GRAYS HARBOR RAIL TERMINAL LLC
INTERTIDAL TECHNICAL REPORT

March 2014

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1. Introduction

This technical report describes the existing conditions of intertidal habitat within or adjacent to the Grays Harbor Rail Terminal Project (Project). The Project and general intertidal habitat conditions within Grays Harbor are described. Then, the methods and results of habitat mapping and invertebrate monitoring are described. Finally, a discussion of potential Project impacts to intertidal habitat and mitigation options is provided.

2. Project Description

Grays Harbor Rail Terminal LLC (GHRT) is proposing a bulk liquids rail logistics facility at the Port of Grays Harbor Terminal 3 (T3) property. The facility will accommodate the receipt for export of not more than 45,000 barrels per day on average of various liquid bulk materials, specifically, various types of crude oil and condensates.

T3 is a 150 acre industrial site and includes an existing 600-foot- long concrete shipping terminal. The Port of Grays Harbor currently leases approximately 25 acres of the T3 site to a private tenant (Willis Enterprises), which utilizes the property for storing and sorting logs, and operating a wood chipping and processing facility. The tenant utilizes the existing wharf for product loading on to barges for export. The remaining area of the property (a former mill site) is occupied by 4 metal buildings and a rail spur line but is otherwise currently vacant.

The liquid bulk materials would be delivered to the proposed facility via unit trains in fully contained liquid bulk rail cars, unloaded into on-site storage tanks, and then loaded onto barges or other marine vessels for delivery to refineries.

The general layout of the proposed rail and off-loading facilities includes four 20-car yard tracks and two 20-car off-loading tracks (120 rail cars total). In addition, a “run-around” track would be used to reposition the locomotive engines and could also be used to hold cars awaiting maintenance. The off-loading spots would be equipped with permanent rack access structures where each rack structure would support connections for a maximum of 40 rail cars (20 spots on each side of a rack). The off-loading spots and central header would be located within secondary containment. The rack structures consist of elevated steel walkways with extendable access platforms used to access the tops of the rail cars. Off-loading would occur via 4-inch dry break connections, hoses, valves, and risers connecting the bottom rail car couplers to a central piping header. The rail cars would be off-loaded by gravity feed into the central header.

The liquid bulk materials would be stored in approximately six to eight above-ground storage tanks with secondary containment and internal floating roofs until a marine vessel (ship or barge) arrives. All tanks will be located outside the Shoreline District. The total combined tank storage would be approximately 800,000 – 1,000,000 barrels. Construction of multiple storage tanks would allow the facility to accommodate interruptions in vessel schedules as well as changes in delivery volumes,

and would allow the facility to maintain consistent operations. Vessel calls are anticipated by barge and Panamax vessels occurring approximately 3-4 times per month.

As noted above, T3 includes an existing 600-foot-long concrete shipping terminal. There are currently four mooring dolphins (three downstream/one upstream) off the existing concrete wharf. Up to four additional mooring dolphins (two downstream and two upstream) would be constructed to minimize vessel movements during liquid bulk materials transfer. No additional overwater expansion of the wharf is proposed. The existing trestle (supporting the Willis conveyor) and the wharf can accommodate the liquid bulk materials pipe rack needed to transfer the materials from the tanks to the vessels. Stormwater collection, drainage improvements, and spill containment measures would be added to the existing wharf but no structural modifications are necessary.

To facilitate operations at the Grays Harbor Rail Terminal, the Puget Sound and Pacific Railroad would be permitting and supervising construction of an industrial lead track extension of their main line railroad system. This industrial lead track would extend from the current main line rail terminus, just east of Paulson Road, for approximately 1,300 lineal feet to the west. The industrial lead track would allow for the backing of rail cars strings into the project site and provide additional rail car storage for other Port tenants. The identification of the industrial lead track is to account for potential indirect or cumulative environmental impacts for the purposes of the State Environmental Policy Act (SEPA) only and is not a project component of the Grays Harbor Rail Terminal site development permitting.

3. Baseline Conditions

The intertidal zone in the vicinity of the Project includes an open-water shoreline with sand and mud flats, and a salt marsh/ surge plain with a tidal channel. The open-water shoreline is associated with the terminal (Figure 1), and is a gradual sloped sand/ mud flat. The salt marsh and is adjacent to the mainline track, and is the eastern portion of the Bowerman Basin.

Grays Harbor is a large, but relatively shallow, coastal estuary generally separated into outer and inner bay areas that have different physical and biological conditions. The estuary is about 23.3 km long from one point near Aberdeen to its mouth and a maximum of about 22.9 km wide just east of its mouth (Stein and Dennison 1965). The outer bay tends to have moderately high salinities, while the inner bay tends to have relatively low salinities dominated by river flows. Grays Harbor supports substantial biological resources of clams, Dungeness crabs, salmon and eelgrass, particularly in the outer bay. The inner bay has limited clam, crab, and eelgrass resources, but is a juvenile rearing area and migratory corridor for most of the salmon stocks produced in the bay's various watersheds.

Grays Harbor's shallow nature results in substantial flushing during tidal exchanges as and has tide flats exposed by low tides. At mean lower low water (MLLW) 58 percent of the bay is mudflat (Loehr and Collias 1981). Grays Harbor had a decrease of nearly 3,500 hectares (ha) of tidal flats between 1883 and 1956. However, there has been an increase of about 410 ha of area below the extreme low water level due to dredging of the navigation channel.

Intertidal invertebrates in Grays Harbor provide prey for juvenile salmonids and other estuarine fishes, as well as migratory shore birds. Albright and Bouthillette (1982) sampled benthic macroinvertebrates at several locations within Grays Harbor and found that the species diversity of benthic invertebrates increased from the inner harbor to the outer harbor and from higher to lower tidal elevations. Invertebrates that were found to be characteristic of the inner harbor included *Manayunkia aestuarina*, *Corophium spinicorne*, *C. salmonis*, *C. brevis*, *Gnorimosphaeroma luteum*, *Streblospio benedicti*, *Macoma balthica*, and unidentified oligochaetes. Intertidal invertebrate surveys recently conducted by WSDOT (2009) found abundant polychaetes, nemerteans, and amphipods along the Port of Grays Harbor intertidal zone, and in a reference site on Rennie Island.

Grays Harbor provides nursery habitat for juvenile stages of Dungeness crab, Cancer magister (Armstrong et al. 2003). Armstrong et al. (1982) found a generally decreasing density of crabs with increasing distance from the harbor mouth and decreasing salinity. Crabs were most abundant in spring and least abundant in summer. During late spring or early summer, vast numbers of crab megalopae (post-larvae) reach the estuary and settle on intertidal flats and in subtidal channels (Armstrong et al. 1995). These reports indicate that the juvenile Dungeness crab nursery areas within Grays Harbor are generally in the outer or western portion of the bay.

A variety of native and introduced clams are present in the mudflats of Grays Harbor, with their distribution influenced by the bay's salinity regime. Several reports have focused on the clam resources of Grays Harbor. Herrmann (1972) determined salinities in Grays Harbor are an important factor in determining the distribution of clams within the bay and he mapped the inner boundaries of the major clam species. He found soft-shell clams (*Mya arenaria*) and bent-nose clams (*Macoma nasuta*) to be the most abundant and widespread species. The only clam identified by Albright and Bouthillette (1982) as common in the inner harbor area was the small *Macoma balthica*. Intertidal invertebrate surveys recently conducted by WSDOT (2009) found primarily *M. arenaria* and *M. balthica* along the Port of Grays Harbor intertidal zone, and in a reference site on Rennie Island.

Both native eelgrass (*Zostera marina*) and introduced japanese eelgrass (*Zostera japonica*) occur in Grays Harbor. Dense *Z. marina* beds occur in the inner harbor along the south channel, and at the western ends of Rennie and Moon Islands. *Z. marina* requires light and relatively stable unconsolidated substrata for growth. These conditions are very limited in the inner portion of Grays Harbor, particularly the east end, because of the water's high turbidity and continuous settlement of fine silt (Borde et al. 2003). The distribution of eelgrass is limited by salinity, which tends to be very low during the winter in the eastern portion of Grays Harbor. *Z. japonica* is present in some portions of Grays Harbor, commonly at higher intertidal elevations than the native eelgrass. *Z. japonica* is limited to the middle to lower intertidal zone (Harrison 1982), generally higher than the native eelgrass (*Z. marina*) that grows from the lower intertidal zone to shallow subtidal depths.

