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ECSI No. 1138
September 21, 2023
Former Portland Gas Manufacturing Site

ANCHOR QEA

Year 3 Monitoring Report: PGM Long-Term Monitoring and Maintenance

Prepared for NW Natural

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ABBREVIATIONS

BTEX	benzene, toluene, ethylbenzene, and xylene
COC	contaminant of concern
CUL	cleanup level
DEQ	Oregon Department of Environmental Quality
DOC	depth of contamination
EMNR	enhanced monitored natural recovery
GAC	granular activated carbon
LTMMP	*Long-Term Monitoring and Maintenance Plan*
MNR	monitored natural recovery
PAH	polycyclic aromatic hydrocarbon
PGM	Portland Gas Manufacturing
RA	remedial action
ROD	Record of Decision
SDU	Sediment Decision Unit
SW	surface water
TPH	total petroleum hydrocarbons
TZW	transition zone water

1 Introduction

The former Portland Gas Manufacturing (PGM) site is located along the west bank of the Willamette River in downtown Portland near river mile 12.2 (Figure 1). The Oregon Department of Environmental Quality (DEQ) issued a Record of Decision (ROD) for the PGM site on July 3, 2017 (DEQ 2017). NW Natural and its contractors, Sevenson Environmental Services, Inc., and Anchor QEA, LLC, completed the sediment remedial action (RA) in July through October 2020 under DEQ oversight, as described in the *Project Completion Report* (Anchor QEA 2021a). There were two primary objectives of the RA: 1) to directly address in-water contamination and reduce risks to aquatic life and humans from exposure to contaminated sediments and porewater; and 2) to provide source control for contaminants in groundwater discharging to sediments and porewater. The contaminants of concern (COCs) in site sediments from historical manufactured gas plant operations and other potential sources are polycyclic aromatic hydrocarbons (PAHs); total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene, and xylene (BTEX); free cyanide; and three metals (lead, mercury, and zinc).

Remedial construction was performed pursuant to the PGM Consent Judgment in Multnomah County Circuit Court Case No. 20CV15456 between the State of Oregon and NW Natural, and associated Statement of Work, dated April 15, 2020, and entered by the Court May 6, 2020. Long-term monitoring and maintenance of the remedy are also being performed under the Consent Judgment.

1.1 PGM Cleanup Levels

PGM cleanup levels (CULs) for sediment, transition zone water (TZW), and surface water (SW) are listed in Table 1. CULs serve as long-term numeric performance criteria for remedy effectiveness and are briefly described in this section.

Sediment Cleanup Levels: CULs for benthic organisms are evaluated on a point-by-point basis, whereas CULs for bioaccumulation-based criteria are evaluated on a site-wide basis using site-wide average concentrations, which is consistent with the spatially averaged nature of bioaccumulation-based exposures.

TZW and SW Cleanup Levels: CULs for aquatic life are evaluated on a point-by-point basis in TZW and SW. Aquatic life criteria for lead and zinc are based on the dissolved fraction and an assumed hardness of 25 milligrams per liter. CULs for bioaccumulation-based criteria (the most conservative being human health fish consumption criteria) are evaluated on a site-wide basis using site-wide average concentrations in SW, which is consistent with the spatially averaged nature of bioaccumulation-based exposures.

1.2 Summary of Remedial Construction Activities

The PGM cleanup area is divided into 11 Sediment Decision Units (SDUs), designated SDUs A through H, as shown in Figure 2. The selected remedy included a combination of dredging, reactive capping (in situ treatment with granular activated carbon [GAC]), cap armoring where needed for erosion protection, enhanced monitored natural recovery (EMNR), monitored natural recovery (MNR), residuals cover placement, institutional controls, and long-term monitoring and maintenance of the remedy (DEQ 2017).

The remedial technologies applied to each SDU were as follows:

Remedial Technology	SDU	Dredging	Cap and Cover Placement
MNR	B1, F2	No active construction	No active construction
EMNR	B2	None	Minimum 12 inches gravelly sand cover
EMNR	C3, F1	None	Minimum 12 inches sand cover
GAC-Amended Treatment	A, D	Stabilize dredging side slope (SDU A only)	Minimum 12 inches GAC-amended, gravelly sand (SDU A), or sand (SDU D) cover
Partial Dredge/ Armored Treatment Cap	C1	Maintenance of berthing depth	Minimum 12 inches GAC-amended, gravelly sand cap plus minimum 12 inches protective armor stone
Hot Spot Dredge/ Armored Treatment Cap	E	Hot spot removal	Minimum 12 inches GAC-amended, gravelly sand cap plus minimum 12 inches protective armor stone
Full Dredge and Residual Cover	G	Full removal of contamination	Minimum 6 inches sand cover
Residual Cover	H	Stabilize dredging side slopes	Minimum 6 inches sand cover

RA activities, including detailed descriptions of dredging, debris removal, cap and cover placement operations, and construction monitoring activities, are described in greater detail in the *Project Completion Report* (Anchor QEA 2021a).

2 Year 3 Bathymetry

This section describes the Year 3 riverbed elevations and morphologies as determined by the Year 3 multibeam bathymetry survey performed on June 20, 2023, following the Rose Festival Fleet Week.

2.1 Bathymetric Survey Results

In October 2020 (Year 0; Anchor QEA 2021b), July 2021 (Year 1; Anchor QEA 2021c), April and June 2022 (Year 2; Anchor QEA 2023), and June 2023 (Year 3; this report) the post-remediation physical condition of the PGM sediment cleanup site was assessed using high-resolution multibeam bathymetry. The Year 3 bathymetry survey is presented in Figure 3. To better characterize how riverbed elevations and morphologies have changed over time during the monitoring period, and in particular, the extent to which cap and cover areas may have accreted or eroded after the completion of the RA, the following graphics were prepared:

- **Figure 4a, 2020 vs. 2021 Bathymetry Comparison:** Isopach map showing changes in riverbed elevation between the Year 0 and Year 1 surveys (first year post-construction)
- **Figure 4b, 2021 vs. 2022 Bathymetry Comparison:** Isopach map showing changes in riverbed elevation between the Year 1 and Year 2 surveys (second year post-construction)
- **Figure 4c, 2022 vs. 2023 Bathymetry Comparison:** Isopach map showing changes in riverbed elevation between the Year 2 and Year 3 surveys (third year post-construction)
- **Figure 4d, 2020 vs. 2023 Bathymetry Comparison:** Isopach map showing changes in riverbed elevation between the Year 0 and Year 3 surveys (first 3 years post-construction)
- **Figure 5, 2020 vs. 2023 Bathymetry Grid Comparison:** Isopach map showing changes in riverbed elevation between the Year 0 and Year 3 surveys, locally averaged using the pre-established PGM compliance grid (approximately 10-foot by 10-foot grids on flat areas and 3-foot by 3-foot grids on sloped areas)
- **Figures 6a and 6b, 2020 vs. 2023 Bathymetry Comparison Cross Sections:** Longitudinal and transverse cross sections through the site showing the pre-construction riverbed elevation, extents and thicknesses of placed caps and covers, and areas of post-construction accretion or erosion; cross-section locations shown in Figure 4c
- **Figures 7a, 7b, and 7c, Detailed Cross Sections of Subsurface Contamination:** Detailed cross sections showing the distribution of subsurface contamination in areas where erosion of sediment or cover material has been observed (SDUs A and F2), current and historical sediment samples and sampling depths, maximum exceedance ratios of sediment sampling intervals, and COCs associated with the maximum exceedance ratios
- **Figure 8, 2023 Cap, Cover, and Infill Thickness:** Isopach map of cap and cover thickness, plus any infill sedimentation on top of the caps and covers; this surface was prepared by comparing the June 2023 bathymetry to the 2020 pre-cap surface, which includes post-

dredge and post-debris removal surfaces in removal areas combined with the pre-construction surface in non-removal areas (i.e., areas of cap or cover on grade)

Over a large majority of the site, there were negligible changes in bathymetric elevations between the June 2022 and June 2023 surveys (i.e., elevation differences were less than 0.3 to 0.5 foot and within the accuracy of the surveys; Figure 4c). The primary bathymetric changes that were observed in Year 3 include the following:

- In SDU B1 (MNR area), the small scour hole that had formed in 2022 has partially filled in with 6 to 18 inches of new sediment.
- In SDU A (GAC-amended cover) and SDU F2 (MNR), there is an area along the seawall that shows a 6-inch to 12-inch loss of elevation. In SDU A, this is along the top of the 2020 dredge cut slope adjacent to the seawall. This loss of elevation could be a result of material sloughing down the slope into SDU C1 or natural river redistribution processes.

Average bathymetric elevation changes on an SDU-specific and site-wide basis are presented in Table 2. This table also provides the estimated thickness of cap and cover material remaining at the site as of the June 2023 bathymetry survey, plus any subsequent riverine deposition (i.e., infill sediment). The estimated accuracy of the bathymetric surveys is less than 0.5 foot, consistent with the assumption used in the Portland Harbor Feasibility Study (EPA 2016, pp. 3–14). The estimated precision of the bathymetric surveys (i.e., "repeatability" under similar measurement conditions) is less than 0.3 foot, consistent with the U.S. Army Corps of Engineers hydrographic survey manual (USACE 2013). However, precision and repeatability do not account for changing river conditions between monitoring years, including changing river temperatures and acoustic velocity profiles and changing sea states (i.e., wind, wave and current disturbances). Compared to point-based bathymetric measurements, greater accuracy is expected when bathymetric elevations are spatially averaged over an SDU, as shown in Table 2. Greater accuracy is also expected when bathymetric elevations are averaged over longer monitoring periods.

SDUs showing net deposition greater than the estimated survey accuracy are shaded in green (SDUs C1 and E), and SDUs showing net erosion greater than the estimated survey accuracy are shaded in orange (SDUs D, C3, and F1). For Year 3, bathymetric differences of 0.3 foot are shaded in yellow (SDUs A and F2) in consideration of the improved accuracy of spatially averaged measurements.

Post-remediation bathymetric survey results are summarized as follows (refer to Figures 4a through 4d, 5, 6a, 6b, 7a through 7b, and 8, and Table 2, as appropriate):

- **Armored GAC-Amended Caps:** The armored, GAC-amended caps in SDU C1 and SDU E remained stable throughout the post-remediation survey period, with average combined cap plus infill thicknesses of 3.9 and 3.1 feet, respectively (Table 2). SDU C1 was a depression

finished below grade in the inner half of the dredge cut and has since accumulated between 6 and 24 inches or more of new sediment over much of the area.

