

Appendix A

Supplemental Sediment Sampling Information

Introduction

This appendix provides information related to the Lower Duwamish Waterway (LDW) Phase I and Phase II Pre-Design Investigation (PDI) sediment sampling, including the following:

- Section 1 – Quality assurance project plan (QAPP) updates based on utility information
- Section 2 – Details regarding field deviations
- Section 3 – Information regarding shoaling location cores
- Section 4 – Vertical extent core profiles

In addition, this appendix includes supplemental maps that provide additional information regarding the design dataset. Maps A-1 through A-8 show dry weight concentrations in surface and subsurface sediment for the four human health risk driver contaminants of concern (COCs) (total polychlorinated biphenyls [PCBs], arsenic, carcinogenic polycyclic aromatic hydrocarbon [cPAH] toxic equivalent [TEQ], and dioxin/furan TEQ). These maps provide information on the spatial extent and patterns of contamination of these COCs in the middle reach. Surface and subsurface PCB concentrations greater than the remedial action level (RAL) are widespread throughout the middle reach (Maps A-1 and A-2), whereas locations with surface and subsurface concentrations greater than RALs for other COCs are limited to specific areas (Maps A-3 to A-8). In addition, Map A-9 presents information regarding vertical extent samples for pre-PDI cores; these samples were used to inform the PDI sampling design.

1 QAPP Updates based on Utility Information

During the Phase II PDI field effort, revisions were made to target coordinates and/or depths at select locations in utility crossing areas as additional information regarding these areas was obtained. These updates, which were provided to the U.S. Environmental Protection Agency (EPA) during the sampling effort, are described in Table A1-1. These revisions to the QAPP Addendum are also noted as part of the field deviations documented in Section 2 of this appendix.

Table A1-1
QAPP Updates for Sediment Samples in Utility Crossing Areas

Location(s)	Description of Revision
Utility Crossing at RM 2.0	
SC1345, SC1346, SC1347	Target locations were shifted approximately 60 feet upstream so these subtidal vertical extent cores would avoid the utility corridor.
IT1374, IT1376, IT1377	Target depths for these intertidal cores were revised to 5 feet (rather than the original 7.5 feet) to avoid the underground utilities in this area.

Location(s)	Description of Revision
Utility Crossing at RM 2.8	
IT1553, IT1555, IT1556	Target locations were shifted so these intertidal vertical extent cores would avoid the utility corridor. Specifically, location 1553 was shifted 17 feet downstream, location 1555 was shifted 43 feet downstream, and location 1556 was shifted 23 feet upstream.
SC1558	The target location for this subtidal core was shifted approximately 60 feet downstream to avoid the utility corridor. The surface sample was collected at the original target location.
IT1568	The target depth for this intertidal core was revised to 1.5 feet (rather than the original 7.5 feet) to avoid the underground utilities in this area (i.e., only the 0- to 45-cm RAL interval sample was collected)

Notes:

QAPP: quality assurance project plan

RAL: remedial action level

RM: river mile

2 Field Deviation Details

The LDW middle reach PDI Phase I and Phase II sediment sampling field deviations are described in Table A2-1. These deviations are categorized as follows:

- **Deviations related to sample acceptance criteria** – Deviations in this category include cores for which the target depth was not achieved and cores for which the recovery percentage was less than the target of 75%.
- **Deviations related to sample location** – Deviations in this category include locations positioned more than 30 feet from the target location, a location positioned outside the target area (i.e., a side slope core collected just inside the Federal Navigation Channel [FNC]), and locations where samples were not collected due to a lack of sampleable material (e.g., because of riprap).
- **Deviations from sampling plan** – Deviations in this category include new locations added during the Phase II effort in response to preliminary data and changes to target locations and/or depths based on information obtained during the Phase II effort regarding utility crossing areas.
- **Deviations related to sample processing** – Deviations in this category include cores that were processed incorrectly (either the sample was not recovery corrected or was collected from the incorrect interval).

The most common deviations were those related to sample acceptance criteria, primarily the achievement of target depth. As described in Section 2.1.1.2 of the data evaluation report (DER), target depths for vertical extent cores were based on maximum depths that could be needed to inform remedial design. As expected, based on these deep targets and the presence of debris or riprap (particularly in intertidal areas), target depths were not achieved for 104 of the vertical extent

cores. Map A-10 shows the percentage of the target depth achieved for individual vertical extent cores. Some key takeaways from this map are as follows:

- Sixty-four percent of the vertical extent cores achieved 80% or more of the total target depth (approximately half achieved 100% of the target depth).
- As expected, the majority (84%) of cores in subtidal areas achieved 80% or more of the target depth. This percentage was much lower in intertidal areas, where only 39% of vertical extent cores achieved 80% or more of the target depth.
- Within the FNC, nearly all of the cores (93%) achieved 80% or more of the total target depth.

As described in Section 4.2 of the DER, the identification of data gaps related to vertical delineation, which requires an understanding of the remedial technology selected for each area, will be determined after 30% remedial design is complete.

Table A2-1
Details Regarding Field Deviations for Sediment Samples

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
Phase I						
SS1035 SC1035	1.7	-	X (>30 feet from target)	-	-	Sample collection was attempted by hand during daytime low tide, but the area was not sampleable within 30 feet of the target due to riprap. The bathymetry in this area suggested that the riprap continued throughout the entire grid cell, including the subtidal area. Per discussion with EPA, the target for this location was shifted to the subtidal area offshore of the nearby outfall. After probing, both a surface sediment sample (0 to 10 cm) and subsurface sediment core (0 to 60 cm) were successfully collected at the edge of the riprap (125.7 feet and 124 feet from the original target location, respectively). After four attempts, the core from attempt four was accepted with 3.0 feet of penetration and 96.7% recovery.
IT1087	2.1	-	X (>30 feet from target)	-	-	The sample was collected 30.2 feet from the target location. The target location was above MHHW in an area under the First Ave S Bridge that was not sampleable. The sample was collected from a nearby representative intertidal location.
IT1126, IT1134	2.2	-	X (core not collected)	-	-	Surface sediment samples were successfully collected at these intertidal locations, but subsurface sediment samples could not be collected. Sample collection was attempted using a vibracorer (two intertidal attempts and three subtidal attempts) and by hand at low tide. Penetration was insufficient on all attempts due to the presence of riprap in this area.
SC1236	2.8	X (recovery)	-	-	-	The subsurface core at this location achieved the full targeted penetration but had a percent recovery that was less than the target of 75%. The core from the best of the three attempts at this location (recovery of 72%) was retained for analysis.
Phase II						
SC1301	1.6	X (target depth)	-	-	-	After two attempts, the vertical extent core from the second attempt was accepted. Penetration of 12.5 feet (to -35.7 feet MLLW) was less than the target elevation of -40 feet MLLW. Both attempts reached refusal between 12 and 14 feet (74% of target depth).
SC1302	1.7	X (target depth and recovery)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 16.0 feet (to -39.0 ft MLLW) was less than the target elevation of -40 ft MLLW (94% of target depth). Recovery of 71.3% was also less than target ($\geq 75\%$).
SC1312	1.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 7.0 feet to refusal at -15.1 feet MLLW was less than the target of -21 feet MLLW (54% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1317	1.7	X (target depth; no vertical collected)	-	-	-	Hand vibracoring was attempted at this higher-elevation bank sampling location (below MHHW) on a slope with riprap. Refusal was encountered less than 2 feet below the surface, and thus only the 0- to 45-cm interval sample was collected (rather than a vertical extent sample).
IT1318	1.7	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 5.5 feet to refusal was less than the target of 7.5 feet (73% of target depth).
SC1320	1.7	X (recovery)	-	-	-	After three attempts, the vertical extent core from the first attempt, with a recovery of 70.9% (target of at least 75%), was accepted. The penetration depths and/or recoveries of the other two attempts were not acceptable.
SC1326	1.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 19 feet to refusal was less than the target of 20 feet (95% of target depth).
SC1329	1.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 10.4 feet to refusal was less than the target of 20 feet (52% of target depth).
IT1330	1.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 3.5 feet to refusal was less than the target of 7.5 feet (47% of target depth).
SC1334	1.9	X (target depth and recovery)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 14.6 feet to refusal was less than the target of 20 feet (73% of target depth). Recovery was also less than the target (65.1%).
SC1336	1.9	X (target depth and recovery)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 11 feet to refusal (-36.2 feet MLLW) was less than the targeted elevation of -41 feet MLLW (70% of target depth). Recovery was also less than the target (72.7%).
SC1338	1.9	X (target depth, sampling constraints)	-	-	-	A penetration depth of 19.5 feet (rather than the target of 20 feet) was accepted due to logistical constraints with collecting cores 20 feet or longer. Accepted core achieved 98% of target depth.
SC1339	1.9	X (target depth)	-	-	-	The first attempt at this location was accepted because of issues encountering refusal at nearby locations (e.g., 1336). The accepted core had a penetration of 14.6 feet to refusal (-37.9 feet MLLW), which was less than the targeted elevation of -41 feet MLLW (82% of target depth).
SC1340	1.9	X (target depth, sampling constraints)	-	-	-	Penetration of 19 feet to refusal at -39.5 feet MLLW was less than the target of -41 feet MLLW due to logistical constraints with collecting cores 20 feet or longer. Accepted core achieved 93% of target depth.