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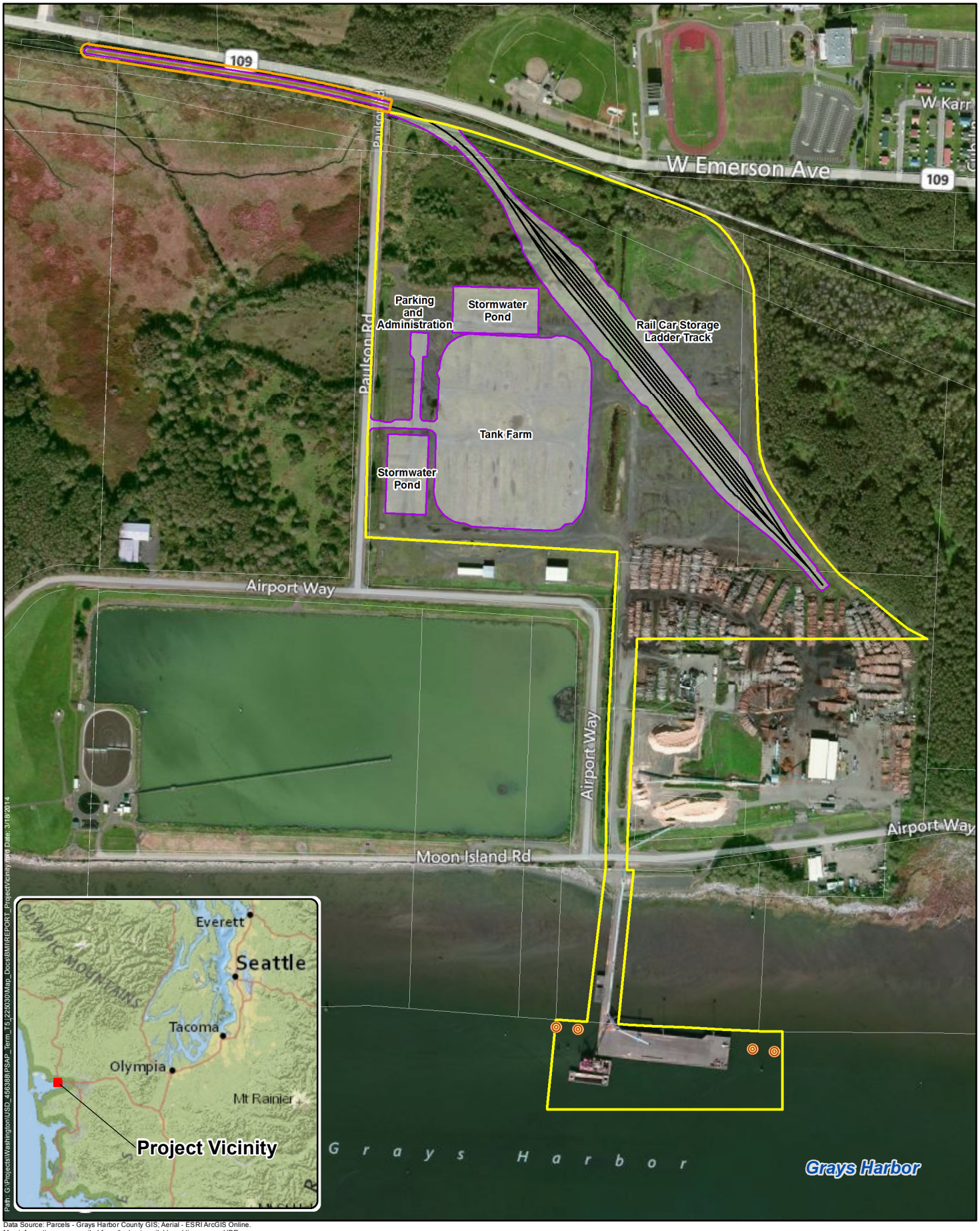

Data Source: Parcels - Grays Harbor County GIS; Aerial - ESRI ArcGIS Online.
Map information was compiled from the best available public sources. HDR does not warrant that the information is accurate or complete.

New Mooring Dolphins
Project Railroad Track
Industrial Lead Railroad Track
Parcel
Detention/Infill Pond, Tank Farm, Rail Car Unloading Tracks
Project Area
Industrial Lead Track

0 125 250 500 Feet

Figure 1 Project Vicinity
Grays Harbor Rail Terminal

Terminal 3 – Port of Grays Harbor, Hoquiam WA
US Development Group LLC

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4. Methodology and Data Sources

In 2012, benthic infaunal communities were quantitatively characterized in the Project Area and a comparable reference reach to the west of the Project Area. In 2014, intertidal benthic habitat was characterized in the sand and mudflats adjacent to the terminal and in the high marsh, adjacent to the mainline extension.

4.1. Sand and Mudflat Habitat Adjacent to Terminal

Intertidal habitat in the Project Area was characterized in March 2014 by making observations along four approximately equally spaced transects (Figure 2). The transects were oriented perpendicular to the shoreline, starting at the shoreline and extending as far waterward as possible, given the low tide and safety limitations. At each transect, observations were made at 20 meter (m) intervals. At each observation point a 0.25 m^2 quadrat was placed on the beach. The following observations were made within each quadrat:

- Percent sediment composition
- Macroalgae and eelgrass presence
- Macroalgae and eelgrass composition and percent cover

Slope will be measured with a clinometer between observation points. Quadrat locations were imported into GIS and mapped on aerial photos with elevation contours. Elevation contours were developed from remotely sensed Lidar data.

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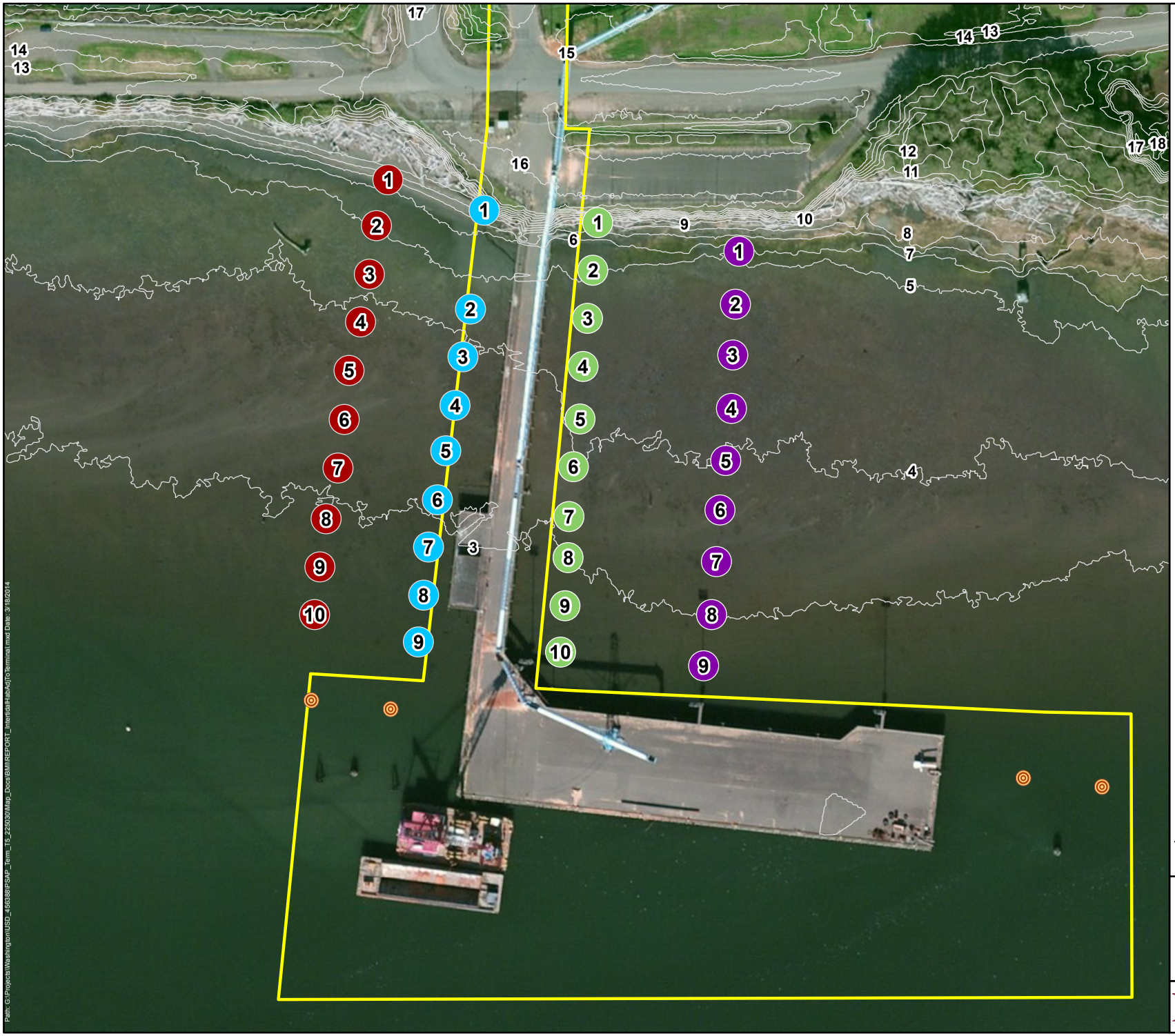