- **Sand Covers:** The sand cover in SDU B2 has been stable throughout the monitoring program. Some loss of cover material was evident in SDUs F1 and C3 during Year 1 (2020 to 2021) as the river was equilibrating with the newly constructed surface (Figure 4a). SDU F1 was the only area that showed measurable erosion in both Year 1 and Year 2 (i.e., year-over-year erosion), but in Year 3, this area had largely stabilized. As of June 2023, the average remaining thickness of sand cover material in SDUs B2, C3, and F1 was 1.2, 1.1, and 0.04 foot, respectively (Table 2). Although sand cover loss was highest in SDU F1, Year 2 analytical results showed that all surface sediment samples in SDU F1 were below CULs.
- **GAC-Amended Sand Covers:** Some loss of GAC-amended cover material was evident in SDU D during Year 1 (2020 to 2021) as the river was equilibrating with the newly constructed surface (Figure 4a), but since then, SDU D has been comparatively stable (Figures 4b and 4c). After 2 years of relative stability, a modest amount of erosion (-0.36 foot) was observed in SDU A during Year 3. As of June 2023, the average remaining thickness of GAC-amended sand cover in SDUs A and D was 1.4 and 0.6 foot, respectively (Table 2). However, that mixing of amended sand with underlying sediment is expected, and loss of thickness does not equate to loss of all amendment.
- **MNR Areas:** Over the 3-year monitoring period, sand cover material that was placed in SDU F1 has migrated through SDU F2 and into the dredged depression of SDU C1, causing riverbed elevations in SDU F2 to first rise with influx of material from SDU F1 and then lower with the continued movement of material into SDU C1, with little net change in SDU F2 (-0.16 foot in 3 years). Some erosion was observed in SDU F2 during Year 3 (-0.37 foot), although it is near the limit of resolution of the bathymetric survey. In SDU B1, a relatively small scour hole, approximately 20 feet by 50 feet, developed in Year 2 between the April 2022 and June 2022 surveys, apparently the result of propwash disturbance associated with Navy vessel docking or undocking during 2022 Fleet Week (Figure 4b). This scour hole has since partially filled in with 6 to 18 inches of new sediment in Year 3 (Figure 4c). No new scour holes were observed at the PGM site during Year 3. On an SDU-averaged basis, the minor depths of elevation change in SDUs B1 and F2 (0.07 and -0.16 foot, respectively) are within the range of bathymetric survey accuracy (Table 2).

2.2 Depth of Contamination in Sediment

Table 3 provides a summary of estimated present-day depths of contamination (DOCs) in existing PGM sediment samples from pre-remediation sediment investigations (collected between 2007 and 2017) relative to the Year 3 mudline elevation. Year 3 DOC estimates were calculated based on the mudline elevation and the DOC at the time of sampling adjusted to the Year 3 mudline elevation in consideration of any material that was removed in dredging areas and/or placed in cap and cover

areas during the 2020 RA. The maximum exceedance ratio of PGM CULs at the DOC and the chemical associated with the maximum exceedance ratio are compiled for each sediment sample. In dredging areas where the upper portion of the contaminated sediment sequence was removed, the post-dredge exceedance ratios and chemicals were revised accordingly.

Detailed cross sections showing the distribution of subsurface contamination in the area where new Year 3 erosion of sediment or cover material was observed (i.e. along the seawall in SDU A and SDU F2; Figure 4c) are shown in Figure 7a (cross-section location map and PGM sampling locations), Figure 7b (longitudinal cross section along the base of the seawall in SDUs A and F2), and Figure 7b (transverse or downslope cross section through SDU F2). Historical sediment samples and sampling depths, maximum exceedance ratios, and the chemicals associated with the maximum exceedance ratios are projected onto the cross sections. The cross sections illustrate the DOC in historical sediment cores relative to the current Year 3 mudline elevations and surface sediment concentrations.

2.2.1 SDU A (GAC-Amended Sand Cover)

On average, 0.36 foot of erosion was observed in SDU A during Year 3, mainly in the upstream portion of SDU A along the top of the former dredging side slope (Table 2 and Figure 4c). This could be the result of material sloughing downslope or natural riverine redistribution processes. The elevations of cores PGM-05 and PGM-06 were reduced by 0.8 foot and 0.3 foot, respectively (Table 3 and Figure 7b). However, there is no imminent risk of exposure of buried contamination in SDU A for the following reasons:

- SDU A remains well covered with GAC-amended sand.
  - On an SDU-averaged basis, 1.4 feet of GAC-amended cover thickness remains throughout the area.
  - Core PGM-05 retains 1.5 feet of GAC-amended sand underlain by another 1.4 feet of sediment with relatively low exceedances within the range of natural recovery (approximately 2 to 3 times the CUL).
  - Core PGM-06 retains 3.1 feet of GAC-amended sand.
  - Cores PGM-35 and PGM-37, located downslope at the border with SDU C1, remain well covered with 2.5 and 2.7 feet of GAC-amended sand, respectively. In addition, the crease in the bathymetry at the base of the dredging side slope where these cores are located is net depositional.
- There were no exceedances of any COCs in Year 2 surface sediment samples SED-10 and SED-11, nor in Year 2 porewater samples TZW-10 and TZW-11 (Figure 7b).
- The amount of GAC needed to provide isolation of contaminated groundwater at PGM-05 and PGM-06 was estimated to be 0.1% GAC by weight, or less, as determined by cap modeling during remedial design (Anchor QEA 2020). The amount of GAC that was actually

placed in SDU A was 10% GAC by weight, or more, as determined through construction confirmation sampling (Anchor QEA 2021a), which provides 100 times more protectiveness for an equivalent thickness of cover material.

- There is little or no driving force to mobilize buried contamination in SDU A because the sheet pile wall at the base of the seawall inhibits groundwater discharge into SDU A, and groundwater advection velocities are near zero.

2.2.2 SDU F2 (MNR)

In SDU F2, an MNR area, all surface sediment samples (SS-08, SS-09, SED-05, and SED-06) are below CULs; surface sediment in the top foot of cores PGM-03, PGM-04, and PGM-42 are below CULs; and subsurface sediment in the 1- to 3-foot depth interval is either below CULs (PGM-42) or within the range of natural recovery processes (PGM-03 and PGM-04). Therefore, there is no imminent risk of exposure of buried contamination in SDU F2 (Figures 7b and 7c).

3 Conclusions

The results and conclusions of the Year 3 monitoring event are summarized in this section. Although some loss of GAC-amended material was observed, the majority of the site has seen negligible changes in mudline elevation. The results and conclusions of the Year 3 bathymetry are summarized as follows:

- The Year 3 multibeam bathymetry survey was performed on June 20, 2023, as shown in Figure 3.
- Bathymetric comparison maps and cross sections were prepared to assess the physical stability of the PGM remedy, as shown in Figures 4a through 4d, 5, 6a, 6b, and Table 2, and the distribution and thickness of remaining cap and cover material, as shown in Figure 8 and summarized in Table 2 (sample location basis) and Table 3 (SDU basis).
- In post-construction Year 1 (2020 through 2021), some loss and redistribution of placed material was observed in some unarmored cover areas as the river sought to reestablish a smooth hydraulic gradient after remedial construction. The main areas affected by material redistribution in Year 1 included SDU F1 (sand cover), SDU C3 (sand cover), and SDU D (GAC-amended sand cover).
- In post-construction Year 2 (2021 to 2022), the site had largely stabilized with minimal changes in bathymetric conditions, except for the following: 1) a relatively small scour hole developed in a downstream MNR area (SDU B1), apparently caused by propwash during Navy vessel docking or undocking during Fleet Week; and 2) continued downstream movement of sand cover material from MNR area SDU F1 to SDU F2 and SDU C1.
- In post-construction Year 3 (2022 to 2023), the site continued to exhibit minimal changes in bathymetric conditions, except for the following:
  - There was a loss of 6 to 12 inches of material along the seawall in SDU A; however, SDU A remains well covered with GAC-amended sand.
  - There was a loss of material from MNR area SDU F2; however, all surface samples are below CULs.
  - The scour hole that developed during Year 2 in SDU B1 following Fleet Week had partially filled in with 6 to 18 inches of new sediment.
- The riverbed has continued to establish a new hydraulic equilibrium following the 2020 RA and generally exhibits increased stability over the course of the monitoring program.

In summary, the remedy is working as designed, with no movement of the armored cap, and all buried contamination remains well isolated. In some cover areas, which were designed to be flexible technologies, movement of placed cover material has been observed during post-construction monitoring. However, sediment concentrations analyzed during the Year 2 monitoring event are either below CULs or are on track to achieve CULs within a few years (well ahead of the 7-year MNR

time frame assumed in the ROD [DEQ 2017]), even in areas where erosion has been observed. Minor areas of new erosion that were observed in Year 3 pose no imminent risk of exposure of buried contamination.

4 Recommendations

According to the *Long-Term Monitoring and Maintenance Plan* (LTMMP; Anchor QEA 2020, Appendix F), the next monitoring event (combined bathymetric survey and sediment/TZW/SW sampling event) is scheduled to occur in Year 5 (2025). In addition to this planned Year 5 event, the following interim monitoring task is recommended:

- **Year 4 Bathymetric Survey:** NW Natural recommends adding a contingency bathymetric survey in Year 4 (2024), in consideration of the movement and erosion of cover material observed in SDU A as well as in other areas in previous years. Consistent with previous surveys, the Year 4 bathymetric survey will be performed after Fleet Week ships have departed in mid- to late June. If areas of significant new erosion are observed, DEQ and NW Natural will discuss the need for follow-up chemical monitoring of sediment or TZW or other diagnostic tools such as GAC content determinations. Consistent with the LTMMP, areas of significant new erosion (i.e., erosion beyond what has already been documented and chemically verified in the Year 2 event) will be identified by DEQ and NW Natural on a case-by-case basis in consideration of the depth, extent, and volume of new erosion and the potential risk of exposing underlying contamination.

5 References

Anchor QEA (Anchor QEA, LLC), 2020. *Revised Final Design Report, Version 4*. Former Portland Gas Manufacturing Site. Prepared for NW Natural. March 2, 2020.

Anchor QEA, 2021a. *Project Completion Report*. Former Portland Gas Manufacturing Site. Prepared for NW Natural. May 4, 2021.

Anchor QEA, 2021b. *Year 0 Monitoring Report: PGM Long-Term Monitoring and Maintenance*. Former Portland Gas Manufacturing Site. Prepared for NW Natural. June 7, 2021.

Anchor QEA, 2021c. *Year 1 Monitoring Report: PGM Long-Term Monitoring and Maintenance*. Former Portland Gas Manufacturing Site. Prepared for NW Natural. December 23, 2021.

Anchor QEA, 2023. *Year 2 Monitoring Report: PGM Long-Term Monitoring and Maintenance*. Former Portland Gas Manufacturing Site. Prepared for NW Natural. June 16, 2023.

DEQ (Oregon Department of Environmental Quality), 2017. *Record of Decision – Selected Remedial Action for Former Portland Gas Manufacturing*. Portland, Oregon. Prepared by Oregon Department of Environmental Quality, Northwest Region Cleanup Section. June 2017.

EPA (U.S. Environmental Protection Agency), 2016. *Portland Harbor RI/FS Feasibility Study Report*. Prepared by EPA and CDM Smith. June 2016. Available at: https://semspub.epa.gov/work/10/840000.pdf

USACE (U.S. Army Corps of Engineers), 2013. *Hydrographic Surveying*. Engineer Manual. EM 1110-2-1003. November 30, 2013.

