TAB 1

MEMORANDUM

To: EPA Region 10 Portland Harbor RI/FS File

From: Portland Harbor RI/FS Team

Date: May 2016

Subject: Evaluation of analyses used to calculate bioaccumulation calculation results
Portland Harbor Superfund Site
RAC Contract Number EP-W-05-049

PURPOSE

The purpose of this memo is to confirm the analyses used to calculate biota-sediment accumulation factors (BSAFs) and biota-sediment accumulation regressions (BSARs) presented in the Portland Harbor Bioaccumulation Modeling Report (Winward Environmental, 2015) and Appendix Da of the draft Portland Harbor Feasibility Study (Anchor QEA, 2012). The primary steps in this evaluation are:

- Review Section 4 of the Bioaccumulation Modeling Report and the current set of PRGs to identify chemicals for which confirmatory analysis is required.
- Use the results presented in Appendix A of the bioaccumulation Report, the Portland Harbor RI data base and supplemental information provided by the Lower Willamette Group (LWG) to confirm the relationship (or lack thereof) between OC normalized sediment and lipid normalized tissue.
- Determine the potential impact on the current sediment PRGs for the human health fish consumption exposure pathway (RAO 2) and ecological receptor biota (predator) exposure pathway (RAO 6).

IDENTIFICATION OF CHEMICALS

This analysis is limited to chemicals for which BSAFs or BSARs were used to develop PRGs that were used to evaluate remedial action alternatives in the Portland Harbor FS. Based on a review of Tables 2.2-5 (RAO 2 PRG Derivation) and 2.2-9 (RAO 6 PRG Derivation), the following PRGs were selected for evaluation:

- Arsenic
- Mercury

- Carcinogenic PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, dibenz(a,h)anthracene and chrysene
- Bis(2-ethylhexyl) phthalate
- Hexachlorobenzene
- Total PCBs

Human health sediment PRGs for carcinogenic PAHs, were based on consumption of shellfish. As a result, the analysis focused on benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene and chrysene in field collected clams. However, the analysis also looked at the development of BSARs for benzo(a)pyrene in smallmouth bass and the development of BSAFs for benzo(a)anthracene, benzo(a)pyrene and dibenz(a,h)anthracene in large home range fish.

In addition to the above chemicals, total PCBs were included in the smallmouth bass evaluation even though PRGs were developed using the mechanistic model to determine whether a BSAR relationship could be established for total PCBs.

Because the all of the RAO 6 sediment PRGs were developed using the Arnot and Gobas mechanistic food web model, the analysis focused specifically on RAO 2 and the BSARs developed for smallmouth bass and clams and the site-wide BSAFs developed for black crappie, brown bullhead and carp. The process for identifying chemicals for evaluation is presented in Tables 1 and 2.

BSAR AND BSAF RELATIONSHIP CONFIRMATION:

BSARs were developed for those species with exposure areas smaller than the site. These species include benthic invertebrates (laboratory worms, field clams, and crayfish), sculpin, and smallmouth bass. Because PRGs were not established based on tissue-sediment relationships for benthic invertebrates and sculpin, this analysis focused on field collected clam tissue and smallmouth bass.

According to the Bioaccumulation Modeling Report, BSARs were attempted using untransformed and log-transformed sediment and tissue data as follows:

1. Untransformed tissue concentrations vs. sediment concentrations
2. Untransformed tissue concentrations vs. log-transformed sediment concentrations
3. Log-transformed tissue concentrations vs. log-transformed sediment concentrations

BSAFs were developed for large home range fish species including brown bullhead, black crappie and carp.

For organic chemicals, sediment concentrations were normalized based on OC content, and tissue chemical concentrations were normalized based on lipid content to account for the partitioning of these chemicals. No adjustments were made to sediment and tissue chemical concentrations for metals.

Field Clam BSARs:

Selected BSARs for field clams are presented in Table 4-1 of the Bioaccumulation Modeling Report. Of the 15 chemicals evaluated, relationships were established only for benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene and chrysene. BSAR equations for these chemicals are presented in Table 3.

To confirm the field clam BSARs, collocated clam tissue and sediment sample data were extracted from the July 2011 version of the Portland Harbor RI data base (RI_BERA20110727+RA-SummedParams.mdb). Table 1 of Appendix A of the Bioaccumulation Modeling Report presents the collocated sediment and field collected clam tissue sample identification numbers. Sediment and tissue results were normalized to total organic carbon and total lipids respectively consistent with the procedures described in the Bioaccumulation Modeling Report. In addition, any co-located data pair with non-detected tissue or sediment concentrations was removed from the BSAR analysis, so that only pairs of detected sediment and detected tissue concentrations were used in BSAR development.

As noted in Table 4-1, all field clam BSARs were developed based on log-log relationships. According to the Bioaccumulation Modeling Report and supplemental information provided to EPA by the LWG on February 12, 2016, a correction factor was utilized when the BSARs were derived using log-transformed data. Correction factors were applied using the the “smearing estimator” of Duan (1983), as described in Helsel and Hirsh (2002). According to Helsel and Hirsh, transforming estimates from a log regression equation back into the original units imparts a bias into the BSAF estimate. Specifically, the arithmetic mean of log-data provides an estimate of the geometric mean or median rather than the arithmetic mean. The correction factor or “smearing estimator” for a linear model requires re-expressing the residuals (difference between predicted and measured or observed value) from the log-log equation into the original units, and computing their mean. This mean is the correction factor. Correction factors presented in the Bioaccumulation Modeling Report were calculated using the equation presented in Duan (1983) and the R software package. R is a software package that allows a wide range of statistical tests and analyses to be performed. The text of the R code is included as attachment A.

The results of the regression analysis confirmation as obtained from Excel (and without application of the correction factor) are presented in Figure 1. A comparison of the regression equations and r^2 values presented in Figure 1 shows that it was possible to confirm the slope of the line and the r-squared values but not the intercept due to application of the correction factor. This is significant because according to information presented in Burkard (2009), unlike untransformed data where the slope of the line is the

BSAF, for log-log transformations, the log of the BSAF is the intercept of the regression line and not the slope:

$$\ln(C(tissue)) = slope\ x \ln\big(C(sediment)\big) + \ln BSAF$$

Although calculation of the correction factor used to developed field clam BSARs has not been confirmed, application of the correction factor is consistent with the statistical procedures presented in Helsel and Hirsh. In addition, because the R software code has been provided by the LWG, sufficient documentation is available to justify the use of the field clam BSARs developed for benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluroanthene and chrysene.

Smallmouth Bass BSARs:

BSARs for smallmouth bass were not established for RAO 2 PRG contaminants not included in the Food Web Model. In order to confirm the lack of a relationship, BASR relationships were attempted for arsenic, mercury, benzo(a)pyrene, bis(2-ethylhexyl) phthalate, and hexachlorobenzene. A BSAR relationship was also attempted for total PCBs to determine whether a BSAR could be developed for a chemical for which a relationship would be expected based on its physiochemical and bioaccumlative properties. Sediment SWAC data corresponding to each fish tissue sample were obtained from Appendix A of the Bioaccumulation Report. Smallmouth bass fish tissue data were taken from the July 2011 version of the Portland Harbor RI data base (RI_BERA20110727+RA-SummedParams.mdb). Whole body fish tissue (or combined fillet and body w/o fillet fractions) were lipid normalized on a sample by sample basis. Unlike the collocated clam tissue results, it does not appear that the non-detected results were eliminated from the data set prior to developing the BSARs. However, evaluation of the data with the non-detected results removed, did not improve the relationships. The results of the regression analysis are presented in Figure 2. With the exception of total PCBs, the results of the analysis confirmed the lack of a relationship between tissue and sediment. Values of r^2 for arsenic, mercury benzo(a)pyrene, bis(2-ethylhexyl)phthalate and hexachlorobenzene ranged between 0.0009 to 0.2564 depending on the transformation applied. For total PCBs, the r^2 values ranged between 0.44 and 0.50 with the untransformed data providing the best relationship. This confirms that a BSAR relationship could be developed for total PCBs.

Large Home Range Fish Tissue BSAFS:

BSAFs were calculated for large home range species. The tissue concentration was the average of available composite samples for each species, and the sediment concentration was the Study Area SWAC based on a natural neighbor interpolation. However, neither the average tissue concentrations nor the sediment SWAC results are presented in the Bioaccumulation Modeling Report.

As presented in Table 4-6, BSAFs for large home range fish species were developed for antimony, lead, benzo(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, tributyltin and hexachlorobenzene. However, the only chemical for which large home range fish

tissue BSAFs were used to develop RAO 2 sediment PRGs is hexachlorobenzene. A summary of the BSAFs developed is presented in Table 4.

An evaluation of the detection frequency for hexachlorobenzene in large home range fish species indicates that there were infrequent detections of hexachlorobenzene in large home range fish tissue (Table 5). Similarly, although BSAFs were developed for brown bullhead and carp for benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene, there were no detections in 6 brown bullhead tissue samples and only 1 or 2 detections in carp samples. Although no model was developed for bis(2-ethylhexyl) phthalate, there was only one detection of this chemical in large home range fish species (brown bullhead).

Neither the Bioaccumulation Modeling Report nor the supplemental data provided by the LWG included organic carbon normalized SWACs for the chemicals of interest. As a result it is not possible to verify the BSAFs for large home range species presented in Table 4-6. However, there are limited detection of hexachlorobenzene in black crappie and brown bullhead and black crappie. The detection frequency of hexachlorobenzene in carp (9 out of 15 samples) is sufficient that this is only species for which hexachlorobenze BSAFs can reasonably be developed. The lack of detections of benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene in large home range fish species indicates that BSAFs should not be used to develop fish consumption based PRGs for these chemicals.

SUMMARY

The results of this analysis show that a BSAR with an r^2 value of greater than 0.3 can be developed for clam tissue and the four carcinogenic PAHs evaluated, and that the slope of the line of the log-log regression can be verified. Although calculation of the correction factor has not been confirmed, the application of the correction factor is consistent with the procedures presented in Helsel and Hirsh.

The analysis also confirms the lack of a tissue sediment relationship for smallmouth bass for all chemicals that were evaluated (arsenic, benzo(a)pyrene, bis(2-ethylhexyl) phthalate, hexachlorobenzene and mercury). However, the bioaccumulation report does not present the results of the regression analysis so it is not possible to verify the BSAR equations presented in Figure 2.

The analysis also shows that with the possible exception of hexachlorobenzene in carp, there are not sufficient detections of benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene in large home range fish species and hexachlorobenzene in black crappie and brown bullhead to warrant the use of BSAFs to develop PRGs for these chemicals and species. However, neither the Bioaccumulation Modeling Report or the supplemental data provided by the LWG included organic carbon normalized SWACs for the chemicals of interest for which BSAFs were developed (benzo(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, and hexachlorobenzene).