Figure 2
Intertidal Habitat Adjacent to the Terminal

New Mooring Dolphins
1ft Contour
Project Area
Industrial Lead Track

Mudflat Transect
1 2 3 4

N
0 50 100 200
Feet

Terminal 3
Port of Grays Harbor
Hoquiam Washington
US Development Group LLC

HDR

Data Source: Parcels - Grays Harbor County GIS; Aerial - ESRI ArcGIS Online. Map information was compiled from the best available public sources. HDR does not warrant that the information is accurate or complete.

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4.2. High Marsh and Surge Plain Habitat Adjacent to Mainline Extension

The Bowerman Basin Wildlife Refuge (Refuge) is located adjacent to the proposed mainline track extension and State Route 109. Within the Refuge, a mudflat transitions to salt marsh habitat, which transitions to the surge plain. Tidal channels occur in a few locations in the high marsh. The tidal channels are outside of the Project Area. A narrow strip of trees buffer the high marsh against the tow of a historical railroad grade. In March 2014, the high marsh was characterized, in terms of general elevation and plant composition. The distribution of tidal channels was mapped with both aerial photo interpretation and field mapping (Figure 3). The tidal channels were characterized, in terms of their upland extent, bankfull width, and bankfull depth.

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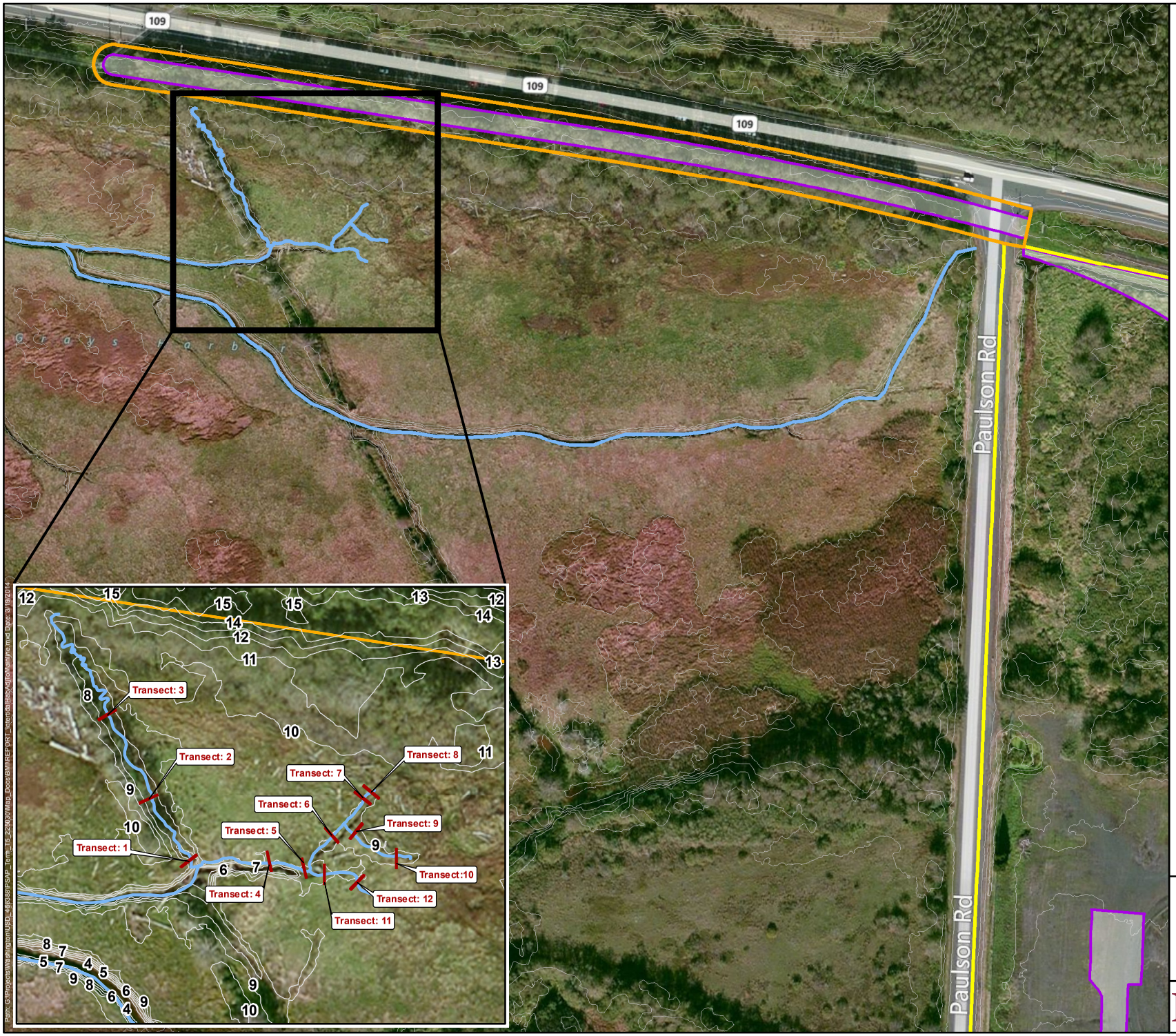

Figure 3
Intertidal Habitat Adjacent to the Mainline Extension

- Transect
- RefugeTidalChannels
- 1ft Contour
- Project Area
- Industrial Lead Track
- Detention/Infill Pond, Tank Farm, Rail Car Unloading Tracks

N

0 50 100 200 Feet

Terminal 3
Port of Grays Harbor
Hoquiam Washington
US Development Group LLC

HDR

Data Source: Parcels - Grays Harbor County GIS; Aerial - ESRI ArcGIS Online. Map information was compiled from the best available public sources. HDR does not warrant that the information is accurate or complete.

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4.3. Benthic Infaunal Survey

In May 2012, HDR conducted an intertidal benthic infaunal survey in the sand and mudflat intertidal zone, with a Before-After-Control-Impact (BACI) monitoring design. The 2012 monitoring was intended established baseline conditions before construction and operation of the proposed Project. Two sample transects in the Project Area were located just west of the Terminal 3 wharf (Figure 4), and are intended to capture any construction or operational impacts from the project. The control reach is located approximately 1.5 km west of the Project Area and 2 corresponding transects were sampled there during the same week as the Project Area reach (Figure 4). The control reach is intended to be relatively similar to the Project Area, but would not be as susceptible to any unforeseen project impacts.