Tables

Table 1
PGM Cleanup Levels

Analyte	Cleanup Level[1]	Units	Reference
Aquatic Life Criteria			
Sediment[2]			
Lead	128	mg/kg	PEC, MacDonald et al. 2000
Mercury	1.06	mg/kg	PEC, MacDonald et al. 2000
Zinc	459	mg/kg	PEC, MacDonald et al. 2000
Anthracene	845	µg/kg	PEC, MacDonald et al. 2000
Benz(a)anthracene	1,050	µg/kg	PEC, MacDonald et al. 2000
Benzo(a)pyrene	1,450	µg/kg	PEC, MacDonald et al. 2000
Chrysene	1,290	µg/kg	PEC, MacDonald et al. 2000
Fluoranthene	2,230	µg/kg	PEC, MacDonald et al. 2000
Fluorene	536	µg/kg	PEC, MacDonald et al. 2000
Naphthalene	561	µg/kg	PEC, MacDonald et al. 2000
Phenanthrene	1,170	µg/kg	PEC, MacDonald et al. 2000
Pyrene	1,520	µg/kg	PEC, MacDonald et al. 2000
Total PAH[3]	22,800	µg/kg	PEC, MacDonald et al. 2000
TPH-diesel	340	mg/kg	WAC 173-204, Table VI
TPH-residual	3,600	mg/kg	WAC 173-204, Table VI
Transition Zone Water/Surface Water[4]			
Free Cyanide	0.0052	mg/L	OAR 340-041, Table 30
Lead[5]	0.54	µg/L	OAR 340-041, Table 30
Mercury	0.012	µg/L	OAR 340-041, Table 30
Zinc[5]	36	µg/L	OAR 340-041, Table 30
2-Methylnaphthalene	72	µg/L	EPA 2003 Final Chronic Value
Acenaphthene	56	µg/L	EPA 2003 Final Chronic Value
Acenaphthylene	307	µg/L	EPA 2003 Final Chronic Value
Anthracene	21	µg/L	EPA 2003 Final Chronic Value
Benzene	130	µg/L	ORNL 1996 Tier II Value
Benzo(a)anthracene	2.2	µg/L	EPA 2003 Final Chronic Value
Benzo(a)pyrene	0.96	µg/L	EPA 2003 Final Chronic Value
Benzo(b)fluoranthene	0.68	µg/L	EPA 2003 Final Chronic Value
Benzo(g,h,i)perylene	0.44	µg/L	EPA 2003 Final Chronic Value
Benzo(k)fluoranthene	0.64	µg/L	EPA 2003 Final Chronic Value
Chrysene	2	µg/L	EPA 2003 Final Chronic Value
Dibenzo(a,h)anthracene	0.28	µg/L	EPA 2003 Final Chronic Value
Ethylbenzene	7.3	µg/L	ORNL 1996 Tier II Value
Fluoranthene	7.1	µg/L	EPA 2003 Final Chronic Value
Fluorene	39	µg/L	EPA 2003 Final Chronic Value
Indeno(1,2,3-c,d)pyrene	0.28	µg/L	EPA 2003 Final Chronic Value
Naphthalene	194	µg/L	EPA 2003 Final Chronic Value
Phenanthrene	19	µg/L	EPA 2003 Final Chronic Value
Pyrene	10	µg/L	EPA 2003 Final Chronic Value
Toluene	9.8	µg/L	ORNL 1996 Tier II Value
Xylenes	13	µg/L	ORNL 1996 Tier II Value

Table 1
PGM Cleanup Levels

Analyte	Cleanup Level[1]	Units	Reference
Bioaccumulation Criteria (Site-Wide Mean and 90% UCL)			
Sediment[2,6]			
Fluoranthene	37,000	µg/kg	DEQ 2007
Pyrene	1,900	µg/kg	DEQ 2007
Near-Bottom Surface Water[7]			
Benzene	1.4	µg/L	OAR 340-041, Table 40
Benzo(a)anthracene	0.0018	µg/L	OAR 340-041, Table 40
Benzo(a)pyrene	0.0018	µg/L	OAR 340-041, Table 40
Benzo(b)fluoranthene	0.0018	µg/L	OAR 340-041, Table 40
Benzo(k)fluoranthene	0.0018	µg/L	OAR 340-041, Table 40
Chrysene	0.0018	µg/L	OAR 340-041, Table 40
Dibenzo(a,h)anthracene	0.0018	µg/L	OAR 340-041, Table 40
Ethylbenzene	210	µg/L	OAR 340-041, Table 40
Indeno(1,2,3-c,d)pyrene	0.0018	µg/L	OAR 340-041, Table 40
Toluene	1,500	µg/L	OAR 340-041, Table 40

Notes:

1. Certain cleanup levels may need to be adjusted for regional or local background conditions.
2. Applicability of cleanup levels in the top foot of sediment is based on a determination that the substrate is stable and not subject to significant erosion from currents or prop wash.
3. Cleanup levels include both total PAH and individual PAH criteria.
4. Cleanup levels for transition zone water are based on chronic ambient water quality criteria.
5. Lead and zinc water quality criteria are based on dissolved fraction and mean Willamette River hardness of 25 mg/L.
6. Surface sediment bioaccumulation criteria for PAHs are based on protection of fish, the most sensitive receptor group.
7. Surface water bioaccumulation criteria are based on protection of humans, the most sensitive receptor group, via fish consumption; the cleanup level is based on a fish ingestion rate of 175 g/day. Bioaccumulation criteria are only listed for those analytes whose criteria are more stringent than the corresponding benthic criteria.

µg/kg: microgram per kilogram
µg/L: microgram per liter
g/day: gallon per day
mg/kg: milligram per kilogram
mg/L: milligram per liter
OAR: Oregon Administrative Rule
PAH: polycyclic aromatic hydrocarbon
PEC: probable effects concentration
TPH: total petroleum hydrocarbon
UCL: upper confidence limit
WAC: Washington Administrative Code

References:

DEQ (Oregon Department of Environmental Quality), 2007. *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment.* Environmental Cleanup Program. January 31, 2007.

EPA (U.S. Environmental Protection Agency), 2003. *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH mixtures.* Office of Research and Development. EPA-600-R-02-013. November 2003.

MacDonald, D.D., C.G. Ingersoll, T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." *Archives of Environmental Contamination and Toxicology* 39(1):20–31.

ORNL (Oak Ridge National Laboratory), 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision.* ES/ER/TM-96/R2. Prepared for the U.S. Department of Energy. June 1996.

Table 2

Average SDU and Site-Wide Bathymetric Differences and Cap/Cover/Infill Thicknesses

SDU	Average Bathymetric Difference Measurement (feet)				Estimated Cap/Cover/Infill Thickness (feet)
	Year 1	Year 2	Year 3	Cumulative	
Start:	**October 2020**	**July 2021**	**June 2022**	**October 2020**	**June/August 2020**[1]
End:	**July 2021**	**June 2022**	**June 2023**	**June 2023**	**June 2023**
Armored Cap					
C1	0.90	-0.01	0.16	1.05	3.85
E	0.52	-0.28	-0.03	0.21	3.11
GAC/Sand Cover					
A	0.38	-0.29	-0.36	-0.24	1.42
D	-0.89	-0.24	-0.03	-1.17	0.61
Sand Cover (EMNR)					
B2	0.26	-0.30	-0.01	-0.04	1.20
C3	-0.26	-0.36	0.24	-0.38	1.13
F1	-0.63	-0.58	-0.13	-1.33	0.04
MNR					
B1	0.32	-0.38	0.10	0.06	0.07
F2	0.43	-0.35	-0.37	-0.27	-0.16
Residuals Cover					
G	-0.44	-0.34	0.13	-0.65	0.60
H	-0.23	-0.26	-0.04	-0.52	0.57
No Action					
Other[2]	0.09	-0.22	0.10	-0.03	0.13
Work Site Total	0.19	-0.26	0.00	-0.06	0.97

Legend for Average Bathymetric Difference Measurements:

- Measurable deposition occurred during the specified time interval.
- Measurable erosion occurred during the specified time interval.
- Bathymetric difference greater than ± 0.3 feet (Year 3 only)
- Bathymetric difference is within the range of survey measurement accuracy (± 0.5 feet), indicating deposition and/or erosion are uncertain.

Notes:

1. Post-dredge/post-debris removal surface (pre-cap/pre-cover) merged with pre-construction surface in undredged areas.
2. Includes outer peripheral areas within the PGM Work Site not assigned to an SDU.

EMNR: enhanced monitored natural recovery

GAC: granular activated carbon

MNR: monitored natural recovery

PGM: Portland Gas Manufacturing

SDU: Sediment Decision Unit

Table 3

Year 3 Estimated Depth of Contamination

Sample Name	SDU	Elevation ATS (feet COP)	Elevation 2023 (feet COP)	Elevation Post-Dredge (feet COP)	DOC ATS (feet bml)	Exceed Ratio ATS	Exceed Chemical ATS	Dredge Depth (feet bml ATS)	Exceed Ratio Post-Dredge	Exceed Chemical Post-Dredge	DOC 2023 (feet bml)	DOC Notes
PGM-05	A	-22.3	-22.4	-23.9	0	1.1	Pb	1.6	4.3	Hg	1.5	G
PGM-06	A	-24.4	-23.7	-26.8	0	2.9	Pyr	2.4	24.0	Zn	3.1	G
PGM-08	A	-26.6	-21.3	nd	1	>HSC	PAH	nd	nd	nd	6.3	G
PGM-35	A-C1	-25.3	-26.9	-29.4	0	>HSC	PAH	4.1	>HSC	PAH	2.5	G
PGM-37	A-C1	-25.2	-26.8	-29.5	1	1.7	Hg	4.3	8.9	Naph	2.7	G
G780	B1	-23.8	-22.3	nd	--	--	--	nd	nd	nd	--	nc
PGM-09	B1	-25.0	-23.9	nd	1	1.8	TPH	nd	nd	nd	2.1	nc
PGM-11B	B1	-32.6	-32.9	nd	1	19.6	Naph	nd	nd	nd	0.7	nc
SS-04	B1	-35.3	-35.7	nd	--	--	--	nd	nd	nd	--	nc
SS-05	B1	-20.0	-19.2	nd	--	--	--	nd	nd	nd	--	nc
UG07	B1	-30.5	-29.7	nd	0	1.5	TPH	nd	nd	nd	0.8	nc
PGM-10	B2	-30.0	-28.3	nd	0	9.4	Phen	nd	nd	nd	1.7	S
SS-03	B2	-25.9	-24.3	nd	--	--	--	nd	nd	nd	--	S
PGM-18	C1	-29.3	-28.7	-32.7	1	11	Pyr	3.4	3.9	Pyr	4.0	G, A
PGM-34	C1	-28.8	-28.7	-32.2	0	4.3	Phen	3.4	>HSC	PAH	3.6	G, A
PGM-39	C1	-28.4	-28.2	-32.7	1	19	Phen	4.3	--	--	--	G, A
PGM-07	C3	-29.4	-28.7	nd	1	1.6	Pyr	nd	nd	nd	1.8	S
UC08/UG08	C3	-28.3	-26.4	nd	1	4.4	Phen	nd	nd	nd	2.9	S
PGM-24	D	-37.7	-38.8	-38.8	3	>HSC	PAH	1.1	>HSC	PAH	1.9	G
PGM-15B	E	-28.4	-29.3	-32.2	0	>HSC	TLM	3.8	23	Naph	2.9	G, A
PGM-16	E	-33.3	-32.3	-35.2	0	28	Naph	1.9	41	Naph	3.0	G, A
PGM-40	E	-29.4	-30.2	-32.7	0	>HSC	TLM	3.2	5.4	Naph	2.5	G, A
G783/C783	F1	-28.6	-28.4	nd	0	5.2	Pyr	nd	nd	nd	0.2	S
PGM-14	F1	-30.9	-30.4	nd	0	3.9	Phen	nd	nd	nd	0.5	S
SS-12	F1	-30.3	-30.7	nd	--	--	--	nd	nd	nd	--	S
PGM-03	F2	-23.3	-22.1	nd	1	3.5	TPH	nd	nd	nd	2.3	nc
SS-08	F2	-22.8	-22.8	nd	--	--	--	nd	nd	nd	--	nc
SS-09	F2	-22.4	-22.5	nd	--	--	--	nd	nd	nd	--	nc
SS-10	F2	-28.2	-29.3	nd	--	--	--	nd	nd	nd	--	nc
SS-11	F2	-27.2	-26.3	nd	--	--	--	nd	nd	nd	--	nc
PGM-41	G	-34.8	-36.6	-37.2	0	>HSC	PAH	2.4	--	--	--	S

