

APPENDIX **C**. MEMORANDUM: DIOXINS/FURANS
ANALYSIS OF NEAR-OUTFALL SEDIMENT, BANK,
AND SEEP SAMPLES

MEMORANDUM

To: Elly Hale, Environmental Protection Agency
 From: Lower Duwamish Waterway Group
 Subject: Dioxins/furans analysis of near-outfall sediment, bank, and seep samples
 Date: November 9, 2018

In accordance with the surface sediment quality assurance project plan (QAPP) (Windward 2018b) and seep QAPP (Windward 2018a), dioxins/furans were analyzed in a subset of near-outfall sediment, bank, and seep samples. Archives of all samples were kept, per Sections 4.1.2.1 and 4.1.2.2 of the surface sediment QAPP and Section 4.1.3 of the seep QAPP, for potential analysis of dioxins/furans. This memorandum outlines which archived samples will be analyzed, following consultation with US Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology). The results of these analyses will be presented in addenda to the sediment and seep data reports and will be discussed in the draft final data evaluation report.

NEAR-OUTFALL SEDIMENT SAMPLES

Dioxins/furans were analyzed in near-outfall sediment samples collected near Outfalls T107Park, 2507, SeattleDistCtr, 5thAveS, CleanScapesB, and 2100A, based on existing surface sediment data (Map 4-6 of the surface sediment QAPP (Windward 2018b)). Archives were kept of all samples. Table 1 presents the dioxin/furan toxic equivalents (TEQs) for the near-outfall sediment samples initially analyzed for dioxins/furans.

Table 1. Dioxin/furan TEQ results for near-outfall sediment samples initially analyzed

Outfall	Approximate RM	Sample ID	Dioxin/furan TEQ- mammal (half DL) (ng/kg)
T107Park	0.6 W	LDW18-SSOT-T107Park	13.4 J
T107Park	0.6 W	LDW18-SSOT-T107Park-FD	15.9 J
2507	2.1 W	LDW18-SSOT-2507	7.22 J
SeattleDistCtr	2.1 E	LDW18-SSOT-SeattleDistCtr	14.2 J
5thAveS	2.5 W	LDW18-SSOT-5thAveS	247 J

Outfall	Approximate RM	Sample ID	Dioxin/furan TEQ- mammal (half DL) (ng/kg)
CleanScapesB	2.7 E	LDW18-SSOT-CleanScapesB	6.65 J
2100A	4.2 W	LDW18-SSOT-2100A-1	21.7 J
2100A	4.2 W	LDW18-SSOT-2100A-2	14 J

DL – detection limit

RM – river mile

J – estimated concentration

TEQ – toxic equivalent

Map 1 of this memorandum shows all near-outfall sediment sample locations; those from which the samples were not initially analyzed for dioxins/furans are circled. Dioxin/furan TEQs in individual sediment samples are labeled on Map 1 if they are referred to in this memorandum. Per the QAPP, all archived samples not yet analyzed for dioxins/furans are to be analyzed for those chemicals unless existing information indicates that dioxins/furans data are not needed at a given location (Windward 2018b). To assess the need for dioxin/furan analysis of these archived samples, nearby remedial investigation/feasibility study (RI/FS), post-Record of Decision (ROD), and Pre-Design Studies data were compared to the dioxin/furan TEQ remedial action level (RAL) of 25 ng/kg. Per the Ecology’s source control strategy, the RAL is used for source control sufficiency determinations for constituents without Washington State Sediment Management Standards (SMS) (e.g., dioxins/furans) (Ecology 2016).

Table 2 lists the near-outfall sediment samples that were not initially analyzed for dioxins/furans, presents the dioxin/furan TEQs for samples collected nearby, and documents which archived samples will be analyzed for dioxins/furans. Of the 11 archived near-outfall sediment samples, 7 will be analyzed for dioxins/furans based on existing data and in consultation with EPA and Ecology. There are sufficient data near the remaining 4 near-outfall sediment sampling locations, so these samples do not need to be analyzed for dioxins/furans.

Table 2. Rationale for whether archived near-outfall sediment samples should be analyzed for dioxins/furans

Outfall next to Near-outfall Sediment Sample Not Yet Analyzed for D/F	Leidos Outfall ID	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0–45 cm) (ng/kg)	D/F TEQs in Nearby Surface Sediment Composite (0–10 cm) (ng/kg)	D/F TEQs in Nearby RI/FS, Post-ROD, or Pre-Design Studies Individual Sediment Locations (0–10 cm) (ng/kg)	Analyze for D/F?
FedCtrS	L0303	0.8 E	Beach 3 B3-Comp1 D/F TEQ = 4.62 J B3-Comp2 D/F TEQ = 8.19 J B3-Comp3 D/F TEQ = 0.306 J	Comp05 D/F TEQ = 7.45 J Comp08 D/F TEQ = 11.8	RI/FS sediment sample D/F TEQ = 5.73 J	yes – the nearest individual surface sediment sample was collected in the navigation channel
GlacierNW-CBP	L0602	1.7 E	no nearby beach play areas	Comp12 D/F TEQ = 8.92 J	nearest RI/FS samples D/F TEQ ≤ 5.0	no – surface sediment composite and nearby sediment samples < RAL (25 ng/kg)
2509	L2003	2.1 W	Beach 4 B4-Comp1 D/F TEQ = 12.0 J B4-Comp2 D/F TEQ = 73.4 J B4-Comp3 D/F TEQ = 4.68 J	Comp14 D/F TEQ = 7.78 J	near-outfall sediment sample (Outfall 2507) D/F TEQ = 7.22 J RI/FS sediment sample D/F TEQ = 9.06 J	yes –there was variability in the Beach 4 composite and while there is a nearby individual sediment sample with D/F TEQ < 25 ng/kg associated with Outfall 2507, there may be differences in the drainage of these two outfalls; sample will be analyzed, per Agency request
2510	L1905	2.1 W	near, but not in, Beach 4	Comp14 D/F TEQ = 7.78 J	near-outfall sediment sample (Outfall 2507) D/F TEQ = 7.22 J RI/FS sediment sample D/F TEQ = 9.06 J	no – surface sediment composite and nearby sediment samples < RAL (25 ng/kg)
DawnFoods	L0801	2.3 E	no nearby beach play areas	Comp15 D/F TEQ = 4.98 J	no nearby samples analyzed for D/F	yes – there are no subsamples from Composite 15 located near this outfall and no other nearby individual surface sediment samples