Further, the underlying assumption BSAR in the analyses – that the BSAF should change in a linear or ln-linear fashion across all sediment concentrations – may be incorrect for some analytes and ranges of sediment and tissue concentrations. A BSAF may be applicable even when r^2 is zero (BSAF doesn't change with sediment concentration). One might still use a BSAF in this case to help guide monitoring during and after remediation.

REFERENCES:

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Helsel DR, Hirsch RM. 2002. Statistical methods in water resources. Chapter A3, Book 4, Hydrologic analysis and interpretation, Techniques of water-resources investigations of the United States Geological Survey [online]. US Geological Survey, Washington, DC. Updated 2002.

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TAB 2

Table J2.2-1c

Rolling River Mile Average Concentrations - cPAHs (µg/kg) - 0.5 Mile Increments

Portland Harbor Superfund Site

Portland, Oregon

		Alternative							
River Mile	Segment	A	B	D	E	F Mod	F	G	I
1.8	East	285.27	285.27	285.22	283.78	282.50	282.50	281.82	283.78
1.9	East	186.86	183.32	182.29	179.84	176.96	176.96	175.82	179.84
2	East	109.20	96.92	94.10	91.09	87.40	87.40	85.85	91.09
2.1	East	70.52	53.34	48.21	43.79	39.56	39.56	37.86	43.79
2.2	East	68.53	46.11	40.46	35.65	30.23	30.23	27.86	35.65
2.3	East	68.30	47.58	42.36	38.13	31.09	31.09	28.41	38.13
2.4	East	72.13	53.50	48.88	45.39	37.72	37.72	34.39	45.39
2.5	East	100.32	90.32	83.48	69.85	51.04	51.04	39.92	69.85
2.6	East	260.05	230.35	127.55	89.82	58.76	58.76	42.40	89.82
2.7	East	291.09	265.35	155.32	106.32	67.62	67.62	49.07	118.83
2.8	East	330.61	302.02	178.48	123.59	83.63	83.63	63.97	137.65
2.9	East	366.76	335.38	199.80	139.56	98.14	98.14	77.89	154.99
3	East	378.99	342.93	193.30	140.72	111.59	111.59	100.92	158.45
3.1	East	147.28	147.28	144.53	129.07	117.79	117.79	114.39	147.28
3.2	East	123.17	123.17	122.85	122.85	122.69	122.69	122.47	122.85
3.3	East	136.32	136.32	133.30	133.30	132.93	132.93	128.12	133.30
3.4	East	127.61	127.61	124.55	124.55	124.09	124.09	118.04	124.55
3.5	East	103.45	103.45	100.97	100.52	91.46	91.46	80.28	100.52
3.6	East	172.84	97.27	84.23	78.46	61.95	61.95	50.44	78.46
3.7	East	179.17	100.32	86.96	79.70	61.10	61.10	45.42	79.70
3.8	East	178.68	93.22	80.33	70.51	47.73	47.73	31.63	70.51
3.9	East	195.24	106.54	91.25	69.90	40.86	40.86	19.42	69.90
4	East	248.27	129.99	109.63	81.01	46.48	46.48	19.35	81.01
4.1	East	728.16	726.84	721.31	477.94	159.25	159.25	56.39	477.94
4.2	East	1246.57	1245.78	1198.34	929.37	181.08	181.08	43.96	929.37
4.3	East	1782.86	1773.03	1345.04	975.23	235.15	235.15	60.41	975.23
4.4	East	3074.92	2823.89	1741.18	1095.22	257.00	257.00	65.42	1095.22
4.5	East	3710.28	3478.82	1862.81	1093.30	281.79	281.79	61.57	1093.30
4.6	East	4185.69	3902.69	1927.87	1114.36	293.82	293.82	61.92	1114.36
4.7	East	4957.91	4571.35	1919.87	905.11	337.01	337.01	91.48	905.11
4.8	East	4953.33	4494.46	1855.23	841.19	324.02	324.02	100.17	841.19
4.9	East	3027.23	3027.23	1047.80	489.04	353.49	353.49	151.99	489.04
5	East	327.32	327.32	327.32	327.32	326.85	326.85	258.05	327.32
5.1	East	396.32	396.32	396.32	396.32	396.32	396.32	261.20	396.32
5.2	East	472.15	472.15	472.15	472.15	472.15	472.15	253.14	472.15
5.3	East	487.34	487.34	487.34	487.34	470.21	470.21	257.25	470.21
5.4	East	648.39	648.39	648.39	648.39	473.76	473.76	201.41	473.76
5.5	East	791.48	791.48	791.48	705.73	425.67	425.67	146.70	425.67
5.6	East	756.13	754.13	754.13	662.10	327.38	327.38	96.74	327.38
5.7	East	753.01	751.51	751.51	682.34	400.16	400.16	101.62	400.16
5.8	East	783.51	782.16	782.16	719.82	444.98	444.98	122.94	475.43

Table J2.2-1c

Rolling River Mile Average Concentrations - cPAHs (µg/kg) - 0.5 Mile Increments

Portland Harbor Superfund Site

Portland, Oregon

		Alternative							
River Mile	Segment	A	B	D	E	F Mod	F	G	I
5.9	East	708.01	706.78	706.78	646.17	462.45	462.45	210.21	511.54
6	East	619.79	618.74	618.64	607.09	486.73	486.73	267.41	542.06
6.1	East	767.76	767.76	716.22	622.10	489.94	489.94	294.15	744.48
6.2	East	746.34	746.34	685.98	575.15	425.84	425.84	315.52	742.84
6.3	East	622.76	622.76	565.35	461.89	343.59	343.59	285.64	619.62
6.4	East	514.43	513.47	457.38	362.84	266.85	266.85	215.13	512.61
6.5	East	411.54	401.88	341.10	255.14	177.55	177.55	134.57	400.61
6.6	East	175.43	159.12	140.00	130.70	105.92	105.92	78.44	157.40
6.7	East	85.51	70.14	56.22	55.99	53.65	53.65	45.73	68.53
6.8	East	63.97	49.64	37.28	37.07	34.93	34.93	30.21	48.14
6.9	East	58.10	44.76	34.06	33.86	31.91	31.91	28.18	44.38
7	East	63.19	44.64	35.46	35.27	33.73	33.73	31.64	56.05
7.1	East	83.64	60.65	42.47	42.46	41.88	41.88	40.58	83.25
7.2	East	95.25	72.49	50.52	50.52	47.62	47.62	45.94	93.68
7.3	East	97.98	74.98	52.76	52.76	49.83	49.83	48.32	96.40
7.4	East	98.34	73.13	48.63	48.63	45.35	45.35	44.13	96.57
7.5	East	88.78	74.07	50.80	50.80	46.58	46.58	44.95	86.51
7.6	East	60.06	58.83	50.07	50.07	45.79	45.79	42.16	57.54
7.7	East	47.33	47.33	47.33	47.33	47.29	47.29	42.92	47.33
7.8	East	53.59	51.37	51.37	50.95	50.59	50.59	32.93	50.95
7.9	East	60.86	41.71	41.71	41.29	40.91	40.91	22.79	41.29
8	East	64.55	32.80	32.80	32.44	31.19	31.19	15.85	32.44
8.1	East	61.58	30.57	30.57	30.22	29.04	29.04	17.10	30.22
8.2	East	58.26	27.88	27.88	27.54	26.38	26.38	15.42	27.54
8.3	East	50.11	13.97	13.97	13.97	12.84	12.84	12.45	13.97
8.4	East	45.83	24.04	24.04	24.04	22.74	22.74	22.30	24.04
8.5	East	34.24	34.24	34.24	34.24	34.24	34.24	34.20	34.24
8.6	East	36.89	36.89	36.89	36.89	36.79	36.79	36.69	36.89
8.7	East	38.29	38.29	38.29	38.29	38.00	38.00	37.70	38.29
8.8	East	38.44	38.44	38.44	38.44	37.77	37.77	33.74	38.44
8.9	East	36.13	36.13	36.13	36.13	33.72	33.72	26.51	36.13
9	East	34.04	34.04	34.04	34.04	31.13	31.13	22.15	34.04
9.1	East	28.84	28.84	28.84	28.84	26.01	26.01	17.38	28.84
9.2	East	23.29	23.29	23.29	23.29	20.75	20.75	12.61	23.29
9.3	East	22.38	22.38	22.38	22.38	19.02	19.02	13.09	22.38
9.4	East	25.39	25.39	25.39	25.39	17.81	17.81	12.92	25.39
9.5	East	24.85	24.85	24.85	24.85	17.40	17.40	11.87	24.85
9.6	East	27.04	27.04	27.04	27.04	19.92	19.92	14.41	27.04
9.7	East	33.15	33.15	33.15	33.15	26.13	26.13	20.71	33.15
9.8	East	50.35	50.25	50.16	48.52	39.91	39.91	28.13	48.52
9.9	East	157.81	157.70	157.60	149.77	67.36	67.36	38.05	154.95

Table J2.2-1c

Rolling River Mile Average Concentrations - cPAHs (µg/kg) - 0.5 Mile Increments

Portland Harbor Superfund Site

Portland, Oregon

		Alternative							
River Mile	Segment	A	B	D	E	F Mod	F	G	I
10	East	218.90	218.78	218.67	210.07	118.10	118.10	78.51	215.75
10.1	East	303.54	303.39	303.26	292.62	178.88	178.88	121.87	299.65
10.2	East	378.63	378.44	378.28	364.85	221.32	221.32	148.55	373.72
10.3	East	435.76	435.76	435.76	422.58	247.08	247.08	171.42	433.75
10.4	East	216.49	216.49	216.49	216.49	206.99	206.99	167.83	216.49
10.5	East	127.54	127.54	127.54	125.13	113.66	113.66	92.83	125.13
10.6	East	58.37	58.37	58.37	49.33	35.81	35.81	29.97	49.33
10.7	East	55.75	55.75	55.75	46.54	27.37	27.37	17.73	46.54
10.8	East	66.50	66.50	66.50	57.49	29.84	29.84	13.99	57.49
10.9	East	71.11	70.31	69.04	58.82	34.29	34.29	15.51	58.82
11	East	74.55	71.13	65.00	54.79	33.29	33.29	12.65	54.79
11.1	East	86.31	71.05	60.46	52.10	31.40	31.40	10.07	52.10
11.2	East	88.58	59.17	46.90	37.41	22.56	22.56	7.26	37.41
11.3	East	72.01	42.92	30.43	20.47	13.20	13.20	5.28	20.47
11.4	East	63.35	34.72	23.18	13.76	7.00	7.00	1.38	13.76
11.5	East	59.21	29.21	20.91	12.40	6.58	6.58	1.78	12.40
11.6	East	47.93	23.63	18.33	12.13	6.79	6.79	1.90	12.13
11.7	East	26.65	23.05	20.74	16.24	10.33	10.33	2.89	16.24
1.8	West	62.11	62.11	62.11	62.11	62.11	62.11	62.11	62.11
1.9	West	62.46	62.46	62.46	62.46	62.46	62.46	62.46	62.46
2	West	69.50	69.50	69.50	69.50	69.50	69.50	69.50	69.50
2.1	West	86.86	86.86	86.86	86.86	86.86	86.86	86.86	86.86
2.2	West	109.69	109.69	109.69	109.69	109.69	109.69	109.69	109.69
2.3	West	160.70	160.70	160.70	160.70	160.70	160.70	160.70	160.70
2.4	West	216.19	216.19	216.19	216.19	216.19	216.19	215.28	216.19
2.5	West	256.95	256.95	256.95	256.95	256.95	256.95	246.87	256.95
2.6	West	320.09	320.09	320.09	320.09	320.09	320.09	285.84	320.09
2.7	West	427.95	427.95	427.95	427.95	427.95	427.95	321.95	427.95
2.8	West	513.27	513.27	513.27	513.27	513.27	513.27	352.94	513.27
2.9	West	526.51	526.51	526.51	526.51	526.51	526.51	371.27	526.51
3	West	586.96	586.96	586.96	586.96	586.96	586.96	394.01	586.96
3.1	West	647.53	647.53	647.53	647.53	647.53	647.53	407.71	647.53
3.2	West	617.29	617.29	617.29	617.29	617.29	617.29	404.33	617.29
3.3	West	546.32	546.32	546.32	546.32	545.47	545.47	365.34	546.32
3.4	West	516.01	516.01	516.01	516.01	515.01	515.01	319.22	516.01
3.5	West	431.10	431.10	431.10	431.10	429.87	429.87	282.44	431.10
3.6	West	320.54	320.54	320.54	320.54	318.90	318.90	251.50	320.54
3.7	West	373.99	373.99	373.99	352.46	258.36	258.36	194.92	352.46
3.8	West	426.48	426.48	426.48	400.88	287.29	287.29	192.64	400.88
3.9	West	503.13	503.13	503.13	472.48	330.22	330.22	212.62	472.48
4	West	644.46	644.46	644.46	605.28	390.05	390.05	176.66	605.28