Table 3
Year 3 Estimated Depth of Contamination

Sample Name	SDU	Elevation ATS (feet COP)	Elevation 2023 (feet COP)	Elevation Post-Dredge (feet COP)	DOC ATS (feet bml)	Exceed Ratio ATS	Exceed Chemical ATS	Dredge Depth (feet bml ATS)	Exceed Ratio Post-Dredge	Exceed Chemical Post-Dredge	DOC 2023 (feet bml)	DOC Notes
PGM-04	H	-27.9	-28.3	nd	1	1.5	Pb	nd	nd	nd	0.7	S
PGM-33	H	-33.9	-34.3	nd	--	--	--	nd	nd	nd	--	S
PGM-38	H	-31.6	-33.1	-32.3	--	--	--	0.7	--	--	--	S
PGM-42	H	-30.1	-30.0	nd	--	--	--	nd	nd	nd	--	S

Notes:
Shaded cells represent current 2022 subsurface conditions.
--: All sediments at these locations are below PGM cleanup levels.
ATS: at time of sampling
bml: below mudline
COP: City of Portland datum
DOC: depth of contamination
nd: not dredged
SDU: Sediment Decision Unit

DOC Notes:
Sediment isolation layer includes the following cap and cover materials:
A: armor
G: sand amended with granular activated carbon
S: sand
nc: no cap or cover placed in these areas

Exceedance Chemicals:
>HSC: above PGM hot spot criteria
Hg: mercury
Naph: naphthalene
PAH: polycyclic aromatic hydrocarbon
Pb: lead
Phen: phenanthrene
Pyr: pyrene
TLM: tar-like material
TPH: total petroleum hydrocarbons, diesel fraction
Zn: zinc

Figures

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SOURCE: ©DeLorme, Topo USA®.

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Filepath: K:\Projects\0029-NW Natural Gas Co\Portland Gas Manufacturing Site_Long Term Monitoring_Year 3 Monitoring Report\0029-RP-001 (Vicinity Map-Year 3 MR).dwg Figure 1

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Figure 1
Site Vicinity Map

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

DRAFT

SOURCE: Hydrographic survey conducted by eTrac on June 20, 2023. Aerial Photograph from Oregon Metro, dated October 25, 2017.
HORIZONTAL DATUM: Oregon State Plane North Zone, North American Datum of 1983 (NAD83), International Feet
VERTICAL DATUM: City of Portland Datum (COP), converted from NAVD88 (-2.10 Feet)
NOTE:
GAC: granular activated carbon

LEGEND:

- City of Portland Sanitary Sewer Utilities
- A — Sediment Decision Unit (SDU) Area
- June 2023 Bathymetric Contours (1- and 5-Foot Intervals)
- 10 — Bollard Location and Number
- Work Site Boundary

REMEDIAL TECHNOLOGIES:

- B1, F2 — Monitored Natural Recovery (MNR)
- B2, C3, F1 — Enhanced MNR (EMNR)
- A, D — GAC-Amended Treatment Cover
- C1 — Partial Dredge and Armored Treatment Cap
- E — Surface Product Removal with Armored Treatment Cap
- G — Full Dredge and Residual Cover
- H — Side Slope Dredge and Residual Cover

0 60 Feet

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Figure 2
Sediment Decision Units and Remedial Technologies

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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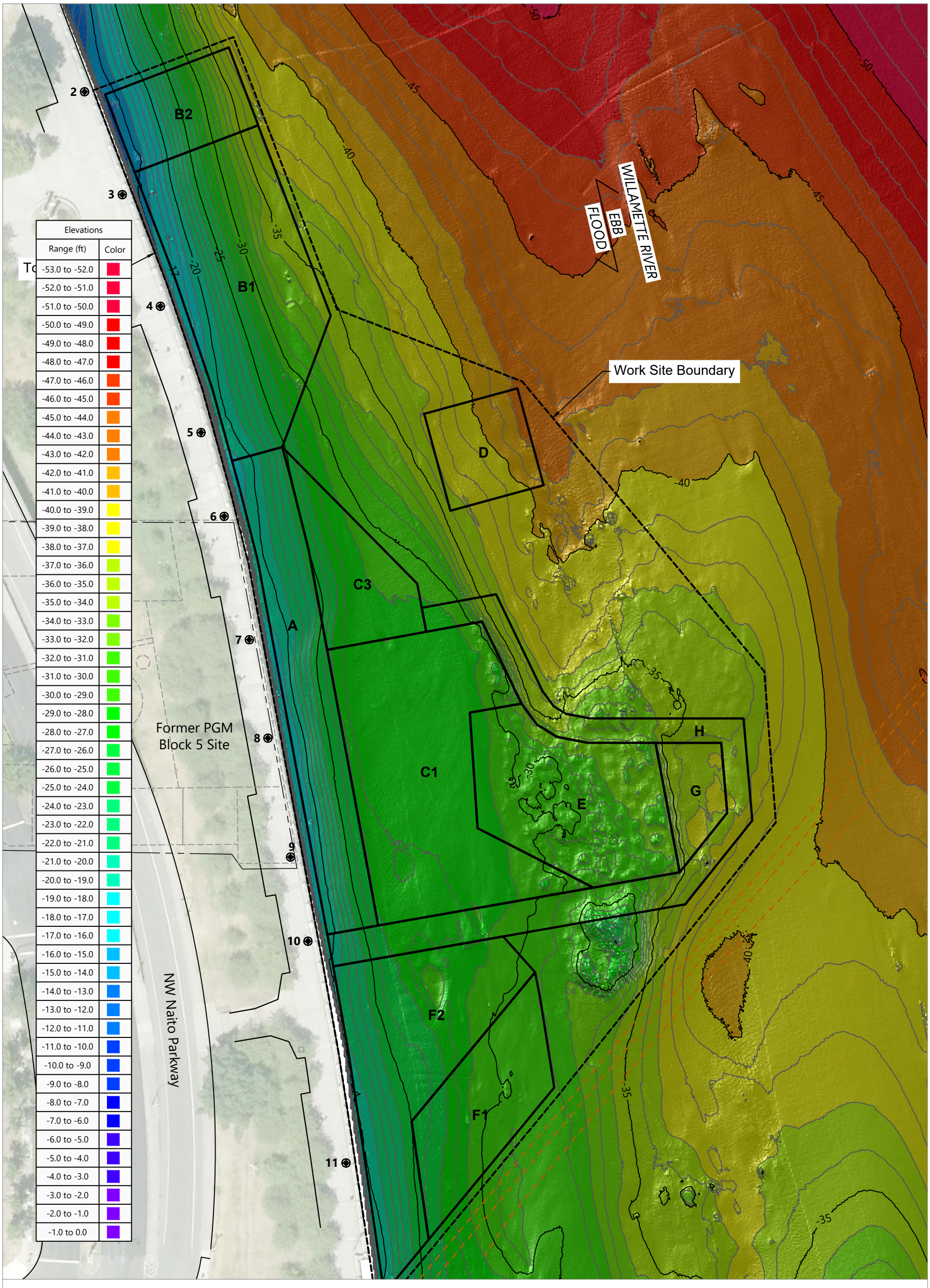

SOURCE: Hydrographic survey conducted by eTrac on June 20, 2023. Aerial Photograph from Oregon Metro, dated October 25, 2017.
HORIZONTAL DATUM: Oregon State Plane North Zone, North American Datum of 1983 (NAD83), International Feet
VERTICAL DATUM: City of Portland Datum (COP), converted from NAVD88 (-2.10 Feet)

LEGEND:

- City of Portland Sanitary Sewer Utility
- A — Sediment Decision Unit (SDU) Area
- 2 — Bollard Location and Number
- June 2023 Bathymetric Contours (1- and 5-Foot Intervals)

0 60
Feet

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Figure 3
Year 3 Bathymetry – June 2023

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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SDU	Remedy
C1	Navigation Dredge, Armored GAC Cap
E	Hot Spot Dredge, Armored GAC Cap
A	Side-slope Dredge, GAC Cover
D	Debris Removal, GAC Cover
B2	Sand Cover (Enhanced MNR)
F1	Sand Cover (Enhanced MNR)
C3	Sand Cover (Enhanced MNR)
G	Dredge to Clean, Residuals Cover
H	No Contamination, Residuals Cover
B1	Monitored Natural Recovery (MNR)
F2	Monitored Natural Recovery (MNR)

Elevations			
Range (ft)	Color	Area (sf)	Volume (cy)
-2.0 to -1.5		547	2
-1.5 to -1.0		4,653	43
-1.0 to -0.5		12,478	199
-0.5 to 0.0		19,051	486
0.0 to 0.5		69,787	1222
0.5 to 1.0		17,007	330
1.0 to 1.5		8,015	117
1.5 to 2.0		2,387	26
2.0 to 2.5		431	3

NOTE: Positive elevations represent deposition and negative elevations represent erosion relative to the October 2020 post-construction surface.

Existing Features:

- City of Portland Sanitary Sewer Utility
- Sediment Decision Unit Areas
- Bollard Location and Number
- 2022 Bathymetric Contours (1- and 5-Foot Intervals)
- Direct TZW/SW Sample Adjacent to Manhole Sampling Device (Amored GAC-Amended Cap)

Long-Term Monitoring Locations:

- Surface Sediment Grab Sample (MNR/EMNR Areas)
- Colocated Surface Sediment Grab Sample and TZW/SW Sample (GAC-Amended Cover)
- Colocated Surface Sediment Grab Sample and Porewater Sample (Armored, GAC-Amended Cap)
- As-Built: Permanent, Manhole-Type Porewater Sampling Device

0 60 Feet

SOURCE: Year 0 hydrographic survey conducted by Meyer Hydrographic on October 15, 2020. Year 1 hydrographic survey conducted by Meyer Hydrographic on July 28, 2021. Aerial Photograph from Oregon Metro, dated October 25, 2017.
HORIZONTAL DATUM: Oregon State Plane North Zone NAD83, International Feet
VERTICAL DATUM: City of Portland (COP)

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Filepath: K:\Projects\0029-NW Natural Gas Co\Portland Gas Manufacturing Site_Long Term Monitoring_Year 3 Monitoring Report\0029-RP-007 (Isopach-2020 vs 2021).dwg Figure 4a

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Figure 4a
2020 vs. 2021 Bathymetry Comparison

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

SDU	Remedy
C1	Navigation Dredge, Armored GAC Cap
E	Hot Spot Dredge, Armored GAC Cap
A	Side-slope Dredge, GAC Cover
D	Debris Removal, GAC Cover
B2	Sand Cover (Enhanced MNR)
F1	Sand Cover (Enhanced MNR)
C3	Sand Cover (Enhanced MNR)
G	Dredge to Clean, Residuals Cover
H	No Contamination, Residuals Cover
B1	Monitored Natural Recovery (MNR)
F2	Monitored Natural Recovery (MNR)

NOTE: Positive elevations represent deposition, and negative elevations represent erosion relative to the July 2021 surface.