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
SC1341	1.9	X (target depth, sampling constraints)	-	-	-	After two attempts, the vertical extent core from the first attempt was accepted; no third attempt was possible due to sampling conditions. Penetration of 23 feet to refusal at -39.5 feet MLLW was less than the target of -41 ft MLLW (94% of target depth).
SC1342	1.9	X (target depth)	-	-	-	After two attempts, the vertical extent core from the second attempt was accepted. Penetration of 17.5 feet to refusal was less than the target of 20 feet (88% of target depth), similar to other cores in this area.
SC1343	1.9	X (target depth)	-	-	-	After two attempts, the vertical extent core from the second attempt was accepted. Penetration of 12.0 feet (-38.1 feet MLLW) was less than the target elevation of -40 ft MLLW (81% of target depth).
SC1345	2.0	X (target depth, sampling constraints)	-	X (utility corridor)	-	A penetration depth of 19 feet (rather than the target of 20 feet) was accepted due to logistical constraints with collecting cores 20 feet or longer. Accepted core achieved 95% of target depth. The target location for this core was also shifted based on utility information, as described in Table A1-1.
SC1346	2.0	X (target depth)	-	X (utility corridor)	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 10.0 feet to refusal at -38.1 feet MLLW was less than the target of -41.0 ft MLLW (89% of target depth). The target location for this core was also shifted based on utility information, as described in Table A1-1.
SC1347	2.0	X (target depth)	-	X (utility corridor)	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 16.5 feet to refusal at -36.4 feet MLLW was less than the target of -41.0 ft MLLW (78% of target depth). The target location for this core was also shifted based on utility information, as described in Table A1-1.
SC1348	1.9	X (target depth)	-	-	-	After two attempts, the vertical extent core from the first attempt was accepted. Penetration of 11.6 feet was less than the target of 20.0 feet (58% of target depth). Both attempts reached refusal between 11.0 and 12.0 feet (similar to other cores in this area).
SC1350	1.9	X (target depth)	-	-	-	After two attempts, the vertical extent core from the second attempt was accepted. Penetration of 9.0 feet to refusal was less than the target of 15.0 feet (60% of target depth), similar to other cores in this area.

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1351 IT1352 IT1355 IT1358 IT1360 IT1363 IT1367 IT1369	1.9	X (target depth)	-	-	-	Hand vibracoring was used to collect cores at eight intertidal locations to the east of the dock at DMC. As expected, penetration depths for all locations were less than the target of 7.5 feet because of refusal. Penetration depths were deepest at the downstream-most locations (6.7 and 6.6 feet at locations 1351 and 1352, respectively), ranged from 5.3 to 5.9 at the next five locations (moving upstream), and was shallowest at the upstream-most location (3.3 feet at location 1369). Accepted cores achieved 44% to 89% of target depth.
SC1353 SC1356	1.9	X (target depth, sampling constraints)	-	-	-	A penetration depth of 19.4 feet (rather than the target of 20 feet) was accepted due to logistical constraints with collecting cores 20 feet or longer. Accepted core achieved was 95% of target depth.
SC1357	1.9	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 9.3 feet to refusal was less than the target of 15 feet. Accepted core achieved 62% of target depth.
IT1359 IT1361 IT1362 IT1364 IT1368	1.9	X (target depth)	-	-	-	Hand vibracoring was used to collect cores at five intertidal locations above the toe wall at DMC. As expected, penetration depths at all locations were less than the target of depth of 7.5 feet because of refusal (27% to 45% of target depth). Penetration depths ranged from 1.5 to 3.4 feet.
SC1365	1.9	X (target depth)	-	-	-	After two attempts, the vertical extent core from the second attempt was accepted. Penetration of 13.0 feet was less than the target of 20 feet (65% of target depth). Both attempts had resistance at 12.0 feet and reached refusal at 13.0 feet.
SC1366	1.9	X (target depth)	-	-	-	Hand vibracoring was used to collect the core at this shallow subtidal location because of logistical difficulties with access. A vertical extent core with a penetration of 6.2 feet (to refusal) was accepted based on access and the depths of encountered refusal at other nearby locations. Accepted core achieved 41% of the target depth of 7.5 feet.
IT1370	1.9	X (target depth; no vertical collected)	-	-	-	Hand vibracoring was used to collect this intertidal core above the toe wall at DMC. Refusal was encountered at less than 1 foot below the surface. The 0- to 45-cm interval sample was hand collected with a shovel.
IT1373	1.9	X (target depth)	-	-	-	After three attempts, the vertical extent core from attempt 3 was accepted. Penetration of 6.0 feet to refusal was less than the target of 7.5 feet (80% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1374	1.9	X (recovery)	-	X (utility corridor)	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 4.5 feet to refusal met the new target penetration in this utility area (see Table A1-1 for information regarding the change in target depth), but recovery was slightly less than the target (68.9% rather than the target of 75%).
IT1376	1.9	X (recovery)	-	X (utility corridor)	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 2.0 feet to refusal was less than the revised target of 4.5 feet in this utility area (see Table A1-1 for information regarding the change in target depth).
IT1377	1.9	X (target depth; no vertical collected)	-	X (utility corridor)	-	After three unsuccessful vibracoring attempts from the vessel at this location, substrate at this higher-elevation bank area location was determined to be unsuitable for coring. A 0- to 45-cm RAL interval sample was hand-collected with a shovel, but deeper vertical intervals could not be collected. The target depth for this core was also revised based on utility information, as described in Table A1-1.
IT1378	2.0	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 3.0 feet to refusal was less than the revised target of 7.5 feet (40% of target depth).
IT1402	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt, which achieved 6.3 feet of penetration, was accepted (target of 7.5 feet, 85% of target depth). The penetration depths for the other two attempts were 4.0 feet or less.
IT1404	2.1	X (target depth)	-	X (core location added)	-	Based on early preliminary data received from the laboratory, an extra core was collected at this location, where the PCB concentration appeared to exceed the ENR upper limit in the surface sediment sample (2,200 µg/kg dw). After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 4.6 feet to refusal was less than the target of 7.5 feet (61% of target depth).
SC1423	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 8.0 feet to refusal was less than the target of 10 feet (80% of target depth).
SC1424	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 6.0 feet to refusal was less than the target of 10 feet (60% of target depth).
IT1427	2.2	X (target depth; no vertical collected)	-	-	-	Hand vibracoring was attempted at this higher-elevation bank sampling location (below MHHW) on a riprap slope. Refusal was encountered at less than 2.0 feet below the surface, and thus only the 0- to 45-cm interval sample was collected (rather than a vertical extent sample).
IT1434	2.3	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 2.2 feet to refusal was less than the target of 7.5 feet (29% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
SC1435	2.3	X (recovery)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration achieved the target of 10 feet, but recovery of 63.1% was less than the target ($\geq 75\%$).
IT1437	2.3	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 3.8 feet to refusal was less than the target of 7.5 feet (51% of target depth).
SC1442	2.3	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 8.5 feet to refusal was less than target of 10 feet (85% of target depth).
IT1443	2.3	X (target depth)	-	-	-	The vertical extent core was accepted after one attempt. Penetration of 7.0 feet to refusal was less than the target of 7.5 feet (93% of target depth). However, the core was accepted due to limited options for collecting the core at a different location but remaining in the intertidal area. During processing, native material was encountered starting at about 4.0 feet below the mudline.
IT1448	2.3	X (target depth)	-	-	-	After six attempts, the vertical extent core from the fourth attempt was accepted. Penetration of 3.2 feet to refusal was less than the target of 7.5 feet (43% of target depth), similar to other cores in this area.
IT1447 IT1449 IT1454 IT1456	2.3	X (target depth; no vertical collected)	-	-	-	Substrate at these higher-elevation bank sampling locations was determined to be unsuitable for coring. A 0- to 45-cm RAL interval sample was collected using a shovel, but deeper vertical intervals could not be collected.
SS1450 SC1450	2.3	X (target depth and recovery)	X (>30 feet from target)	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 9.9 feet to refusal was just less than the target of 10 feet (99% of target depth). Recovery was also slightly less than the target (67% rather than the target of $\geq 75\%$). In addition, both the vertical core and surface grab at this location were collected about 35.5 feet toward shore from the original target location (into the intertidal area), because of difficulties associated with relocating the riverboat.
IT1455	2.3	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 2.0 feet to refusal for this intertidal core was less than the target of 7.5 feet. Accepted core achieved 27% of target depth.
IT1457	2.4	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 4.0 feet to refusal was less than the target of 7.5 feet (53% of target depth), similar to other cores in this area.
IT1458	2.4	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 2.2 feet to refusal was less than the target of 7.5 feet (22% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1463	2.4	X (target depth and recovery)	-	-	-	After five attempts (the first three from the vessel, the second two using the handheld vibracoring unit), the vertical extent core from the fifth attempt was accepted. Penetration of 3.00 feet to refusal was less than the target of 7.50 feet (40% of target depth), similar to other cores in this area. Recovery of 71.7% was less than the target ($\geq 75\%$). Accepted core achieved 40% of target depth.
SC1466	2.4	X (recovery)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration achieved the target of -31 feet MLLW, but recovery of 58% was less than target ($\geq 75\%$).
IT1469	2.4	X (recovery)	-	-	-	After three attempts, the vertical extent core from the second attempt, with a recovery of 69% (target $\geq 75\%$), was accepted. The penetration depths for the other two attempts were less than the target of 7.5 feet.
SC1479	2.5	X (target depth)	-	-	-	After two attempts, the vertical extent core from the first attempt was accepted. Penetration of 9.5 feet to refusal was less than the target of 10 feet (95% of target depth), similar to other cores in this area.
SC1483	2.5	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 9.0 feet to refusal was less than the target of 10 feet (90% of target depth), similar to other cores in this area.
IT1485	2.5	X (target depth; no vertical collected)	-	-	-	Substrate at this higher-elevation bank sampling location was not suitable for coring. A 0- to 45-cm RAL interval sample was collected, but deeper vertical intervals could not be collected.
IT1486	2.5	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 4.8 feet to refusal was less than the target of 7.5 feet (64% of target depth).
SS1487	2.5	-	X (surface sample not collected)	-	-	No surface sediment sample (0 to 10 cm) at this location was collected due to access issues.
SC1490	2.5	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration of 9.0 feet to refusal was less than the target of 10 feet (90% of target depth), similar to other cores in this area.
SC1491	2.5	-	X (outside target area)	-	-	Because of the logistics of anchoring near the sunken barge in the subtidal area, this side slope core was collected 2 feet into the FNC rather than just outside the FNC.