Table J2.2-1c

Rolling River Mile Average Concentrations - cPAHs (µg/kg) - 0.5 Mile Increments

Portland Harbor Superfund Site

Portland, Oregon

		Alternative							
River Mile	Segment	A	B	D	E	F Mod	F	G	I
4.1	West	821.69	821.69	821.69	782.88	489.17	489.17	144.37	782.88
4.2	West	682.16	682.16	682.16	677.65	533.94	533.94	145.20	677.65
4.3	West	732.10	732.10	732.10	727.05	571.97	571.97	135.33	727.05
4.4	West	840.73	840.73	840.73	835.63	557.96	557.96	94.96	835.63
4.5	West	772.50	772.50	772.50	772.50	499.14	499.14	119.79	772.50
4.6	West	593.79	593.79	593.79	592.04	376.81	376.81	136.58	592.04
4.7	West	718.99	718.99	711.00	652.47	325.64	325.64	160.79	652.47
4.8	West	696.78	696.78	688.77	630.08	296.69	296.69	182.46	630.08
4.9	West	756.67	756.67	706.02	604.99	298.34	298.34	201.23	604.99
5	West	904.84	904.84	845.85	597.11	283.58	283.58	187.08	597.11
5.1	West	1352.60	1352.60	980.81	638.54	300.18	300.18	167.35	638.54
5.2	West	2277.41	1934.17	906.25	545.19	286.52	286.52	127.53	545.19
5.3	West	3143.22	2757.01	1149.48	648.54	279.96	279.96	65.85	648.54
5.4	West	3233.89	2819.33	1154.25	673.79	396.69	396.69	59.08	673.79
5.5	West	3059.56	2650.05	1008.27	707.00	475.85	475.85	75.97	707.00
5.6	West	2640.67	2264.25	1070.46	836.59	518.55	518.55	127.89	859.25
5.7	West	1869.14	1836.29	1266.85	917.04	504.08	504.08	171.97	1158.39
5.8	West	2391.43	1841.79	1354.01	1098.30	510.74	510.74	165.33	1354.01
5.9	West	6066.89	2386.42	1320.10	1019.74	404.12	404.12	140.70	1320.10
6	West	14260.55	2215.14	1193.81	906.11	328.49	328.49	116.58	1193.81
6.1	West	21991.86	2044.06	1034.16	760.87	249.80	249.80	81.87	1034.16
6.2	West	29236.75	1824.08	779.40	627.65	183.65	183.65	41.57	779.40
6.3	West	40104.32	1213.09	285.27	177.98	22.86	22.86	0.00	285.27
6.4	West	38796.86	294.52	214.70	165.60	46.48	46.48	10.64	47.78
6.5	West	25684.49	586.63	504.02	402.75	89.43	89.43	13.56	90.77
6.6	West	11444.97	950.62	843.35	662.72	130.46	130.46	15.80	131.76
6.7	West	2747.09	819.26	678.48	511.10	100.81	100.81	12.81	101.80
6.8	West	955.57	730.89	601.93	447.69	88.31	88.31	11.43	88.31
6.9	West	573.49	476.19	403.08	296.09	51.95	51.95	4.36	51.95
7	West	431.07	288.39	222.10	150.91	26.41	26.41	2.66	26.41
7.1	West	388.34	93.24	39.15	7.75	1.09	1.09	1.19	1.09
7.2	West	337.05	32.98	18.15	6.13	1.25	1.25	0.00	1.25
7.3	West	301.70	27.00	18.52	12.86	8.11	8.11	4.10	8.11
7.4	West	242.36	38.97	36.32	33.02	28.44	28.44	18.99	28.44
7.5	West	174.70	51.50	49.49	45.92	36.50	36.50	22.23	36.50
7.6	West	72.27	65.47	64.07	61.45	49.58	49.58	27.75	49.58
7.7	West	67.72	65.88	64.55	62.32	51.23	51.23	28.44	51.23
7.8	West	65.82	65.80	65.73	64.95	53.14	53.14	28.90	54.27
7.9	West	69.93	69.92	69.83	66.98	47.04	47.04	21.18	55.04
8	West	81.38	81.38	81.38	71.75	44.11	44.11	18.32	64.36
8.1	West	154.22	154.22	152.78	127.27	13.66	13.66	2.77	126.62

Table J2.2-1c

Rolling River Mile Average Concentrations - cPAHs (µg/kg) - 0.5 Mile Increments

Portland Harbor Superfund Site

Portland, Oregon

		Alternative							
River Mile	Segment	A	B	D	E	F Mod	F	G	I
8.2	West	182.11	182.11	180.96	158.76	37.60	37.60	8.66	158.76
8.3	West	166.50	165.99	165.12	142.72	43.08	43.08	20.70	142.72
8.4	West	164.84	163.87	163.05	131.35	39.75	39.75	19.52	131.35
8.5	West	157.94	156.98	156.07	122.94	38.06	38.06	19.12	122.94
8.6	West	127.83	119.42	110.27	78.72	40.20	40.20	20.23	78.72
8.7	West	126.22	90.14	77.50	40.06	21.28	21.28	17.73	40.06
8.8	West	157.77	85.13	59.05	15.14	2.29	2.29	0.58	15.14
8.9	West	199.49	73.54	34.76	5.52	0.00	0.00	0.00	5.52
9	West	244.30	88.99	22.98	3.73	0.00	0.00	0.00	3.73
9.1	West	177.20	61.01	24.76	13.06	4.58	4.58	2.95	13.06
9.2	West	117.12	60.71	33.93	24.75	10.68	10.68	6.83	24.75
9.3	West	88.48	58.85	42.66	34.62	11.69	11.69	7.59	34.62
9.4	West	102.36	77.62	61.19	36.99	12.35	12.35	8.13	36.99
9.5	West	148.22	125.81	81.07	34.07	10.73	10.73	7.05	34.07
9.6	West	173.60	145.67	90.06	34.97	10.55	10.55	7.00	34.97
9.7	West	212.97	176.37	103.49	31.20	7.10	7.10	5.20	31.20
9.8	West	277.97	226.84	125.00	23.84	8.75	8.75	7.45	23.84
9.9	West	300.06	277.99	132.37	28.88	19.25	19.25	12.56	28.88
10	West	122.87	122.87	121.18	110.42	90.67	90.67	38.14	112.11
10.1	West	156.51	156.51	155.27	144.59	87.73	87.73	31.04	145.83
10.2	West	282.49	282.49	281.38	272.30	222.85	222.85	121.80	273.41
10.3	West	354.58	354.58	353.49	344.85	297.10	297.10	199.55	345.93
10.4	West	352.57	352.57	351.48	342.73	295.04	295.04	208.29	343.81
10.5	West	186.72	186.72	186.72	185.45	167.31	167.31	106.71	185.45
10.6	West	146.85	146.85	146.85	146.85	146.85	146.85	100.48	146.85
10.7	West	92.15	92.15	92.15	92.15	92.15	92.15	70.90	92.15
10.8	West	70.85	70.85	70.85	70.85	70.85	70.85	52.63	70.85
10.9	West	66.88	66.88	66.88	66.88	66.88	66.88	50.18	66.88
11	West	65.35	65.35	65.35	65.35	65.35	65.35	65.33	65.35
11.1	West	77.48	77.48	77.48	77.48	77.48	77.48	77.48	77.48
11.2	West	91.43	91.43	91.43	91.43	91.43	91.43	90.27	91.43
11.3	West	89.88	89.88	89.88	89.88	89.88	89.88	88.54	89.88
11.4	West	79.16	79.16	79.16	79.16	79.16	79.16	77.95	79.16
11.5	West	84.56	84.56	84.56	84.56	84.56	84.56	83.18	84.56
11.6	West	77.70	77.70	77.70	77.70	77.70	77.70	75.99	77.70
11.7	West	49.64	49.64	49.64	49.64	49.64	49.64	49.64	49.64
7.8	Swan Isl	274.24	34.87	34.82	3.82	1.90	1.90	0.28	3.82
7.9	Swan Isl	180.11	14.06	13.93	7.22	1.90	1.90	0.72	7.22
8	Swan Isl	230.60	19.33	18.31	9.87	4.01	4.01	0.98	9.87
8.1	Swan Isl	270.08	21.30	19.69	11.76	5.88	5.88	1.26	11.76
8.2	Swan Isl	306.92	20.23	18.69	11.55	6.23	6.23	2.12	11.55