Difference in Elevation Between Base Surface and Comparison Surface (Positive Values Indicate the Comparison Surface is a Higher Elevation)	
Vertical Difference in Feet	Color
-3.0 to -1.5	
-1.5 to -1.0	
-1.0 to -0.5	
-0.5 to 0.0	
0.0 to 0.5	
0.5 to 1.0	
1.0 to 1.5	

Existing Features:

- City of Portland Sanitary Sewer Utility
- A — Sediment Decision Unit Areas
- 2 — Bollard Location and Number
- 2022 Bathymetric Contours (1- and 5-Foot Intervals)
- Direct TZW/SW Sample Adjacent to Manhole Sampling Device (Amored GAC-Amended Cap)

Long-Term Monitoring Locations:

- Surface Sediment Grab Sample (MNR/EMNR Areas)
- Colocated Surface Sediment Grab Sample and TZW/SW Sample (GAC-Amended Cover)
- Colocated Surface Sediment Grab Sample and Porewater Sample (Armored, GAC-Amended Cap)
- As-Built: Permanent, Manhole-Type Porewater Sampling Device

0 60 Feet

SOURCE: Year 1 hydrographic survey conducted by Meyer Hydrographic on July 28, 2021. Year 2 hydrographic survey conducted by eTrac on June 14, 2022. Aerial Photograph from Oregon Metro, dated October 25, 2017.
HORIZONTAL DATUM: Oregon State Plane North Zone NAD83, International Feet
VERTICAL DATUM: City of Portland (COP)

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Figure 4b
2021 vs. 2022 Bathymetry Comparison

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

SDU	Remedial Technology
A	GAC-Amended Treatment (Gravelly Sand with GAC)
B1	MNR
B2	EMNR (Gravelly Sand)
C1	Partial Dredge/Armored Treatment Cap
C3	EMNR (Sand)
D	GAC-Amended Treatment (Sand with GAC)
E	Hot Spot Dredge/Armored Treatment Cap
F1	EMNR (Sand)
F2	MNR
G	Full Dredge and Residual Cover
H	Residual Cover

Top of Seawall

Work Site Boundary

WILLAMETTE RIVER

NW Naito Parkway

Former PGM Block 5 Site

Difference in Elevation Between Base Surface and Comparison Surface (Positive Values Indicate the Comparison Surface is a Higher Elevation)	
Vertical Difference in Feet	Color
-3.0 to -1.5	
-1.5 to -1.0	
-1.0 to -0.5	
-0.5 to 0.0	
0.0 to 0.5	
0.5 to 1.0	
1.0 to 1.5	
1.5 to 2.0	
2.0 to 2.5	
2.5 to 3.0	

NOTE: Positive elevations represent deposition, and negative elevations represent erosion relative to the June 2022 surface.

Existing Features:

- City of Portland Sanitary Sewer Utility
- A — Sediment Decision Unit Areas
- 2 — Bollard Location and Number
- 2023 Bathymetric Contours (1- and 5-Foot Intervals)
- Direct TZW/SW Sample Adjacent to Manhole Sampling Device (Amored GAC-Amended Cap)

Long-Term Monitoring Locations:

- Surface Sediment Grab Sample (MNR/EMNR Areas)
- Colocated Surface Sediment Grab Sample and TZW/SW Sample (GAC-Amended Cover)
- Colocated Surface Sediment Grab Sample and Porewater Sample (Armored, GAC-Amended Cap)
- As-Built: Permanent, Manhole-Type Porewater Sampling Device

0 60 Feet

SOURCE: Year 2 hydrographic survey conducted by eTrac on June 14, 2022. Year 3 hydrographic survey conducted by eTrac on June 20, 2023. Aerial Photograph from Oregon Metro, dated October 25, 2017.
HORIZONTAL DATUM: Oregon State Plane North Zone NAD83, International Feet
VERTICAL DATUM: City of Portland (COP)

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Figure 4c
2022 vs. 2023 Bathymetry Comparison

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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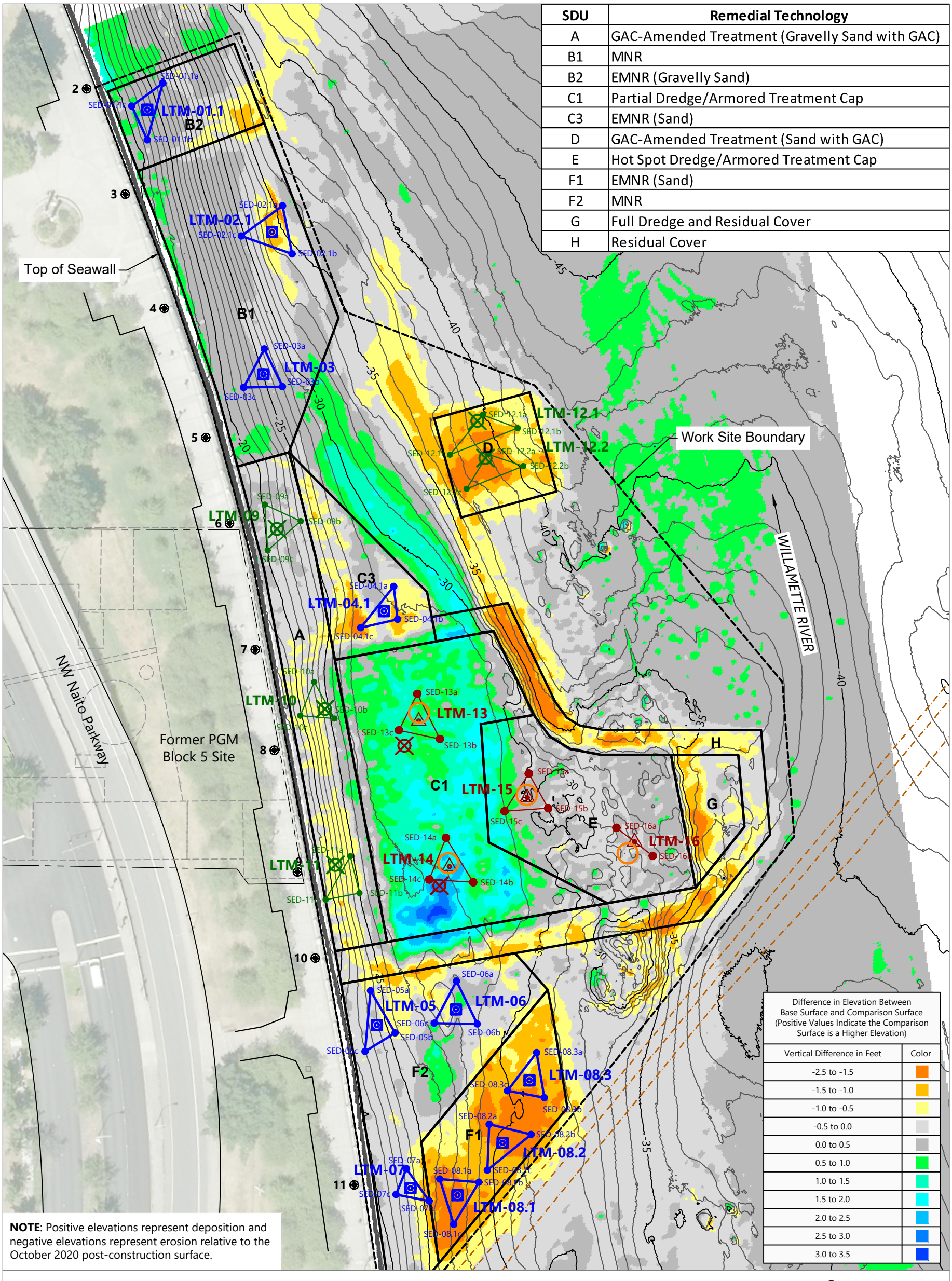
SDU	Remedial Technology
A	GAC-Amended Treatment (Gravelly Sand with GAC)
B1	MNR
B2	EMNR (Gravelly Sand)
C1	Partial Dredge/Armored Treatment Cap
C3	EMNR (Sand)
D	GAC-Amended Treatment (Sand with GAC)
E	Hot Spot Dredge/Armored Treatment Cap
F1	EMNR (Sand)
F2	MNR
G	Full Dredge and Residual Cover
H	Residual Cover



NOTE: Positive elevations represent deposition and negative elevations represent erosion relative to the October 2020 post-construction surface.

Existing Features:

- City of Portland Sanitary Sewer Utility
- A — Sediment Decision Unit Areas
- 2 — Bollard Location and Number
- 2022 Bathymetric Contours (1- and 5-Foot Intervals)
- Direct TZW/SW Sample Adjacent to Manhole Sampling Device (Amored GAC-Amended Cap)

Long-Term Monitoring Locations:

- Surface Sediment Grab Sample (MNR/EMNR Areas)
- Colocated Surface Sediment Grab Sample and TZW/SW Sample (GAC-Amended Cover)
- Colocated Surface Sediment Grab Sample and Porewater Sample (Armored, GAC-Amended Cap)
- 2 — As-Built: Permanent, Manhole-Type Porewater Sampling Device

0 60 Feet

SOURCE: Year 0 hydrographic survey conducted by Meyer Hydrographic on October 15, 2020. Year 3 hydrographic survey conducted by eTrac on June 20, 2023. Aerial Photograph from Oregon Metro, dated October 25, 2017.
HORIZONTAL DATUM: Oregon State Plane North Zone NAD83, International Feet
VERTICAL DATUM: City of Portland (COP)

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Figure 4d
2020 vs. 2023 Bathymetry Comparison

