINARY GEOTECHNICAL CONSIDERATIONS

The following preliminary geotechnical considerations are provided to assist the design team with initial project planning.

Liquefaction

Liquefaction is a process by which loose, saturated granular materials, such as clean sand and, to a somewhat lesser degree, non-plastic and low-plasticity silts, temporarily lose stiffness and strength during and immediately after a seismic event. This degradation in soil properties may be substantial and abrupt, particularly in loose sands. Liquefaction occurs as seismic shear stresses propagate through a saturated soil and distort the soil structure, causing loosely packed groups of particles to contract or collapse. If drainage is impeded and cannot occur quickly, the collapsing soil structure causes the pore water pressure to increase between the soil grains. If the pore water pressure becomes sufficiently large, the intergranular stresses become small and the granular layer temporarily behaves as a viscous liquid rather than a solid. After liquefaction is triggered, there is an increased risk of settlement, loss of bearing capacity, lateral spreading, and/or slope instability, particularly along waterfront areas. Liquefaction-induced settlement occurs as the elevated pore water pressures dissipate and the soil consolidates after the earthquake.

Based on our review of the explorations within the vicinity of the proposed structures, the sand soils at the site below the groundwater are highly susceptible to liquefaction. Simplified liquefaction evaluation procedures indicate ground surface settlements on the order of 18 to 30 inches will occur at the site following a code level earthquake (1% in 50 year probability of collapse hazard level). Liquefaction settlements (when considering building support) are typically mitigated using either a deep foundation system or ground improvement. Previous work on nearby projects have demonstrated the use of open-ended pipes piles can be an effective method of installing deep foundations. Pipe piles typically range in diameters of 12.75 inches to 24 inches and are driven deep into the underlying dense soils. Piles embedded 20 to 30 feet into the underlying deep soils will likely achieve allowable capacities on the order of 150 kips to 400 kips. As an alternative to deep foundations, axial settlement could also be mitigated utilizing ground improvement such as deep soil mixing (DSM) that extends to the underlying dense soils.

Lateral Spreading

As noted above, the site is underlain by soils susceptible to liquefaction from a code-based seismic event. In riverfront areas, liquefaction can also cause large lateral spreading deformations of the riverbank, which may extend hundreds of feet into the upland areas. Our experience with similar projects along the Willamette River, and the use of simplified empirical methods for lateral spreading (Youd et al, 2002) (Rauch and Martin, 2000) indicate lateral deformations greater than

10 ft on the north side (river side) of the proposed structures and will decrease to less than 5 ft on the south side of the structures.

We understand a sheet pile wall is located under the dock at the riverbank. Based on review of the as-built drawings provided by you, the existing sheet piles do not extend deep enough or provide enough lateral resistance to reduce lateral spreading to acceptable levels (typically 6 to 18 inches). For this reason, we recommend the use of a ground improvement buttress to mitigate the lateral spreading at the site. Past experience has shown that the use of Deep Soil Mixing (DSM) often provides the best combination of performance and value when used to mitigate lateral spreading. For preliminary purposes, we recommend the DSM extend through the liquefiable sands and key into the underlying dense soils. Existing explorations at the site, indicate dense soils were encountered at depths of about 115 ft within the current building footprint.

Seismic Mitigation Alternatives

Considering the use of ground improvement such as DSM is required to mitigate lateral spreading and buildings will need to be supported by either deep foundations or ground improvement In our opinion, two options should be considered for layout of the DSM and structural support of the building. Alternative 1 includes the use of a ground improvement buttress in front of the building and piles to support the structure. Alternative 2 includes the use of a larger ground improvement block which will act as both building support and buttress. See Figures 1 & 2 for conceptual level DSM layouts. Additional details regarding the two alternatives are provided below.

Alternative 1:

DSM Buttress (outside building footprint)

- Width of 120 ft (perpendicular to the river)
- Extend ground improvement 50 ft laterally beyond the ends of the building
- Extend to a depth of about 120 ft (keyed 5 ft into underlying dense soils)
- Area replacement ratio on the order of 20 to 25%
- Rough cost (2022 rates) of $150 per cubic yard of treatment

Pipe Piles (Foundation/Slab Support)

- Embed piles 20 to 30 ft into the underlying dense soils
- Open ended pipe piles with diameters between 12.75 and 24 inches
- Allowable capacities on the order of 150 to 400 kips each
- May require end driving to complete installation
- Rough cost (2022 rates) of $35 to $50 per ft for 12.75 inch open ended pipe piles

Alternative 2:

DSM Buttress and DSM Foundation/Slab Support

- Footprint of DSM should match entire footprint of the building
- Extend to a depth of about 120 ft (keyed 5 ft into underlying dense soils)
- Area replacement ratio on the order of 20 to 25%
- DSM gridlines lined up with building gridlines for shallow foundation support
- Rough cost (2022 rates) of $150 per cubic yard of treatment

LIMITATIONS

This memo has been prepared for use by the project team and should not be relied upon by any other entity without the written permission of an authorized representative. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the Terminal 2 Redevelopment at the time of this memorandum. In the event any changes in the design and location of the improvements as outlined in this memorandum are planned, we should be given the opportunity to review the changes and modify or reaffirm the conclusions and recommendations of this memorandum in writing.