Table J2.2-1c

Rolling River Mile Average Concentrations - cPAHs (µg/kg) - 0.5 Mile Increments

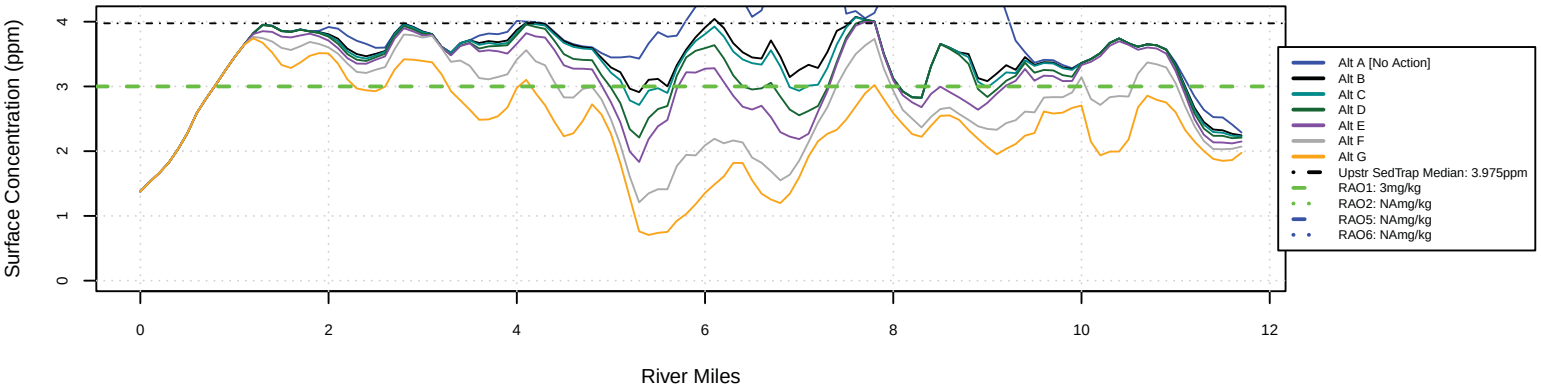
Portland Harbor Superfund Site

Portland, Oregon

		Alternative							
River Mile	Segment	A	B	D	E	F Mod	F	G	I
8.3	Swan Isl	324.18	18.63	17.03	11.80	6.47	6.47	2.34	11.80
8.4	Swan Isl	385.51	21.35	19.09	13.03	8.70	8.70	3.54	13.03
8.5	Swan Isl	388.14	18.20	15.29	11.45	9.16	9.16	5.45	11.45
8.6	Swan Isl	359.27	21.05	10.30	7.14	6.12	6.12	5.51	7.14
8.7	Swan Isl	288.09	25.06	8.82	5.66	4.49	4.49	3.91	5.66
8.8	Swan Isl	258.99	26.91	8.34	5.28	3.96	3.96	3.54	5.28
8.9	Swan Isl	309.88	108.46	63.12	40.65	6.27	6.27	4.28	87.76
9	Swan Isl	339.31	131.60	76.02	49.89	7.15	7.15	4.69	109.02
9.1	Swan Isl	325.88	167.56	104.18	68.44	8.88	8.88	5.55	151.36
9.2	Swan Isl	379.46	258.88	169.67	111.36	13.46	13.46	8.08	249.40
9.3	Swan Isl	431.88	369.29	248.47	162.50	19.22	19.22	11.44	366.47
9.4	Swan Isl	63.59	63.59	63.59	63.59	63.59	63.59	63.59	63.59

TAB 3

[t=0] Arsenic − Site − rolling avg 0.5 mile



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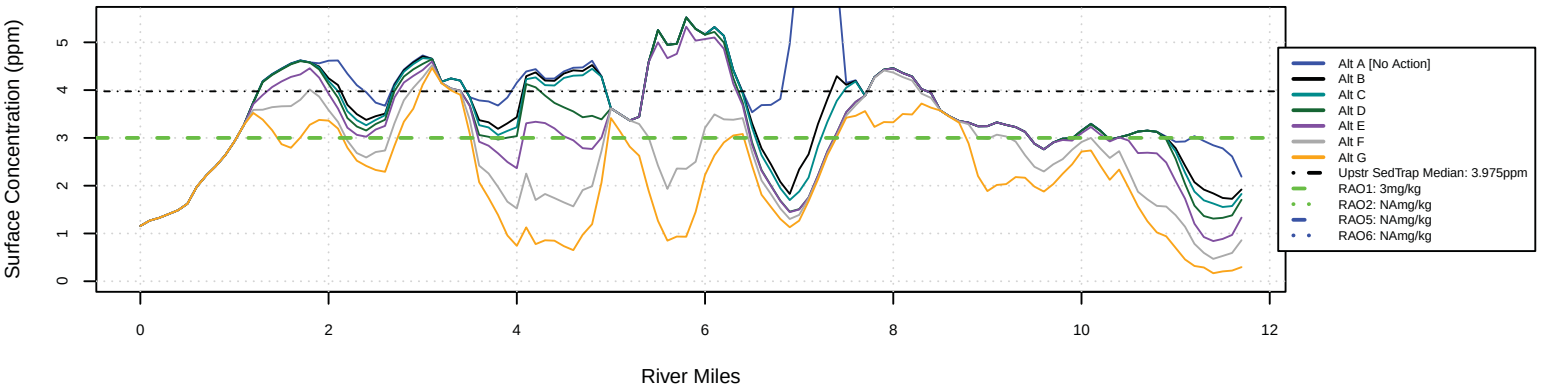

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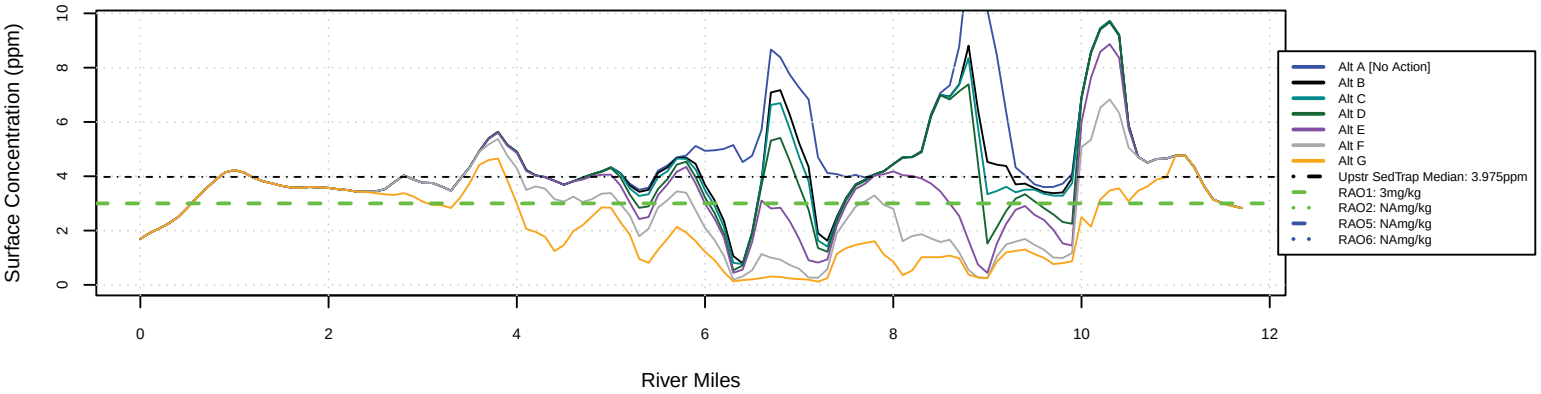

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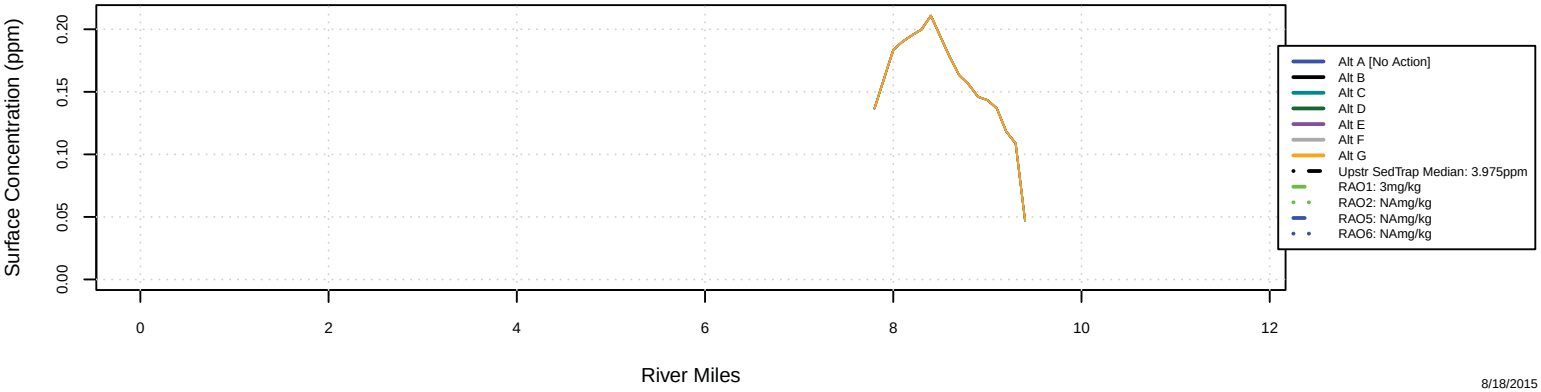
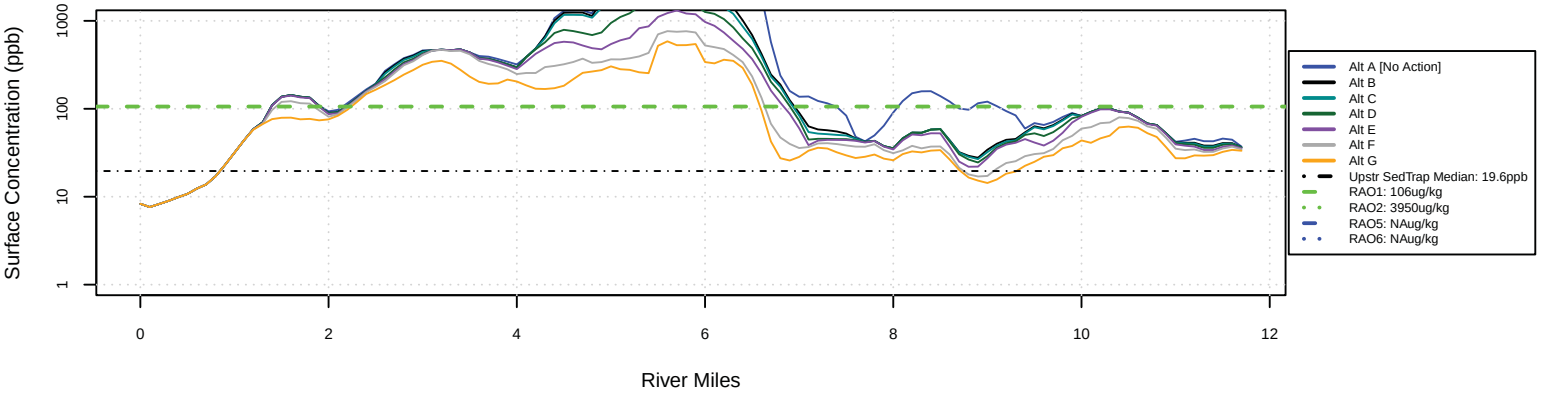