Outfall next to Near-outfall Sediment Sample Not Yet Analyzed for D/F	Leidos Outfall ID	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0–45 cm) (ng/kg)	D/F TEQs in Nearby Surface Sediment Composite (0–10 cm) (ng/kg)	D/F TEQs in Nearby RI/FS, Post-ROD, or Pre-Design Studies Individual Sediment Locations (0–10 cm) (ng/kg)	Analyze for D/F?
2114	L2011	2.4 W	near, but not in, Beach 5	Comp15 D/F TEQ = 4.98 J	near-outfall sediment sample (Outfall 5thAveS) D/F TEQ = 247 J	yes – nearby near-outfall sediment sample > RAL (25 ng/kg)
2109-1 and 2109-2	L2108	2.9 W	Beach 5 B5-Comp1 D/F TEQ = 4.40 J B5-Comp2 D/F TEQ = 6.41 J B5-Comp3 D/F TEQ = 5.07 J	Comp17 D/F TEQ = 3.09 J	no nearby samples analyzed for D/F	yes –there are no subsamples from Composite 17 located near this outfall and no other nearby individual surface sediment samples; sample 2109-1 will be analyzed
2101	L2304	4.0 W	no nearby beach play areas	Comp20 D/F TEQ = 2.91 J	downstream RI/FS sample D/F TEQ ≤ 5.0	yes – there is insufficient source control data from the outfall drainage basin of this outfall and no nearby individual sediment samples; therefore, this sample will be analyzed per Agency request
DeltaMarine	L2307	4.2 W	Beach 7 B7-Comp1 D/F TEQ = 1.87 J B7-Comp2 D/F TEQ = 2.24 J B7-Comp3 D/F TEQ = 2.27 J	Comp22 D/F TEQ = 2.13 J	nearby RI/FS samples D/F TEQ ≤ 5.0 and 15.5	yes – there is one subsample from Beach 7 nearby but no individual surface sediment samples nearby; this sample will be analyzed per Agency request
DuwSD3	L2404	4.4 W	Beach 7 B7-Comp1 D/F TEQ = 1.87 J B7-Comp2 D/F TEQ = 2.24 J B7-Comp3 D/F TEQ = 2.27 J	Comp22 D/F TEQ = 2.13 J	upstream and downstream sediment samples D/F TEQ ≤ 5.0	no – beach play area and surface sediment composite and nearby sediment samples < RAL (25 ng/kg)
Ditch 2	L2408	4.9 W	Beach 8 B8-Comp1 TEQ = 2.92 J B8-Comp2 TEQ = 4.08 J B8-Comp3 TEQ = 5.15 J	Comp24 TEQ = 0.462 J	all nearby sediment samples D/F TEQ ≤ 5.0	no – beach play area and surface sediment composite and nearby sediment samples < RAL (25 ng/kg)

Note: Sample IDs in this table are truncated: "LDW18-" and the sample type have been removed.

D/F – dioxin/furan

ID – identification

J – estimated concentration

RAL – remedial action level

RI/FS – remedial investigation/feasibility study

RM – river mile

ROD – Record of Decision

TEQ – toxic equivalency

BANK SAMPLES

Dioxins/furans were analyzed in the sample collected at Bank 2 (location BNK2-1 on Map 2), based on existing surface sediment data (Map 4-6 of the surface sediment QAPP (Windward 2018b)). Archives were kept of all other bank samples. Per the QAPP, archived samples are to be analyzed for dioxins/furans unless existing information indicates dioxins/furans data are not needed at a given location. Map 2 shows all of the bank sample locations; those not initially analyzed for dioxins/furans are circled. In addition, dioxin/furan TEQs in individual sediment samples are labeled on Map 2 if they are referred to in this memorandum.

Table 3 presents the dioxin/furan TEQ results for the sample collected at Bank 2.

Table 3. Dioxin/furan TEQ result for Bank 2 sample

Bank	Approximate RM	Sample ID	Dioxin/furan TEQ – mammal (half DL) (ng/kg)
2	1.0 W	LDW18-BNK2-1	1.37 J

DL – detection limit

RM – river mile

J – estimated concentration

TEQ – toxic equivalency

Table 4 presents the bank samples not yet analyzed for dioxins/furans. To determine whether any of the archived bank samples should be analyzed for dioxins/furans, nearby RI/FS, Post-ROD, and Pre-Design Studies data were compared to the 0-10-cm sediment RAL for dioxins/furans. The results of this comparison are presented in Table 4 along with the rationale for analysis. Of the 10 archived bank samples, 5 will be analyzed for dioxins/furans and 1 analysis will be contingent on a near-outfall sediment sample analysis to be conducted. The remaining 4 archived bank samples will not be analyzed because sufficient data exist to indicate their analysis for dioxins/furans is not needed.