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
SC1494	2.5	X (target depth; recovery)	-	-	X (core not recovery corrected)	The core intervals were inadvertently not recovery corrected. Rather than recollecting the core, the elevations in the database were entered to reflect how the core was processed. Three cores were collected at this location to obtain sufficient volume for the 0- to 60-cm bioassay sample. Attempt two of four was accepted as the vertical extent sample. Penetration of 14.0 feet to refusal at -23.1 feet MLLW was less than the target of -25 feet MLLW (88% of target depth). Recovery of 68% was less than the target ($\geq 75\%$).
SC1495	2.6	X (target depth)	-	-	-	Three cores were collected at this location to obtain sufficient volume for the 0- to 60-cm bioassay sample. Attempt three of three was accepted as the vertical extent sample. Penetration of 5.5 feet to refusal was less than the target of 10 feet (55% of target depth). Penetration was 5.0 feet for the other two attempts.
IT1505	2.6	X (target depth; no vertical collected)	-	-	-	After three attempts, the vertical extent core from the second attempt, which had 2.0 feet of penetration (target of 7.5 feet), was accepted. The penetration depths and/or recoveries of the other two attempts were not acceptable.
IT1508	2.6	X (target depth; no vertical collected)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 1.5 feet to refusal was less than the target of 7.5 feet.
IT1516	2.6	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt, which had 7.0 feet of penetration (target of 7.5 feet), was accepted (93% of target depth). The penetration depths of the other two attempts were both approximately 3.0 feet. During processing, native material was encountered starting 3.7 feet below the mudline.
IT1519	2.7	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 4.0 feet was less than the target of 7.5 feet (53% of target depth).
IT1522	2.7	X (target depth)	-	-	-	After six attempts, the vertical extent core from the sixth attempt was accepted. Penetration to refusal at 2.6 feet was less than the target of 7.5 feet (35% of target depth), similar to nearby core IT1519.
SC1528	2.7	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 13 feet at -16.3 feet MLLW was less than the target of -29 feet MLLW (51% of target depth).
SC1531	2.7	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 7.6 feet was less than the target of 10 feet (76% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
SC1532	2.7	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration to refusal at 17 feet at -22.5 feet MLLW was less than the target of -29 feet MLLW (72% of target depth).
IT1540	2.7	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 4.4 feet was less than the target of 7.5 feet (59% of target depth).
IT1546 IT1547	2.7	-	-	X (target depth)	-	As communicated to EPA via email on May 29, 2024, target depths for these cores were changed from 15 to 7.5 feet. These cores were collected successfully on May 31, 2024.
IT1551	2.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 4.3 feet was less than the target of 7.5 feet (57% of target depth).
IT1552	2.8	X (target depth and recovery)	-	-	-	After four attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 6.5 feet was less than the target of 7.5 feet (87% of target depth); at the bottom, approximately 1 foot of sediment was washed out during retrieval. Recovery was less than the target (66% rather than ≥75%).
IT1553	2.8	X (target depth)	-	X (utility corridor)	-	After four attempts, the vertical extent core from the fourth attempt was accepted. Penetration of 4.9 feet to refusal was less than the target of 7.5 feet (65% of target depth). The target location for this core was also shifted based on utility information, as described in Table A1-1.
SC1554	2.8	X (target depth)	-	-	-	After four attempts, the vertical extent core from the second attempt was accepted. Penetration to refusal at 5.7 feet was less than the target of 10 feet (57% of target depth).
IT1555	2.8	X (target depth)	-	X (utility corridor)	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 2.9 feet was less than the target of 7.5 feet (39% of target depth). The target location for this core was also shifted based on utility information, as described in Table A1-1.
IT1556	2.8	X (target depth)	-	X (utility corridor)	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 4.5 feet was less than the target of 7.5 feet (60% of target depth). The target location for this core was also shifted based on utility information, as described in Table A1-1.
SC1558	2.8	-	-	X (utility corridor)	-	The target location for this core was shifted based on utility information, as described in Table A1-1.
IT1560	2.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt, with 5.4 feet of penetration (target of 7.5 feet), was accepted (72% of target depth). The penetration depths and/or recoveries of the other two attempts were not acceptable.

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1561 IT1564	2.8	X (target depth; no vertical collected)	-	-	-	After attempting core collection at these higher-elevation bank areas (both from the vessel and via hand coring), substrate at these sampling locations was determined to be unsuitable for coring. A 0- to 45-cm RAL interval sample was collected using a shovel, but deeper vertical intervals could not be collected.
IT1562	2.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt, with 6 feet of penetration (target of 7.5 feet), was accepted (80% of target depth). The penetration depths for the other two attempts were ≤ 4 feet.
IT1566	2.8	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration of 4.0 feet to refusal was less than the target of 7.5 feet (53% of target depth).
IT1568	2.8	-	-	X (utility corridor)	-	The target depth for this intertidal core was revised to 1.5 feet (rather than the original 7.5 feet) to avoid the underground utilities in this area.
SC1584	3	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration of 7.8 feet to refusal was less than the target of 10 feet (78% of target depth).
SC1586	3	X (recovery)	-	-	-	After four attempts, the vertical extent core from the third attempt was accepted. Penetration achieved the target of -26 feet MLLW, but the recovery of 67% was less than the target of ≥ 75%.
SS1588	2.6	-	X (> 30 feet from target)	-	-	The 0- to 10-cm surface sediment sample at this location was collected 32.2 feet downstream (i.e., more than 30 feet) from the target sampling location because of a structure blocking access to this area.
IT1590	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 5.0 feet at -1.2 feet MLLW was less than the target of -5 feet MLLW (57% of target depth).
IT1592	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 2.5 feet at -1.8 feet MLLW was less than the target of -5 feet MLLW (44% of target depth).
IT1593	2.2	X (target depth; recovery)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration to refusal at 5 feet at -3.1 feet MLLW was less than the target of -6 feet MLLW (63% of target depth). Recovery was also less than the target (58% rather than the target of ≥ 75%).
IT1594	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 5.8 feet at -5.2 feet MLLW was less than the target of -6 feet MLLW (88% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1595	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 6.5 feet at -3.5 feet MLLW was less than the target of -5 feet MLLW (81% of target depth).
IT1596	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 3.8 feet at -1.9 feet MLLW was less than the target of -5 feet MLLW (55% of target depth).
IT1597	2.2	X (target depth)	-	-	-	After four attempts, the vertical extent core from the fourth attempt was accepted. Penetration of 2.5 feet to refusal at +1.9 feet MLLW was less than the target of -5 feet MLLW (27% of target depth).
IT1598	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 1.9 feet at +4.1 feet MLLW was less than the target of -5 feet MLLW (17% of target depth).
IT1600	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 5.2 feet at -2.2 feet MLLW was less than the target of -5 feet MLLW (65% of target depth).
IT1601	2.2	X (target depth)	-	-	-	The vertical extent core from the first attempt was accepted. Penetration to refusal at 10.5 feet at -4.9 feet MLLW was slightly less than the target of -5 feet MLLW (99% of target depth).
IT1602	2.2	-	X (> 30 feet from target)	-	-	After five attempts, the vertical extent core from the fifth attempt was accepted. Penetration to refusal at 2.0 feet at +1.4 feet MLLW was less than the target of -3 feet MLLW. Sample was collected 31.2 feet from the target at a sampling location where the field crew found sampleable sediment during probing.
IT1603	2.2	X (target depth; recovery)	-	-	-	After three attempts, the vertical extent core from the first attempt was accepted. Penetration to refusal at 3.5 feet at +0.5 feet MLLW was less than the target of -3 feet MLLW (50% of target depth). Recovery was also less than the target (63% rather than the target of ≥ 75%).
IT1604	2.2	-	X (> 30 feet from target)	-	-	After six attempts, the vertical extent core from the fourth attempt was accepted. Penetration to refusal at 2.0 feet at +2.1 feet MLLW was less than the target of -3 feet MLLW. Sample was collected 30.9 feet from the target at a sampling location where the field crew found sampleable sediment during probing.
IT1606	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 5.0 feet at -0.7 feet MLLW was less than the target of -3 feet MLLW (68% of target depth).