8/18/2015

[t=0] cPAHs − Site − rolling avg 0.5 mile



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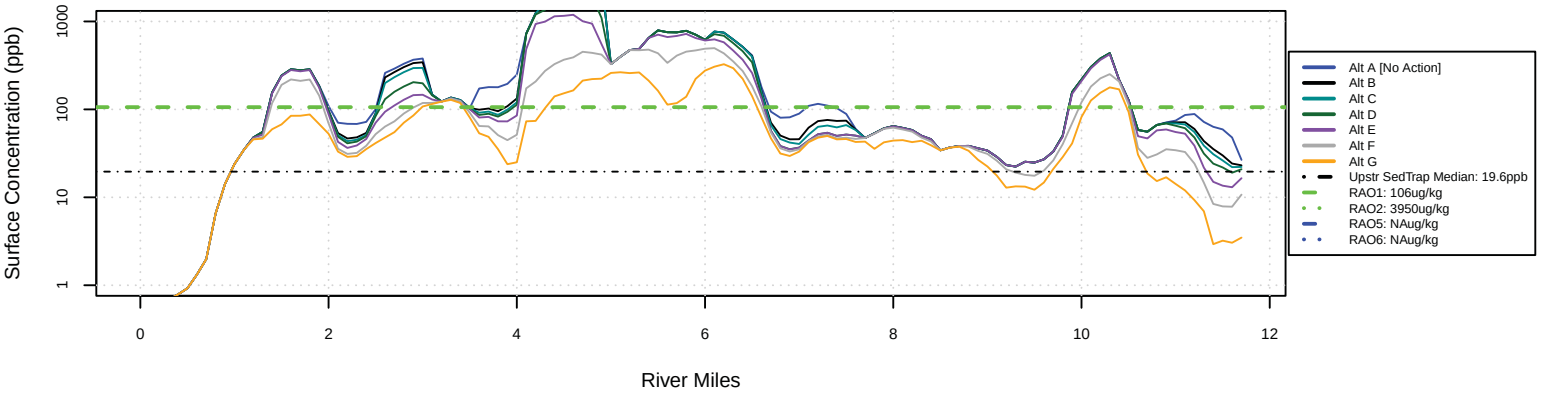

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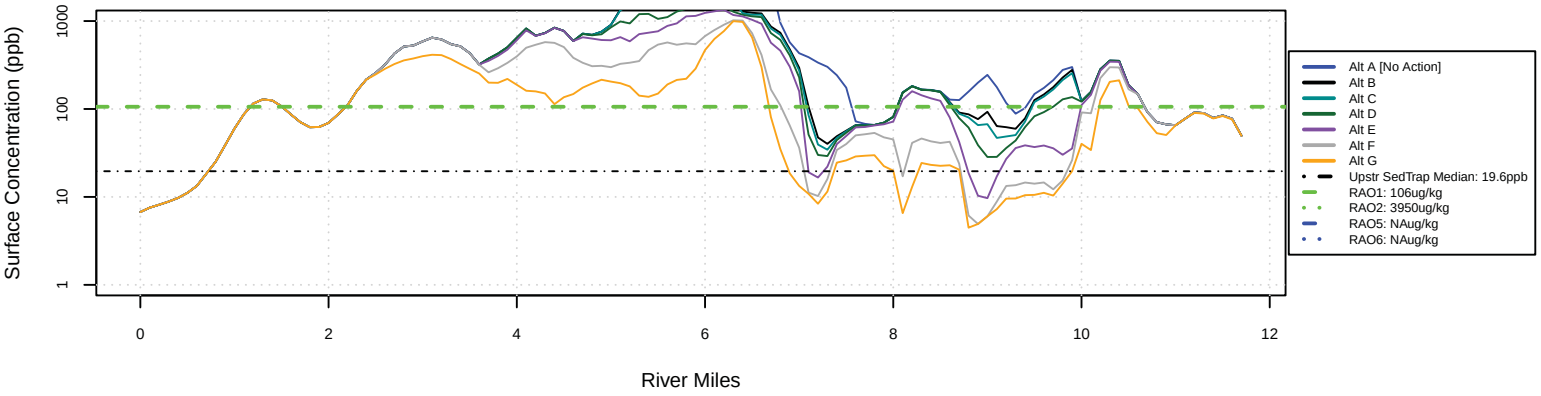

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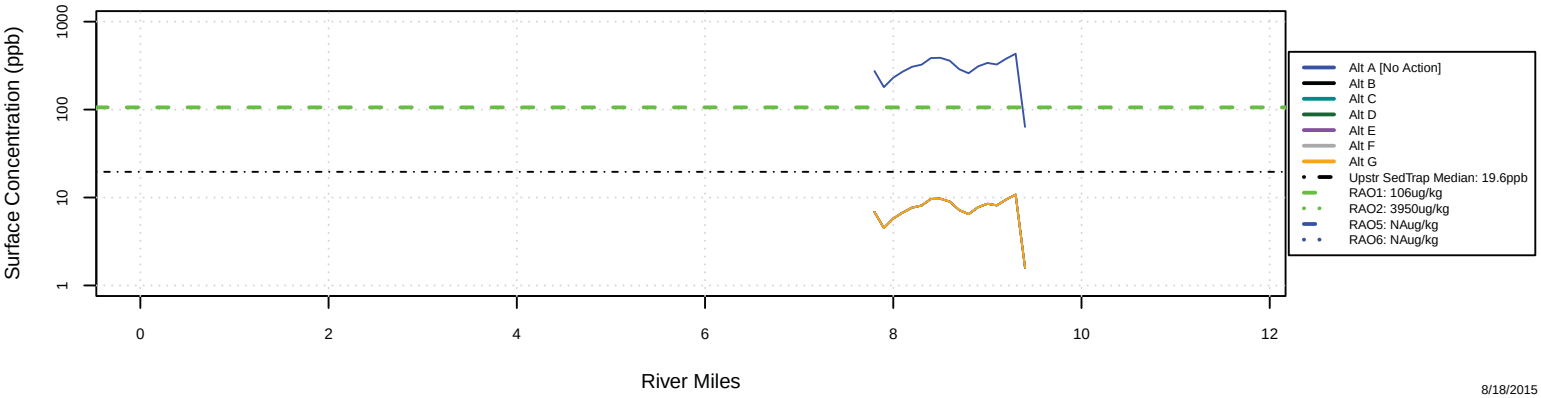

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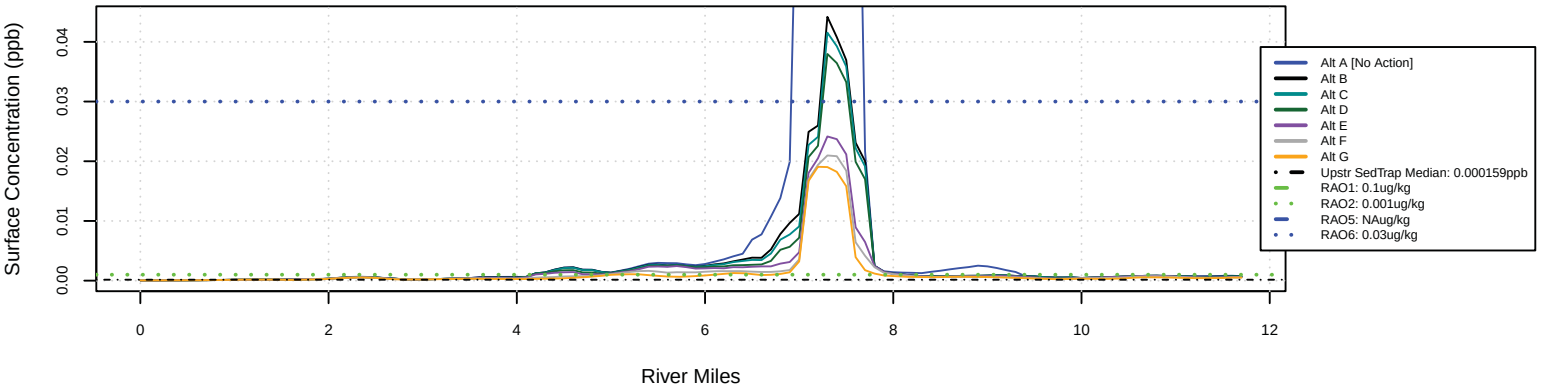

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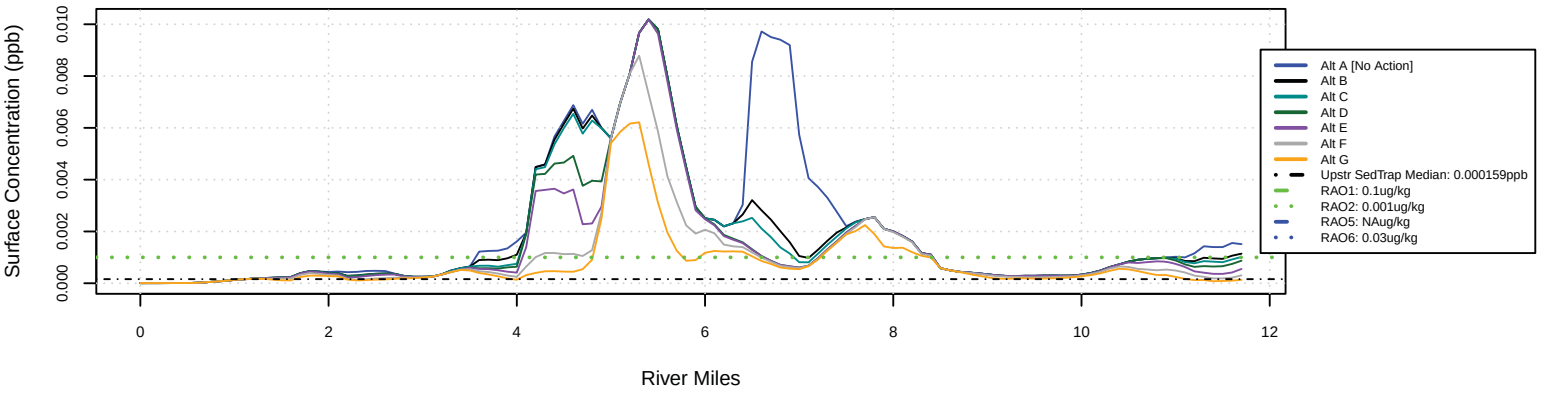

