APPENDIX F – VOLUME CALCULATIONS EAST WATERWAY OPERABLE UNIT FEASIBILITY STUDY

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1 INTRODUCTION

A key component of developing and evaluating remedial alternatives for the East Waterway (EW) Operable Unit (OU) Feasibility Study (FS) is estimating the volume of contaminated sediment that would potentially be removed as part of remediation, and the amount of material placed in the waterway as part of capping, enhanced natural recovery (ENR), residuals management, or in situ treatment. In particular, the sediment volumes for removal and disposal are a major driver of estimated costs and construction timeframes for all of the remedial alternatives.

This appendix summarizes the methods used to estimate removal and placement volumes in the FS, and discusses the following:

1. The methods used to create a triangular irregular network (TIN) surface and subsequently develop isopach layers of contaminated sediment removal thickness (Section 2.1) to determine neatline volumes for the Deep Main Body Reach, Shallow Main Body Reach, and adjacent berthing areas.
2. Determining sediment neatline volume estimates for other Construction Management Areas (CMAs). All other CMAs were completed using various methods, which typically consisted of multiplying the surface area and a sediment thickness (Section 2.2).
3. Determining the sediment neatline volume estimates for partial dredging and capping and partial dredging and ENR in the navigation channel or berthing areas (ENR-nav) (Section 2.3).
4. Determining the estimated total removal volume for the alternatives (Section 2.4).
5. Methods for estimating placement volumes (Section 3).
6. Uncertainties in the data and methods (Section 4).

The level of accuracy of the estimated volumes in this FS is considered sufficient for calculating dredged material removal volumes for remedial alternatives. Volume estimates will require refinement during the remedial design phase prior to remedial action.

2 METHODS FOR CALCULATING VOLUME OF CONTAMINATED SEDIMENT

The FS has divided the EW into CMAs, grouping areas with similar characteristics and common remedial technology assignments. The following sections describe the methods for estimating neatline volumes in each CMA. Neatline volumes are the volumes of contaminated sediment determined by multiplying removal depth by area prior to considering slopes, overdredge, and other constructability factors.

2.1 Development of the Triangular Irregular Network and Neatline Dredge Volumes

The thickness of contaminated sediment in the Deep and Shallow Main Body Reaches and adjacent berthing areas (T-18 Berth Area, T-25 Berth Area, and T-30 Berth Area) was estimated by identifying the deepest depth of contaminated sediment for each core and interpolating between core locations with a TIN for the three sets[1] of remedial action levels (RALs) developed in FS Section 6. A TIN creates an interpolated surface by drawing straight-line slopes between depths of sediment exceeding RALs determined from sediment cores. All of the cores in the Supplemental Remedial Investigation (SRI)/FS dataset were used to create the TIN surfaces, with the exception of cores that have been dredged subsequent to sampling. For duplicate samples, the average of the two concentrations was used to determine neatline dredging depths.

The depth of contamination for each core was determined by reviewing the detected RAL exceedances (see Section 6 of the FS) of all core sample intervals for each set of RALs. Note that, although RALs were not developed for all benthic risk-drivers, the depth of contamination determined by all RAL exceedances resulted in the inclusion of all detected exceedances of all benthic risk drivers where the removal technology is used. In other words, dredging to the base of RAL exceedances will also remove the full set of benthic risk-driver exceedances at each core location, because all benthic risk-driver exceedances are co-located with RAL exceedances in the FS dataset. To compensate for any core compaction during sampling, the core interval depths were divided by the percent recovery for each core, where this information was available. If percent recovery was not available, the sample

[1] Differences in RAL sets are for PCBs only; all other COCs have the same RAL. The three PCB RALs are 12, 7.5, and 5 mg/kg OC.

interval depths were used without applying a compaction correction. Four types of results were obtained from the cores and the depth of contamination was determined, as follows:

- If the deepest RAL exceedance was just above an interval without a detected RAL exceedance, then the depth of contaminated sediment was assumed to be at the contact between the two intervals.
- If the deepest RAL exceedance was just above an interval that was not analyzed, then the un-analyzed interval was assumed to be a RAL exceedance, and the depth of contamination was assumed to be the top of the next interval without a detected RAL exceedance.
- If the deepest sample interval was a RAL exceedance, then the depth of contamination was assumed to be the depth of the core plus an additional 1 foot. This was a reasonable assumption based on comparing these core locations to nearby cores where the depth of contamination was bounded.
- If the core had no RAL exceedances, then the depth of contamination was assumed to be 1 foot if the core was within the remediation footprint (i.e., if the surface sediment at that core location exceeds RALs), and 0 feet if the core was outside the remediation area (i.e., if surface sediment at that core location does not exceed RALs).

The depths of contamination for each core, as determined by the metrics described above, were inputted into a CAD program to generate a TIN surface based on thickness below the existing sediment surface (i.e., the TIN was generated as a thickness of contaminated sediment as opposed to an elevation; Figures 1a, 1b, 2a, 2b, 3a, and 3b). Manual points were entered into the TIN surface to simulate a contamination thickness of 2 feet at the pier faces and at the edge of the site in locations without piers. This assumption represents a reasonable estimate of the average thickness of sediment at the pier faces based on jet probe data under the piers (see Section 2.2.2 for discussion of jet probe data under the piers), and represents a reasonable boundary condition for areas without pier structures. Note that in practice, the full thickness of contaminated sediment along pier faces may not be able to be removed without compromising structures or slopes; the FS assumes that dredging in areas adjacent to piers and slopes would occur to the maximum extent practicable and remaining contamination would be addressed as part of residuals management.

The dredging neatline volume was determined in CAD by multiplying TIN thicknesses by removal area for each TIN, as presented in Tables 1a and 1b. The neatline volume calculation assumes vertical cuts from mudline down to the dredging elevation along the boundary of dredging areas (e.g., bordering unremediated areas). During construction, these locations would be sloped for sediment stability, as discussed in Section 2.4.

2.2 Development of Remaining Construction Management Area Dredging Neatline Volumes

For the remaining CMAs, the TIN was not used because TIN-layer boundary assumptions have a larger influence on the dredging volume and do not accurately represent the proposed removal actions in the alternatives. In particular, small CMAs with a large proportion of shoreline and few sediment cores would have dredging depths determined by TIN boundary assumptions, as opposed to actual data. Therefore, volumes were calculated for each area individually by the methods described in the following sections.

2.2.1 Open-water Construction Management Areas

Dredging volumes for the smaller open-water CMAs, including the Sill Reach, Former Pier 24 Piling Field, T-25 Nearshore, Mound Area and Slip 27 Shoreline, Slip 27 Channel, T-30 Nearshore, T-46 Offshore, and Slip 36, were based on an average removal thickness for each RAL set obtained from core data in each area. Note that the dredge depth was the same for all three RAL sets for all cores in these areas. For these CMAs, the contamination thicknesses of the applicable cores were averaged to estimate contamination thickness across the CMA. This thickness was then multiplied by the surface area of the CMA to derive neatline volumes, as shown in Tables 1a and 1b.

2.2.2 Underpier Construction Management Area

The volume of all sediment (both above RALs and below RALs) in the underpier CMA was estimated by analyzing jet probe data and cross sections. For T-18, T-25, and T-30 under piers, jet probe data collected by Sunchasers in 1998 and 2000 were used to measure the lateral extent of sediment in underpier areas and sediment thickness along transects (Sunchasers 2000). Estimations were made of the cross sectional areas of soft sediment at representative bents. The cross sectional areas of soft sediment based on the jet probe data were multiplied by the representative pier length to estimate the total volume of soft sediment. For Slip 27 and T-46 under piers, jet probe data were not available, so cross sections that approximated original construction conditions (Anchor and Windward 2008) were used to estimate sediment cross sectional areas based on multibeam bathymetry collected in underpier areas. From these cross sections, the area of sediment was calculated based on the depiction of soft sediment on the drawing, or by inferring a 2.5 horizontal to 1 vertical (2.5H:1V) sediment slope starting approximately halfway down the riprap slope to the edge of the pier face. The cross sectional area was multiplied by the length of the structures to estimate a total volume. Finally, for Pier 36/37, because of the lack of information regarding underpier conditions, 2.0 feet of sediment was estimated over half of the footprint under the Pier 36/37 structure to calculate volumes.

For all underpier areas, the total volume of sediment estimated was approximately 51,000 cubic yards (cy). The volume of contaminated sediment requiring removal was then assumed to be proportional to the area of underpier sediment requiring removal relative to the total area of underpier sediment (14.4 acres). For Underpier Options C and C+, the removal area was 1.9 acres, resulting in a volume of 7,016 cy. For Underpier Options D and E, the removal area was 12.1 acres, 12.7 acres, and 13.4 acres for the RAL sets, which included 12 milligrams per kilogram of organic carbon (mg/kg OC), 7.5 mg/kg OC, and 5.0 mg/kg OC for PCBs, respectively. The resulting removal volumes were 43,940 cy, 46,216 cy, and 48,816 cy, respectively.

2.2.3 Communication Cable Crossing

A communication cable is positioned within a rock structure that crosses the EW between stations 1400 to 2000 located at elevations from approximately -70 feet MLLW up to -50 feet MLLW, depending on the location in the waterway. Moving, replacing, or modifying the communications cable crossing would be a challenging and expensive modification to infrastructure in the EW. Due to uncertainties with existing conditions in the Communication Cable Crossing CMA and lack of as-built or cable survey information, an estimated sediment thickness of 3 feet to the top of the cable's armored trench was used to determine the volume of removal in this CMA. Neatline volume was calculated by multiplying removal depth by dredging area. Additional investigations will be required during design to determine the sediment thickness over the ballast rock to more accurately characterize conditions to perform the maximum practicable removal of contaminated sediment in the location.

2.3 Partial Dredging Depth Volume Calculations

2.3.1 Partial Dredging and Capping

Partial dredging and capping is part of all remedial alternatives for two or more CMAs. The assumptions used to calculate partial dredging volumes were different for the Shallow Main Body Reach and nearshore areas and are described in more detail in this section.