Location	RM	Field Deviation Category				Additional Notes Regarding Deviations
		Sample Acceptance Criteria	Sample Location	Sampling Plan	Sample Processing	
IT1608	2.2	-	X (core not collected)	-	-	After three attempts and sediment probing in this area, this location was determined to be unsamplable. No soft sediment was encountered that was not already within 10 feet of other sampled locations.
IT1609	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the third attempt was accepted. Penetration to refusal at 2.0 feet at +3.6 feet MLLW was less than the target of -3 feet MLLW.
IT1610	2.2	X (target depth)	-	-	-	After three attempts, the vertical extent core from the second attempt was accepted. Penetration to refusal of 1.4 feet at +2.3 feet MLLW was less than the target of -3 feet MLLW.
IT1611 IT1612	2.2	-	-	X (core location added)	-	Because of challenges collecting cores that reached the target elevations in the inner inlet, two extra cores were collected in areas where the crew encountered softer sediment during probing. These cores had penetrations of 6.0 and 8.0 feet to refusal at +0.4 and -4.7 ft MLLW for locations 1611 and 1612, respectively.
Phase I under-structure samples						
SC1803 SC1804	1.7	X (recovery)	-	-	-	Due to the silty nature of the sediment at these locations, which are under the structure at Terminal 115, some material was lost from the bottoms of the subsurface cores upon core extraction from the sediment. In both cases, recovery was acceptable ($\geq 75\%$). At location SC1803, the drive depth was 2.5 feet and the recovery was 88%. During extraction from the sediment, about 6 inches of material was lost from the bottom of the core. After recovery correction, the remaining sediment was determined to represent the top 56.5 cm of sediment (94% of the targeted 60 cm). This core was accepted for processing. At location SC1804, the first attempt was rejected (about 8 inches of material was lost). The drive depth of the second attempt was 2.0 feet and the recovery was 93%. During extraction from the sediment, about 4 inches of material was lost from the bottom of the core. After recovery correction, the remaining sediment was determined to represent the top 48.4 cm of sediment (81% of the targeted 60 cm). This core was accepted for processing.
IT1812 IT1813	2.4	-	-	-	X (incorrect interval collected)	Divers collected cores under the Seattle Iron and Metals wharf. After a QC review of field-calculated mudline elevations for both under-structure locations, it was discovered that core samples had been erroneously homogenized as 0- to 60-cm subtidal samples rather than 0- to 45-cm intertidal samples. After consulting with EPA, the 0- to 60-cm samples were analyzed and compared to the 0- to 45-cm RALs for the Recovery Category 2/3 area, rather than risk diver safety to recollect these cores.

Notes:
DMC: Duwamish Marine Center
dw: dry weight

FINAL

ENR: enhanced natural recovery
EPA: U.S. Environmental Protection Agency
FNC: federal navigation channel
MHHW: mean higher high water
MLLW: mean lower low water
PCB: polychlorinated biphenyl
QC: quality control
RAL: remedial action level
RM: river mile

3 Information Regarding Shoaling Location Cores

This section provides information regarding cores collected in shoaling areas of the FNC during Phases I and II of the PDI. As described in the QAPP and summarized in Figure 2-1 of the DER, the processing of shoaling cores was dependent on the amount of shoaled material at each location. Table A3-1 summarizes the counts of cores by the amounts of shoaled material.

Table A3-1
Count of Shoaling Location Cores by Amount of Shoaled Material

Amount of Shoaled Material ¹	Number of Shoaling Intervals	Count of Locations
< 30 cm of shoal material	none (shoaling material combined with overdredge interval)	15
≥ 30 and < 90 cm shoal material	1 shoaling interval	25
≥ 90 cm to < 240 cm shoal material	2 shoaling interval	33
≥ 240 cm shoal material	3 shoaling interval	5

Notes:

1. Categories of shoaled material are as shown on Figure 2-1 in the DER.

DER: data evaluation report

cm: centimeter

Information regarding the shoaling cores is summarized on Map 2-3 (which also includes vertical extent core profiles for each shoaling core), and individual sample results are included in the design dataset (Appendix M). In addition, Table A3-2 provides information regarding shoaling core locations where a 0- to 60-cm Z-layer interval sample was collected and analyzed (also shown on Map 2-3).

Table A3-2
Shoaling Cores with Z-layer Samples that have been Analyzed

Location	RAL Exceedances by Sample Type		Z-layer Interval (Compared with Surface Sediment RAL)
	Shoal Interval(s)	Overdredge Interval	
Shoaling Reach from RM 0 to RM 2 (authorized depth of -30 ft MLLW)			
LDW23-SC1006	no exceedance ¹		no exceedance
LDW23-SC1011	no exceedance ¹		no exceedance
LDW23-SC1016	no exceedance ¹		no exceedance
LDW23-SC1022	no exceedance ¹		no exceedance
Shoaling Reach from RM 2 to RM 2.8 (authorized depth of -20 ft MLLW)			
LDW23-SC1156	no exceedance	no exceedance	PCBs above surface sediment RAL (EF of 1.1)
LDW23-SC1170	no exceedance ¹		no exceedance
LDW23-SC1184	no exceedance ¹		no exceedance
LDW23-SC1205	no exceedance ¹		no exceedance

Location	RAL Exceedances by Sample Type		Z-layer Interval (Compared with Surface Sediment RAL)
	Shoal Interval(s)	Overdredge Interval	
LDW24-SC1501	RAL EF of 2.8 for PCBs (interval B)	RAL EF of 1.3 for PCBs	<i>PCBs above surface sediment RAL (EF of 1.3)</i>
LDW24-SC1502	no exceedance	no exceedance	<i>PCBs above surface sediment RAL (EF of 1.4)</i>
LDW24-SC1520	archive	RAL EF of 2.9 for PCBs	<i>PCBs above surface sediment RAL (EF of 1.3)</i>
LDW24-SC1558	archive	RAL EF of 12 for PCBs	<i>PCBs above surface sediment RAL (EF of 1.4)</i>

Notes:

1. Shoaling material was combined with the overdredge interval because less than 30 cm of shoaling material was present.

EF: exceedance factor

RAL: remedial action level

RM: river mile

PCB: polychlorinated biphenyl

4 Vertical Extent Core Profiles

Information regarding the vertical extent of contamination, which is used to define the depth of contamination as described in Section 3.4.2 of the DER, is presented in the vertical core profiles shown on the Map 3-1 series. In addition, versions of the core profiles with concentration data are included as part of this appendix to provide additional context for understanding the PDI data. The core profiles, which provide information regarding the vertical extent of contamination, primarily present data from Phases I and II of the PDI (along with select pre-PDI results where applicable).

While legends are also included with the core profiles (both as part of the Map 3-1 series and in the core profile figures attached to this appendix [Figures A-1 to A-25]) to explain the different symbology used, this section provides additional details regarding several key components of the vertical core profiles.

- Shading indicates RAL exceedance status** – The exceedance status of a RAL interval is indicated with red shading (RAL exceedance) or green shading (not a RAL exceedance). The exceedance status of a vertical extent interval below the RAL interval(s) compared to the surface sediment RAL is indicated with purple shading (exceedance of surface RAL) or green shading (not an exceedance of surface RAL). Light yellow shading indicates that the interval was not analyzed.
- Bold outlined samples** – Some Phase II vertical extent cores were collected from the same locations (within 30 feet) as Phase I subsurface RAL interval samples (i.e., 0 to 45 cm, 0 to 60 cm, or shoaling cores) where additional vertical extent information was needed. Because most Phase I RAL samples were analyzed, the corresponding Phase II RAL interval samples from the same locations were generally not analyzed. In these cases (i.e., where there were existing RAL interval data), bold red or green outlines on core profiles indicate the RAL

exceedance status of the existing data (Phase I and remedial investigation/feasibility study samples): red for an exceedance or green for no exceedance.

- **Concentrations** – As noted, the versions of the vertical extent core profiles included in this appendix include the concentrations of PCBs in each sample (including the bold-outlined Phase I and remedial investigation/feasibility study samples described above). Concentration data for other chemicals with RAL exceedances are also provided. Details regarding units are provided in the legend.
- **Native material** – Material identified as native is indicated with vertical hashing. All intervals containing native material were archived, and thus are shown with yellow hashing.
- **Transect shading** – Alternating light blue and white backgrounds on the core profiles indicate different transects across the waterway.