Each reach was sampled according to the general protocol used by the Washington Department of Natural Resources (WDNR). This protocol was used during a recent shoreline development project in Grays Harbor (WSDOT 2009) and Puget Sound (Diether and Berry 2011). At both the impact and control reaches, a tape measure was used to delineate a 50 m transect parallel to the water line at both the mean sea level (MSL) and mean low water (MLW) elevations. This elevation and position along the shoreline was determined with tide tables. The MLW elevation and transect locations was delineated during an outgoing tide, when the water elevation was predicted to be at that elevation. Ten locations were randomly selected along each 50 m transect. At each location, a 0.25 m2 quadrat was placed next to the tape measure. Within the quadrat, seagrasses, macroalgae, and invertebrates that were visible on the beach surface were identified and enumerated. Sediment composition, percent vegetative cover, and pore water salinity were measured. One 10 cm (diameter) x 15 cm (depth) core sample was taken within each quadrat. Each core sample was processed through a 1.0-mm mesh sieve using in-situ seawater. The in situ seawater was pre-sieved with a 0.25-mm mesh sieve to remove any animals in the target size fraction (i.e. >1.0-mm). The material retained on each sieve (i.e. each replicate sample) was transferred into a wide-mouth 500 ml polypropylene jar, labeled, and preserved with a 5% aqueous solution of borax-buffered formalin. After core samples were processed, one additional quadrat per transect was excavated with a shovel to approximately 0.5 m depth. Excavated sediment was searched for bivalves. Approximately 10 days after field work, the core samples were re-screened with 70% ethanol.. The samples were then shipped to Aquamarine, Inc. for sorting and taxonomic identification. All invertebrates were sorted out of the samples and identified to the lowest practical level (Ecology 2007).

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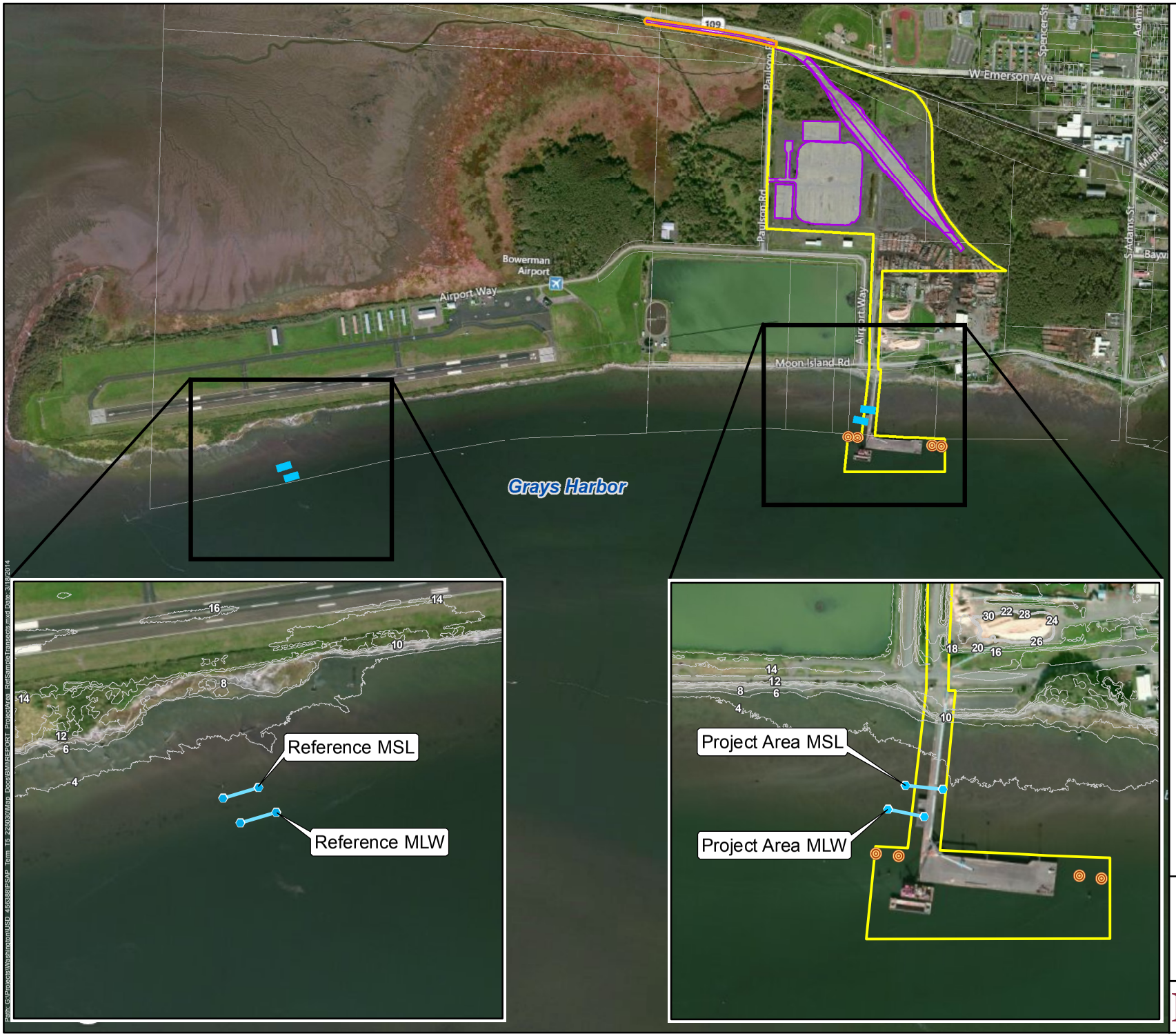

Figure 4
Benthic Infaunal Sample Transects

- New Mooring Dolphins
- 2ft Contour
- Project Area
- Industrial Lead Track
- Detention/Infill Pond, Tank Farm, Rail Car Unloading Tracks
- Parcel
- Sample Transect

MSL = Mean Sea Level

MLW = Mean Low Water

N

0 375 750 1,500 Feet

Terminal 3
Port of Grays Harbor
Hoquiam Washington
US Development Group LLC

HDR

Data Source: Parcels - Grays Harbor County GIS; Aerial - ESRI ArcGIS Online. Map information was compiled from the best available public sources. HDR does not warrant that the information is accurate or complete.

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5. Affected Environment

5.1. Sand and Mudflat Habitat Adjacent to Terminal

Intertidal habitat was qualitatively characterized on March 10, 2014. In the Project Area and adjacent shoreline, the intertidal zone had a very narrow marsh fringe, separating the uplands from lower elevation tidal flats. Woody debris were observed, stacked up on the shoreline. The slope was between 4-5% immediately next to the shoreline, but quickly tapered off to between 1-2% (Table 1; Appendix A, Figure A-1). The slope at transect 4 increased to 3% near the terminal. The terminal is approximately at the MLW elevation of 1.5 ft (MLLW datum). The federal navigation channel was located waterward of the terminal and is managed subtidal habit. Dozens of derelict piles were observed in the immediate vicinity of the terminal (Appendix A, Figures A-2, A-3). Most of these piles were less than a few feet tall (from being cut or from rot), and appeared to be 4" x 4" posts. A much smaller amount of larger derelict piles were present. Large quarry rocks were observed along the shoreline, and are presumably there for shoreline protection.

Sediment composition in the intertidal zone ranged from silty sand with some gravel to silt with clay (i.e. mud). Silty sand was observed from the shoreline to approximately 140- 180 m waterward (Table 2). Gravel was a substantial component of the silty sand near the shoreline. In this silty sand zone, *Zostera japonica* (Japanese eelgrass) and *Fucus distichus* (brown algae; aka rockweed) were observed. *Z. japonica* was observed in small clumps, relatively evenly distributed, growing in the silty sand (Appendix A, Figure A-4). *F. distichus* was not found in the quadrats, but were observed growing on old pilings, rocks, etc. As substrate transitioned to mud, no marine grasses or macroalgae were observed (Appendix A, Figure A-5).

Table 1. Percent slope between quadrats in each respective transect.

Quadrats	Transect 1	Transect 2	Transect 3	Transect 4
1 to 2	5	4	4	4
2 to 3	2	4	2	2
3 to 4	2	2	1	2
4 to 5	1	1	2	1
5 to 6	1	2	2	1
6 to 7	1	1	1	2
7 to 8	1	2	2	2
8 to 9	1	1	2	3
9 to 10	2	NA	0	NA

Table 2. Percent sediment composition, vegetation cover and vegetation types in each quadrat, in each respective transect.