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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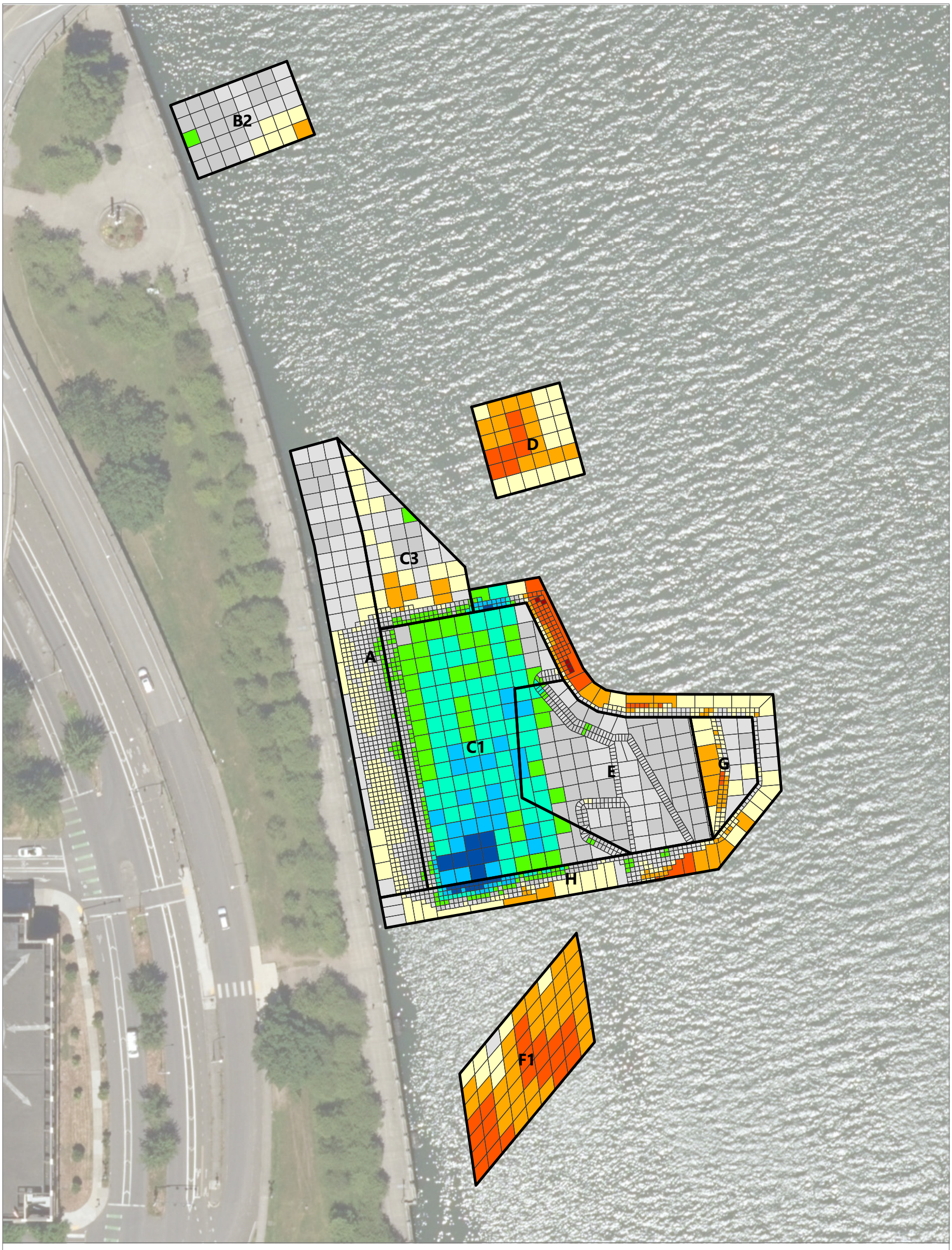

Mean Elevation Difference in Feet[1]

- <=-2
- -1.9 to -1.5
- -1.4 to -1
- -0.9 to -0.5
- -0.4 to 0
- 0.1 to 0.5
- 0.6 to 1
- 1.1 to 1.5
- 1.6 to 2
- >2

NOTES:
1. Positive elevations represent deposition, and negative elevations represent erosion relative to the October 2020 post-construction surface.
2. Year 3 bathymetric survey data for June 20, 2023, provided by eTrac, Inc.
3. Vertical datum is City of Portland, International Feet.
4. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
5. Aerial imagery provided by City of Portland, Oregon, and dated summer 2022.

0 80
Feet

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Figure 5
2020 vs. 2023 Bathymetry Grid Comparison
Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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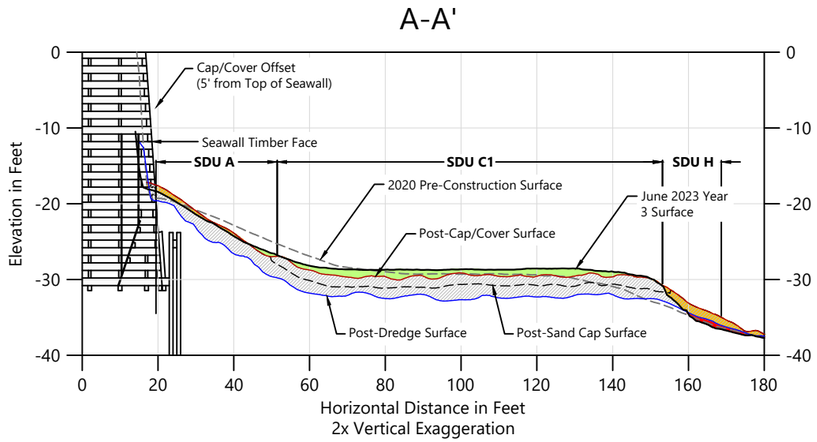

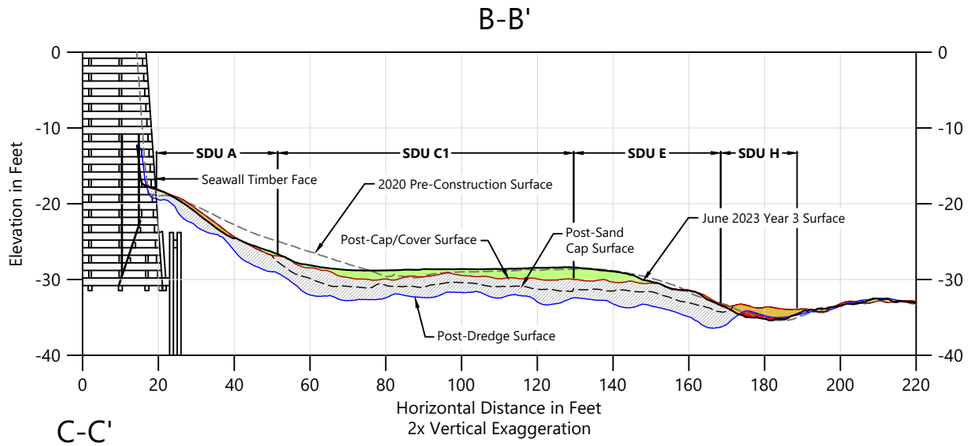

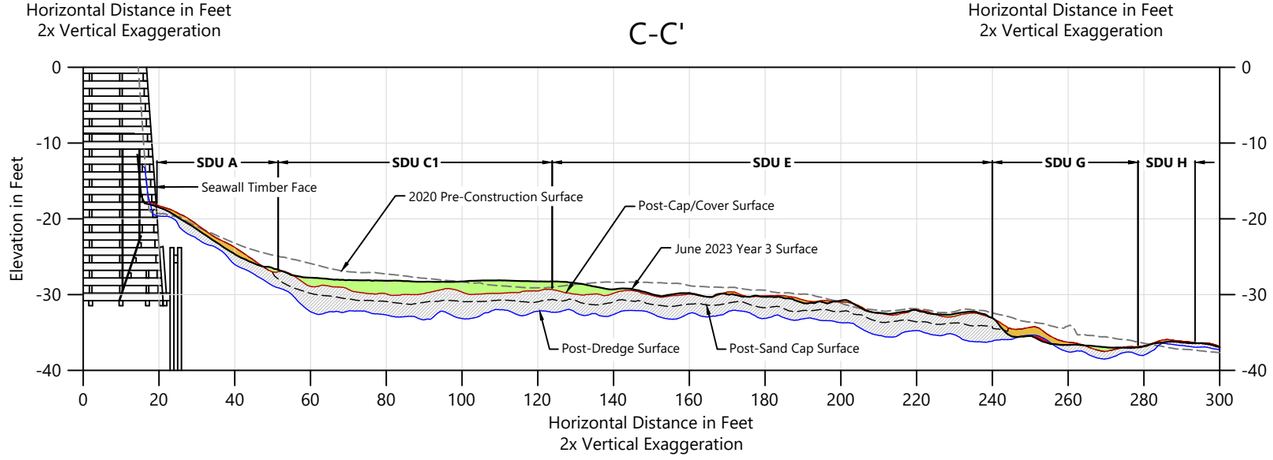

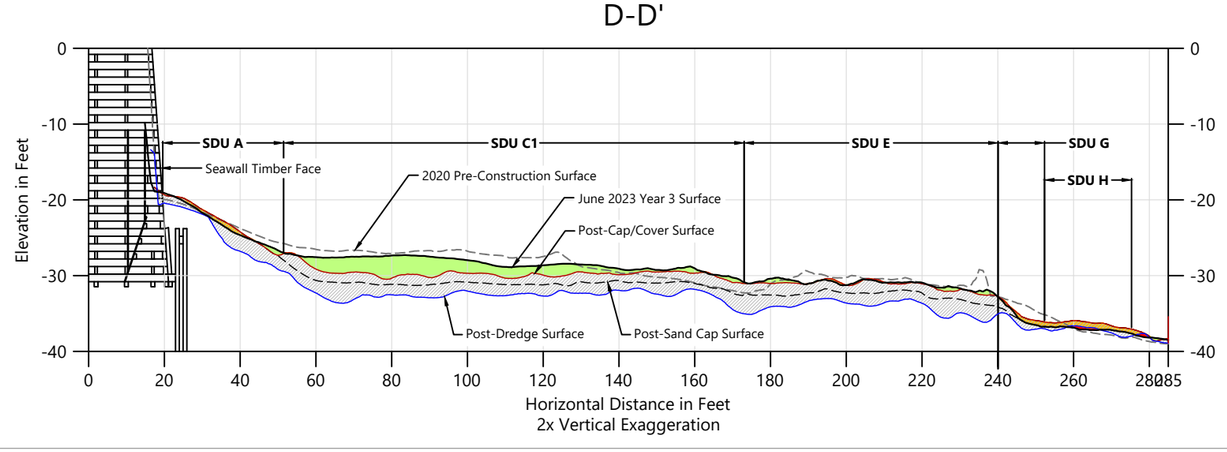

SDU	Remedial Technology
A	GAC-Amended Treatment (Gravelly Sand with GAC)
B1	MNR
B2	EMNR (Gravelly Sand)
C1	Partial Dredge/Armored Treatment Cap
C3	EMNR (Sand)
D	GAC-Amended Treatment (Sand with GAC)
E	Hot Spot Dredge/Armored Treatment Cap
F1	EMNR (Sand)
F2	MNR
G	Full Dredge and Residual Cover
H	Residual Cover

LEGEND:

- Cap/Cover Thickness
- Area of Cap/Cover/Sediment Erosion
- Area of Cap/Cover/Sediment Accretion
- Area of Erosion to Pre-Cap/Cover Elevation

HORIZONTAL DATUM: Oregon State Plane North Zone, North American Datum of 1983 (NAD83), International Feet
VERTICAL DATUM: City of Portland Datum (COP), converted from NAVD88 (-2.10 Feet)