Table 4. Rationale for whether archived bank samples should be analyzed for dioxins/furans

Bank Sample not Analyzed for D/F	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0-45 cm) (ng/kg)	D/F TEQs in Surface Sediment Composite (0-10 cm) (ng/kg)	D/F TEQs in Nearby RI/FS, Post-ROD, or Pre-Design Studies Individual Sample Locations (0-10 cm) (ng/kg)	Analyze for D/F?
BNK1-1	0.6 W	Beach 2 B2-Comp1 D/F TEQ = 27.0 J B2-Comp2 D/F TEQ = 11.7 J B2-Comp3 D/F TEQ = 8.34 J	Comp4 D/F TEQ = 13.5	T107Park (just upstream) D/F TEQ = 13.4 J RI sediment sample D/F TEQ = 16 J FS sediment sample D/F TEQ = 74.5 J no seep data for the bank	yes – 1 of 3 beach play area composites > RAL; nearby sediment sample reported in FS (74.5 J ng/kg) > RAL
BNK3-1	2.1 W	Beach 4 (nearby) B4-Comp1 D/F TEQ = 12.0 J B4-Comp2 D/F TEQ = 73.4 J ^a B4-Comp3 D/F TEQ = 4.68 J	Comp14 D/F TEQ = 7.78 J	Near-Outfall 2507 D/F TEQ = 7.22 J RI/FS sediment sample D/F TEQ = 9.06 J no seep data for the bank	no – sample not collected from within Beach 4; surface sediment composite and nearby sediment samples < RAL (25 ng/kg)
BNK3-2	2.1 W	Beach 4 (nearby) B4-Comp1 D/F TEQ = 12.0 J B4-Comp2 D/F TEQ = 73.4 J B4-Comp3 D/F TEQ = 4.68 J	Comp14 D/F TEQ = 7.78 J	Near-Outfall 2507 D/F TEQ = 7.22 J RI/FS sediment sample D/F TEQ = 9.06 J no seep data for the bank	no – sample not collected from within Beach 4; surface sediment composite and nearby sediment samples < RAL (25 ng/kg)
BNK3-3	2.1 W	Beach 4 (nearby) B4-Comp1 D/F TEQ = 12.0 J B4-Comp2 D/F TEQ = 73.4 J B4-Comp3 D/F TEQ = 4.68 J	Comp14 D/F TEQ = 7.78 J	Near-Outfall 2507 D/F TEQ = 7.22 J RI/FS sediment sample D/F TEQ = 9.06 J no seep data for the bank	contingent - analysis is dependent on D/F results from near-outfall sediment sample associated with Outfall 2509; if D/Fs are elevated in the near-outfall sample collected near Outfall 2509, this bank sample will be analyzed for D/Fs to aid Ecology in determining the source of the D/Fs, per Agency request
BNK4-1	2.6 W	Beach 5 B5-Comp1 D/F TEQ = 4.40 J B5-Comp2 D/F TEQ = 6.41 J B5-Comp3 D/F TEQ = 5.07 J	Comp16 D/F TEQ = 3.88 J	Near-Outfall 5thAveS D/F TEQ = 247 J no nearby seep data	yes – nearby near-outfall sediment sample > RAL (25 ng/kg)

Bank Sample not Analyzed for D/F	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0–45 cm) (ng/kg)	D/F TEQs in Surface Sediment Composite (0–10 cm) (ng/kg)	D/F TEQs in Nearby RI/FS, Post-ROD, or Pre-Design Studies Individual Sample Locations (0–10 cm) (ng/kg)	Analyze for D/F?
BNK4-2	2.6 W	Beach 5 B5-Comp1 D/F TEQ = 4.40 J B5-Comp2 D/F TEQ = 6.41 J B5-Comp3 D/F TEQ = 5.07 J	Comp16 D/F TEQ = 3.88 J	RI sediment sample D/F TEQ = 3.9 J Between near-Outfall 5thAveS D/F TEQ = 247 J and FS sediment sample D/F TEQ = 35.7 J no nearby seep data	yes – nearby near-outfall sediment samples > RAL (25 ng/kg)
BNK4-3	2.7 W	Beach 5 B5-Comp1 D/F TEQ = 4.40 J B5-Comp2 D/F TEQ = 6.41 J B5-Comp3 D/F TEQ = 5.07 J	Comp16 D/F TEQ = 3.88 J	RI sediment sample D/F TEQ = 3.9 J FS sediment sample D/F TEQ = 35.7 J no nearby seep data	yes – nearby sediment sample > RAL (25 ng/kg)
BNK5-1	3.0 W	Beach 5 B5-Comp1 D/F TEQ = 4.40 J B5-Comp2 D/F TEQ = 6.41 J B5-Comp3 D/F TEQ = 5.07 J	Comp18 D/F TEQ = 1.82 J Comp17 (just downstream) D/F TEQ = 3.09 J	RI sediment sample D/F TEQ ≤ 5.0 no nearby seep data	no – beach play area and surface sediment composites and nearby sediment sample < RAL (25 ng/kg)
BNK6-1	4.7 W	Beach 8 B8-Comp1 D/F TEQ = 2.92 J B8-Comp2 D/F TEQ = 4.08 J B8-Comp3 D/F TEQ = 5.15 J	Comp24 D/F TEQ = 0.462 J	multiple post-ROD and RI/FS sediment samples D/F TEQs ≤ 5.0 no nearby seep data	yes – this sample had total PCBs detected at a concentration of 3,180 µg/kg and pentachlorophenol was not detected at a reporting limit of 19.0 µg/kg; sample being analyzed per Agency request
BNK6-2	4.7 W	Beach 8 B8-Comp1 D/F TEQ = 2.92 J B8-Comp2 D/F TEQ = 4.08 J B8-Comp3 D/F TEQ = 5.15 J	Comp24 D/F TEQ = 0.462 J	multiple post-ROD and RI/FS sediment samples D/F TEQs < RAL no nearby seep data	no – nearby beach and surface sediment composites and individual sediment samples < RAL (25 ng/kg)