Partial dredging and capping was assigned in the Shallow Main Body Reach for Open-water Technology Groups 1 and 2 (see Appendix L or Section 8). In these areas, the partial dredging depth depended on maintaining the required operational navigation elevations. In the Shallow Main Body – North (Stations 4950 to 6200), the operational depth required to maintain site use is -40 feet mean lower low water (MLLW). To accommodate an assumed 4-foot buffer, the top of the cap would be at -44 feet MLLW. This requires a partial dredging elevation of -49 feet MLLW to allow for an assumed 5-foot-thick cap (see Section 7.2.5.1 of the FS). In the Shallow Main Body – South (Stations 6200 to 6800), the operational depth required to maintain site use is -30 feet MLLW. Subsequently, the top of the cap would be at -34 feet MLLW. This requires a partial dredging elevation at -39 feet MLLW to accommodate a 5-foot-thick cap. The partial dredging depth was calculated as the existing bathymetric sediment surface elevation minus the partial dredging elevation requirements described above. In certain areas of these CMAs, the existing sediment surface elevation is at or below the partial dredging elevation, and no dredging would be necessary to place a cap in these areas (only capping would be necessary). Where the partial dredging depth is greater than the thickness of contamination, the thickness of contamination was considered the partial dredging depth and constitutes the volumes provided for the Shallow Main Body Reach in Table 1b. The dredging isopach needed to accommodate partial dredging and capping is presented in Figures 4a and 4b. The dredging depth depicted in Figures 4a and 4b was multiplied by area to estimate the neatline dredging volume in these areas.

In the Mound Area/Slip 27 Shoreline, Slip 27 Head, and the Coast Guard Nearshore, the partial dredging depth was assumed to be 5 feet for the FS, to accommodate a 5-foot cap while restoring the surface elevations to the existing grade. In some areas, additional removal would be necessary to ensure that the surface of the final cap is at a stable grade once appropriate offsets from the navigation channel are included. In particular, the Mound Area would require significant additional removal in the area adjacent to the navigation channel to create stable slopes (e.g., 3V:1H) from the edge of the navigation channel. To accommodate this slope, an additional removal of approximately 7,800 cy of material would be required, and is included in the volume estimate.

2.3.2 Partial Dredging and ENR-nav

Partial dredging and ENR-nav is part of Open-water Technology Group 1 in the Deep Main Body Reach, Communication Cable Crossing area, and Deep Draft Berthing Areas. In these areas, the partial dredging depth was calculated to fit an assumed 1.5-foot-thick ENR-nav layer. Partial dredging was assumed to extend to -54 feet MLLW, approximately 3 feet below the maintenance dredging depths. Where the partial dredging depth is greater than the thickness of contamination, the thickness of contamination was considered the partial dredging depth. The dredging isopach needed to accommodate partial dredging and ENR-nav is presented in Figures 4a and 4b. The dredging depth depicted in Figure 2 was multiplied by area to estimate the neatline dredging volume in these areas.

2.4 Constructable Dredge Volume Calculation

Neatline volumes including those previously described under-represent the amount of material that will be removed during construction due to several factors, including the following:

- Additional volume required to design constructable dredge prisms, consisting of flat-bottom or constant thickness units with stable side slopes. Additional volume is also generated with dredge prisms from side slopes between dredge units and adjacent unremediated areas, and payable overdepth allowances.
- Additional horizontal and vertical sediment volumes (e.g., presence of contaminants below the currently estimated depth of contamination), particularly where cores had RAL exceedances in the deepest interval.

- Additional volume for sedimentation that may occur before remedy implementation.
- An allowance to account for slumping sediment within the dredge prism.

To account for the multiple allowances listed above, the neatline volumes were increased by 50% to represent the anticipated construction dredge volume. This adjustment is consistent with the method used in the LDW (e.g., AECOM 2012), and is derived from actual removal volumes for large sediment remediation sites (Palermo 2009). A constructability factor of 1.5 was multiplied by the neatline dredging volumes in all CMAs except the Underpier CMA. In these areas, dredging would be performed down to the underlying rock slope (i.e., down to the riprap layer); therefore, several of the increased volume allowances above do not apply, and the volume factor was not applied in these areas.

Placing the constructability factor into context shows that the neatline volume times 1.5 is reasonable for the EW, based on project experience in the EW. The average neatline dredge depth is about 3.5 feet for the alternatives. Because a typical overdredging depth is 1 foot beyond the targeted construction depth, overdredging contributes about 30% of the constructability volume. Therefore, the other 20% of the constructability volume (an average of 8 inches over the entire dredging area) is from the other factors, including dredge prism design, side slopes, sloughing, and additional characterization. The 8 inches of allowance for these factors is reasonable based on project experience.

2.5 Total Volume Estimates for Remedial Alternatives

Table 2 provides the total rounded dredging volumes for the remedial alternatives. The total volumes range from 810,000 cy (Alternative 1A(12)) to 1,150,000 cy (Alternative 3E(5.0)).

3 PLACEMENT VOLUME CALCULATION

Table 3 provides the placement volume calculation by CMA. The placement volumes are calculated based on placement thickness multiplied by area. The placement volume assumptions for the FS are listed in the following bullets; material specifications and thicknesses will be revisited during remedial design, and suitable habitat substrates will be used where applicable. These placement depths are developed in FS Section 7.2.5.1, based on the analysis in Appendix D (for capping).

- Capping is assumed to be 5 feet thick and consist of the following:
  - 1.5 feet of armor (stone)
  - 1 foot of filter material (gravel)
  - 2.5 feet of isolation material (sand with controlled total organic carbon (TOC) or activated carbon (AC) as necessary as determined in design)
- ENR and residuals management cover are assumed to be 9 inches thick (sand)
- In situ treatment is assumed to be 3 inches thick (AC plus substrate)
- Backfill thickness is assumed to be the same as the removal thickness in the area requiring backfill (sand)

The total placement volumes for the CMAs and alternatives are shown on Tables 3 and 4.

4 SOURCES OF UNCERTAINTY

The removal volume estimates represent the estimate of future dredge volumes based on current information. The following list provides a summary of the major uncertainties associated with this estimate:

- The accuracy of the volume estimate is limited by the density of core data, and the dredging volume will change with additional sediment characterization.
  - Although the EW OU is well characterized, approximately 63 of 146 cores used in the volume analysis (43%) had exceedances at the base of the core. Most of these locations were cores that were sampled for dredge material disposal characterization and were sectioned in 4 feet or greater increments. In these locations in particular, deeper contamination than the assumed 1 additional foot could be encountered during remedial design (Section 2.1). Based on the average dredge depth in Table 2, if an additional 1 foot of contaminated sediment were present below the base of these cores (for a total of 2 feet of contaminated sediment below the base of these cores), then the total project dredging volume (and associated costs) would increase by about 12%. For the alternatives, this uncertainty is assumed to be captured by the constructability factor of 1.5 times the neatline volume, and by contingency costs (which are 30% of total capital costs).
  - Cores with thicker sample intervals (e.g., 4 feet) have greater uncertainty in estimating the depth of contaminated sediment exceeding RALs (i.e., neatline dredge depth). The neatline dredge depth could be thicker or thinner than estimated depending on the effect of compositing layers of higher concentrations with layers of lower concentrations (i.e., an exceedance could be masked by blending or drawn deeper by blending).
  - Approximately 36 acres of the EW OU is outside of the remediation footprint because sediments are below RALs. The boundaries of remediation areas may need to be adjusted based on remedial design sampling.
- The dredging volume will be adjusted to account for structural and slope limitations during design.

- As discussed in the FS, structural stability will limit dredging adjacent to structures and slopes. During construction, some contaminated sediment will remain in place and will be managed as part of residuals management and, subsequently, will not be incorporated into the total removal volume.
- Typical maximum stable dredge-cut slopes are approximately 3H:1V; however, the TIN surface was generated with no slope restrictions and, therefore, likely underestimates the final volume relative to when slopes are incorporated into the design.

In general, these key uncertainties are accounted for by the 1.5 constructability factor, as described in Section 2.4.

5 REFERENCES

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TABLES

Table 1a
Remediation Areas, Technology Assignments, and Average Dredge Depth by Construction Management Area