0 40
Feet

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Figure 6a
2020 vs. 2023 Bathymetry Comparison Cross Sections (Part 1)
Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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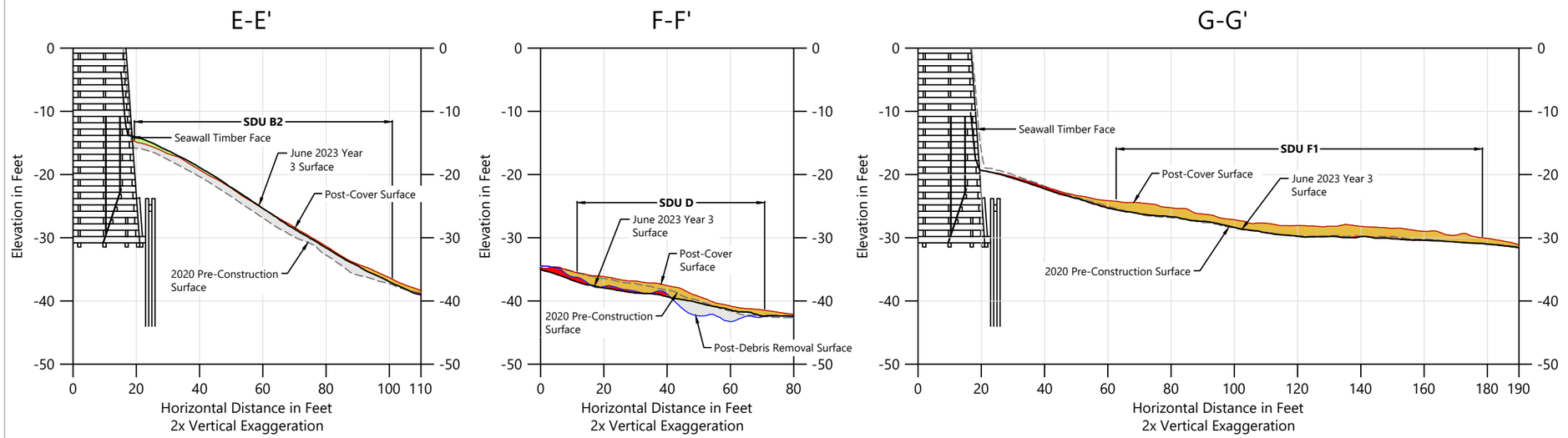

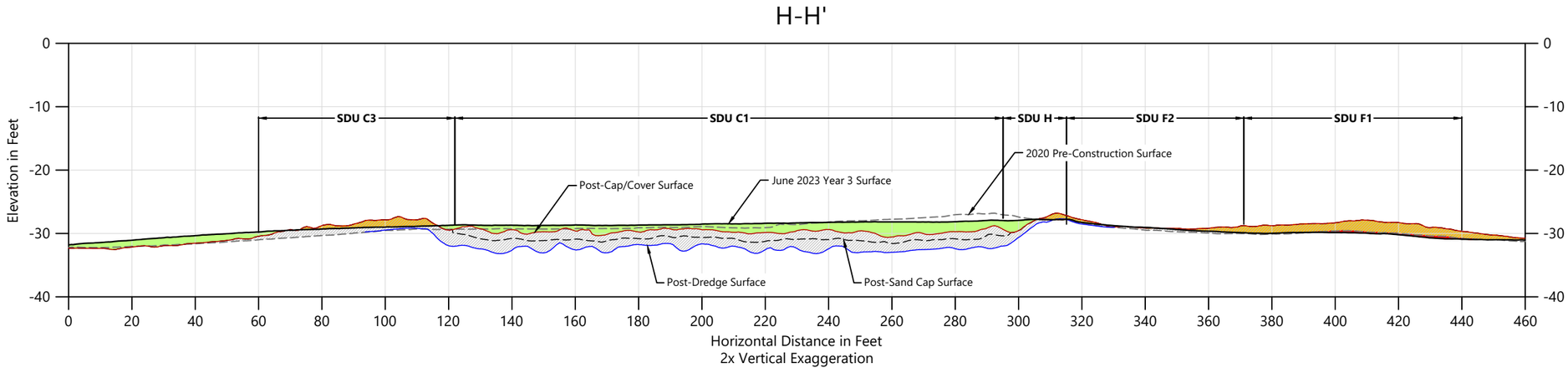

SDU	Remedial Technology
A	GAC-Amended Treatment (Gravelly Sand with GAC)
B1	MNR
B2	EMNR (Gravelly Sand)
C1	Partial Dredge/Armored Treatment Cap
C3	EMNR (Sand)
D	GAC-Amended Treatment (Sand with GAC)
E	Hot Spot Dredge/Armored Treatment Cap
F1	EMNR (Sand)
F2	MNR
G	Full Dredge and Residual Cover
H	Residual Cover

LEGEND:

- Cap/Cover Thickness
- Area of Cap/Cover/Sediment Erosion
- Area of Cap Cover Accretion
- Area of Erosion to Pre-Cap/Cover Elevation

HORIZONTAL DATUM: Oregon State Plane North Zone, North American Datum of 1983 (NAD83), International Feet
VERTICAL DATUM: City of Portland Datum (COP), converted from NAVD88 (-2.10 Feet)

0 40
Feet

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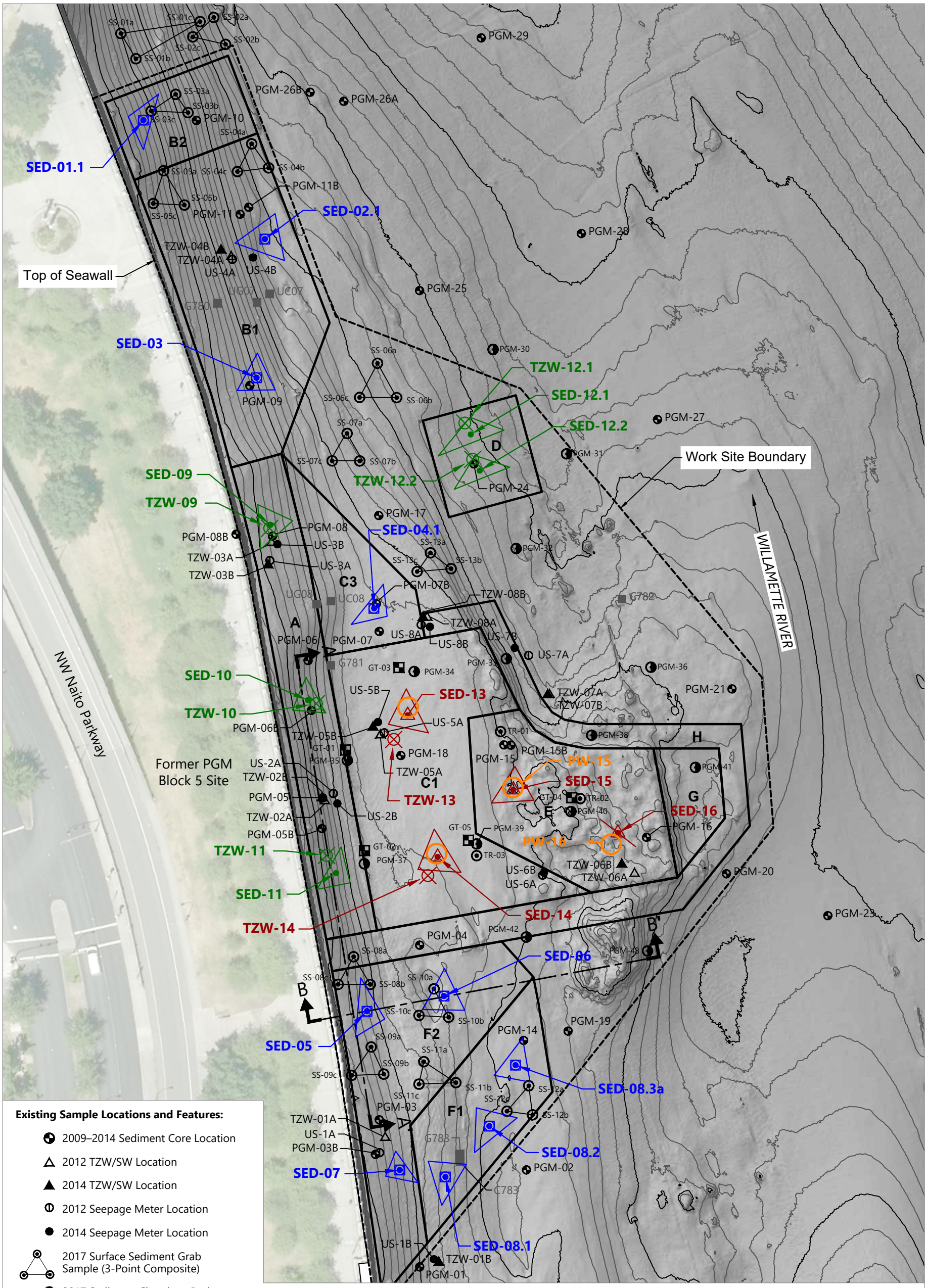
Figure 6b
2020 vs. 2023 Bathymetry Comparison Cross Sections (Part 2)
Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

DRAFT



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Filepath: K:\Projects\0029-NW Natural Gas Co\Portland Gas Manufacturing Site_Long Term Monitoring_Year 3 Monitoring Report\0029-RP-009 (Sections-Subsurf-Contam-Year 3 MR).dwg Figure 7a

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Figure 7a
Detailed Cross Sections of Subsurface Contamination – Location Map

Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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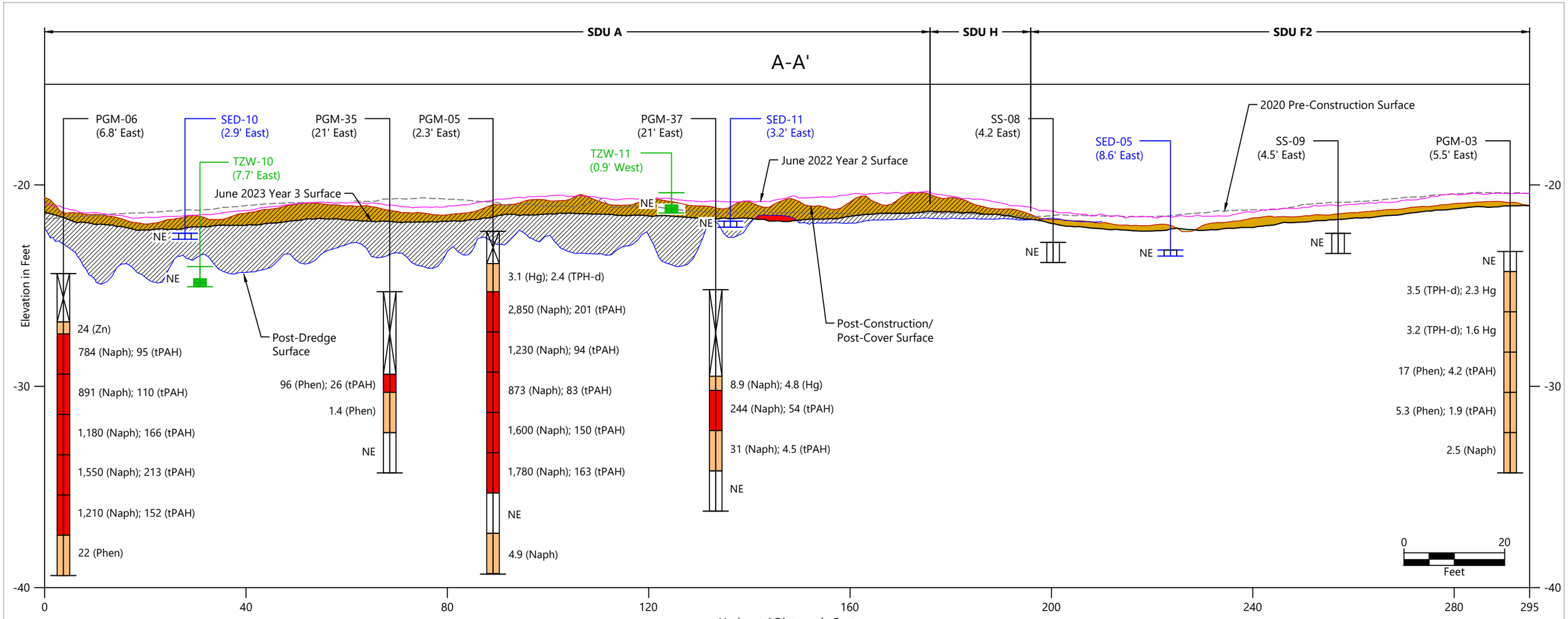