Note: Sample IDs in this table are truncated: “LDW18-“ and the sample type have been removed.

^a As discussed in the near-outfall section, the Beach 4 composite samples include sediment from the Trotsky Inlet, from which a sediment sample with a dioxin/furan TEQ of 412 ng/kg was reported in the RI (Windward 2010).

D/F – dioxin/furan

Ecology – Washington State Department of Ecology

FS – feasibility study

J – estimated concentration

PCB - polychlorinated biphenyl

RAL – remedial action level

RI – remedial investigation

ROD – Record of Decision

RM – river mile

TEQ – toxic equivalency

SEEP SAMPLES

Of the 26 seeps sampled as part of the Pre-Design Studies, 12 were analyzed initially for dioxins/furans: SP-01, SP-24, SP-42, SP-57, SP-66, SP-70, SP-77, SP-78, SP-79, SP-86, SP-87, and SP-88. Table 5 presents the dioxin/furan TEQ results for the 12 seeps initially analyzed for dioxins/furans. No congeners were detected in 9 of the 13 samples (including the field duplicate). In the other four samples, only one or two congeners were detected; these detected results contributed between 0.27% and 0.80% of the dioxin/furan TEQ.

Table 5. Dioxin/furan TEQ results for seep samples initially analyzed

Seep	Approximate RM	Sample ID	Dioxin/furan TEQ – mammal (half DL) (pg/L)	Dioxin/furan Congeners Detected
SP-01	2.2 E	LDW18-SP-01	0.746 U EMPC	none
SP-24	4.2 E	LDW18-SP-24	0.740 U EMPC	none
SP-24	4.2 E	LDW18-SP-24-FD	0.767 U EMPC	none
SP-42	3.9 W	LDW18-SP-42	0.756 U EMPC	none
SP-57	2.0 W	LDW18-SP-57	0.748 U EMPC	none
SP-66	0.9 W	LDW18-SP-66	0.741 J	OCDD, OCDF
SP-70	0.2 W	LDW18-SP-70	0.732 U	none
SP-77	1.1 E	LDW18-SP-77	0.741 U EMPC	none
SP-78	1.4 E	LDW18-SP-78	0.838 J	OCDD
SP-79	1.5 E	LDW18-SP-79	0.744 U EMPC	none
SP-86	0.8 W	LDW18-SP-86	0.750 J	1,2,3,4,6,7,8-HpCDF
SP-87	2.1 W	LDW18-SP-87	0.747 J	OCDD, OCDF
SP-88	0.2 E	LDW18-SP-88	0.782 U EMPC	none

DL – detection limit

EMPC – estimated maximum possible concentration

HpCDF – heptachlorodibenzofuran

J – estimated concentration

RM – river mile

OCDD – octachlorodibenzo-*p*-dioxin

OCDF – octachlorodibenzofuran

TEQ – toxic equivalent

U – not detected at given concentration

Samples from 14 seeps were not initially analyzed for dioxins/furans because existing surface sediment dioxin/furan TEQs in the vicinity of the seeps were less than 5 ng/kg (Map 4-4 of the surface sediment QAPP (Windward 2018b)). Seep samples from these locations were archived for potential dioxin/furan analysis if PCP was detected in nearby bank samples, or if the dioxin/furan TEQs in nearby sediment samples were greater than the RAL (25 ng/kg). All 26 seeps sampled as part of the Pre-Design Studies are shown on Map 3; those not initially analyzed for dioxins/furans are circled.

Table 6 lists the 14 seep samples that were not originally analyzed for dioxins/furans and presents the nearby sediment and bank sample data. All of the locations discussed in Table 6 are labeled on Map 3. Per Agency request, one of the seep samples (from seep SP-83) will be analyzed for dioxins/furans. Dioxin/furan analysis (of seep SP-32) will be conducted if dioxins/furans are elevated in the bank sample from BNK6-1.