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-1

RM 1.6 to RM 1.75 - FNC									
Location	1002	1006	1007	1011	1012	1016	1017	1022	1023
Mudline	-26.9	-29.3	-27.8	-29.3	-28.3	-29.8	-28.5	-29.4	-28.8
Core Target	-34 ft MLLW	-34 ft MLLW	-34 ft MLLW	-34 ft MLLW					
-27 to -28 ft	shoal 6.24								
-28 to -29 ft	shoal 4.47		shoal 4.98		shoal 5.41		shoal 4.03		shoal
-29 to -30 ft		shoal 4.47		shoal 5.31		shoal 5.62	shoal 7.5	shoal 8.35	shoal 4.73
-30 to -31 ft	over-dredge 9.69	over-dredge 8.38	over-dredge 5.37	over-dredge 5.31	over-dredge 7.54	over-dredge 5.62	over-dredge 7.5	over-dredge 8.35	over-dredge 6.37
-31 to -32 ft									
-32 to -33 ft	C	3.02	C	6.14	C	5.11	C	3.9	C
-33 to -34 ft									

Figure A-2

Area 36 - Slip 2		
Location	1321	1320
Mudline	-19.8	-14.3
Core Target	10 ft core	10 ft core
Older Loc.	-	-
-13 to -14 ft		46.7
-14 to -15 ft		
-15 to -16 ft		B
-16 to -17 ft		C
-17 to -18 ft		D
-18 to -19 ft		E
-19 to -20 ft		F
-20 to -21 ft	34	G
-21 to -22 ft		H
-22 to -23 ft	B	I
-23 to -24 ft	0.59 U	J
-24 to -25 ft	0.44 U	
-25 to -26 ft	4 U dw	
-26 to -27 ft	4 U dw	
-27 to -28 ft	G	
-28 to -29 ft	H	
-29 to -30 ft	I	
-30 to -31 ft		

Figure A-3

Area 34 - Slip 2			
Location	1309	1310	1312
Mudline	-19.7	-17.1	-8.1
Core Target	10 ft core	10 ft core	-21 ft MLLW
Older Loc.	-	1025	-
-8 to -9 ft			4,420 dw
-9 to -10 ft			
-10 to -11 ft			B
-11 to -12 ft			33.4
-12 to -13 ft			14
-13 to -14 ft			42
-14 to -15 ft			26
-15 to -16 ft			ref.
-16 to -17 ft			
-17 to -18 ft			19.5
-18 to -19 ft			
-19 to -20 ft	11.1 *	0.78	
-20 to -21 ft		0.12	
-21 to -22 ft	B	D	
-22 to -23 ft	C	0.23 U	
-23 to -24 ft	D	F	
-24 to -25 ft	E	0.56 U	
-25 to -26 ft	F	H	
-26 to -27 ft	G	4 U dw	
-27 to -28 ft	H		
-28 to -29 ft	I		
-29 to -30 ft	J		
-30 to -31 ft			

Figure A-4

Area 35 & 32			
Location	1318	1317	1330
Mudline	-3.5	na	-0.2
Core Target	7.5 ft core	7.5 ft core	7.5 ft core
Older Loc.	1034	-	-
5 to 4 ft		est. 65.6 dw	
4 to 3 ft			
break		ref.	
0 to -1 ft			17.3 dw
-1 to -2 ft			B
-2 to -3 ft			C
-3 to -4 ft			
-4 to -5 ft	0-45 A		ref.
-5 to -6 ft	4 U dw		
-6 to -7 ft	4 U dw		
-7 to -8 ft	D		
-8 to -9 ft	4 U dw		
-9 to -10 ft	ref.		

Figure A-5

RM 1.6 E		
Location	1301	1302
Mudline	-23.2	-23.0
Core Target	-40 ft MLLW	-40 ft MLLW
Older Loc.	-	-
-23 to -24 ft	7.57	10.8 *
-24 to -25 ft		
-25 to -26 ft	B	7.81
-26 to -27 ft	C	7.97
-27 to -28 ft	D	D
-28 to -29 ft	E	E
-29 to -30 ft	F	F
-30 to -31 ft	G	G
-31 to -32 ft	H	H
-32 to -33 ft	I	I
-33 to -34 ft	J	J
-34 to -35 ft	K	K
-35 to -36 ft	L	L
-36 to -37 ft	ref.	M
-37 to -38 ft		N
-38 to -39 ft		O
-39 to -40 ft		ref.

Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- > surface RAL for vertical interval (PCBs unless noted)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted.
 PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-6