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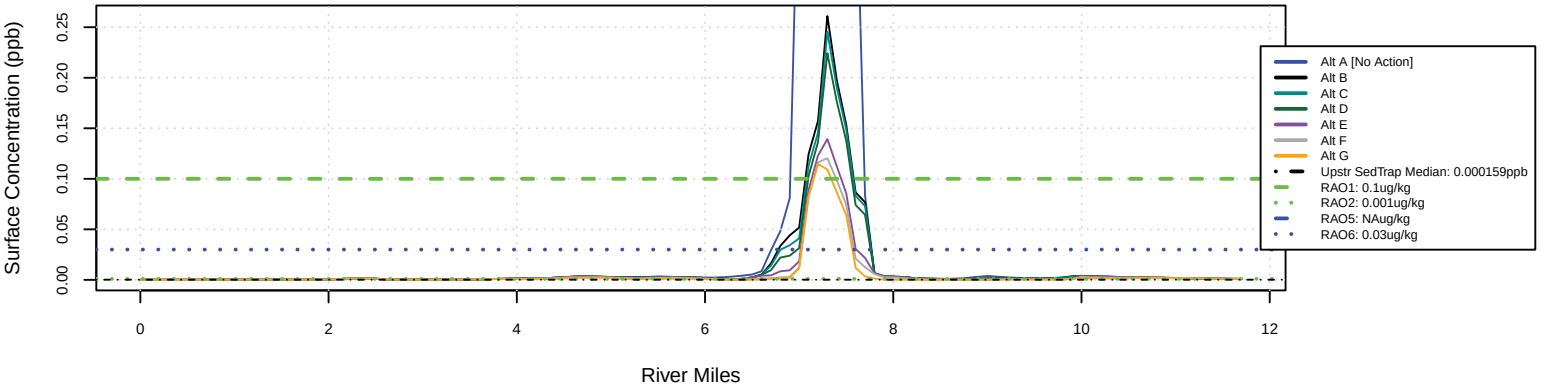

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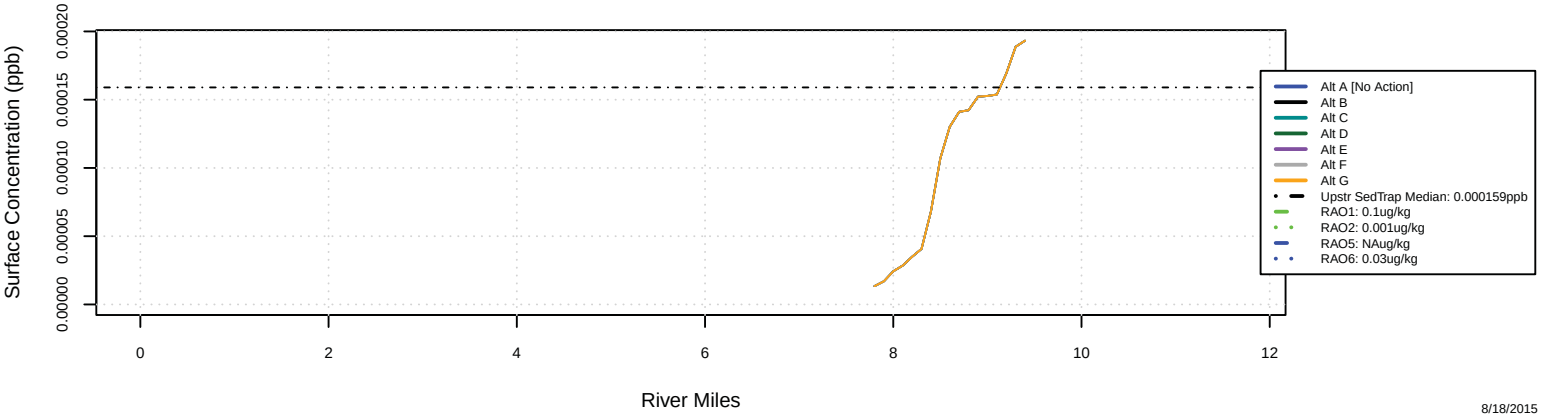

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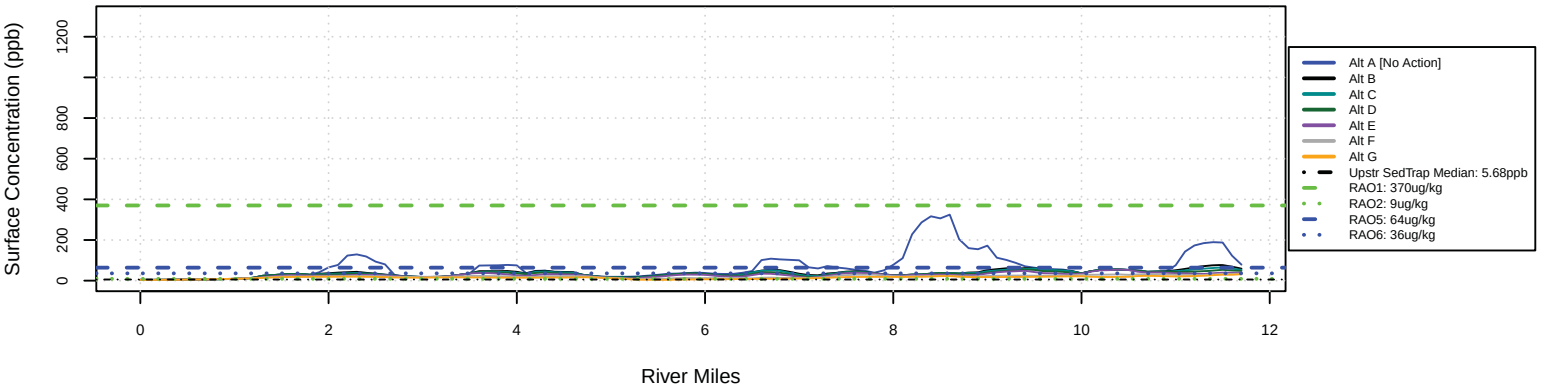

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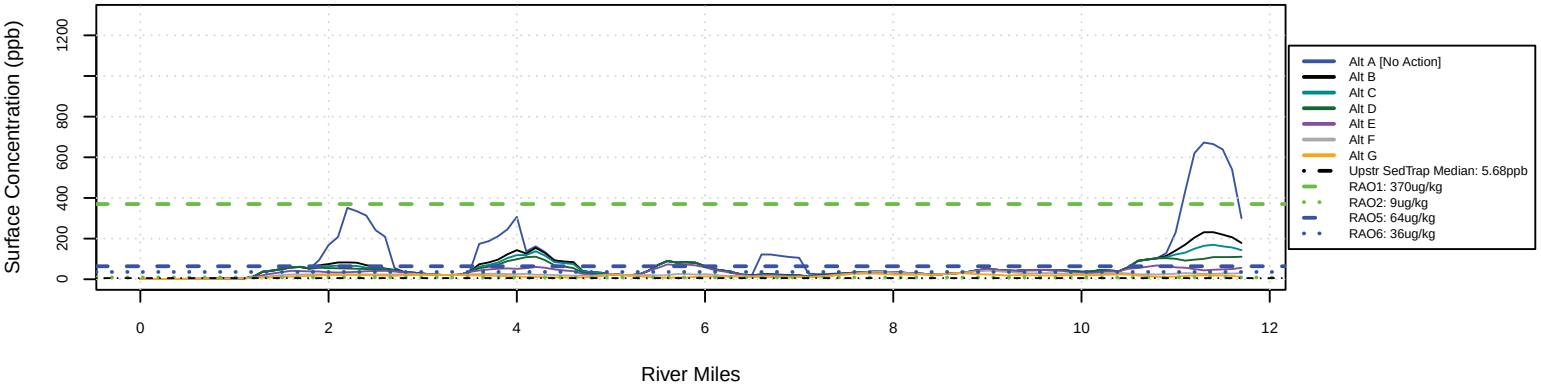

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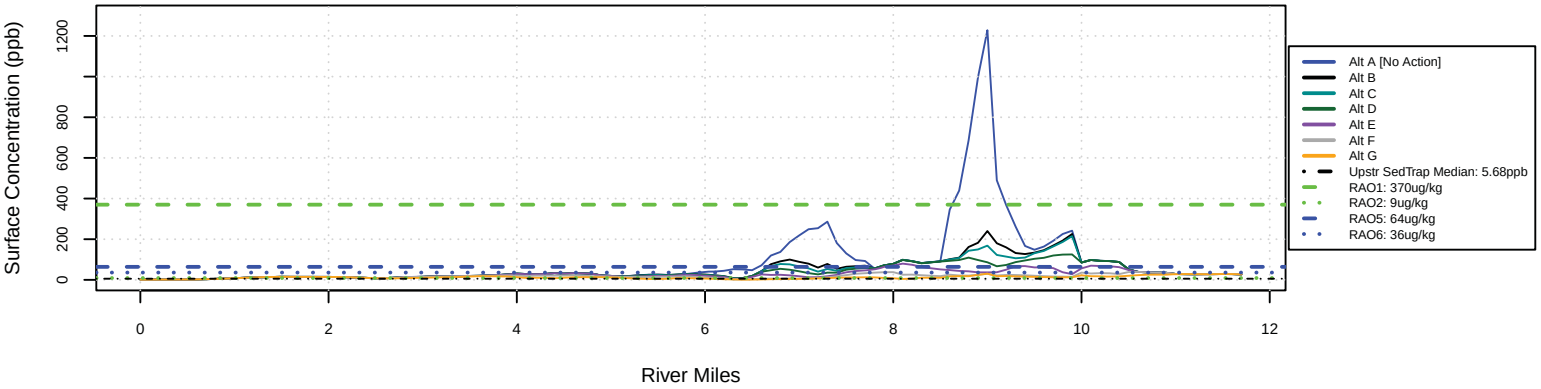
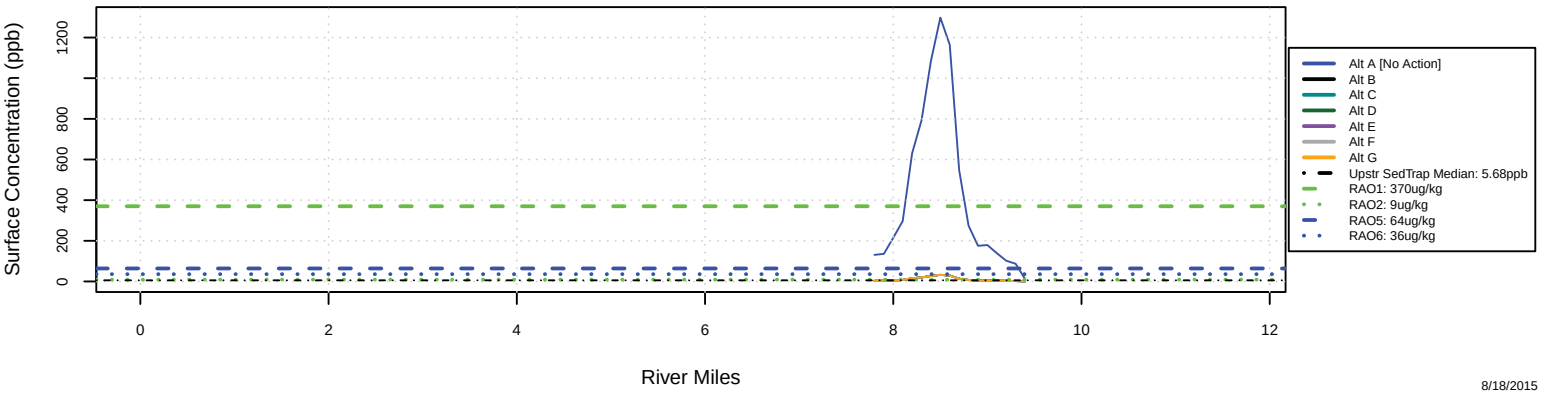