Transect	Quadrat	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Vegetation Cover (%)	Vegetation Types
1	1	20	75	55	0	0	
1	2	0	95	5	0	0	
1	3	0	95	5	0	2	*Z japonica*
1	4	0	75	25	0	0	
1	5	0	75	25	0	0	
1	6	0	75	25	0	0	
1	7	0	60	40	0	2	*Z japonica*
1	8	0	60	40	0	0	
1	9	0	50	40	10	0	
1	10	0	30	50	20	0	
2	1	40	55	5	0	0	
2	2	0	75	25	0	0	
2	3	0	75	25	0	1	*Z. japonica*
2	4	0	70	30	0	0	
2	5	0	70	30	0	0	
2	6	0	60	40	0	0	
2	7	0	60	40	0	0	
2	8	0	50	40	10	0	
2	9	0	30	50	20	0	
3	1	5	90	5	0	0	
3	2	0	70	30	0	0	
3	3	0	70	30	0	0	
3	4	0	70	30	0	0	
3	5	0	70	30	0	0	
3	6	0	60	40	0	0	
3	7	0	60	40	0	0	
3	8	0	50	50	0	0	
3	9	0	40	50	10	0	
3	10	0	40	50	10	0	
4	1	0	80	20	0	0	
4	2	0	70	30	0	0	
4	3	0	70	30	0	1	*Z japonica*
4	4	0	70	30	0	2	*Z japonica*
4	5	0	70	30	0	0	
4	6	0	60	40	0	0	
4	7	0	50	50	0	0	
4	8	0	40	50	10	0	
4	9	0	30	50	20	0	

5.2. High Marsh and Surge Plain Habitat Adjacent to Mainline Track

Land within the Refuge and adjacent to the track is dominated by high salt marsh vegetation. Species include Lyngby's sedge (*Carex lyngbyei*), Pacific silverweed (*Potentilla palustris*), and tufted hairgrass (*Deschampsia caespitosa*) (Appendix A, Figures A-6, A-7, A-8). The Scrub-shrub riparian area is dominated by Hooker's willow (*Salix hookeriana*), red alder (*Alnus rubra*) salmonberry (*Rubus spectabilis*), black twinberry (*Lonicera involucrata*) and reed canarygrass (*Phalaris arundinacea*) (Appendix A, Figure A-7). A tidal channel maintained by perennial freshwater flow, exits the Project Area, across Paulson Road, and runs west through the high marsh in the Refuge (Figure 3). The elevation of the high marsh is approximately 8- 10 ft MLLW. As the channel crosses under Paulson Road, it is directly adjacent to the proposed track alignment, but is only impacted by the project on the east side of road (Figure 3). The existing habitat in this eastern portion of the tidal channel is described in the tidal channel technical memorandum associated with this project (HDRa 2014).

Approximately 400 meters downstream, a branch of the tidal channel extends north in a dendritic channel formation, towards the mainline extension (Figure 3). The channel alignments and the terminal ends of the tidal channels were mapped in the field. This formation of dendritic channel starts out with a bankfull depth of over 1m and a bankfull width of over 2 m (cross-section 1), but as the channel branches, the bankfull width and depth get progressively more shallow, terminating at the high marsh elevation (Figure 3; Table 3; Appendix A, Figues A-6, A-7, A-8). One of the branches runs north, towards the tow of the historical railroad grade (Figure 3).

Table 3. Tidal channel bankfull width and depth.

Cross-Section	Bankfull Width (m)	Bankfull Depth (m)
1	2.2	1.1
2	0.8	0.3
3	1.0	0.2
4	1.5	0.8
5	1.4	1.0
6	1.1	0.7
7	0.9	0.6
8	0.5	0.2
9	0.7	0.7
10	0.5	0.3
11	0.4	0.6
12	0.4	0.3

5.3. Benthic Infaunal Survey

Benthic infaunal samples were collected on May 9-10, 2012. MLW transects were at an elevation of approximately 1.5 ft MLLW. MSL transects were at an elevation of approximately 3.5 ft MLLW. Salinity of the sediment pore water ranged between 15.2 and 17.3 ppt and was slightly less saline at the Project Area (Table 4). MSL quadrats at both the treatment and reference plots were composed of silty sand with a minimal amount of vegetative cover (Table 5). MLW quadrats were composed of silty sand at the reference site, but graded to sandy silt at the Project Area. Invertebrates were not found on the surface in the sample quadrats, although fecal castings were observed in all of the Reference MSL quadrats and in one of the Project Area MLW quadrats. *Z. japonica* was observed infrequently in Reference MSL, Reference MLW, and Study Area MSL quadrats. In locations where *Z. japonica* was observed, it only accounted for 1-2% cover in the quadrat areas.

Table 4. Intertidal infaunal transect attributes

Site	Sample Date	Sample Time	Elevation (ft MLLW)	Pore Water Salinity (ppt)
Project Area MLW	5/9/2012	0830- 1145	1.5	Not Measured
Reference MLW	5/9/2012	0830- 1145	1.5	17.3
Project Area MSL	5/10/2012	0820- 1030	7	15.2
Reference MSL	5/10/2012	0820- 1100	7	17.9

Table 5. Intertidal infaunal sample quadrat attributes

Quadrat	Project Area MLW				Project Area MSL			
	Substrate Composition	% Cover	Macroalgae/ Seagrasses	Surface Invertebrates	Substrate Composition	% Cover	Macroalgae/ Seagrasses	Surface Invertebrates
1	Sandy Silt	0	None	None	Silty Sand	0	None	None
2	Silty Sand	0	None	Fecal Casting	Silty Sand	0	None	None
3	Silty Sand	0	None	None	Silty Sand	2	*Z. japonica*	None
4	Silty Sand	0	None	None	Silty Sand	0	None	None
5	Sandy Silt	0	None	None	Silty Sand	0	None	None
6	Sandy Silt	0	None	None	Silty Sand	0	None	None
7	Sandy Silt	0	None	None	Silty Sand	0	None	None
8	Sandy Silt	0	None	None	Silty Sand	0	None	None
9	Silty Sand	0	None	None	Silty Sand	1	*Z. japonica*	None
10	Sandy Silt	0	None	None	Silty Sand	1	*Z. japonica*	None
Quadrat	Reference MLW				Reference MSL			
	Substrate Composition	% Cover	Macroalgae/ Seagrasses	Surface Invertebrates	Substrate Composition	% Cover	Macroalgae/ Seagrasses	Surface Invertebrates
1	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
2	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
3	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
4	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
5	Silty Sand	0	None	None	Silty Sand	2	*Z. japonica*	Fecal Castings
6	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
7	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
8	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
9	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings
10	Silty Sand	0	None	None	Silty Sand	0	None	Fecal Castings

Invertebrate species richness in each individual quadrat ranged between 1-6 species for all samples (Table 6; Appendix B). Cumulative species richness appeared to reach higher asymptotic richness at the MSL elevation than at the MLW transect elevations (Figure 5). On average, the Project Area samples had higher abundance and slightly more species than the Reference samples (Table 6). The higher Project Area abundance at the MSL samples was due to the relatively abundant *Eohaustorius estuarius*, an amphipod grazer. The higher Project Area abundance at the MLW samples was due to the relatively abundant *Americorophium salmonis,* an amphipod filter feeder. The slightly higher species richness at in the Project Area samples, in both the MSL and MLW samples was due to variable species, but mostly more frequently encountered polychaetes. Invertebrate community diversity and evenness between the Project Area and Reference samples were very similar at both the MSL and MLW. MSL samples were somewhat more diverse at both locations. The general invertebrate composition was similar to previous studies in Grays Harbor (WSDOT 2009)