Table 6. Rationale for whether archived seep samples should be analyzed for dioxins/furans

Seep not Analyzed for D/F	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0–45 cm) (ng/kg)	D/F TEQs in Surface Sediment Composite (0–10 cm) (ng/kg)	PCP Detected in Nearby Bank Sample?	D/F TEQs in RI/FS, Post-ROD, and Pre-Design Studies Individual Sediment (0–10-cm sediment [ng/kg] or pg/L in seeps)	Analyze for D/F?
SP-73	0.6 E	Beach Play Area 3: B3Comp1 TEQ = 4.62 J B3Comp2 TEQ = 8.19 J B3Comp3 TEQ = 0.306 J	Comp5 TEQ = 7.45 J	no nearby bank samples	RI/FS sediment sample D/F TEQ = 4.31 J no nearby seep samples analyzed for D/F	no – beach and surface sediment composites and individual sediment sample < RAL (25 ng/kg)
SP-74	0.7 E	Beach Play Area 3: B3Comp1 TEQ = 4.62 J B3Comp2 TEQ = 8.19 J B3Comp3 TEQ = 0.306 J	Comp5 TEQ = 7.45 J	no nearby bank samples	no nearby sediment, seep, or bank samples analyzed for D/F	no – beach and surface sediment composites < RAL (25 ng/kg)
SP-84	1.7 E	no nearby beach play area	Comp12 = 8.92 J	no nearby bank samples	RI/FS sediment sample D/F TEQ = 8.03 J no nearby seep samples	no – surface sediment composite and individual sediment sample < RAL (25 ng/kg)
SP-83	2.2 E	no nearby beach play area	Comp13 = 10.4	no nearby bank samples	D/Fs not detected at SP-01, 125 ft away SeattleDistCtr (near-outfall sediment sample) D/F TEQ = 14.2 J RI/FS sediment sample D/F/ TEQ = 15.9 J	yes – seep is located in an area of source control interest so is being analyzed per Agency request
SP-05	2.6 E	no nearby beach play area	Comp16: D/F TEQ = 3.88 J ng/kg	no nearby bank samples	post-ROD sediment sample D/F TEQ = 4.99 J no nearby seep samples analyzed for D/F	no – surface sediment composites and individual sediment sample < RAL (25 ng/kg)
SP-06	2.6 E	no nearby beach play area	Comp16: D/F TEQ = 3.88 J ng/kg	no nearby bank samples	post-ROD sediment sample D/F TEQ = 0.563 J no nearby seep samples analyzed for D/F	no – surface sediment composite and individual sediment sample < RAL (25 ng/kg)
SP-47	3.1 W	Beach Play Area 5: B5Comp1 TEQ = 4.40 J B5Comp2 TEQ = 6.41 J B5Comp3 TEQ = 5.07 J	Comp18 TEQ = 1.82 J	no nearby bank samples analyzed for D/F	RI/FS sediment sample D/F TEQ = 2.72 J no nearby seep samples analyzed for D/F	no – beach and surface sediment composites and individual sediment sample < RAL (25 ng/kg)

Seep not Analyzed for D/F	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0–45 cm) (ng/kg)	D/F TEQs in Surface Sediment Composite (0–10 cm) (ng/kg)	PCP Detected in Nearby Bank Sample?	D/F TEQs in RI/FS, Post-ROD, and Pre-Design Studies Individual Sediment (0–10-cm sediment [ng/kg] or pg/L in seeps)	Analyze for D/F?
SP-45	3.3 W	Beach Play Area 5: B5Comp1 TEQ = 4.40 J B5Comp2 TEQ = 6.41 J B5Comp3 TEQ = 5.07 J	Comp18 TEQ = 1.82 J	no nearby bank samples	RI/FS sediment sample D/F TEQ ≤ 5.0 no nearby seep samples analyzed for D/F	no – beach and surface sediment composites and individual sediment sample < RAL (25 ng/kg)
SP-43	3.8 W	no nearby beach play area	Comp20 TEQ = 2.91 J	no nearby bank samples	post-ROD sediment sample D/F TEQ ≤ 5.0 D/F not detected in nearby seep SP-42	no – surface sediment composite and individual sediment sample < RAL (25 ng/kg) and not detected in nearby seep
SP-38	4.4 W	Beach Play Area 7: B7Comp1 TEQ = 1.87 J B7Comp2 TEQ = 2.24 J B7Comp3 TEQ = 2.27 J	Comp23 TEQ = 2.32 J Comp22 (just downstream) TEQ = 2.13 J	no nearby bank samples	post-ROD sediment sample D/F TEQ ≤ 5.0 no nearby seep samples analyzed for D/F	no – beach play and surface sediment composites and individual sediment sample < RAL (25 ng/kg)
SP-35	4.6 E	no nearby beach play area	Comp23 TEQ = 2.32 J	no nearby bank samples	post-ROD sediment sample D/F TEQ ≤ 5.0 no nearby seep samples analyzed for D/F	no – surface sediment composite and individual sediment sample < RAL (25 ng/kg)
SP-32	4.8 W	Beach Play Area 8: B8Comp1 TEQ = 2.92 J B8Comp2 TEQ = 4.08 J B8Comp3 TEQ = 5.15 J	Comp24 TEQ = 0.462 J	BNK6-2 PCP = 2.1 J µg/kg (BNK6-1 also nearby, PCP = 19.0 U µg/kg)	RI/FS and post-ROD sediment samples D/F TEQ= ≤ 5.0 no nearby seep or bank samples analyzed for D/F	contingent – analysis is dependent on results of dioxin/furan analysis of bank sample from BNK6-1: sample will be analyzed if dioxins/furans are elevated in bank sample from BNK6-1 in order to aid Ecology in source control, per Agency request
SP-33	4.8 E	no nearby beach play area	Comp24 TEQ = 0.462 J	no nearby bank samples	post-ROD sediment sample D/F TEQ ≤ 5.0 no nearby seep samples analyzed for D/F	no – surface sediment composite and individual sediment sample < RAL (25 ng/kg)
SP-30	4.9 W	Beach Play Area 8:	Comp24 TEQ = 0.462 J	no nearby bank samples	no nearby seep or sediment samples analyzed for D/F	no – beach play area and surface sediment