[t=0] PCB − Swan Isl − rolling avg 0.5 mile



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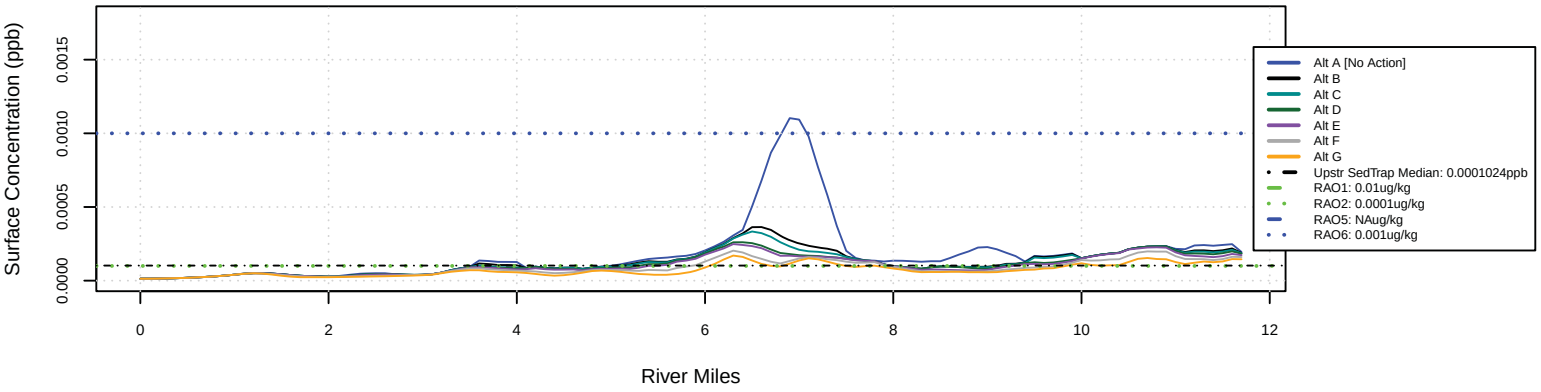

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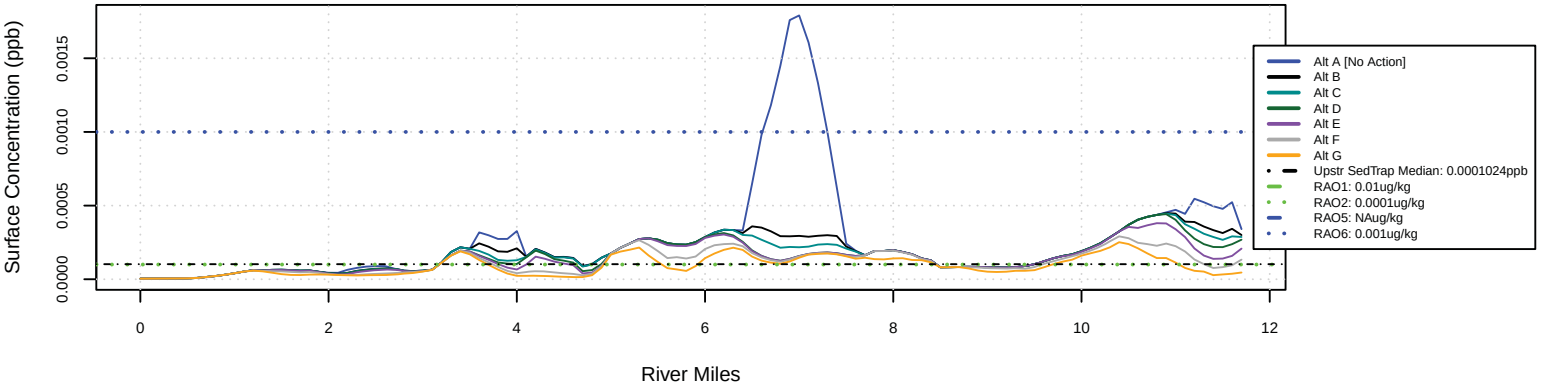

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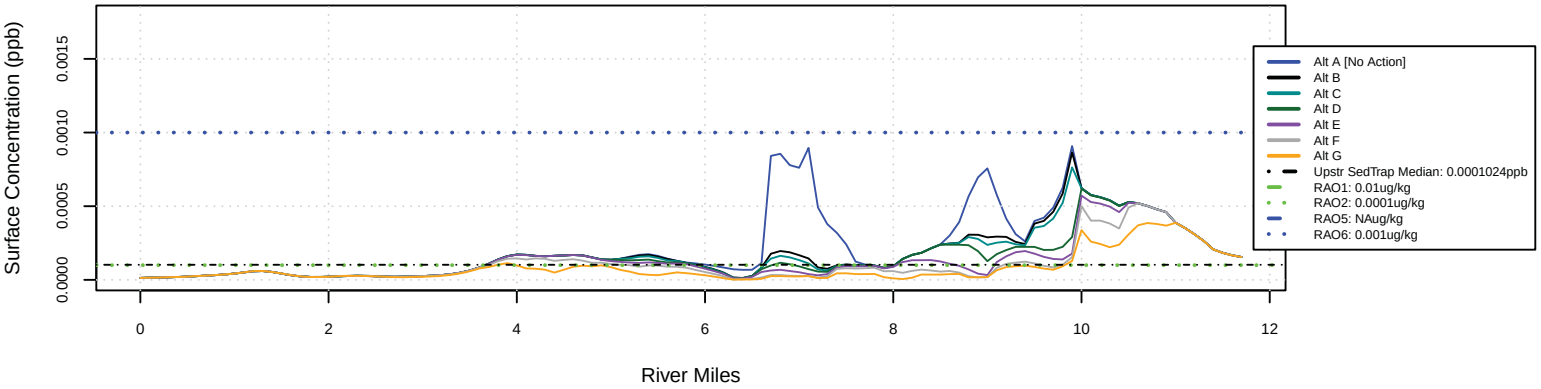

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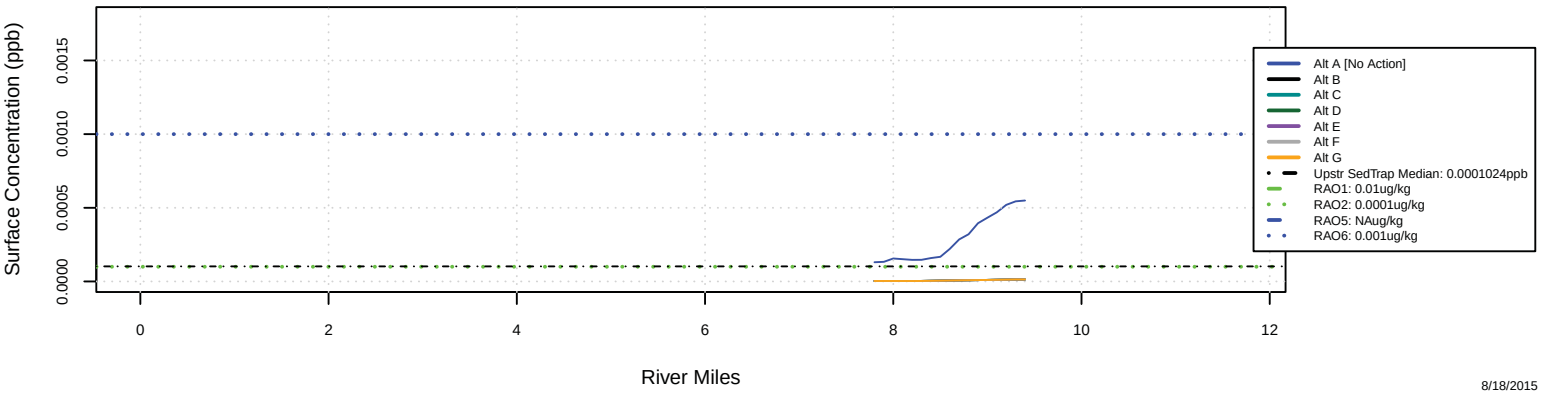

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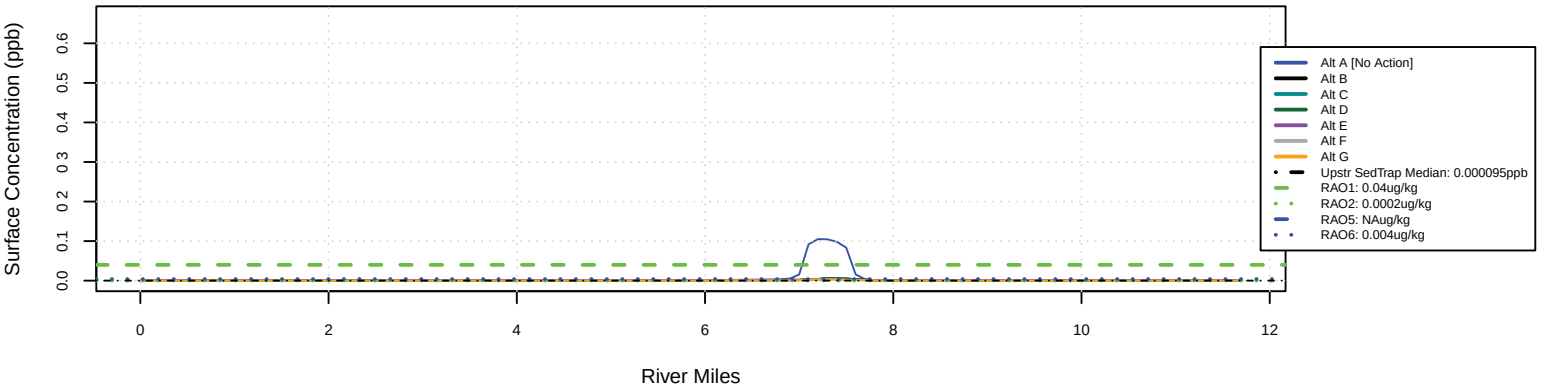