CMA	Total Area (Acres)	Remediation Area For RAL Set[a] (acres)			Technology Option[c]			Average Dredge Depth (feet)[d]						
		RAL Set including 12 mg/kg OC for PCBs	RAL Set including 7.5 mg/kg OC for PCBs	RAL Set including 5.0 mg/kg OC for PCBs[b]	Open-water Option 1	Open-water Option 2	Open-water Option 3	Open-water Option 1, RAL Set including 12 mg/kg OC	Open-water Option 2, RAL Set including 12 mg/kg OC	Open-water Option 3, RAL Set including 12 mg/kg OC	Open-water Option 2, RAL Set including 7.5 mg/kg OC	Open-water Option 3, RAL Set including 7.5 mg/kg OC	Open-water Option 2, RAL Set including 5.0 mg/kg OC	Open-water Option 3, RAL Set including 5.0 mg/kg OC
Open-water CMAs														
Deep Main Body – North and South	56.4	43.0	47.3	50.2	Removal/ Partial Removal and ENR-nav	Removal	Removal	2.7	3.5	3.5	3.4	3.4	3.4	3.4
T-18 Berth Area	18.7	15.2	16.7	17.3	Removal/ Partial Removal and ENR-nav	Removal	Removal	2.2	2.3	2.3	2.2	2.2	2.3	2.3
T-25 Berth Area	5.7	4.8	4.8	5.3	Removal	Removal	Removal	3.7	3.7	3.7	3.8	3.8	3.8	3.8
T-30 Berth Area	6.6	4.7	5.6	5.6	Removal	Removal	Removal	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Slip 36	7.1	5.0	6.5	7.1	Removal	Removal	Removal	2.3	2.3	2.3	2.4	2.4	2.5	2.5
Slip 27 Channel	2.4	2.4	2.4	2.4	Removal	Removal	Removal	7.2	7.2	7.2	7.4	7.4	7.6	7.6
T-25 Nearshore	0.5	0.5	0.5	0.5	Removal	Removal	Removal	5.0	5.0	5.0	5.2	5.2	5.3	5.3
T-30 Nearshore	3.2	3.1	3.1	3.1	Removal	Removal	Removal	4.3	4.3	4.3	4.4	4.4	4.5	4.5
T-46 Offshore	2.0	0.0	0.4	0.4	n/a	Removal	Removal	n/a	n/a	n/a	5.0	5.0	5.1	5.1
Shallow Main Body – North	14.0	9.5	9.5	11.6	Removal/ Partial Removal and Cap	Removal/ Partial Removal and Cap	Removal	3.7	3.7	4.4	4.5	4.5	4.7	4.7
Shallow Main Body – South	6.6	4.5	5.3	6.1	Removal/ Partial Removal and Cap	Removal/ Partial Removal and Cap	Removal	3.8	3.8	5.0	4.6	4.6	4.6	4.6
Sill Reach – West Seattle Bridge	1.9	1.7	1.9	1.9	ENR-sill	ENR-sill	Removal	n/a	n/a	4.1	n/a	4.2	n/a	4.3
Sill Reach – Low Bridges	1.8	1.2	1.3	1.3	ENR-sill/ MNR	ENR-sill	ENR-sill	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Junction Reach	2.2	0.0	0.5	0.5	n/a	Removal	Removal	n/a	n/a	n/a	3.6	3.6	3.7	3.7
Former Pier 24 Piling Field	1.1	1.1	1.1	1.1	Partial Removal and Cap	Partial Removal and Cap	Removal	5.0	5.0	7.9	5.0	8.2	5.0	8.4
Mound Area and Slip 27	5.0	5.0	5.0	5.0	Partial Removal and Cap	Partial Removal and Cap	Partial Removal and Cap	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Coast Guard Nearshore	2.5	2.5	2.5	2.5	Partial Removal and Cap	Partial Removal and Cap	Partial Removal and Cap	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Communication Cable Crossing	5.1	4.8	4.8	4.8	Removal/ Partial Removal and ENR-nav	Removal	Removal	2.1	3.0	3.0	3.0	3.0	3.0	3.0
Subtotal	**143**	**109**	**119**	**127**										

CMA	Total Area (Acres)	RAL Set including 12 mg/kg OC for PCBs	RAL Set including 7.5 mg/kg OC for PCBs	RAL Set #3 (5 mg/kg OC)	CSL for PCBs and Hg	Underpier Options A & B	Underpier Options C & C+	Underpier Option D	Underpier Options E	Underpier Options A & B	Underpier Options C & C+ & D & E (Same Removal Depth for all Options)[e]
Underpier CMA											
Underpier	14.4	12.1	12.7	13.4	1.9	No removal (MNR & In Situ Treatment Respectively)	Diver assisted hydraulic dredging in areas exceeding CSL for PCBs and Hg (also in situ treatment)	Diver assisted hydraulic dredging in areas exceeding RALs	Diver assisted hydraulic dredging in areas exceeding RALs (also in situ treatment)	n/a	2.3

Total Remediation Area	**157**	**121**	**132**	**140**

Notes:
a. The RALs are presented in FS Section 6. The RAL sets for the alternatives are distinguished based on the PCB RALs: 12 mg/kg OC (121 acres of remediation), 7.5 mg/kg OC (131 acres of remediation), and 5.0 mg/kg OC (144 acres of remediation).
b. The RAL of 5.0 mg/kg OC was not carried forward in the detailed evaluation of alternatives (FS Section 9), as described in FS Appendix L.
c. Open-water technology options 1, 2, and 3 denote the following: 1 = Removal with capping and ENR where applicable; 2 = Removal with capping where applicable; and 3 = Maximum removal to the extent practicable. Underpier technology options A, B, C, D and E denote the following: A = MNR; B = In situ treatment; C = Diver-assisted hydraulic dredging in areas exceeding CSL for PCBs and Hg and in situ treatment for other areas exceeding RALs; C+ = Same as C, but with in situ treatment employed within the diver-assisted dredging areas following removal; D = Diver-assisted hydraulic dredging; and E = Diver-assisted hydraulic dredging followed by in situ treatment.
d. For neatline volumes calculated using dredge depths, the average dredge depths are the average depths to base of contamination of the cores listed in Table 1b.
e. The dredging depth in the underpier is based on cross sectional area down to riprap, and is therefore the same for all underpier technology options and RAL sets.

CAD - computer-aided drafting
CMA - Construction Management Area
ENR-nav - enhanced natural recovery applied in the navigation channel and deep-draft berthing areas
ENR-sill - enhanced natural recovery used in the Sill Reach
MNR - monitored natural recovery
n/a - not applicable (no removal)
OC - organic-carbon normalized
RAL - remedial action level
TIN - triangular irregular network

Table 1b

Neatline and Total Dredge Volumes by Construction Management Area

CMA	Neatline Dredge Volume (cy) [a]: Open-water Option 1, RAL Set including 12 mg/kg OC	Open-water Option 2, RAL Set including 12 mg/kg OC	Open-water Option 3, RAL Set including 12 mg/kg OC	Open-water Option 2, RAL Set including 7.5 mg/kg OC	Open-water Option 3, RAL Set including 7.5 mg/kg OC	Open-water Option 2, RAL Set including 5.0 mg/kg OC	Open-water Option 3, RAL Set including 5.0 mg/kg OC	Method for Calculating Neatline Volume	Constructability Factor[b]	Total Dredge Volume by Alternative (PCB RAL in mg/kg OC) (cy): Open-water Option 1, RAL Set including 12 mg/kg OC	Open-water Option 2, RAL Set including 12 mg/kg OC	Open-water Option 3, RAL Set including 12 mg/kg OC	Open-water Option 2, RAL Set including 7.5 mg/kg OC	Open-water Option 3, RAL Set including 7.5 mg/kg OC	Open-water Option 2, RAL Set including 5.0 mg/kg OC	Open-water Option 3, RAL Set including 5.0 mg/kg OC	Dredging Designation
Open-water CMAs																	
Deep Main Body – North and South	190,026	240,710	240,710	263,360	263,360	274,931	274,931	TIN (CAD)	1.5	285,039	361,065	361,065	395,040	395,040	412,397	412,397	Open water
T-18 Berth Area	55,059	56,930	56,930	60,490	60,490	64,132	64,132	TIN (CAD)	1.5	82,589	85,395	85,395	90,735	90,735	96,198	96,198	Open water
T-25 Berth Area	28,755	28,755	28,755	29,391	29,391	32,356	32,356	TIN (CAD)	1.5	43,133	43,133	43,133	44,087	44,087	48,534	48,534	Open water
T-30 Berth Area	18,807	18,807	18,807	22,585	22,585	22,585	22,585	TIN (CAD)	1.5	28,211	28,211	28,211	33,878	33,878	33,878	33,878	Open water
Slip 36	18,121	18,121	18,121	24,477	24,477	27,153	27,153	Average of 5 cores in the slip (EW10-SC57 through -SC61).	1.5	27,181	27,181	27,181	36,716	36,716	40,730	40,730	Open water
Slip 27 Channel	27,685	27,685	27,685	28,792	28,792	29,346	29,346	Average of 2 cores in or near the slip (EW10-SC30 and EW10-SC27).	1.5	41,527	41,527	41,527	43,188	43,188	44,019	44,019	Open water
T-25 Nearshore	4,006	4,006	4,006	4,167	4,167	4,247	4,247	Assume average of 3 cores near area (EW10-SC24, S49, and S50).	1.5	6,010	6,010	6,010	6,250	6,250	6,370	6,370	Open water
T-30 Nearshore	21,381	21,381	21,381	22,236	22,236	22,664	22,664	Average of 4 cores in area (EW10-SC48, EW10-SC50, EW-160, and S45).	1.5	32,071	32,071	32,071	33,354	33,354	33,995	33,995	Open water
T-46 Offshore	n/a	n/a	n/a	3,601	3,601	3,670	3,670	Based on core S30 in the remediation area within T-46.	1.5	n/a	n/a	n/a	5,401	5,401	5,505	5,505	Open water
Shallow Main Body – North	57,033	57,033	66,887	68,655	68,655	88,051	88,051	TIN (CAD)	1.5	85,550	85,550	100,331	102,983	102,983	132,077	132,077	Open water
Shallow Main Body – South	27,375	27,375	36,536	39,830	39,830	44,554	44,554	TIN (CAD)	1.5	41,063	41,063	54,804	59,745	59,745	66,831	66,831	Open water
Sill Reach – West Seattle Bridge	n/a	n/a	11,101	n/a	12,910	n/a	13,158	Average of 2 cores in area (EW10-SC3 and -SC4)	1.5	n/a	n/a	16,651	n/a	19,365	n/a	19,737	Restricted Access
Sill Reach – Low Bridges	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Junction Reach	n/a	n/a	n/a	3,141	3,141	3,201	3,201	Site-wide average dredge depth (no cores in the area).	1.5	n/a	n/a	n/a	4,711	4,711	4,802	4,802	Open water
Former Pier 24 Piling Field	8,873	8,873	14,020	8,873	14,581	8,873	14,861	Estimate 5 feet of removal for capping (Alternatives 1 and 2); Average of 3 adjacent cores (EW10-SC6, -SC8, and -SC9) (Alternative 3).	1.5	13,310	13,310	21,030	13,310	21,871	13,310	22,292	Open water
Mound Area and Slip 27	48,400	48,400	48,400	48,931	48,931	48,931	48,931	5 feet of partial dredging depth plus additional volume to accommodate a 3H:1V slope from the navigation channel.	1.5	72,600	72,600	72,600	73,397	73,397	73,397	73,397	Open water
Coast Guard Nearshore	20,167	20,167	20,167	20,167	20,167	20,167	20,167	5 feet of partial dredging depth estimated	1.5	30,250	30,250	30,250	30,250	30,250	30,250	30,250	Open water
Communication Cable Crossing	16,392	23,232	23,232	23,232	23,232	23,232	23,232	3 feet of removal estimated (Alternatives 2 and 3). Adjustment made in CAD for partial dredging and ENR-nav and ENR-nav areas (Alternative 1).	1.5	24,588	34,848	34,848	34,848	34,848	34,848	34,848	Open water
Subtotal	**542,080**	**601,475**	**636,737**	**671,928**	**690,545**	**718,093**	**737,239**			**813,120**	**902,212**	**955,106**	**1,007,892**	**1,035,818**	**1,077,140**	**1,105,858**	