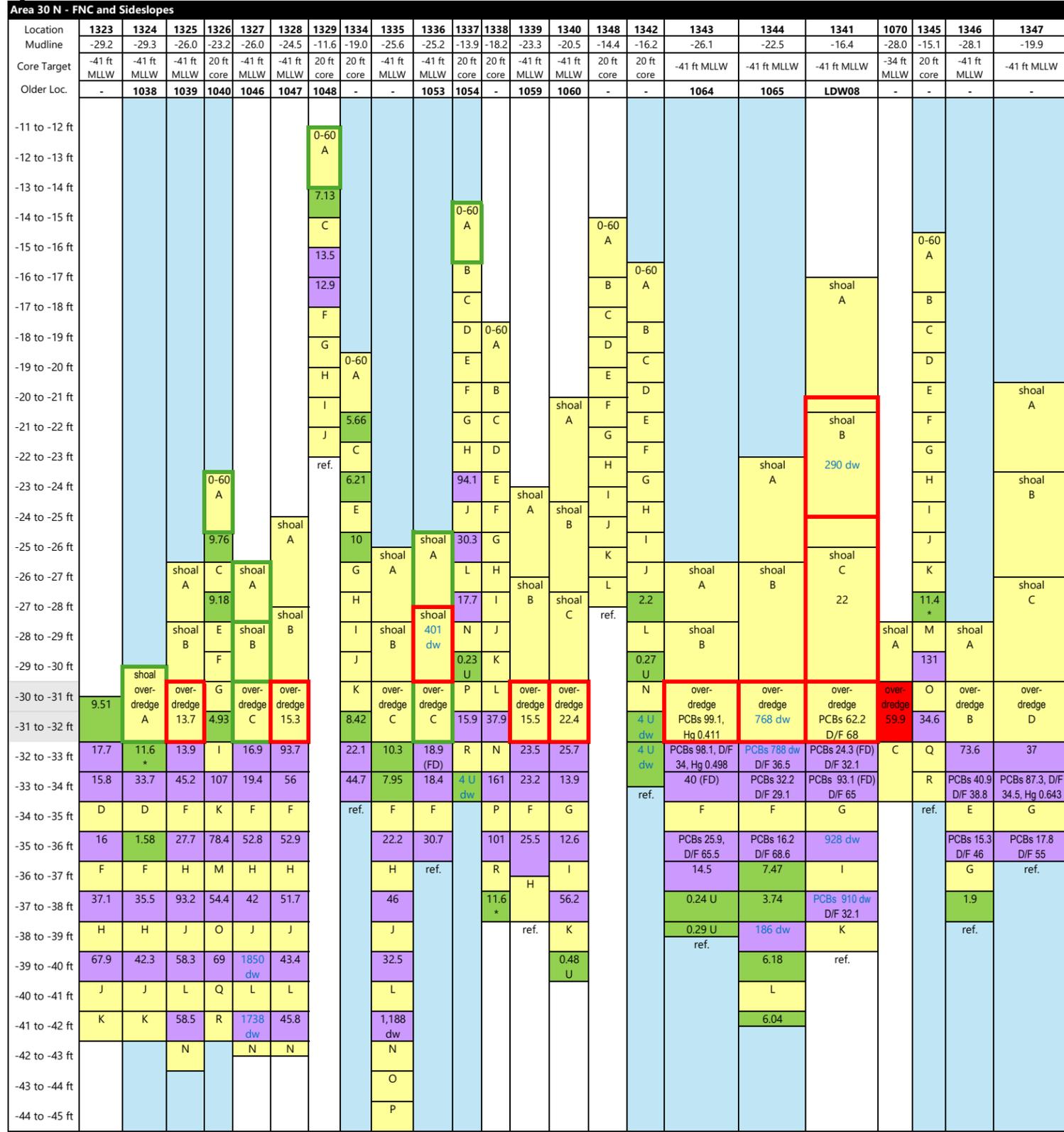


Figure A-7

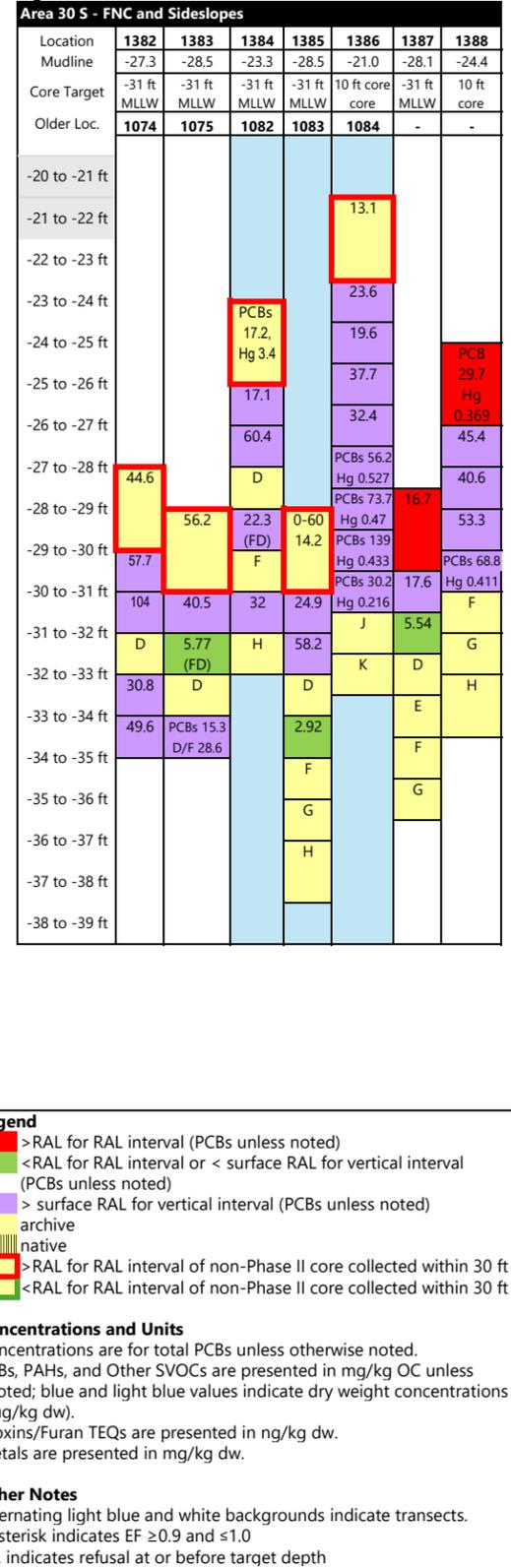
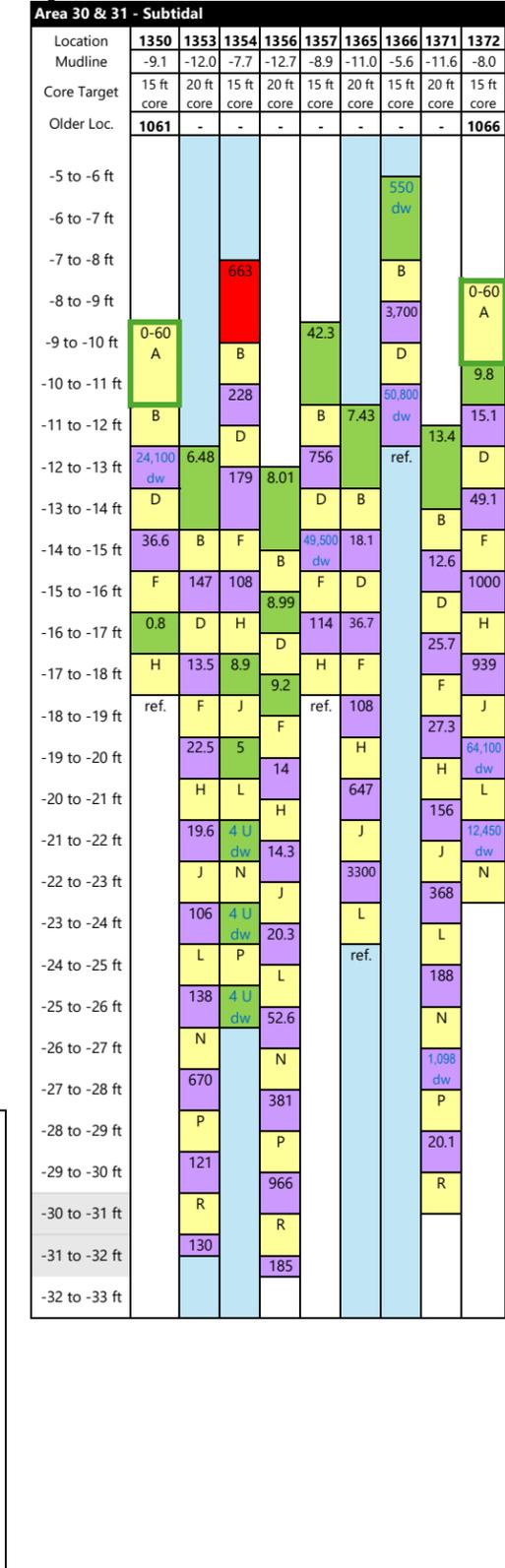


Figure A-8



Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- > surface RAL for vertical interval (PCBs unless noted)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted. PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-9

Area 31 - Intertidal																			
Location	1351	1352	1355	1358	1359	1360	1362	1361	1363	1364	1367	1368	1369	1370	1373	1374	1376	1377	1378
Mudline	-4.0	-4.0	-3.9	-4.1	na	-4.6	na	na	-3.9	na	-3.9	na	-3.4	na	-2.3	-0.6	-3.0	nd	-0.6
Core Target	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core							
Older Loc.	-	-	-	-	-	-	1067	-	-	-	-	-	-	-	-	-	-	-	-
3 to 2 ft					est.		est.	est.		est.		est.		est.				est.	51.6 dw
2 to 1 ft					17,400 dw		48,100 dw	PCBs 51,700 dw D/F 326		16,900 dw D/F 146		138,700 dw		971 dw					ref.
1 to 0 ft					152,700 dw		173,000 dw	PCBs 145,600 D/F 1,980		180,400 dw		69,900 dw		ref.					
0 to -1 ft					ref.		225,000 dw	ref.		ref.		ref.							37
-1 to -2 ft																			
-2 to -3 ft																			230.1 dw
-3 to -4 ft																			ref.
-4 to -5 ft	43	13.4	1,121 dw	23.3			2,850 dw		622 dw		1,081 dw		701 dw						
-5 to -6 ft	80.5	25.6	2,020 dw	68.4					42.3		991 dw		2,464 dw						
-6 to -7 ft	148	35.9	106	2,420			3,830 dw		57.3		1,740 dw		1,265 dw						
-7 to -8 ft	985	242	9,580 dw	167,700 dw			276		77		156		ref.						
-8 to -9 ft	66,000 dw	663	2,920 dw	59,700 dw			1550		428		26,700 dw								
-9 to -10 ft	52,800 dw	71,400 dw	ref.	ref.			161,100 dw		ref.		ref.								
-10 to -11 ft	ref.	ref.					ref.		ref.		ref.								

Note: Location 1373 intervals C, D, and E were not able to be analyzed because they were majority gravel.

Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- maximum EF <10 relative to surface sediment RAL (PCBs)
- maximum EF ≥10 relative to surface sediment RAL (PCBs)
- maximum EF ≥100 relative to surface sediment RAL (PCBs)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted.
 PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-10

Area 29	
Location	1390
Mudline	-8.6
Core Target	10 ft core
Older Loc.	1077
-8 to -9 ft	0-60 A
-9 to -10 ft	
-10 to -11 ft	31
-11 to -12 ft	34
-12 to -13 ft	D
-13 to -14 ft	164.8 dw
-14 to -15 ft	F
-15 to -16 ft	94.4 dw
-16 to -17 ft	H
-17 to -18 ft	100 dw
-18 to -19 ft	J
-19 to -20 ft	

Figure A-11

Area 27								
Location	1404	1411	1413	1418	1426	1427	1428	1434
Mudline	0.3	-3.6	-3.5	-3.5	-2.5	nd	-2.9	-2.4
Core Target	7.5 ft core	7.5 ft core	7.5 ft core					
Older Loc.	-	-	1114	1120	1121	-	-	-
6 to 5 ft						est. 59.1 dw		
** break **						ref.		
1 to 0 ft	86							
0 to -1 ft	B							
-1 to -2 ft	12.3							
-2 to -3 ft	7.17				0-45 A			150.1 dw
-3 to -4 ft	1.93	133	239	112	12.4 (FD)		491	33.5 dw
-4 to -5 ft	ref.	88.2	15.1 (FD)	250 dw	5.74		95	ref.
-5 to -6 ft		3.42	5.47	4.66	5.76		PCBs 327 Hg 0.976	
-6 to -7 ft		D	D	D	126 dw *		D	
-7 to -8 ft		0.25 U	9.51 F	185 dw	16.4		311	
-8 to -9 ft		F	F	14.3	1.45		F	
-9 to -10 ft		0.27 U	0.21 H	0.5	H		96	
-10 to -11 ft		H	H	0.448				
-11 to -12 ft								
-12 to -13 ft								
-13 to -14 ft								

Figure A-12

Area 26 - Slip 3	
Location	1402
Mudline	-3.3
Core Target	7.5 ft core
Older Loc.	-
-3 to -4 ft	7.8 (FD)
-4 to -5 ft	B
-5 to -6 ft	C
-6 to -7 ft	D
-7 to -8 ft	E
-8 to -9 ft	
-9 to -10 ft	ref.

Figure A-13

Area 23											
Location	1423	1424	1425	1432	1433	1441	1442	1452	1453	Location	1443
Mudline	-15.7	-18.6	-11.3	-16.9	-6.8	-17.1	-8.4	-14.4	-14.8	Mudline	-3.5
Core Target	10 ft core	Core Target	7.5 ft core								
Older Loc.	-	-	-	-	-	-	1139	1145	-	Older Loc.	-
-7 to -8 ft					0-60 A					-3 to -4 ft	16 (FD)
-8 to -9 ft							38.5			-4 to -5 ft	B
-9 to -10 ft					37.4					-5 to -6 ft	C
-10 to -11 ft					109					-6 to -7 ft	C
-11 to -12 ft					D					-7 to -8 ft	D
-12 to -13 ft					0-60 A					-7 to -8 ft	E
-13 to -14 ft										-8 to -9 ft	F
-14 to -15 ft					31.4					-9 to -10 ft	G
-15 to -16 ft					21.5					-10 to -11 ft	ref.
-16 to -17 ft	0-60 A				D						
-17 to -18 ft					35.2						
-18 to -19 ft	B				F	0-60 A	0-60 A	ref.		1.061 dw	42.7
-19 to -20 ft	C	0-60 A	27.2 (FD)	16.5						35.4	25.1
-20 to -21 ft	D				27.5					33.1 (FD)	40.7
-21 to -22 ft	E	38.5	0.22 U		D					F	
-22 to -23 ft	F	59	J		24.1					4.13	6.92
-23 to -24 ft	G	D	K		F					H	
-24 to -25 ft	ref.	50			71.3					9.28	21.3
-25 to -26 ft		ref.			H					J	
-26 to -27 ft					112					K	
-27 to -28 ft										J	
-28 to -29 ft										K	
-29 to -30 ft										L	
-30 to -31 ft										M	

Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- > surface RAL for vertical interval (PCBs unless noted)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted.
 PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-14

Area 24 - Inlet at RM 2.2W																									
Location	1428	1434	1427	1590	1592	1594	1593	1595	1597	1596	1599	1598	1612	1611	1601	1600	1602	1610	1603	1604	1605	1607	1606	1609	
Mudline	-2.9	-2.4	nd	3.8	0.7	0.6	1.9	3.0	4.4	1.9	2.5	6.0	3.3	6.4	5.6	3.1	3.4	3.7	4.0	4.1	4.3	4.1	4.3	5.6	
Core Target	7.5 ft core	7.5 ft core	7.5 ft core	-5 ft MLLW	-5 ft MLLW	-6 ft MLLW	-6 ft MLLW	-5 ft MLLW	-5 ft MLLW	-5 ft MLLW	-5 ft MLLW	-5 ft MLLW	-3 ft MLLW	-3 ft MLLW	-5 ft MLLW	-5 ft MLLW	-3 ft MLLW								
7 to 6 ft			est.																						
6 to 5 ft			59.1 dw									3,590 dw		599 dw											40.5
5 to 4 ft												1,810		110	468										
4 to 3 ft			ref.	0.74 U					256 dw					428	99.7										
3 to 2 ft				B				0-45 A	59.1 dw			12,080 dw		821 dw	PCBs 20,600 dw Hg 7.79	215	9,180 dw	50,200 dw			17,700		0-45 A	47.9	ref.
2 to 1 ft				C					ref.	456	13,600 dw		850	155	PCBs 38,200 dw Hg 23.3	19.3	2,490 dw								
1 to 0 ft				D	26.8 dw	PCBs 174 D/F 192	6.46	250			PCBs 6,840 Hg 1.82		11.8 *	37	PCBs 145 Hg 0.891	0.31									
0 to -1 ft				ref.							53.3				PCBs 100 Hg 1.15										
-1 to -2 ft				4 U dw	6.15		0.23	11.3 *							16.3										
-2 to -3 ft				ref.	2.52			1.9							0.2										
-3 to -4 ft	491		150.1 dw					2.34																	
-4 to -5 ft			53.5 dw																						
-5 to -6 ft	95		ref.																						
-6 to -7 ft	PCBs 327 Hg 0.976																								
-7 to -8 ft	D																								
-8 to -9 ft	311																								
-9 to -10 ft	F																								
-10 to -11 ft	96																								

Note: Core profiles are ordered from the mouth of the inlet to the head of the inlet.

Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- maximum EF <10 relative to surface sediment RAL (PCBs)
- maximum EF ≥10 relative to surface sediment RAL (PCBs)
- maximum EF ≥100 relative to surface sediment RAL (PCBs)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
Concentrations are for total PCBs unless otherwise noted.
PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
Dioxins/Furan TEQs are presented in ng/kg dw.
Metals are presented in mg/kg dw.

Other Notes
Alternating light blue and white backgrounds indicate transects.
* asterisk indicates EF ≥0.9 and ≤1.0
ref. indicates refusal at or before target depth
est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-15

Area 22 - FNC and Sideslopes																								
Location	1405	1406	1408	1409	1414	1415	1416	1419	1420	1421	1422	1429	1430	1431	1435	1438	1439	1440	1451	1459	1460	1465	1466	1156
Mudline	-14.3	-20.8	-15.5	-17.0	-12.9	-16.6	-18.7	-9.6	-14.2	-18.1	-23.4	-9.6	-16.3	-18.2	-7.4	-10.7	-16.8	-22.5	-15.6	-12.4	-17.8	-16.3	-18.7	-17.3
Core Target	15 ft core	-31 ft MLLW	15 ft core	-31 ft MLLW	10 ft core	15 ft core	-31 ft MLLW	10 ft core	15 ft core	-31 ft MLLW	-31 ft MLLW	10 ft core	15 ft core	-31 ft MLLW	10 ft core	10 ft core	-31 ft MLLW	-31 ft MLLW	-31 ft MLLW	10 ft core	-31 ft MLLW	10 ft core	-31 ft MLLW	-24 ft MLLW
Older Loc.	-	1091	-	1109	1115	-	LDW09	1122	-	1123	-	1128	-	1130	-	-	1137	-	1143	-	1150	-	-	-
-7 to -8 ft																								
-8 to -9 ft																								
-9 to -10 ft																								
-10 to -11 ft																								
-11 to -12 ft																								
-12 to -13 ft																								
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-31 to -32 ft																								
-32 to -33 ft																								
-33 to -34 ft																								
-34 to -35 ft																								
-35 to -36 ft																								

Figure A-16

Area 21													
Location	1437	1447	1448	1449	1450	1454	1455	1456	1457	1458	1463		
Mudline	-2.2	nd	-0.6	nd	-1.0	nd	-1.4	nd	0.1	-2.0	nd		
Core Target	7.5 ft core	7.5 ft core	7.5 ft core	7.5 ft core	10 ft core	7.5 ft core							
Older Loc.	1136	-	1142	-	-	-	-	-	1147	1148	-		
4 to 3 ft													
3 to 2 ft													
2 to 1 ft													
1 to 0 ft													
0 to -1 ft													
-1 to -2 ft													
-2 to -3 ft													
-3 to -4 ft													
-4 to -5 ft													
-5 to -6 ft													
-6 to -7 ft													
-7 to -8 ft													
-8 to -9 ft													
-9 to -10 ft													
-10 to -11 ft													

Figure A-17

Area 20						
Location	1162	1169	1170	1177	1183	1184
Mudline	-18.4	-15.5	-19.8	-13.8	-10.7	-19.1
Core Target	-24 ft MLLW					
Older Loc.	-	-	-	-	-	-
-10 to -11 ft						
-11 to -12 ft						
-12 to -13 ft						
-13 to -14 ft						
-14 to -15 ft						
-15 to -16 ft						
-16 to -17 ft						
-17 to -18 ft						
-18 to -19 ft						
-19 to -20 ft						
-20 to -21 ft						
-21 to -22 ft						
-22 to -23 ft						
-23 to -24 ft						

Figure A-18

Area 20			
Location	1468	1469	1470
Mudline	-4.0	-2.9	-3.8
Core Target	-27 ft MLLW	7.5 ft core	7.5 ft core
Older Loc.	-	-	1160
-3 to -4 ft			
-4 to -5 ft			
-5 to -6 ft			
-6 to -7 ft			
-7 to -8 ft			
-8 to -9 ft			
-9 to -10 ft			
-10 to -11 ft			
-11 to -12 ft			
-12 to -13 ft			
-13 to -14 ft			
-14 to -15 ft			
-15 to -16 ft			
-16 to -17 ft			
-17 to -18 ft			
-18 to -19 ft			
-19 to -20 ft			
-20 to -21 ft			
-21 to -22 ft			
-22 to -23 ft			
-23 to -24 ft			
-24 to -25 ft			
-25 to -26 ft			
-26 to -27 ft			
-27 to -28 ft			