Seep not Analyzed for D/F	Approximate RM	D/F TEQs in Nearby Beach Play Area Composite (0–45 cm) (ng/kg)	D/F TEQs in Surface Sediment Composite (0–10 cm) (ng/kg)	PCP Detected in Nearby Bank Sample?	D/F TEQs in RI/FS, Post-ROD, and Pre-Design Studies Individual Sediment (0–10-cm sediment [ng/kg] or pg/L in seeps)	Analyze for D/F?
		B8Comp1 TEQ = 2.92 J B8Comp2 TEQ = 4.08 J B8Comp3 TEQ = 5.15 J				composites < RAL (25 ng/kg)

Note: Sample IDs in this table are truncated: “LDW18-“ and the sample type have been removed.

D/F – dioxin/furan

Ecology – Washington State Department of Ecology

FS – feasibility study

J – estimated concentration

PCB - polychlorinated biphenyl

PCP – pentachlorophenol

RAL – remedial action level

RI/FS – remedial investigation/feasibility study

RM – river mile

TEQ – toxic equivalency

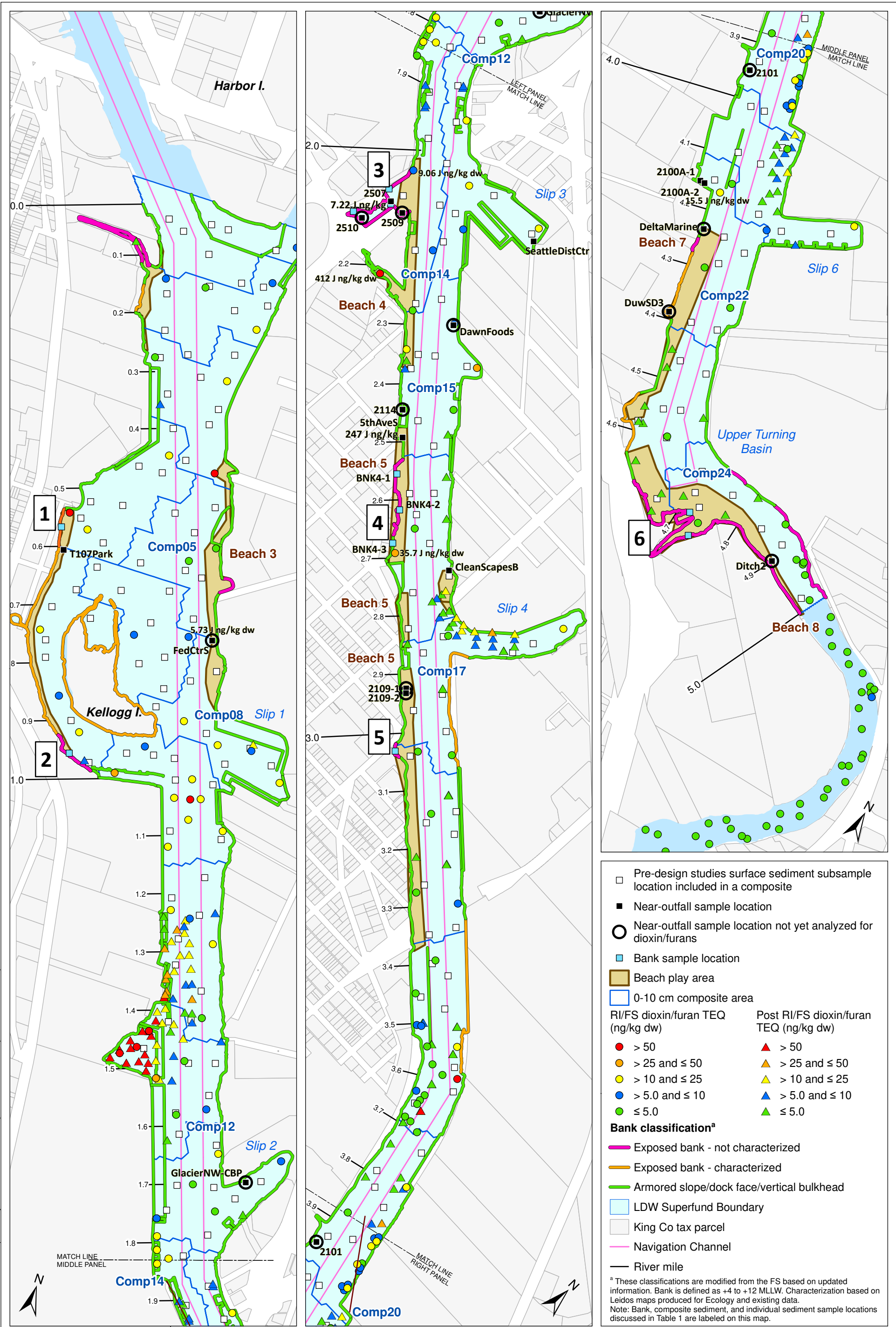
U – not detected at given concentration

CONCLUSIONS

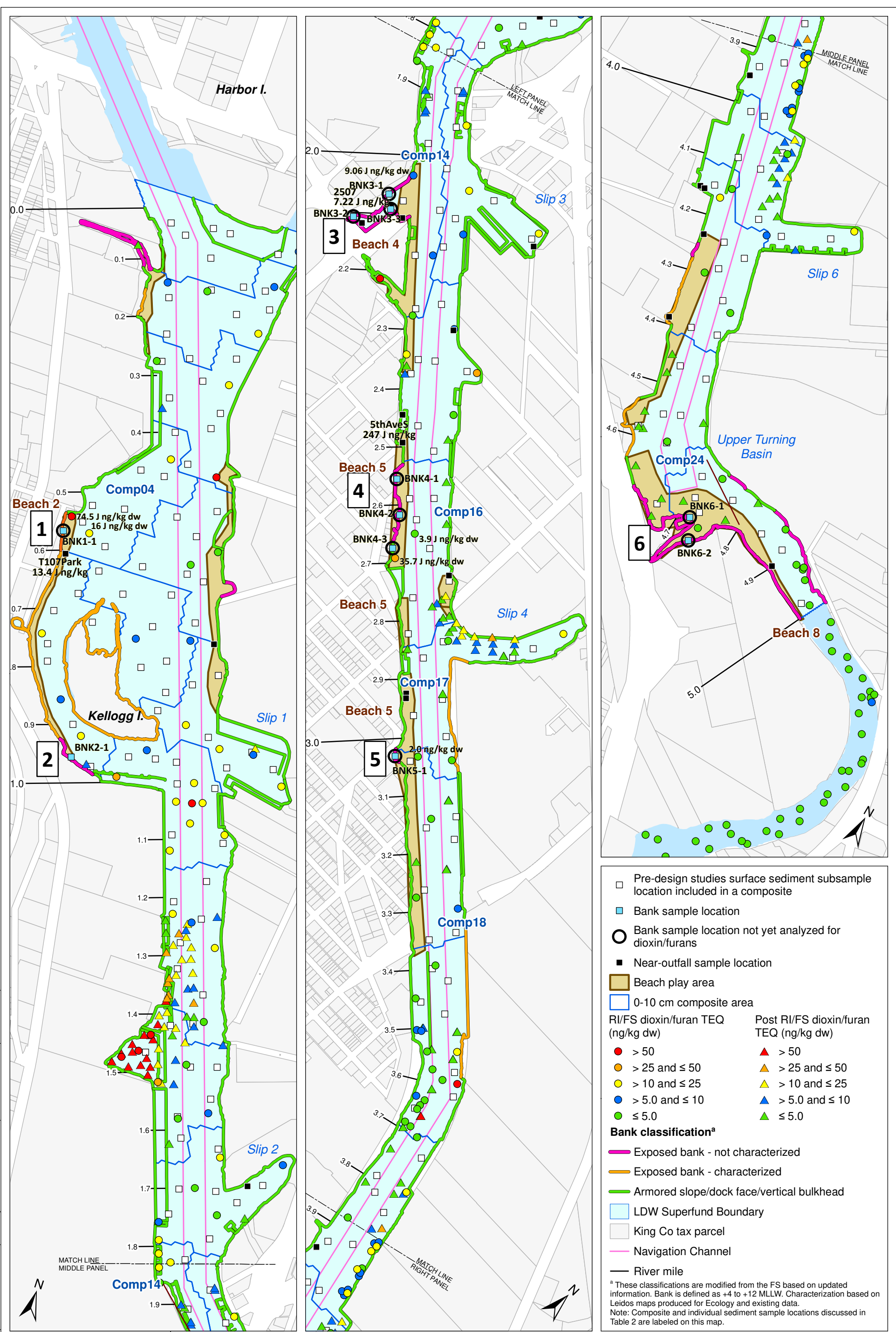
Based on the available data, seven near-outfall sediment samples will be analyzed for dioxins/furans, five additional bank samples will be analyzed for dioxins/furans, and one additional seep sample will be analyzed for dioxins/furans. One bank sample and one seep sample will also be analyzed for dioxins/furans contingent on the dioxin/furan results of nearby near-outfall sediment and bank samples, respectively.

REFERENCES

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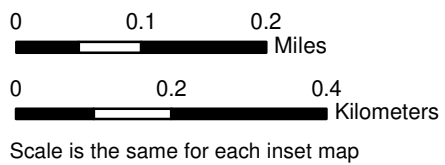
Prepared by: miley_10/30/2018; W:\Projects\Duwamish_AOC3\GIS\Map_2_Analysis\Task_06_Data_Evaluation_Report\Dioxin\Furan_Memo_Map_2_6966_Bank_Samples.mxd