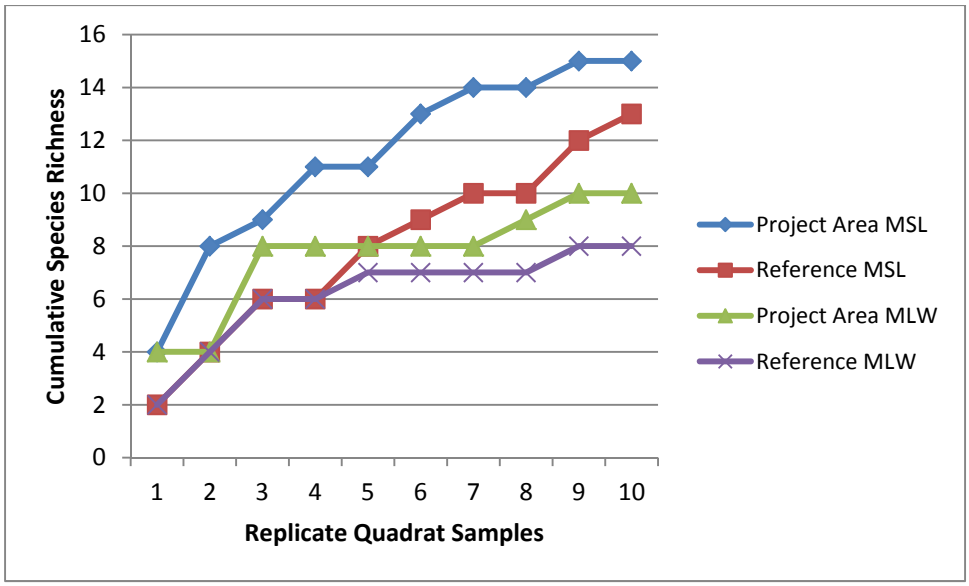

Figure 5. Cumulative species richness at the Project Area and Reference site

Table 6. Invertebrate community metric average values and two-sample test of significant difference results (non-parametric Mann-Whitney)

Transect	Abundance	Richness	Shannon Diversity	Pielous Evenness
Mean Sea Level				
Reference MSL Average	13.5	4.4	1.2	0.8
Project Area MSL Average	28.5	5.3	1.2	0.7
Mann-Whitney U	82	67	48	39
P-Value	0.02	0.18	0.88	0.41
Statistical Difference (α= 0.05)	yes	No	No	No
Mean Low Water				
Reference MLW Average	13.8	3.2	0.8	0.7
Project Area MLW Average	28.1	5.1	1.0	0.6
Mann-Whitney U	80	87	60	36
P-Value	0.02	0.00	0.45	0.29
Statistical Difference (α= 0.05)	Yes	Yes	No	No

5.3.1. Annelida

The annelids collected in the project samples were all in subphylum polychaeta (polychaetes). Capitellid polychaetes (*Barantolla Americana*, *Heteromastus filiformis*, and *Mediomastus californiensis*) were found in all transects (Table 7). Capitellid polychates are deposit feeders, and form burrows or tubes in the sediment that are connected to the surface. Individuals in family Nephtyidae (*Bipalponephtys cornuta*) were found in only one of the Project Area MLW transect samples. This polychaete is common in sandy to muddy intertidal zone sediments, and is a motile predator, feeding on mollusks, crustaceans, and other polychaetes. Phyllodocid polychaetes (*Eteone californica*) were found in the Project Area transects at both the MSL and MLW transect samples. Phylladocid polychaetes are widespread and are motile predators and scavengers. Goniadid polychaetes (*Glycinde picta*) were found in all transects. Goniadids are widespread in soft sediments throughout all depths and are predators. Paraonid polychaetes (*Paraonella platybranchia*) were only found in the Reference MSL transect. Paraonids are deposit feeders and are common in soft sediments. Spionid polychaetes (*Pseudopolydora kempi*) were only found in the Reference MSL samples. Spionids are common and widespread in soft sediments and bore into mollusc shells.

5.3.2. Arthropoda

Arthropods collected in the project samples include filter feeding amphipods (*Americorophium* salmonis), herbivore/ grazer amphipods (*Eogammarus confervicolus* and *Eohaustorius estuarius*), an invasive amphipod of unknown feeding strategy (*Grandidierella japonica*), and a predatory shrimp (*Crangon franciscorum*) (Table 7). *C. franciscorum* feeds on amphipods, bivalves, and other invertebrates.

A. salmonis was present at all transects, but was much more abundant at the Project Area MLW transect (Table 7). *E. estuarius* was also present at all transects, but was much more abundant at the Project Area MSL transect. The other arthropods were infrequently encountered.

5.3.3. Mollusca

The two mollusks found in this study were the bivalves *Macoma balthica* and *Mya arenaria* (Table 7). Both species were found in all transects. *M. balthica* is commonly found in muddy sand along the coastal estuaries, near the surface. *M. Balthica* feeds on organic matter on the sediment surface or in the water. *M. arenaria* (eastern softshell clam) is also found in estuaries in a mix of sand and mud substrate, and filters plankton out of the water column. *M. arenaria* is an invasive species introduced from the east coast.

5.3.4. Nemertea

The nemerteans *Tubulanus sp.*, *Tetrastemma sp.*, *Zygonemertes virescens*, and Lineidae were infrequently encountered (Table 7), and solitary, when present. Nemerteans are predators.

Table 7. Average abundance of Project Area and Reference Site transect samples

Genus species	Ecology	Project Area MSL	Reference MSL	Project Area MLW	Reference MLW
Barantolla nr americana	Deposit Feeder	0.1	0	0.1	0
Bipalponephtys cornuta	Predator	0	0	0.1	0
Eteone californica	Predator	0.3	0	0.2	0
Glycinde picta	Predator	0.5	0.3	1.2	0.3
Heteromastus filiformis	Deposit Feeder	0.5	1.1	1.9	0.1
Mediomastus californiensis	Deposit Feeder	0.1	0.3	0	0
Neanthes limnicola	Variable	0.1	0	0	0
Paraonella platybranchia	Deposit Feeder	0	0.3	0	0
Pseudopolydora kempi	Predator	0	0.1	0	0
Pygospio elegans	Predator	1.3	0.1	0	0
Scolelepis squamata	Predator	0.1	0	0.1	0.1
Americorophium salmonis	Filter feeder	0.1	0.2	23.1	7.4
Grandidierella japonica	Unknown	0.2	0	0.2	0
Crangon franciscorum	Predator	0.1	0.1	0	0
Eogammarus confervicolus	Herbivore/ Grazer	0	0.1	0	0
Eohaustorius estuarius	Herbivore/ Grazer	17.1	6.1	1.2	0.9
Macoma balthica	Deposit Feeder	6.2	2.8	2.3	1.1
Mya arenaria	Filterer	2.4	2.7	3.8	3.8
Tubulanus sp	Predator	0.1	0	0	0
Nemertea fragments	Predator	0.2	0	0	0
Tetrastemma sp	Predator	0	0.2	0	0
Zygonemertes virescens	Predator	0	0	0.2	0
Lineidae	Predator	0	0	0	0.1

6. Environmental Consequences

Potential project impacts to intertidal open-water shoreline habitat will result from the installation of 4 new mooring dolphins. Each dolphin will be comprised of 8 24-inch diameter steel piles. This will result in the displacement of approximately 25.1 square feet of intertidal open-water shoreline habitat per dolphin, or a total impact area of approximately 100.5 square feet for the 4 new dolphins. This action will eliminate benthic invertebrate production habitat in these areas. Increased vessel traffic may increase wave action along the beach which may increase erosion along the shoreline. However, waves from the vessels used for this project are not expected impact the project area shoreline because they will be moving very slowly as they move into the terminal berth. Wave impacts at the project site are also not anticipated because the existing upper intertidal zone is already armored with riprap, making the shoreline very resistant to wave action. Prop wash from tugboats may be of concern, as they move the tankers in and out of the terminal berth, but these actions would occur within the dredged navigation channel that is maintained by the U.S. Army Corps of Engineers.

There are no direct impacts to the high marsh or tidal channel habitat west of Paulson Road in the Grays Harbor National Wildlife Refuge. All of the project actions will take place east of Paulson Road. The intertidal surge plain extends onto the project site near the northwest corner of the site in the form of an intertidal channel. This ditch connects to the intertidal areas to the west via a culvert under Paulson Road near the intersection with State Route 109. Approximately 0.08 acre of intertidal salt marsh/ surge plain that contains a tidal channel will be filled for the new facility. These impacts and proposed mitigation are discussed in connection with fish habitat (HDR 2014a) and wetlands (HDR 2014b).