CMA	Underpier Options A & B	Underpier Options C & C+	Underpier Options D & E, RAL Set including 12 mg/kg OC	Underpier Options D & E, RAL Set including 7.5 mg/kg OC	Underpier Options D & E, RAL Set including 5.0 mg/kg OC	Method for Calculating Neatline Volume	Constructability Factor	Underpier Options A & B	Underpier Options C & C+	Underpier Options D & E, RAL Set including 12 mg/kg OC	Underpier Options D & E, RAL Set including 7.5 mg/kg OC	Underpier Options D & E, RAL Set including 5.0 mg/kg OC	Dredging Designation
Underpier CMA													
Underpier	n/a	7,016	43,940	46,216	48,816	Estimated from underpier cross sections	1.0	n/a	7,016	43,940	46,216	48,816	Underpier
Subtotal	**n/a**	**7,016**	**43,940**	**46,216**	**48,816**			**n/a**	**7,016**	**43,940**	**46,216**	**48,816**	

Notes:

a. Neatline dredge volume represents the idealized dredge prism to the base of contamination without considering constructability factors (see footnote b). Underpier technology options A and B do not include removal. Underpier technology options D and E have the same removal volume and are therefore shown together.

b. The constructability factor accounts for additional dredge volume required to perform dredging in practice, for overdredge depth/volume required to construct stable side-slopes or remove slough material, and for additional volume to design elevation-based dredge prisms. The constructability factor is estimated to be 1.5 for open-water areas. The constructabilty factor is estimated to be 1.0 in underpier areas because dredging is bound by riprap surfaces in these areas.

CAD - computer-aided drafting
CMA - Construction Management Area
cy - cubic yard
mg/kg - milligram per kilogram
n/a - not applicable
OC - organic-carbon normalized
PCB - polychlorinated biphenyl
RAL - remedial action level
TIN - triangular irregular network

Table 2
Removal Volumes for Alternatives

Alternative	Areas			Average Neatline Dredge Depth (feet)	Neatline Volume (cubic yards)	Total Dredge Volume[a]	
	Total Sediment Area (acres)	Remediation Area (acres)	Removal or Partial Removal Area (acres)			Unrounded Dredge Volume (cubic yards)	***Rounded Dredge Volume (cubic yards)***
1A(12)	157	121	97	3.4	542,080	813,120	***810,000***
1B(12)	157	121	97	3.4	542,080	813,120	***810,000***
1C+(12)	157	121	99	3.4	549,096	820,135	***820,000***
2A(12)	157	121	106	3.5	601,475	902,212	***900,000***
2B(12)	157	121	106	3.5	601,475	902,212	***900,000***
2C(12)	157	121	108	3.5	608,491	909,228	***910,000***
2C+(12)	157	121	108	3.5	608,491	909,228	***910,000***
3B(12)	157	121	108	3.7	636,737	955,106	***960,000***
3C+(12)	157	121	110	3.6	643,753	962,121	***960,000***
3D(12)	157	121	118	3.6	680,677	999,046	***1,000,000***
2C+(7.5)	157	132	118	3.6	678,944	1,014,908	***1,010,000***
3C+(7.5)	157	132	120	3.6	697,561	1,042,834	***1,040,000***
3E(7.5)	157	132	131	3.5	736,761	1,082,034	***1,080,000***
2C+(5.0)	157	140	126	3.6	725,109	1,084,155	***1,080,000***
3D(5.0)	157	140	139	3.5	786,055	1,154,675	***1,150,000***
3E(5.0)	157	140	139	3.5	786,055	1,154,675	***1,150,000***

Notes:

a. Total dredge volume is equal to neatline volume times the constructability factor of 1.5 to account for dredge prism design, overdredge, side-slopes, slump material, sedimentation that occurs before remedy implementation, and dredge prism uncertainty.

Bold/italic - Total dredge volumes used in Sections 8, 9, and 10 of Feasibility Study.

Table 3
Remediation Areas and Placement Volumes By Technology Areas

Remedial Technology	Remediation Areas For Alternatives (acres)															
	1A(12)	1B(12)	1C+(12)	2A(12)	2B(12)	2C(12)	2C+(12)	3B(12)	3C+(12)	3D(12)	2C+(7.5)	3C+(7.5)	3E(7.5)	2C+(5.0)	3D(5.0)	3E(5.0)
Open-water																
Removal	73.2	73.2	73.2	87.9	87.9	87.9	87.9	92.3	92.3	92.3	97.7	102.2	102.1	105.2	109.6	109.6
Removal to the Extent Practicable and Backfill (Communication Cable Crossing Area)	3.3	3.3	3.3	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Removal and Backfill to Existing Contours	0.7	0.7	0.7	0.7	0.7	0.7	0.7	3.5	3.5	3.5	0.8	3.8	3.8	0.8	3.8	3.8
Partial Removal and Cap	12.8	12.8	12.8	12.8	12.8	12.8	12.8	7.3	7.3	7.3	12.8	7.3	7.3	12.8	7.3	7.3
Partial Removal and ENR-nav	7.4	7.4	7.4													
ENR-sill	2.4	2.9	2.9	2.4	2.9	2.9	2.9	1.2	1.2	1.2	3.2	1.3	1.3	3.2	1.3	1.3
ENR-nav	8.7	8.7	8.7													
MNR	0.5			0.5												
Interior Unremediated Area [a]	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	15.1	15.1	15.1	9.2	9.2	9.2
Exterior Unremediated	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	8.5	8.5	8.5	6.9	6.9	6.9
Subtotal	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**	**143**
Underpier																
Hydraulic Dredging followed by In situ Treatment			1.9				1.9		1.9		1.9	1.9	12.7	1.9		13.4
Hydraulic Dredging						1.9				12.1					13.4	
In situ Treatment		12.1	10.1		12.1	10.1	10.1	12.1	10.1		10.7	10.7		11.5		
MNR	12.1			12.1												
Underpier Unremediated	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1.9	1.8	1.8	1.1	1.1	1.1
Subtotal	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**	**14.5**
Total	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**	**157**

Table 3
Remediation Areas and Placement Volumes By Technology Areas

Remedial Technology	Placement Type	Placement Thickness (feet)	Placement Volumes (cubic yards)															
			1A(12)	**1B(12)**	**1C+(12)**	**2A(12)**	**2B(12)**	**2C(12)**	**2C+(12)**	**3B(12)**	**3C+(12)**	**3D(12)**	**2C+(7.5)**	**3C+(7.5)**	**3E(7.5)**	**2C+(5.0)**	**3D(5.0)**	**3E(5.0)**
Open-water																		
Removal	RMC	0.75	88,580	88,580	88,580	106,341	106,341	106,341	106,341	111,735	111,735	111,735	118,258	123,607	123,592	127,233	132,566	132,566
Removal to the Extent Practicable and Backfill (Communication Cable Crossing Area)	Backfill	4.5	23,931	23,931	23,931	34,593	34,593	34,593	34,593	34,593	34,593	34,593	34,593	34,593	34,593	34,593	34,593	34,593
Removal and Backfill to Existing Contours	Backfill	Average Total Dredge Depth	5,980	5,980	5,914	6,091	6,091	6,029	6,029	30,938	30,615	29,524	7,291	33,256	31,669	7,329	31,819	31,819
Partial Removal and Cap	Armor	1.5	30,931	30,931	30,931	30,931	30,931	30,931	30,931	17,654	17,654	17,654	31,062	17,786	17,786	31,062	17,786	17,786
	Filter	1	20,620	20,620	20,620	20,620	20,620	20,620	20,620	11,769	11,769	11,769	20,708	11,857	11,857	20,708	11,857	11,857
	Isolation	2.5	51,551	51,551	51,551	51,551	51,551	51,551	51,551	29,423	29,423	29,423	51,770	29,643	29,643	51,770	29,643	29,643
Partial Removal and ENR-nav	ENR-nav	1.5	17,980	17,980	17,980													
ENR-sill	ENR-sill	0.75	2,873	3,478	3,478	2,873	3,478	3,478	3,478	1,421	1,421	1,421	3,861	1,562	1,562	3,861	1,562	1,562
ENR-nav	ENR-nav	1.5	21,097	21,097	21,097													
MNR	n/a	n/a																
Interior Unremediated Area[a]	RMC	0.75	22,971	22,971	22,971	22,971	22,971	22,971	22,971	22,971	22,971	22,971	18,223	18,223	18,223	11,091	11,091	11,091
Exterior Unremediated	n/a	n/a																
Subtotal			**286,512**	**287,117**	**287,051**	**275,971**	**276,576**	**276,513**	**276,513**	**260,506**	**260,183**	**259,092**	**285,766**	**270,526**	**268,925**	**287,647**	**270,916**	**270,916**
Underpier																		
Hydraulic Dredging followed by In situ Treatment	In situ Treatment	0.25			782				782		782		782	782	5,113	782		5,401
Hydraulic Dredging	n/a	0																
In situ Treatment	In situ Treatment	0.25		4,867	4,085		4,867	4,085	4,085	4,867	4,085		4,331	4,331		4,619		
MNR	n/a	n/a																
Underpier Unremediated	n/a	n/a																
Subtotal			**0**	**4,867**	**4,867**	**0**	**4,867**	**4,085**	**4,867**	**4,867**	**4,867**	**0**	**5,113**	**5,113**	**5,113**	**5,401**	**0**	**5,401**
Total			**286,512**	**291,984**	**291,918**	**275,971**	**281,443**	**280,598**	**281,380**	**265,373**	**265,049**	**259,092**	**290,879**	**275,640**	**274,038**	**293,048**	**270,916**	**276,318**

Notes:

a. Interior unremediated areas are sediment areas with no remedial action level exceedances, but which are surrounded by areas to be remediated.