The conclusions and recommendations submitted in this memorandum are based on the data obtained from previous field investigation and our understanding of the subsurface conditions. It is acknowledged that variations in soil conditions may exist at the project location. It should be understood our recommendations are for conceptual planning only and additional explorations and analysis will be required.

Please contact the undersigned if you have any questions regarding this memorandum.

Submitted for GRI,

REGISTERED PROFESSIONAL ENGINEER
85582
OREGON
SEPT. 11, 2018
JASON DONALD BOCK

Renews 12-2023

Jason D. Bock, PE
Principal

Melissa Preciado
Staff Engineer

REFERENCES

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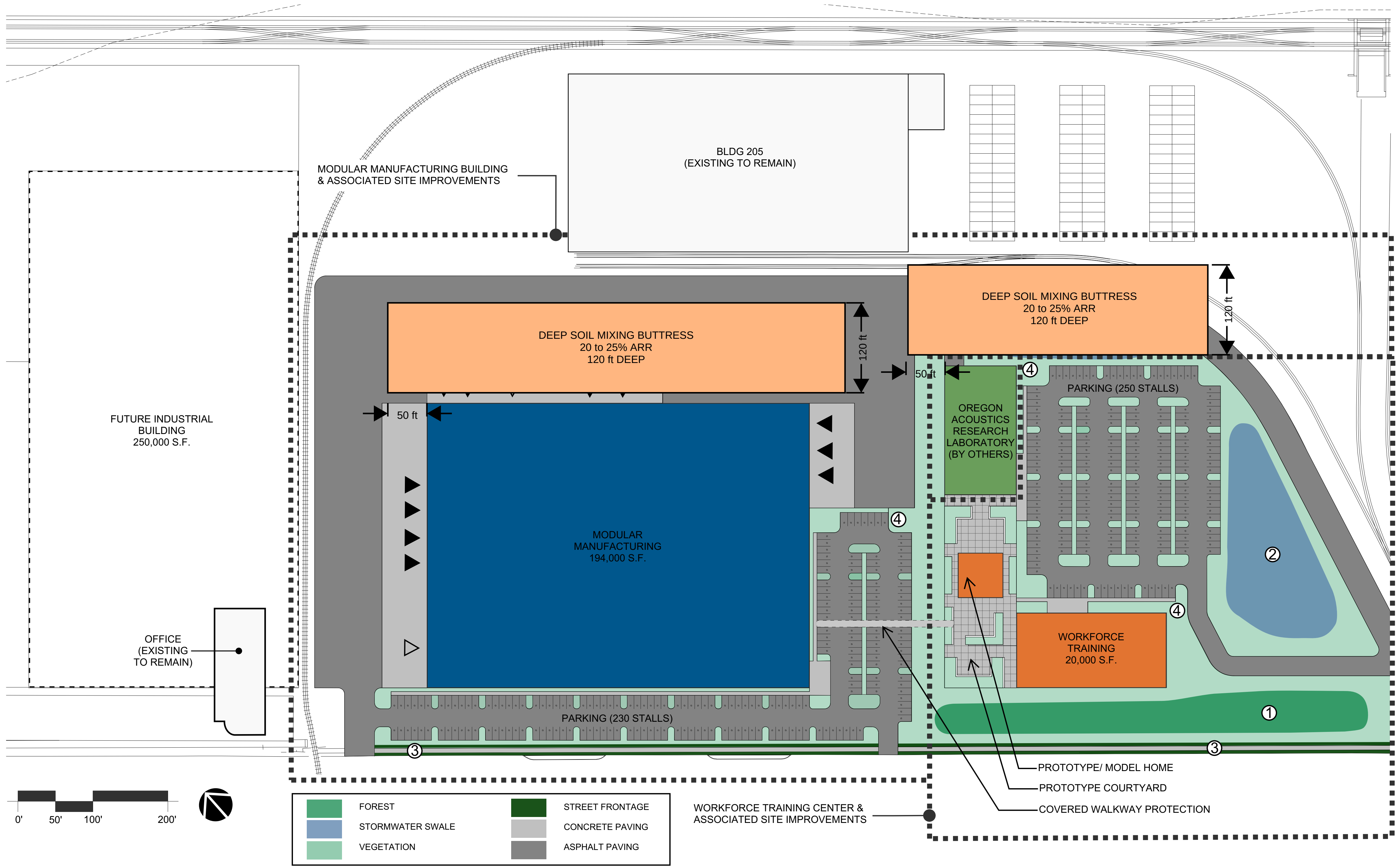
POP T2 REDEVELOPMENT MEMORANDUM