VERTICAL DATUM: City of Portland Datum (COP), converted from NAVD88 (-2.10 Feet)

ABBREVIATION KEY:

Hg	Mercury
Naph	Napthalene
Pb	Lead
Phen	Phenanthrene
Pyr	Pyrene
tPAH	Total PAH
TPH-d	TPH - Diesel
Zn	Zinc
NE	No Exceedances

LEGEND:

- Cap/Cover Thickness
- Area of Erosion
- Area of Accretion
- Historical Sediment Core
- Year 2 Surface Sediment Sample
- Year 2 Porewater Sample
- Sample Interval
- Cleanup Level Exceedance Interval
- Hot Spot Criterion Exceedance Interval
- Dredged Sample Interval
- 2020 Pre-Construction Surface
- Post-Debris Removal Surface
- Post-Construction/Post-Cover Surface
- June 2022 Year 2 Surface
- June 2023 Year 3 Surface

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Figure 7b
Detailed Cross Sections of Subsurface Contamination (Part 1)
Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

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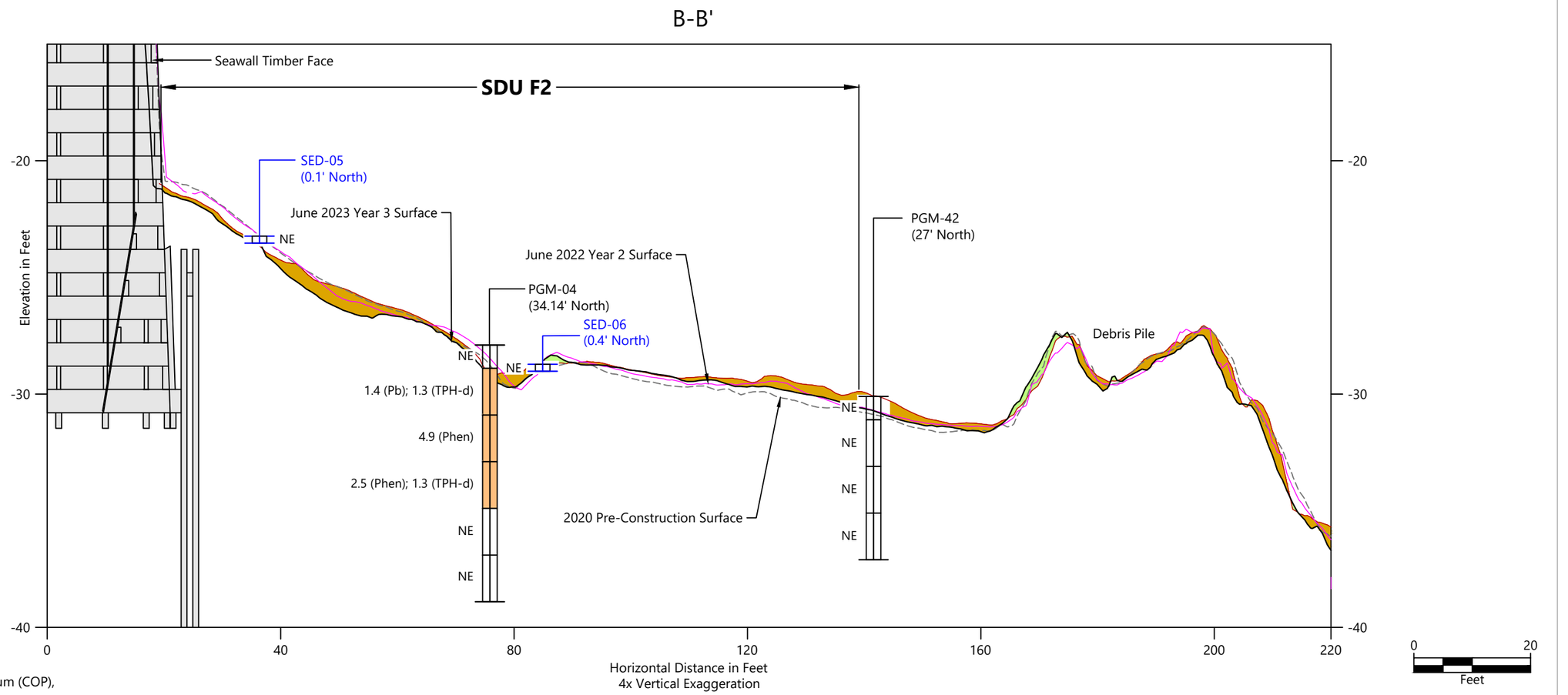

VERTICAL DATUM: City of Portland Datum (COP), converted from NAVD88 (-2.10 Feet)

ABBREVIATION KEY:

Hg	Mercury
Naph	Napthalene
Pb	Lead
Phen	Phenanthrene
Pyr	Pyrene
tPAH	Total PAH
TPH-d	TPH - Diesel
Zn	Zinc
NE	No Exceedances

LEGEND:

- Cap/Cover Thickness
- Area of Erosion
- Area of Accretion
- Historical Sediment Core
- Year 2 Surface Sediment Sample
- Year 2 Porewater Sample
- Sample Interval
- Cleanup Level Exceedance Interval
- Hot Spot Criterion Exceedance Interval
- Dredged Sample Interval
- 2020 Pre-Construction Surface
- Post-Debris Removal Surface
- Post-Construction/Post-Cover Surface
- June 2022 Year 2 Surface
- June 2023 Year 3 Surface

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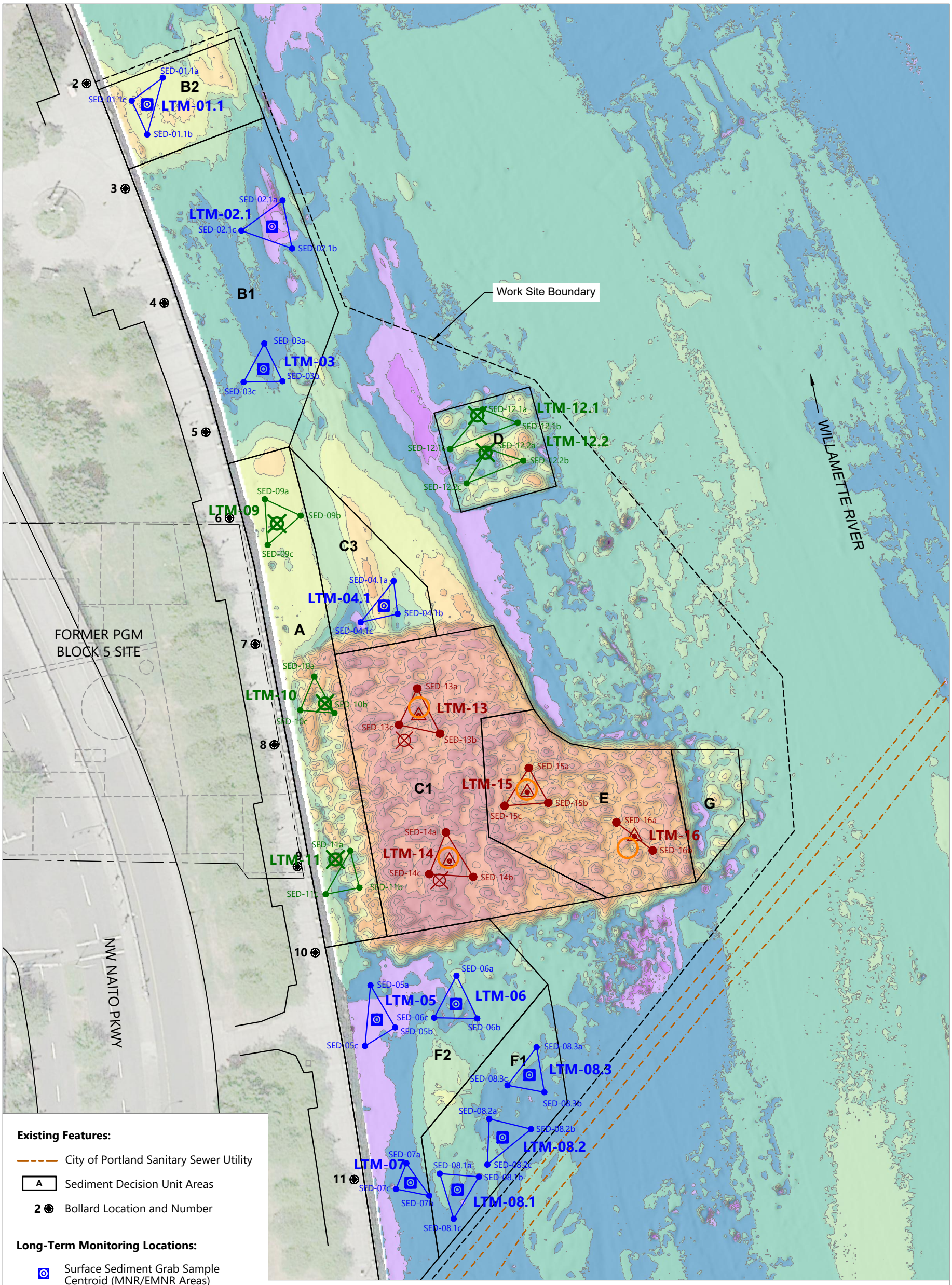
Figure 7c
Detailed Cross Sections of Subsurface Contamination (Part 2)
Year 3 Monitoring Report
Former Portland Gas Manufacturing Site

DRAFT



Existing Features:

- City of Portland Sanitary Sewer Utility
- A — Sediment Decision Unit Areas
- 2 — Bollard Location and Number

Long-Term Monitoring Locations:

- Surface Sediment Grab Sample Centroid (MNR/EMNR Areas)
- Colocated Surface Sediment Grab Sample and TZW/SW Sample (GAC-Amended Cover)
- Direct TZW/SW Sample Adjacent to Manhole Sampling Device (Amored GAC-Amended Cap)
- Colocated Surface Sediment Grab Sample and Porewater Sample (Armored, GAC-Amended Cap)
- As-Built: Permanent, Manhole-Type Porewater Sampling Device

Total Fill and Infill Thickness in Feet (See Note)

< -2 to -2	> 0.5 to 1
> -2 to -1.5	> 1 to 1.5
> -1.5 to -1	> 1.5 to 2
> -1 to -0.5	> 2 to 3
> -0.5 to 0	> 3 to 4
> 0 to 0.5	> 4

NOTE: Total thickness above the pre-cap elevation surface; this includes cap, cover, and armor material placed during the 2020 remediation (fill material) as well as any newly deposited sediment that has accumulated on top of the cap and cover material since remediation (infill material).

0 60
Feet

HORIZONTAL DATUM: Oregon State Plane North Zone NAD83, International Feet
VERTICAL DATUM: City of Portland (COP)

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Figure 8
2023 Cap, Cover, and Infill Thickness

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