ENR-nav - enhanced natural recovery applied in the navigation channel and deep-draft berthing areas

ENR-sill - enhanced natural recovery used in the Sill Reach

MNR - monitored natural recovery

n/a - not applicable

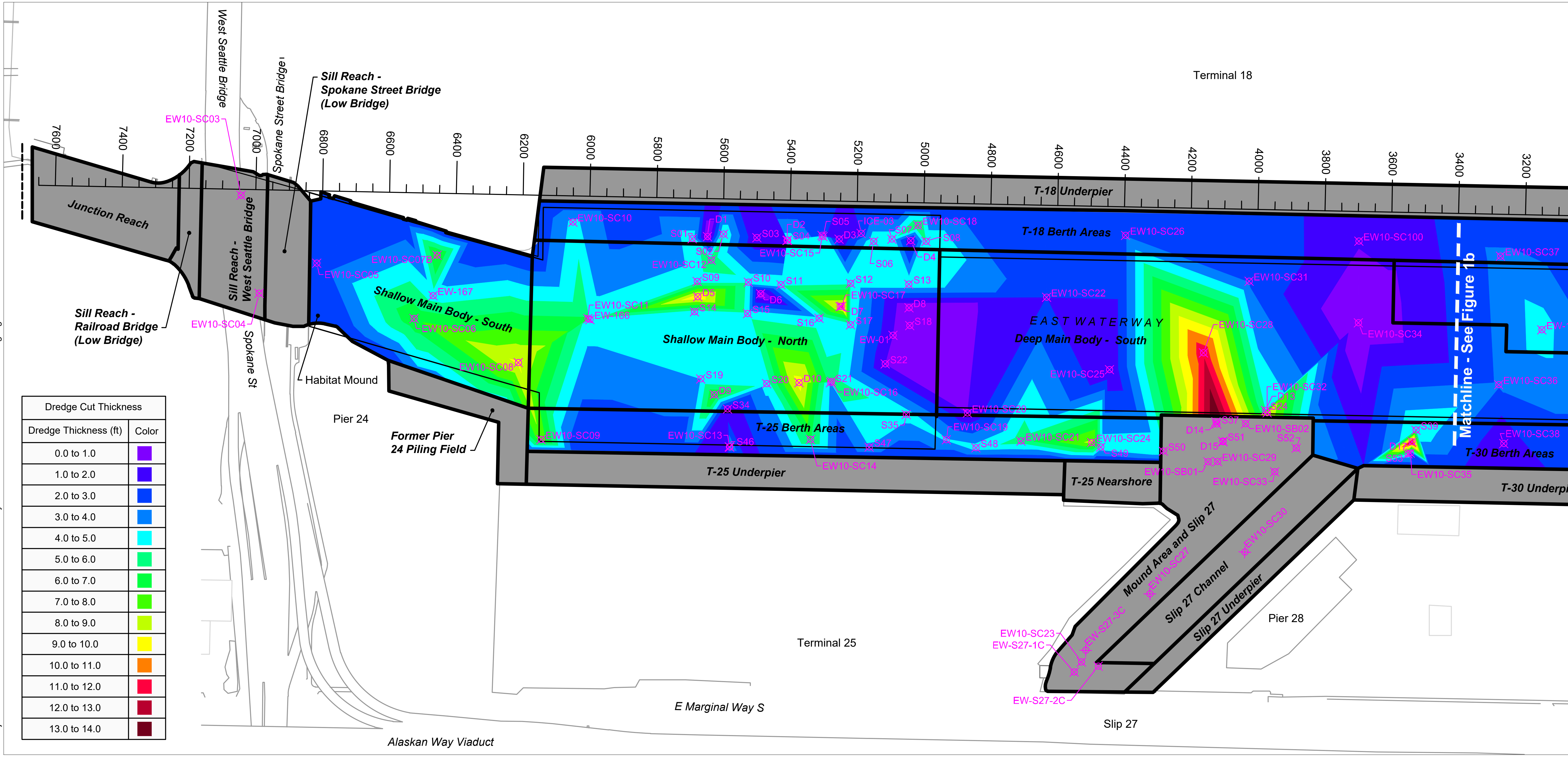
RMC - residuals management cover

Table 4
Placement Volumes for Alternatives

Alternative (PCB RAL mg/kg OC)	Placement Volume by Remedial Technology (cy)								Total Placement Volume	
	RMC	Backfill	ENR-sill	ENR-nav	Capping			In situ Treatment	Unrounded Placement Volume (cy)	*Rounded Placement Volume (cy)*
					Armor	Filter	Isolation			
1A(12)	111,551	29,911	2,873	39,076	30,931	20,620	51,551	0	286,512	***290,000***
1B(12)	111,551	29,911	3,478	39,076	30,931	20,620	51,551	4,867	291,984	***290,000***
1C+(12)	111,551	29,845	3,478	39,076	30,931	20,620	51,551	4,867	291,918	***290,000***
2A(12)	129,312	40,685	2,873	0	30,931	20,620	51,551	0	275,971	***280,000***
2B(12)	129,312	40,685	3,478	0	30,931	20,620	51,551	4,867	281,443	***280,000***
2C(12)	129,312	40,622	3,478	0	30,931	20,620	51,551	4,085	280,598	***280,000***
2C+(12)	129,312	40,622	3,478	0	30,931	20,620	51,551	4,867	281,380	***280,000***
3B(12)	134,706	65,531	1,421	0	17,654	11,769	29,423	4,867	265,373	***270,000***
3C+(12)	134,706	65,208	1,421	0	17,654	11,769	29,423	4,867	265,049	***270,000***
3D(12)	134,706	64,118	1,421	0	17,654	11,769	29,423	0	259,092	***260,000***
2C+(7.5)	136,480	41,884	3,861	0	31,062	20,708	51,770	5,113	290,879	***290,000***
3C+(7.5)	141,830	67,849	1,562	0	17,786	11,857	29,643	5,113	275,640	***280,000***
3E(7.5)	141,814	66,262	1,562	0	17,786	11,857	29,643	5,113	274,038	***270,000***
2C+(5.0)	138,323	41,922	3,861	0	31,062	20,708	51,770	5,401	293,048	***290,000***
3D(5.0)	143,656	66,413	1,562	0	17,786	11,857	29,643	0	270,916	***270,000***
3E(5.0)	143,656	66,413	1,562	0	17,786	11,857	29,643	5,401	276,318	***280,000***

Notes:
cy - cubic yards
ENR-nav - enhanced natural recovery applied in the navigation channel and deep-draft berthing areas
ENR-sill - enhanced natural recovery used in the Sill Reach
mg/kg - milligram per kilogram
OC - organic-carbon normalized
PCB - polychlorinated biphenyl
RAL - remedial action level
RMC - residuals management cover

FIGURES



Dredge Cut Thickness

Dredge Thickness (ft)	Color
0.0 to 1.0	
1.0 to 2.0	
2.0 to 3.0	
3.0 to 4.0	
4.0 to 5.0	
5.0 to 6.0	
6.0 to 7.0	
7.0 to 8.0	
8.0 to 9.0	
9.0 to 10.0	
10.0 to 11.0	
11.0 to 12.0	
12.0 to 13.0	
13.0 to 14.0	

K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 1a

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HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:

1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

East Waterway Study Boundary

Construction Management Areas

CMA Areas not included in TIN

EW-S27-2C Sediment Core

0 300 Scale in Feet

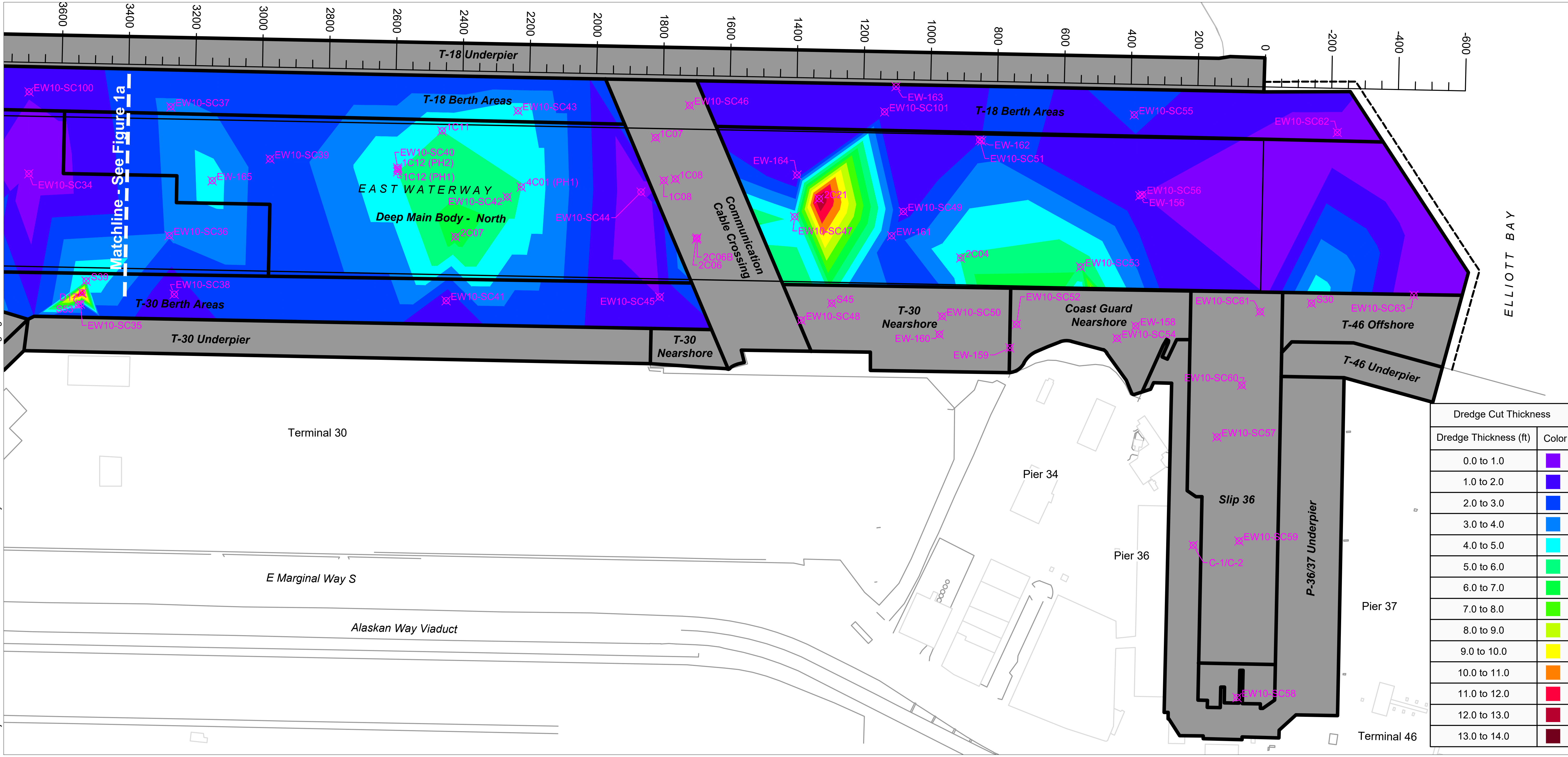
N

Figure 1a

Full Removal TIN Neatline Isopach (All RALs, PCBs = 12 mg/kg OC)