7. Mitigation

The additional mooring dolphins have a relatively modest footprint, but the reduction in benthic habitat function in these areas may require compensatory mitigation. Derelict piles have a similar impact to the intertidal zone as the dolphins, in terms of reducing benthic productivity. However, most derelict piles also have resulted in a local toxic impact, because most were treated with creosote or other preservatives before they were originally installed. Derelict piles are widespread in Grays Harbor, and there are many near the Project Area. Removal of a select number of derelict piles would be a reasonable option to off-set impacts associated with the new dolphins. Derelict pile removal could be accomplished from a barge and using a vibratory hammer. The selection of derelict piles for removal should be prioritized based on the following criteria:

- Near Project Area
- Similar tidal elevation to the proposed impact areas
- Substantial length; visible during high tide.

The number of derelict piles to be removed could be based on a 1:1 offset of benthic area. That is, since the dolphins will result in 100.5 square feet of benthic impact, 100.5 square feet of derelict pile removal would be an appropriate target for compensatory mitigation. Removal should occur before dolphin installation, in order to avoid a lag in net habitat benefits.

8. Conclusion

High-quality intertidal habitat currently exists at and adjacent to the Project footprint. Unavoidable impacts to the sand and mud flat intertidal zone are proposed to occur at the terminal, from installation of the mooring dolphins. It is expected that these impacts can be mitigated by removal of derelict piles in the vicinity of the project. No impacts are expected to occur in the high marsh and tidal channels, west of Paulson Road.

9. References

Albright, R., and P.K. Bouthillette. 1982. Benthic invertebrate studies in Grays Harbor, Washington. Washington Department of Game report to U.S. Army Corps of Engineers, Seattle, Washington. 224 p.

Armstrong, D.A., B.G. Stevens, and J.C. Hoeman. 1982. Distribution and abundance of Dungeness crab and crangon shrimp and dredging-related mortality of invertebrates and fish in Grays Harbor, Washington. Washington Department of Fisheries, Olympia, Washington. 371 p.

Armstrong, J.L., D.A. Armstrong, and S.B. Mathews. 1995. Food habits of estuarine staghorn sculpin, Leptocottus armatus, with focus on consumption of juvenile Dungeness crab, Cancer magister. Fishery Bulletin 93(3):456-46. http://fishbull.noaa.gov/933/armstrong.pdf.

Armstrong, D.A., C. Rooper, and D. Gunderson. 2003. Estuarine production of juvenile Dungeness Crab (Cancer magister) and contribution to the Oregon-Washington Coastal Fishery. Estuaries 26:1174-1178.

Borde, A.B., R.M. Thom, S. Rumrill, and L.M. Miller. 2003. Geospatial habitat change analysis in Pacific Northwest Coastal estuaries. Estuaries 26:1104-1116.

Washington State Department of Ecology [Ecology]. 2007. Condition of Coastal Waters of Washington State, 2000-2003, a Statistical Summary. Publication No. 07-03-051.

HDR. 2014a. Fish Habitat Technical Report, Grays Harbor Rail Terminal Project.

HDR. 2014b. Wetland Technical Report, Grays Harbor Rail Terminal Project.

Herrmann, R.B. 1972. The distribution and abundance of clams in Grays Harbor as related to environmental conditions. Publication No. 72-e28, Weyerhaeuser Company, Longview, Washington. 31 p. http://www.ecy.wa.gov/pubs/72e28.pdf.

Loehr, L.C., and E.E. Collias. 1981. A review of water characteristics of Grays Harbor 1938-1979 and an evaluation of possible effects of the widening and deepening project upon present water characteristics. U.S. Army Corps of Engineers, Seattle, Washington. 97 p.

Stein, J.E., and J.G. Denison. 1965. Resident time of waste in Grays Harbor. Olympic Research Division Report G-10, p. 1-2. Rayonier, Inc.

Dethier, M. and H. Berry. 2011. Impacts of the Construction of the Brightwater Marine Outfall on Intertidal Biotic Communities. February 25, 2011.

Washington State Department of Transportation [WSDOT]. 2009. Pontoon Construction Project:-Final Mudflat Surveys for Pontoon Construction Sites Technical Memorandum.

Appendix A: Habitat Survey Photographs

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Figure A-1. Sand and mud flat under and adjacent to the Terminal 3 pier; view is to the southeast.

Figure A-2. Sand and mud flat adjacent to the Terminal 3 pier; view is to the east.

Figure A-3. Sand and mud flat, north of the terminal, and along Transect 4, view is to the south.

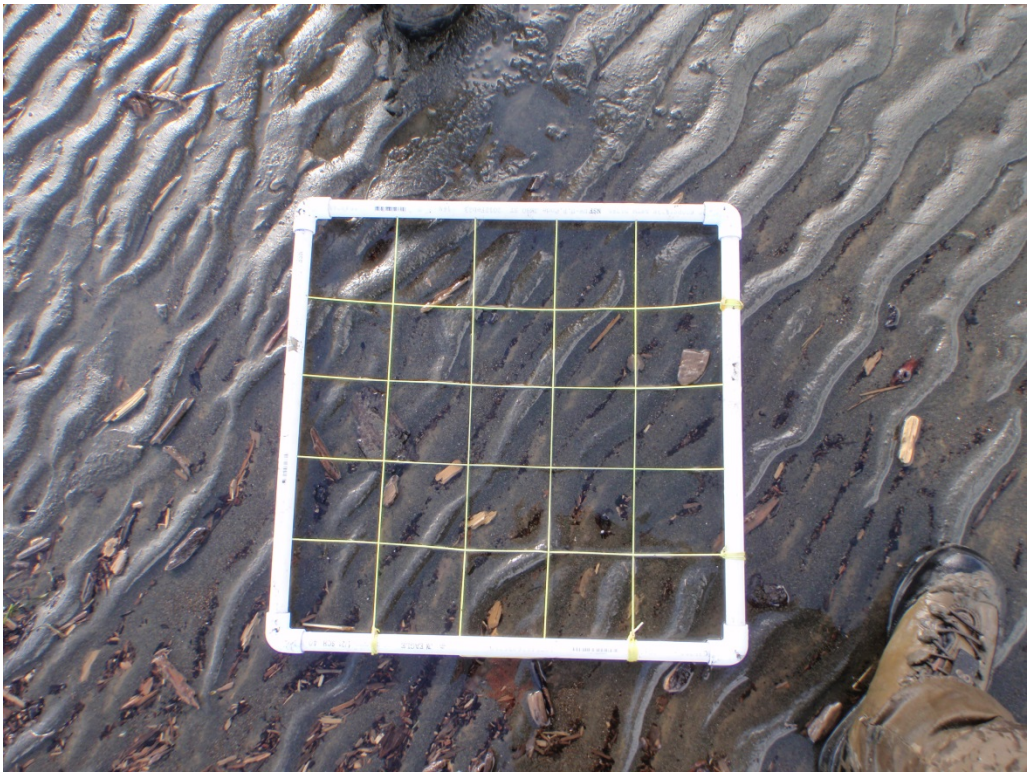

Figure A-4. Typical quadrat sample with silty sand substrate and Z. japonica (Transect 4, Quadrat 2).