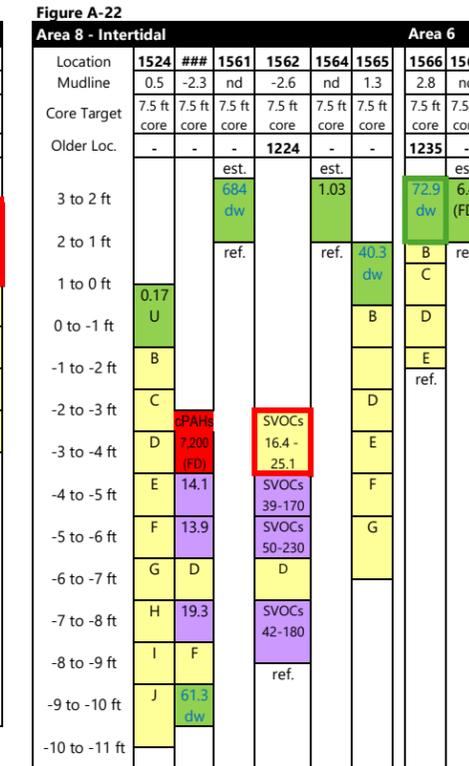
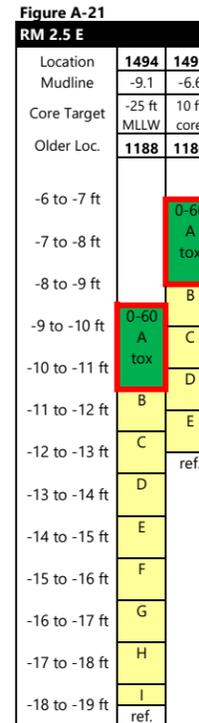
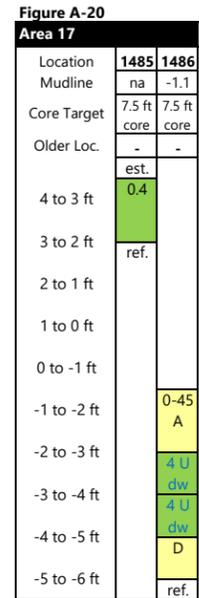
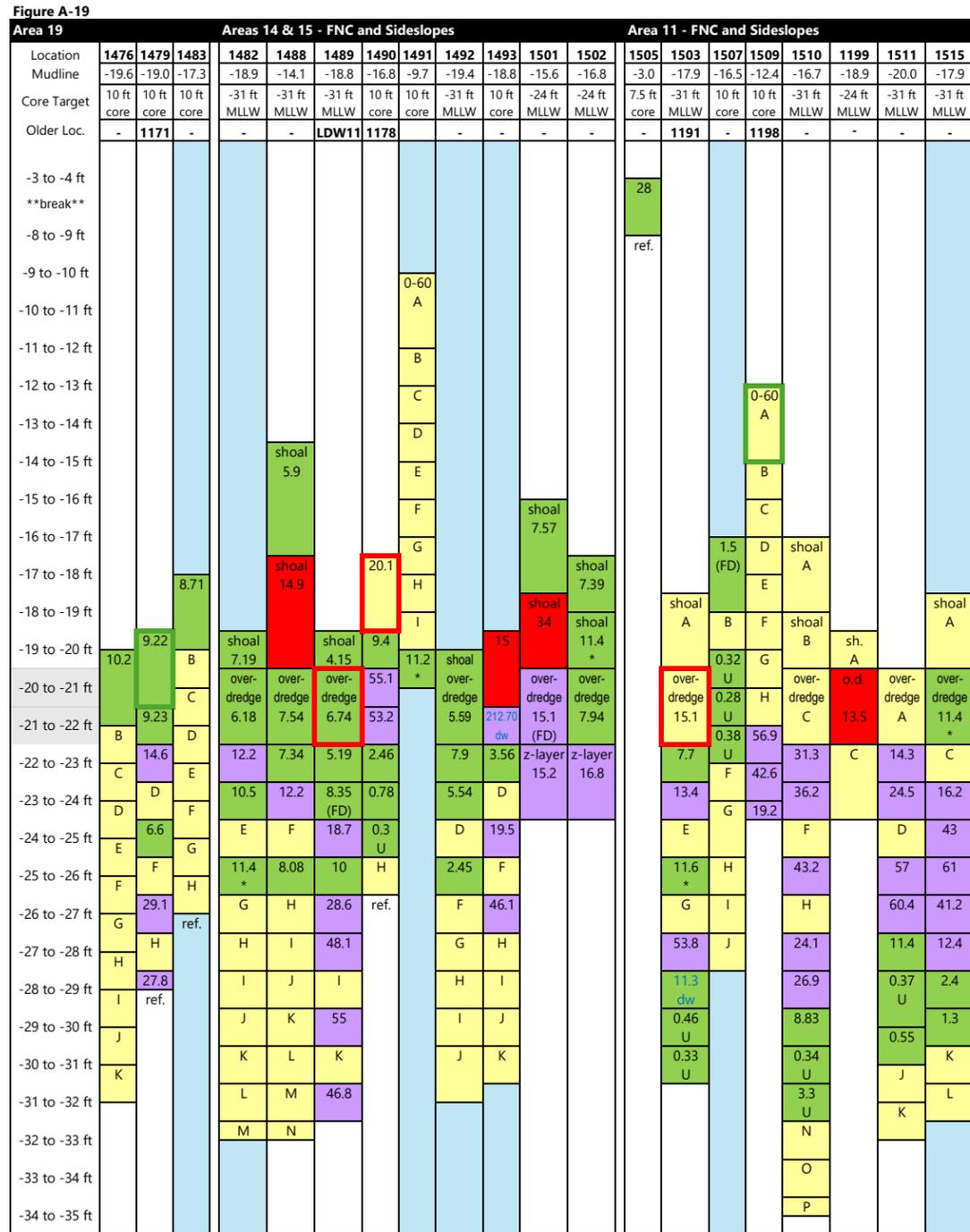
Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- > surface RAL for vertical interval (PCBs unless noted)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted.
 PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations



Note: dark green shading indicates subsurface bioassay passed.

Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- > surface RAL for vertical interval (PCBs unless noted)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted.
 PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline

Phase II PDI DER for the LDW – Middle Reach
Vertical Extent and Shoaling Core Profiles with Concentrations

Figure A-23

Areas 8 & 9 Intertidal and Subtidal - FNC and Sideslopes													Area 9 S - Subtidal					Area 7				
Location	1205	1520	1528	1529	1534	1214	1535	1536	1532	1531	1541	1542	1221	1226	1538	1544	1549	1554	1558	1559	1563	
Mudline	-19.3	-19.0	-3.3	-14.7	-18.5	-19.3	-19.5	-12.1	-5.5	-15.7	-19.0	-19.4	-18.8	-18.7	-14.6	-14.6	-14.0	-14.2	-18.1	-11.5	-12.1	
Core Target	-24 ft MLLW	-24 ft MLLW	-29 ft MLLW	10 ft core	-31 ft MLLW	-24 ft MLLW	-31 ft MLLW	10 ft core	-29 ft MLLW	10 ft core	-31 ft MLLW	-31 ft MLLW	-24 ft MLLW	-24 ft MLLW	10 ft core	10 ft core	10 ft core	10 ft core	-24 ft MLLW	10 ft core	10 ft core	
Older Loc.	-	-	1212	1213	-	-	-	1215	-	-	LDW12	-	-	-	-	1222	-	1227	-	-	1225	
-3 to -4 ft																						
-4 to -5 ft			D/F 25.8																			
-5 to -6 ft			13.8																			
-6 to -7 ft			9.38																			
-7 to -8 ft			D																			
-8 to -9 ft			8.2																			
-9 to -10 ft			F																			
-10 to -11 ft			20.5																			
-11 to -12 ft			H																			
-12 to -13 ft			PCBs 20.6 D/F 34.6																			
-13 to -14 ft			J																			
-14 to -15 ft			4.86	0-60 A																		
-15 to -16 ft			L																			
-16 to -17 ft			33.4 dw	B																		
-17 to -18 ft			ref.	C																		
-18 to -19 ft			23.7	shoal A																		
-19 to -20 ft			E																			
-20 to -21 ft	shoal over-dredge 5.86	over-dredge 43.8 (FD)	76.1	over-dredge B	shoal+ over-dredge 16.7	29.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
-21 to -22 ft			G																			
-22 to -23 ft	9.31	15	23.1	9.35	B	37.4	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
-23 to -24 ft			I																			
-24 to -25 ft			6.17																			
-25 to -26 ft			K																			
-26 to -27 ft																						
-27 to -28 ft																						
-28 to -29 ft																						
-29 to -30 ft																						
-30 to -31 ft																						
-31 to -32 ft																						
-32 to -33 ft																						
-33 to -34 ft																						

Figure A-24

Area 9 - Intertidal													Area 5				
Location	1508	1513	1519	1522	1539	1540	1543	1545	1546	1547	1550	1551	1553	1552	1555	1556	1560
Mudline	-3.3	-1.1	-0.1	-1.5	-3.7	1.7	-0.1	-3.9	-0.5	0.5	-3.1	2.5	3.8	6.2	-1.5	-1.7	-3.9
Core Target	7.5 ft core	15 ft core	15 ft core	7.5 ft core													
Older Loc.	-	-	1209	1210	1217	1218	-	-	-	-	-	-	-	-	-	-	-
6 to 5 ft														As 564			
5 to 4 ft														As 72.4			
4 to 3 ft													156.1 dw	88.4 dw			
3 to 2 ft													3.09	6.2 dw			
2 to 1 ft													3.9 U	ref.			
1 to 0 ft													933 dw	D			
0 to -1 ft													160	ref.			
-1 to -2 ft													1,363 dw	ref.			
-2 to -3 ft																	
-3 to -4 ft																	
-4 to -5 ft																	
-5 to -6 ft																	
-6 to -7 ft																	
-7 to -8 ft																	
-8 to -9 ft																	
-9 to -10 ft																	
-10 to -11 ft																	
-11 to -12 ft																	
-12 to -13 ft																	
-13 to -14 ft																	

Figure A-25

Areas 1 & 2					
Location	1579	1581	1582	1584	1586
Mudline	-18.1	-14.5	-17.4	-14.5	-18.2
Core Target	-26 ft MLLW	10 ft core	-26 ft MLLW	10 ft core	-26 ft MLLW
Older Loc.	-	1270	1271	1276	1277
-14 to -15 ft					
-15 to -16 ft					
-16 to -17 ft					
-17 to -18 ft					
-18 to -19 ft					
-19 to -20 ft					
-20 to -21 ft					
-21 to -22 ft					
-22 to -23 ft					
-23 to -24 ft					
-24 to -25 ft					
-25 to -26 ft					
-26 to -27 ft					
-27 to -28 ft					

Legend

- >RAL for RAL interval (PCBs unless noted)
- <RAL for RAL interval or < surface RAL for vertical interval (PCBs unless noted)
- > surface RAL for vertical interval (PCBs unless noted)
- archive
- native
- >RAL for RAL interval of non-Phase II core collected within 30 ft
- <RAL for RAL interval of non-Phase II core collected within 30 ft

Concentrations and Units
 Concentrations are for total PCBs unless otherwise noted.
 PCBs, PAHs, and Other SVOCs are presented in mg/kg OC unless noted; blue and light blue values indicate dry weight concentrations (ug/kg dw).
 Dioxins/Furan TEQs are presented in ng/kg dw.
 Metals are presented in mg/kg dw.

Other Notes
 Alternating light blue and white backgrounds indicate transects.
 * asterisk indicates EF ≥0.9 and ≤1.0
 ref. indicates refusal at or before target depth
 est. indicates estimated mudline