Feasibility Study - Appendix F

East Waterway Study Area



Dredge Cut Thickness	
Dredge Thickness (ft)	Color
0.0 to 1.0	
1.0 to 2.0	
2.0 to 3.0	
3.0 to 4.0	
4.0 to 5.0	
5.0 to 6.0	
6.0 to 7.0	
7.0 to 8.0	
8.0 to 9.0	
9.0 to 10.0	
10.0 to 11.0	
11.0 to 12.0	
12.0 to 13.0	
13.0 to 14.0	

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:
1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

East Waterway Study Boundary

Construction Management Areas

CMA Areas not included in TIN

EW-S27-2C Sediment Core

0 300 Scale in Feet

N

Figure 1b

Full Removal TIN Neatline Isopach (All RALs, PCBs = 12 mg/kg OC)

Feasibility Study - Appendix F

East Waterway Study Area

K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 1b

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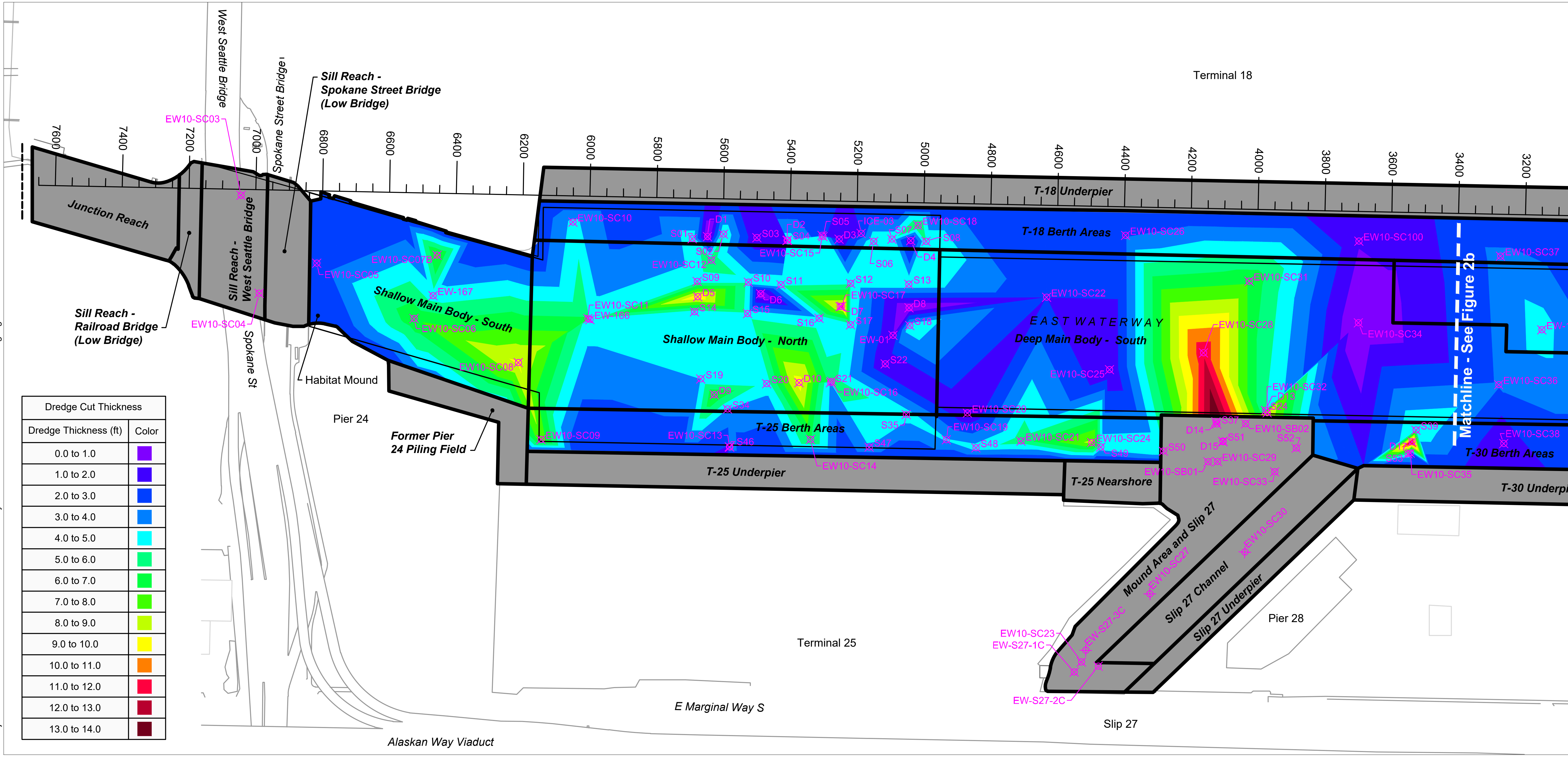


Dredge Cut Thickness	
Dredge Thickness (ft)	Color
0.0 to 1.0	
1.0 to 2.0	
2.0 to 3.0	
3.0 to 4.0	
4.0 to 5.0	
5.0 to 6.0	
6.0 to 7.0	
7.0 to 8.0	
8.0 to 9.0	
9.0 to 10.0	
10.0 to 11.0	
11.0 to 12.0	
12.0 to 13.0	
13.0 to 14.0	

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:
1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

East Waterway Study Boundary

Construction Management Areas

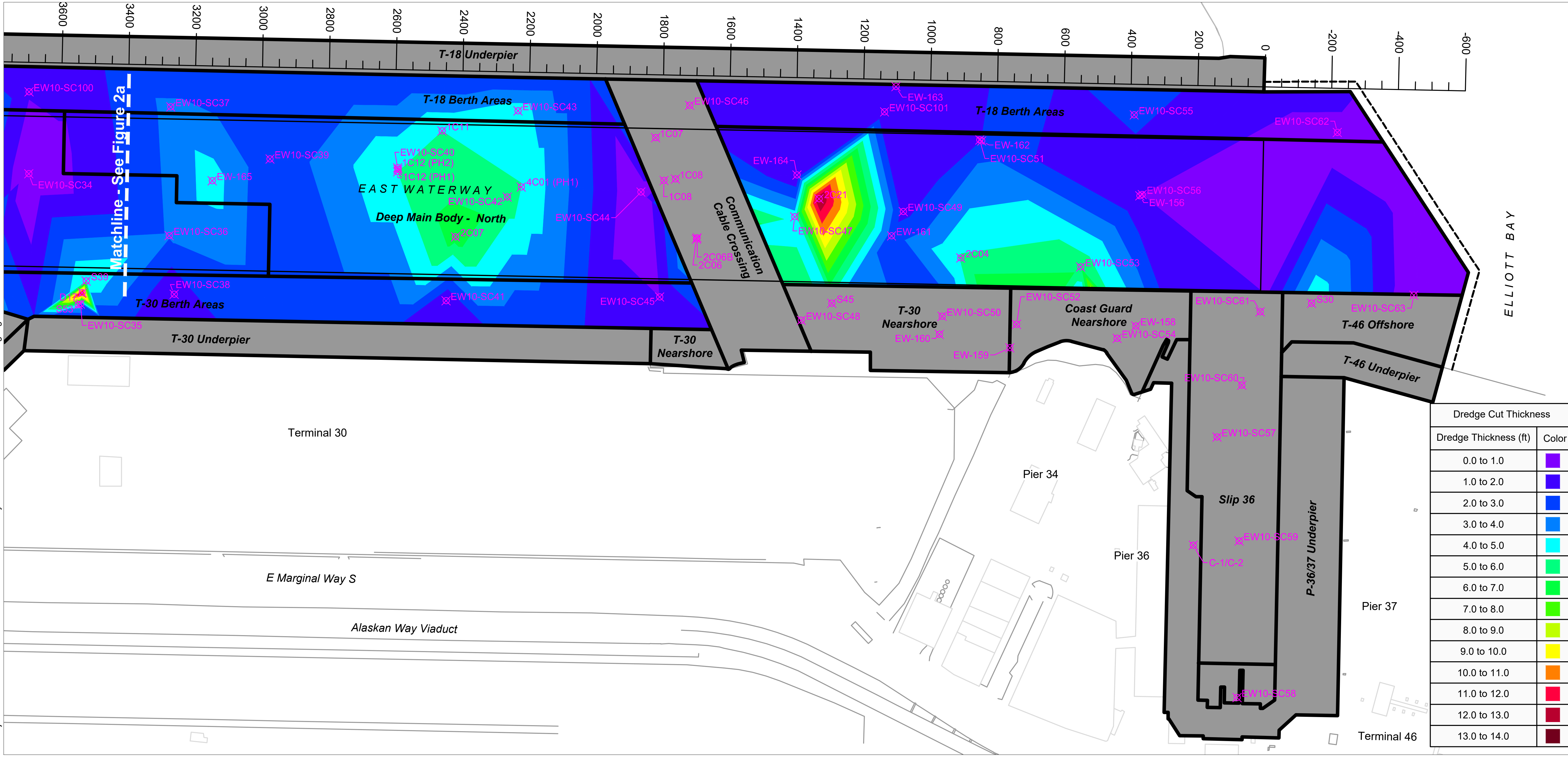
CMA Areas not included in TIN

EW-S27-2C Sediment Core

0 300
Scale in Feet

N

Figure 2a
Full Removal TIN Neatline Isopach (All RALs, PCBs = 7.5 mg/kg OC)
Feasibility Study - Appendix F
East Waterway Study Area



HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:

1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

- East Waterway Study Boundary
- Construction Management Areas
- CMA Areas not included in TIN
- EW-S27-2C Sediment Core

0 300
Scale in Feet

N

Figure 2b
Full Removal TIN Neatline Isopach (All RALs, PCBs = 7.5 mg/kg OC)
Feasibility Study - Appendix F
East Waterway Study Area

K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 2b

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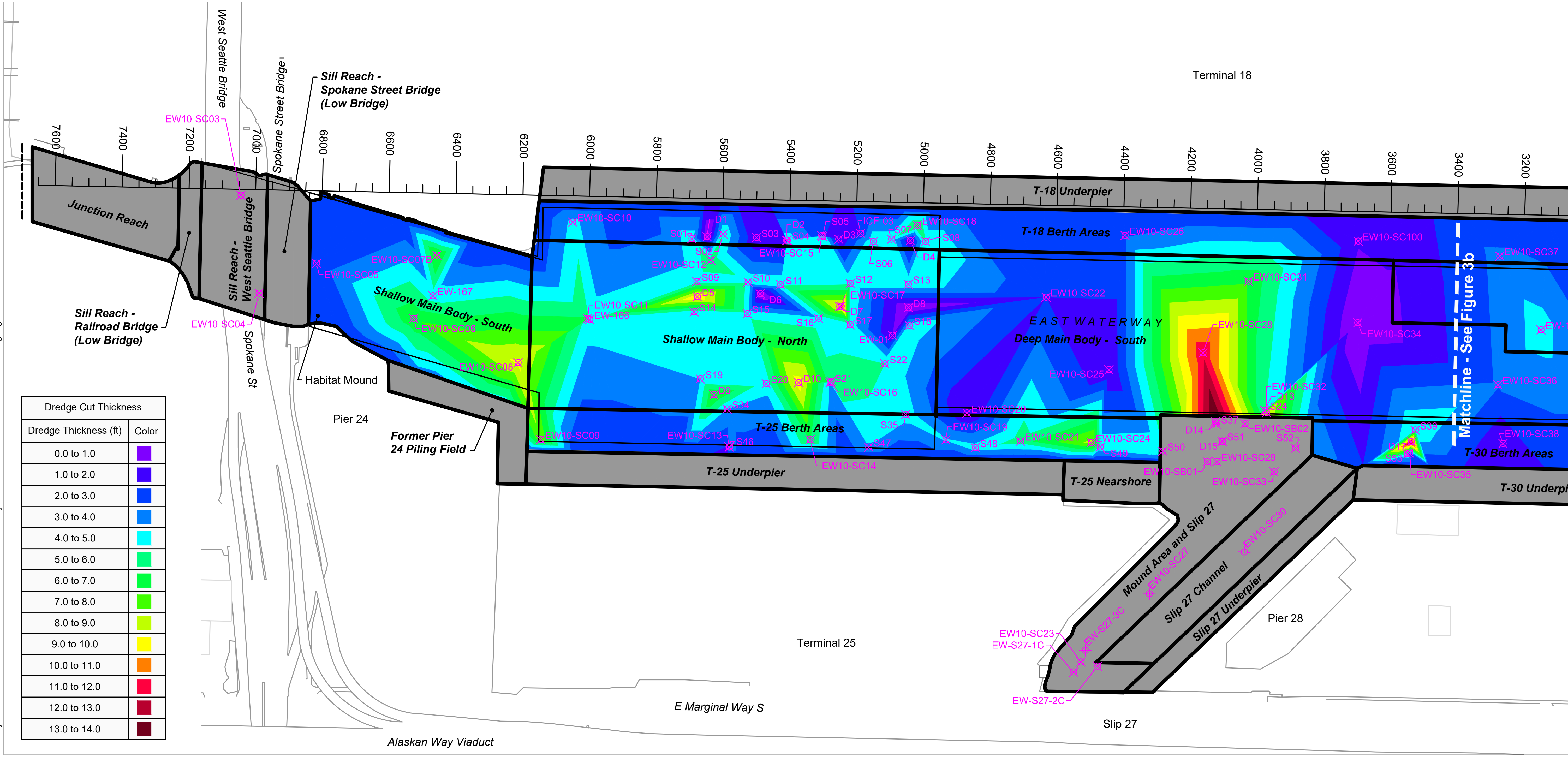

Dredge Cut Thickness	
Dredge Thickness (ft)	Color
0.0 to 1.0	
1.0 to 2.0	
2.0 to 3.0	
3.0 to 4.0	
4.0 to 5.0	
5.0 to 6.0	
6.0 to 7.0	
7.0 to 8.0	
8.0 to 9.0	
9.0 to 10.0	
10.0 to 11.0	
11.0 to 12.0	
12.0 to 13.0	
13.0 to 14.0	

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:
1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:
- East Waterway Study Boundary
- Construction Management Areas
- CMA Areas not included in TIN
- EW-S27-2C Sediment Core

0 300 Scale in Feet

Figure 3a
Full Removal TIN Neatline Isopach (All RALs, PCBs = 5.0 mg/kg OC)
Feasibility Study - Appendix F
East Waterway Study Area

K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 3a
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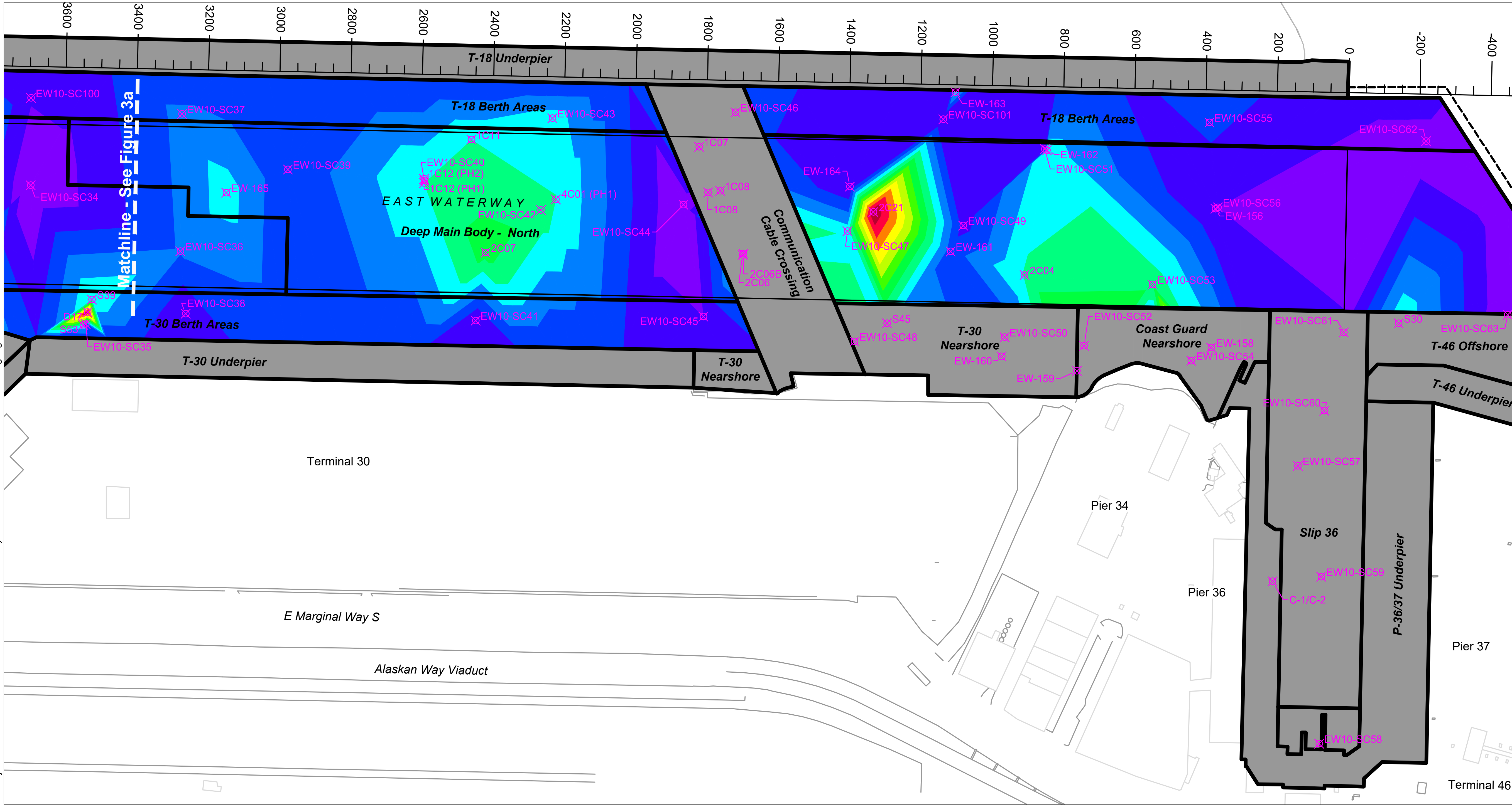

Dredge Cut Thickness	
Dredge Thickness (ft)	Color
0.0 to 1.0	
1.0 to 2.0	
2.0 to 3.0	
3.0 to 4.0	
4.0 to 5.0	
5.0 to 6.0	
6.0 to 7.0	
7.0 to 8.0	
8.0 to 9.0	
9.0 to 10.0	
10.0 to 11.0	
11.0 to 12.0	
12.0 to 13.0	
13.0 to 14.0	