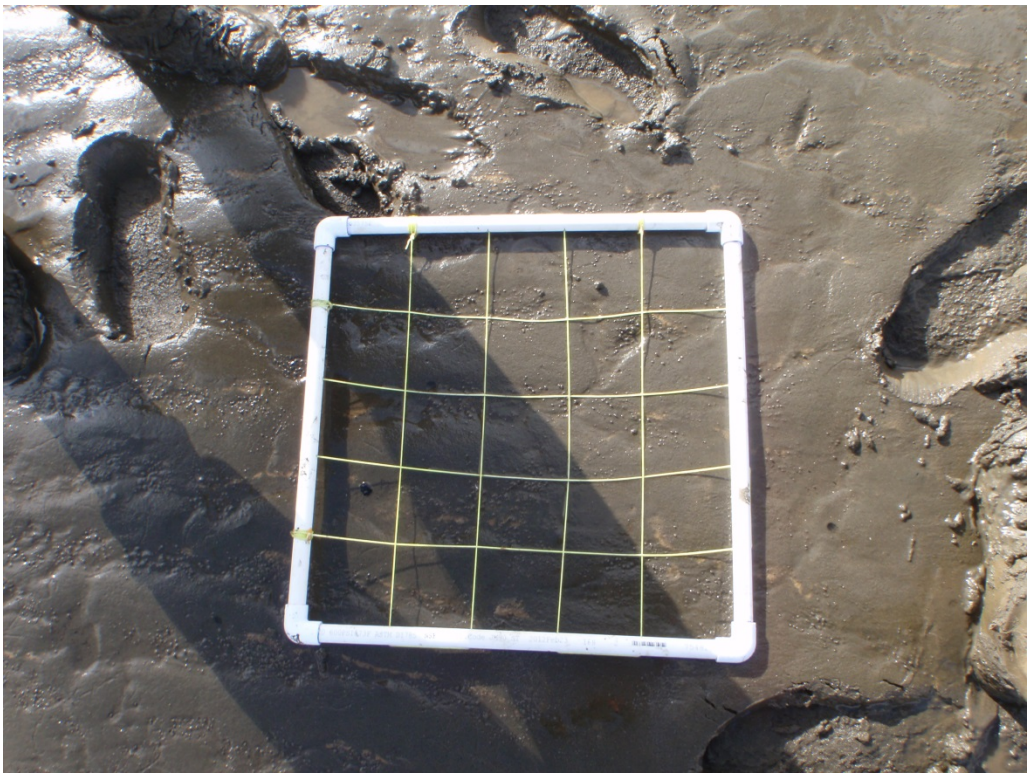

Figure A-5. Typical quadrat sample with sandy silt and clay substrate (Transect 4, Quadrat 9).

Figure A-6. Tidal channel and high marsh with cross-section 9 in the foreground; view is to the east.

Figure A-7. Tidal channel and high marsh with cross-sections 7-8 in the background; view is to the north.

Figure A-8. Tidal channel and high marsh with cross-section 6 in the background; view is to the SW.

Appendix B: Invertebrate Species and Abundance Data

Phylum	Species	TRTMSL01	TRTMSL02	TRTMSL03	TRTMSL04	TRTMSL05	TRTMSL06	TRTMSL07	TRTMSL08	TRTMSL09	TRTMSL10	TRTMSLClams
Annelida	Barantolla nr americana									**1**		
Annelida	Bipalponephtys cornuta											
Annelida	Eteone californica	**1**						**2**				
Annelida	Glycinde picta		**1**		**3**	**1**						
Annelida	Heteromastus filiformis						**3**		**1**	**1**		
Annelida	Mediomastus californiensis							**1**				
Annelida	Neanthes limnicola									1		
Annelida	Paraonella platybranchia											
Annelida	Pseudopolydora kempi											
Annelida	Pygospio elegans		2		1	1	2		2		5	
Annelida	Scolelepis squamata			1								
Arthropoda	Americorophium salmonis				1							
Arthropoda	Grandidierella japonica (=Amphipoda 1)				2							
Arthropoda	Crangon franciscorum (=Decapoda)		1									
Arthropoda	Eogammarus confervicolus											
Arthropoda	Eohaustorius estuarius	1	61	4	6	7	14	12	8	28	21	
Mollusca	Macome balthica	6	5	4	6	6	4	8	12	3	8	3
Mollusca	Mya arenaria	1		3	4	2	2	3	5	2	2	15
Nemertea	Tubulanus sp		1									
Nemertea	Nemertea fragments (no heads)						1		1			
Nemertea	Tetrastemma sp											
Nemertea	Zygonemertes virescens											
Nemertea	Lineidae											

Phylum	Species	REFMSL01	REFMSL02	REFMSL03	REFMSL04	REFMSL05	REFMSL06	REFMSL07	REFMSL08	REFMSL09	REFMSL10	REFMSLClams
Annelida	Barantolla nr americana											
Annelida	Bipalponephtys cornuta											
Annelida	Eteone californica											
Annelida	Glycinde picta		**1**		**1**				**1**			
Annelida	Heteromastus filiformis						**1**			**4**	**6**	
Annelida	Mediomastus californiensis										**3**	
Annelida	Neanthes limnicola											
Annelida	Paraonella platybranchia					1			1		1	
Annelida	Pseudopolydora kempi									1		
Annelida	Pygospio elegans									1		
Annelida	Scolelepis squamata											
Arthropoda	Americorophium salmonis			1	1							
Arthropoda	Grandidierella japonica (=Amphipoda 1)											
Arthropoda	Crangon franciscorum (=Decapoda)							1				
Arthropoda	Eogammarus confervicolus					1						
Arthropoda	Eohaustorius estuarius	9		2	9	1	4	4	7	15	1	
Mollusca	Macome balthica		4	4	2	3	3	2	3	5	2	3
Mollusca	Mya arenaria	1			2	5	3	2	2	6	6	36
Nemertea	Tubulanus sp											
Nemertea	Nemertea fragments (no heads)											
Nemertea	Tetrastemma sp			1			1					
Nemertea	Zygonemertes virescens											
Nemertea	Lineidae											

Phylum	Species	TRTMLW01	TRTMLW02	TRTMLW03	TRTMLW04	TRTMLW05	TRTMLW06	TRTMLW07	TRTMLW08	TRTMLW09	TRTMLW10	TRTMLWClams
Annelida	Barantolla nr americana				**1**							
Annelida	Bipalponephtys cornuta							**1**				
Annelida	Eteone californica			**2**								
Annelida	Glycinde picta	**1**	**1**	**2**	**1**	**3**		**1**	**1**	**1**	**1**	
Annelida	Heteromastus filiformis			**1**		**1**	**1**			**7**		
Annelida	Mediomastus californiensis											
Annelida	Neanthes limnicola											
Annelida	Paraonella platybranchia											
Annelida	Pseudopolydora kempi											
Annelida	Pygospio elegans											
Annelida	Scolelepis squamata			1								
Arthropoda	Americorophium salmonis	4	31	28	36	15	2	45	1	7	17	
Arthropoda	Grandidierella japonica (=Amphipoda 1)								1		1	
Arthropoda	Crangon franciscorum (=Decapoda)											
Arthropoda	Eogammarus confervicolus											
Arthropoda	Eohaustorius estuarius									2	1	
Mollusca	Macome balthica	1	3	1		1	4		1	8	4	
Mollusca	Mya arenaria	1	6	7	3	3	4	2	7	3	2	5
Nemertea	Tubulanus sp											
Nemertea	Nemertea fragments (no heads)											
Nemertea	Tetrastemma sp											
Nemertea	Zygonemertes virescens			1			1					
Nemertea	Lineidae											

Phylum	Species	REFMLW01	REFMLW02	REFMLW03	REFMLW04	REFMLW05	REFMLW06	REFMLW07	REFMLW08	REFMLW09	REFMLW10	REFMLWClams
Annelida	Barantolla nr americana											
Annelida	Bipalponephtys cornuta											
Annelida	Eteone californica											
Annelida	Glycinde picta					**1**		**1**			**1**	
Annelida	Heteromastus filiformis			**1**								
Annelida	Mediomastus californiensis											
Annelida	Neanthes limnicola											
Annelida	Paraonella platybranchia											
Annelida	Pseudopolydora kempi											
Annelida	Pygospio elegans											
Annelida	Scolelepis squamata		1									
Arthropoda	Americorophium salmonis	8	2	6	3	3		21	7	6	18	
Arthropoda	Grandidierella japonica (=Amphipoda 1)											
Arthropoda	Crangon franciscorum (=Decapoda)											
Arthropoda	Eogammarus confervicolus											
Arthropoda	Eohaustorius estuarius		1	1		2			2	3		
Mollusca	Macome balthica	2				1		5	1	1	1	
Mollusca	Mya arenaria			13	1		15		1	6	2	25
Nemertea	Tubulanus sp											
Nemertea	Nemertea fragments (no heads)											
Nemertea	Tetrastemma sp											
Nemertea	Zygonemertes virescens											
Nemertea	Lineidae									1		