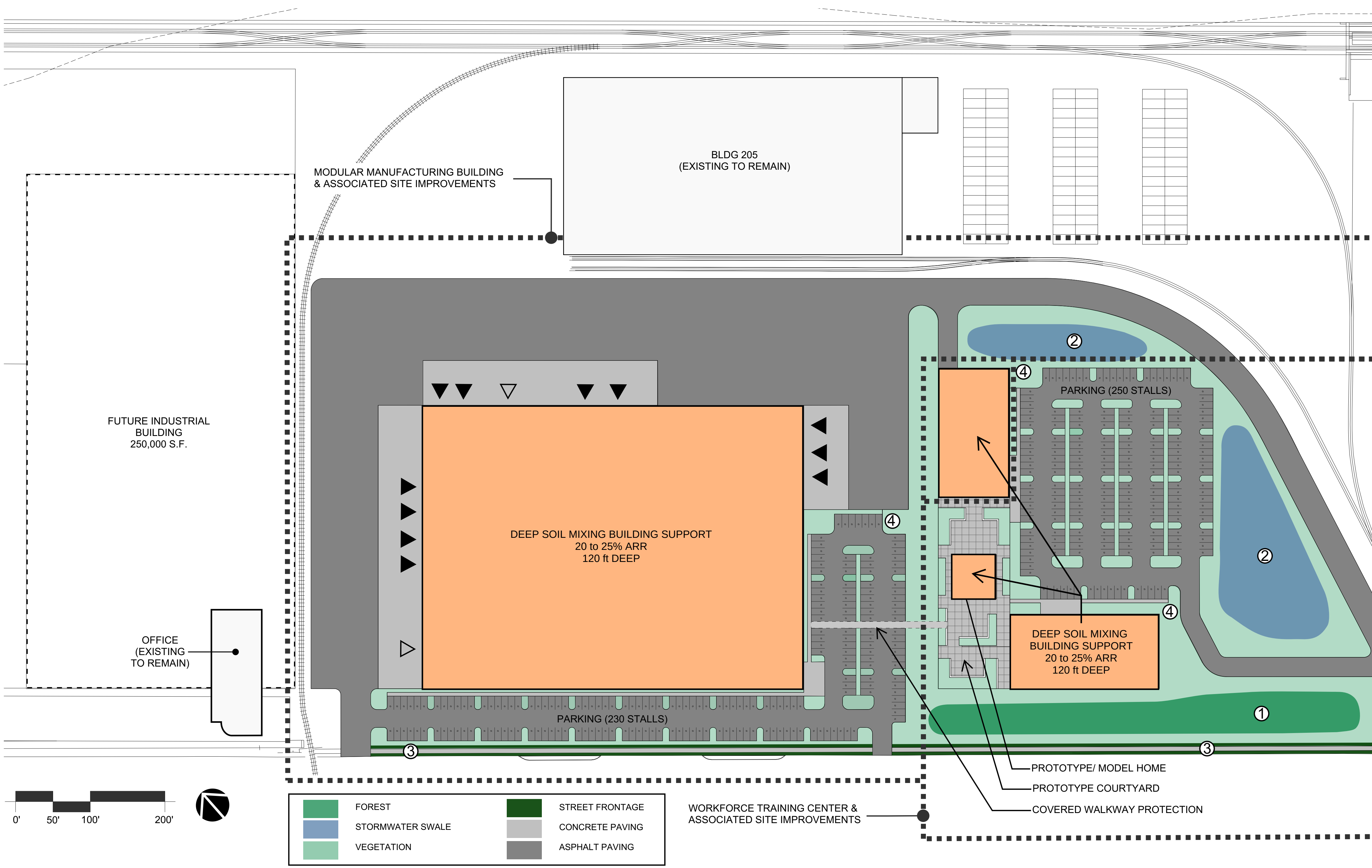


GRI

PORT OF PORTLAND
TERMINAL 2 (T2) REDEVELOPMENT

MITIGATION OPTION #1

MARCH 2022 JOB NO. 6632-14 FIG. 1



GRI

PORT OF PORTLAND
TERMINAL 2 (T2) REDEVELOPMENT

MITIGATION OPTION #2

MARCH 2022 JOB NO. 6632-14 FIG. 2