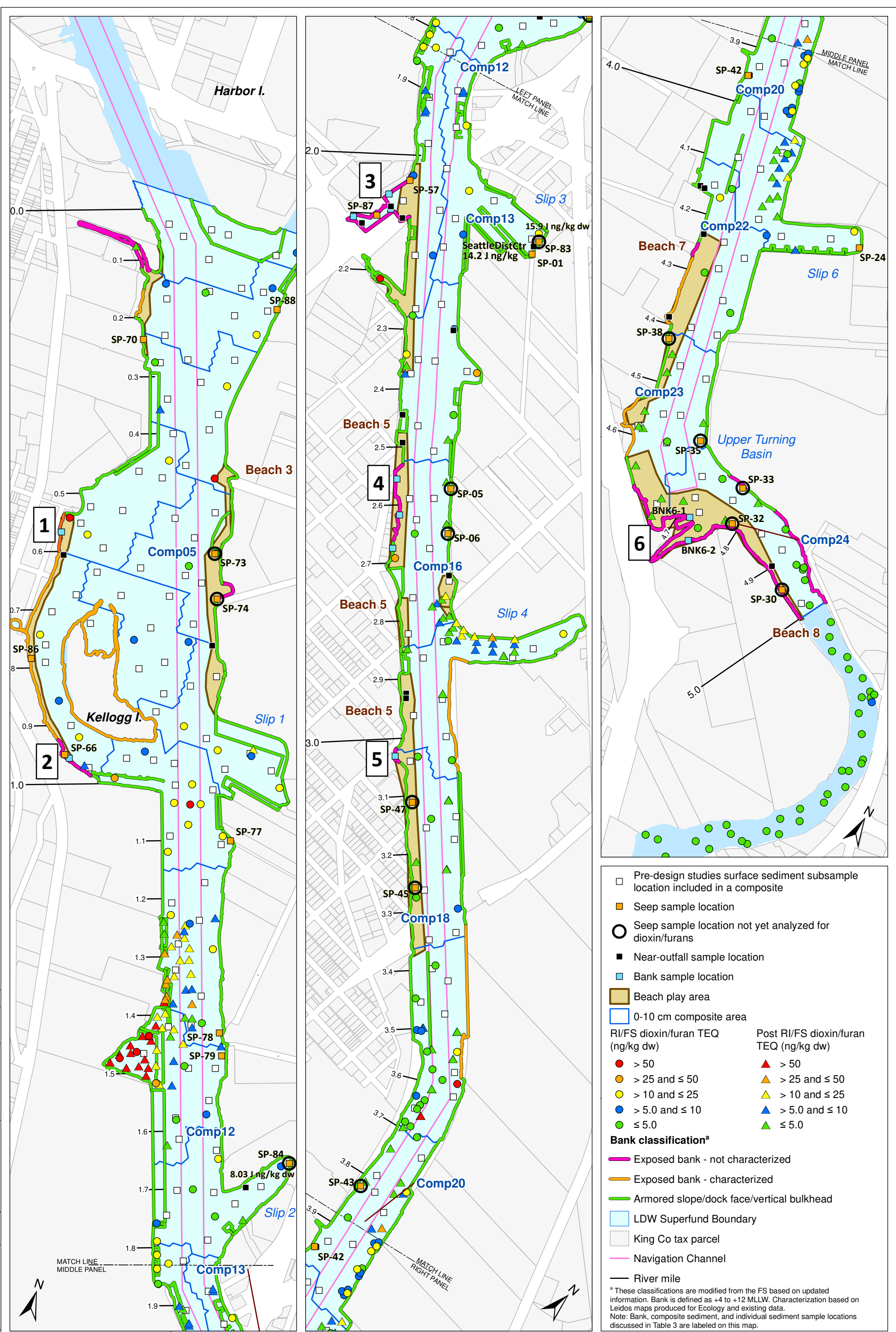
- Pre-design studies surface sediment subsample location included in a composite
 - Bank sample location
 - Bank sample location not yet analyzed for dioxin/furans
 - Near-outfall sample location
 - Beach play area
 - 0-10 cm composite area
- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>RI/FS dioxin/furan TEQ (ng/kg dw)</p> <ul style="list-style-type: none"> ● > 50 ● > 25 and ≤ 50 ● > 10 and ≤ 25 ● > 5.0 and ≤ 10 ● ≤ 5.0 | <p>Post RI/FS dioxin/furan TEQ (ng/kg dw)</p> <ul style="list-style-type: none"> ▲ > 50 ▲ > 25 and ≤ 50 ▲ > 10 and ≤ 25 ▲ > 5.0 and ≤ 10 ▲ ≤ 5.0 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- Bank classification^a**
- Exposed bank - not characterized
 - Exposed bank - characterized
 - Armored slope/dock face/vertical bulkhead
 - LDW Superfund Boundary
 - King Co tax parcel
 - Navigation Channel
 - River mile
- ^a These classifications are modified from the FS based on updated information. Bank is defined as +4 to +12 MLLW. Characterization based on Leidos maps produced for Ecology and existing data. Note: Composite and individual sediment sample locations discussed in Table 2 are labeled on this map.

Map 2. Bank samples not initially analyzed for dioxins/furans

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	Pre-design studies surface sediment subsample location included in a composite
	Seep sample location
	Seep sample location not yet analyzed for dioxin/furans
	Near-outfall sample location
	Bank sample location
	Beach play area
	0-10 cm composite area

RI/FS dioxin/furan TEQ (ng/kg dw)	Post RI/FS dioxin/furan TEQ (ng/kg dw)

Bank classification^a

- Exposed bank - not characterized
- Exposed bank - characterized
- Armored slope/dock face/vertical bulkhead
- LDW Superfund Boundary
- King Co tax parcel
- Navigation Channel
- River mile

^a These classifications are modified from the FS based on updated information. Bank is defined as +4 to +12 MLLW. Characterization based on Leidos maps produced for Ecology and existing data. Note: Bank, composite sediment, and individual sediment sample locations discussed in Table 3 are labeled on this map.

Map 3. Seep samples not initially analyzed for dioxins/furans

DRAFT

0 0.1 0.2
 Miles
 0 0.2 0.4
 Kilometers
 Scale is the same for each inset map