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:
1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

East Waterway Study Boundary

Construction Management Areas

CMA Areas not included in TIN

EW-S27-2C Sediment Core

0 300 Scale in Feet

N

Figure 3b
Full Removal TIN Neatline Isopach (All RALs, PCBs = 5.0 mg/kg OC)
Feasibility Study - Appendix F
East Waterway Study Area

K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 3b

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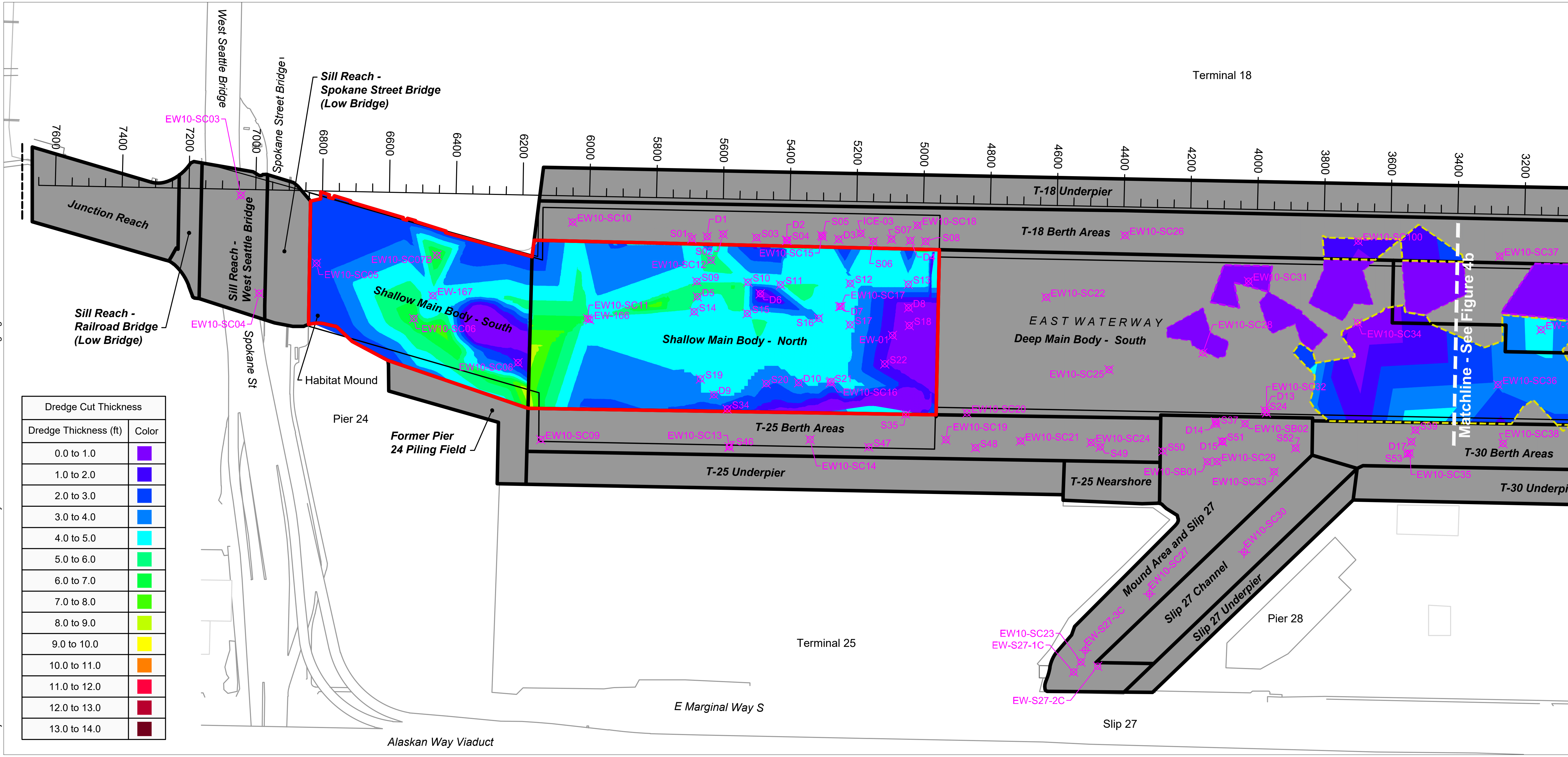


K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 4a

Aug 07, 2017 10:44am tgriga

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:
1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

East Waterway Study Boundary

Construction Management Areas

EW-S27-2C Sediment Core

CMA Areas not included in Partial Removal TIN

Partial Removal and Capping Area (Removal Depth Shown; Applicable to Open-water Technology Groups 1 and 2)

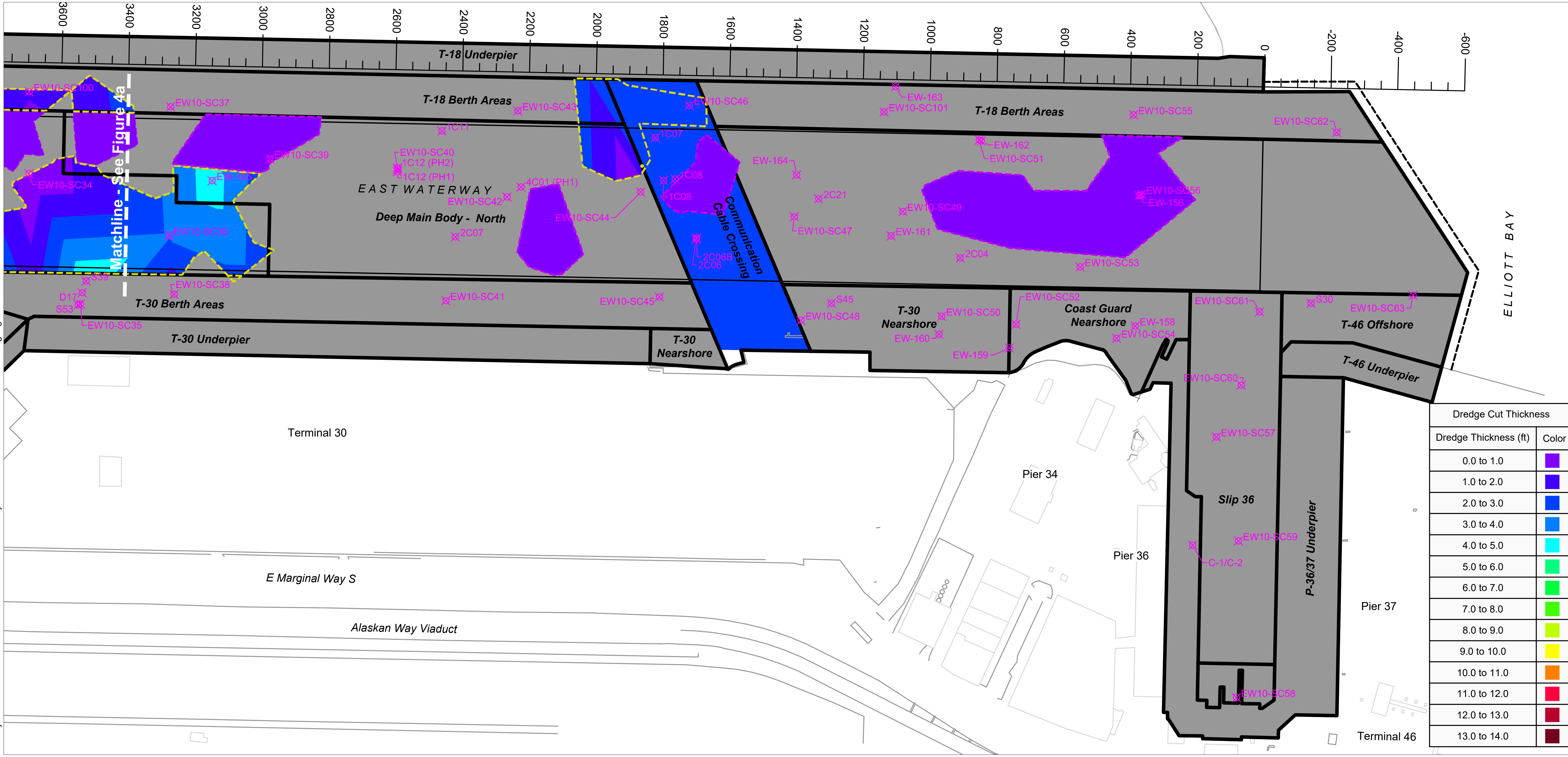
ENR-nav Area (No Removal; Applicable to Open-water Technology Group 1)

Partial Removal and ENR-nav Area (Removal Depth Shown; Applicable to Open-water Technology Group 1)

0 300
Scale in Feet

N

Figure 4a
Partial Removal TIN Neatline Isopach
Feasibility Study - Appendix F
East Waterway Study Area



Dredge Cut Thickness	
Dredge Thickness (ft)	Color
0.0 to 1.0	
1.0 to 2.0	
2.0 to 3.0	
3.0 to 4.0	
4.0 to 5.0	
5.0 to 6.0	
6.0 to 7.0	
7.0 to 8.0	
8.0 to 9.0	
9.0 to 10.0	
10.0 to 11.0	
11.0 to 12.0	
12.0 to 13.0	
13.0 to 14.0	

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

NOTES:

1. Previously established station locations for the East Waterway are shown along the western shoreline for reference.
2. TIN = Triangulated Irregular Network

LEGEND:

- East Waterway Study Boundary
- Construction Management Areas
- EW-S27-2C Sediment Core
- CMA Areas not included in Partial Removal TIN
- ENR-nav Area (No Removal; Applicable to Open-water Technology Group 1)
- Partial Removal and ENR-nav Area (Removal Depth Shown; Applicable to Open-water Technology Group 1)

K:\Projects\0003-Port of Seattle\POS SD-101 East Waterway SRI-FS\0003-RP-020-Iso-June 2016.dwg Figure 4b

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Figure 4b
Partial Removal TIN Neatline Isopach
Feasibility Study - Appendix F
East Waterway Study Area