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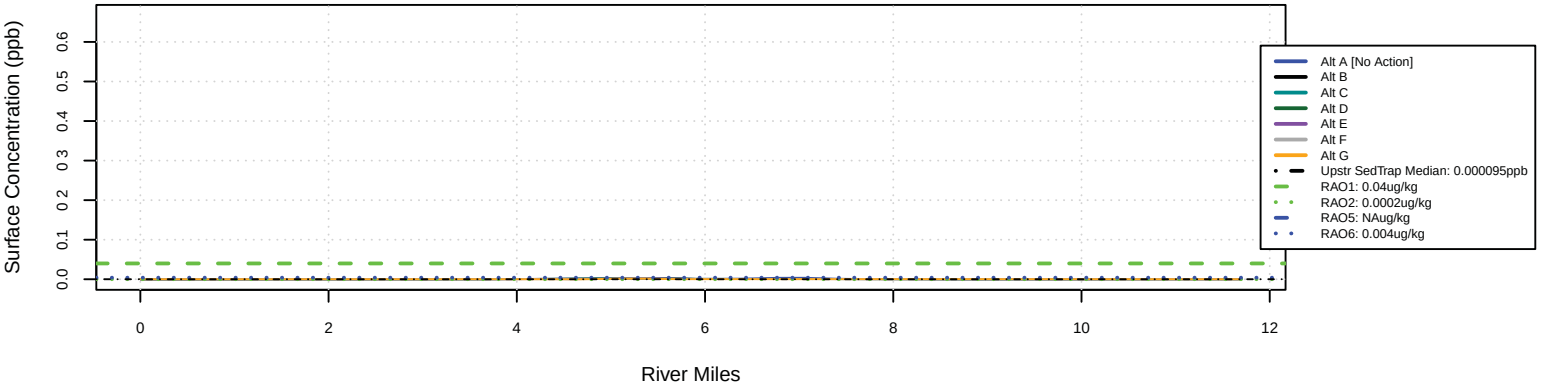

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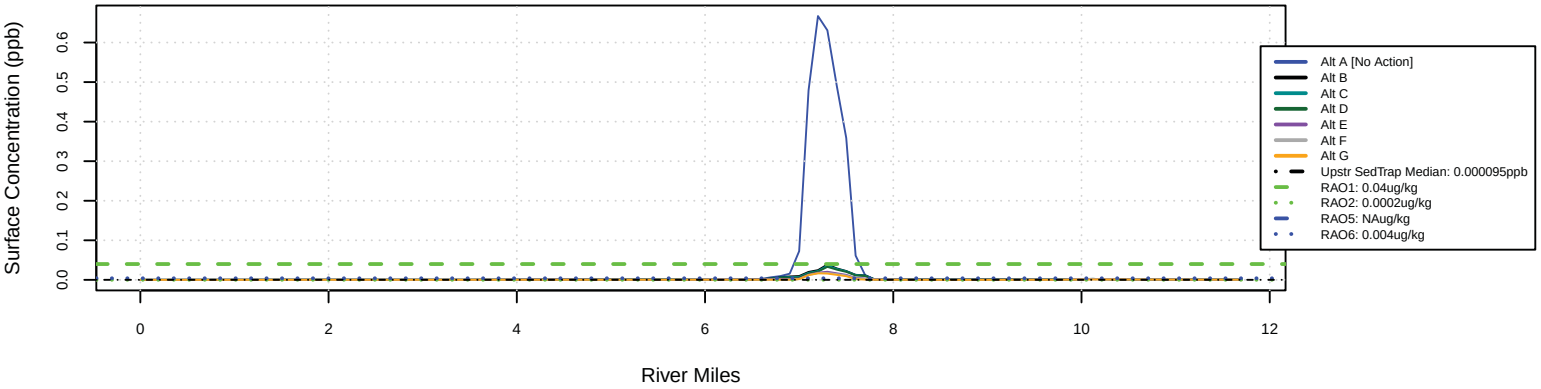

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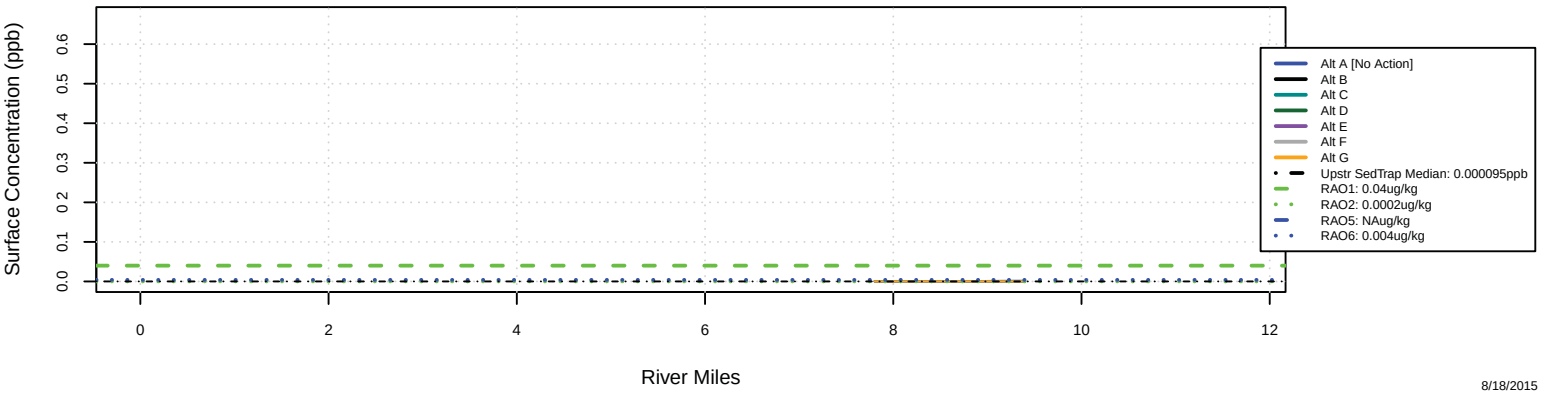

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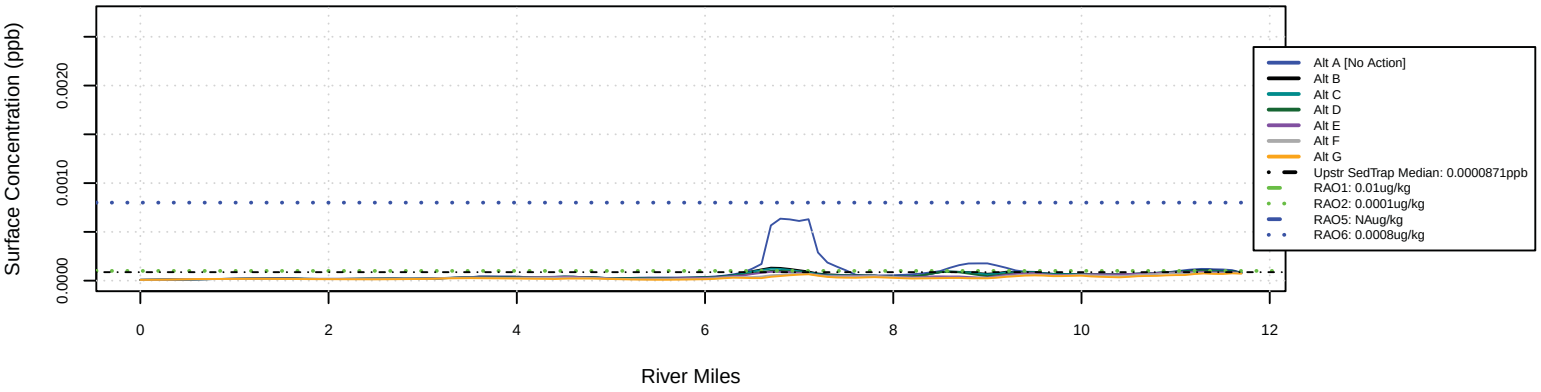

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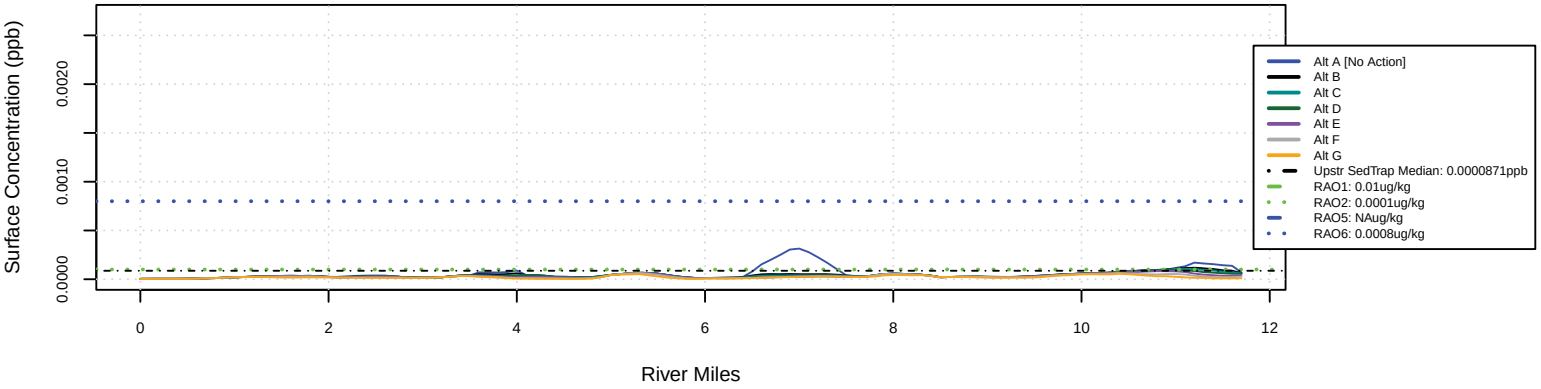

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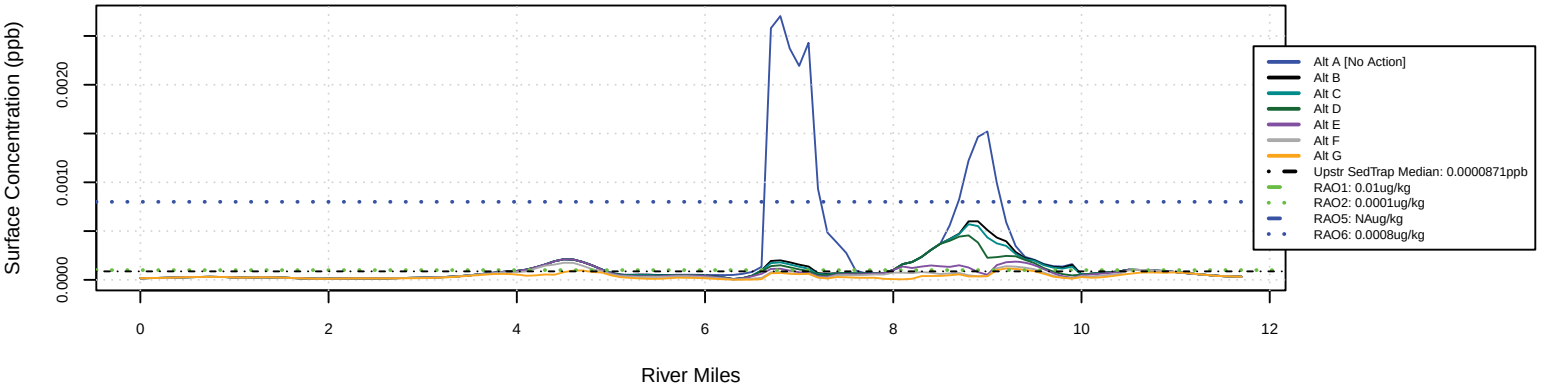

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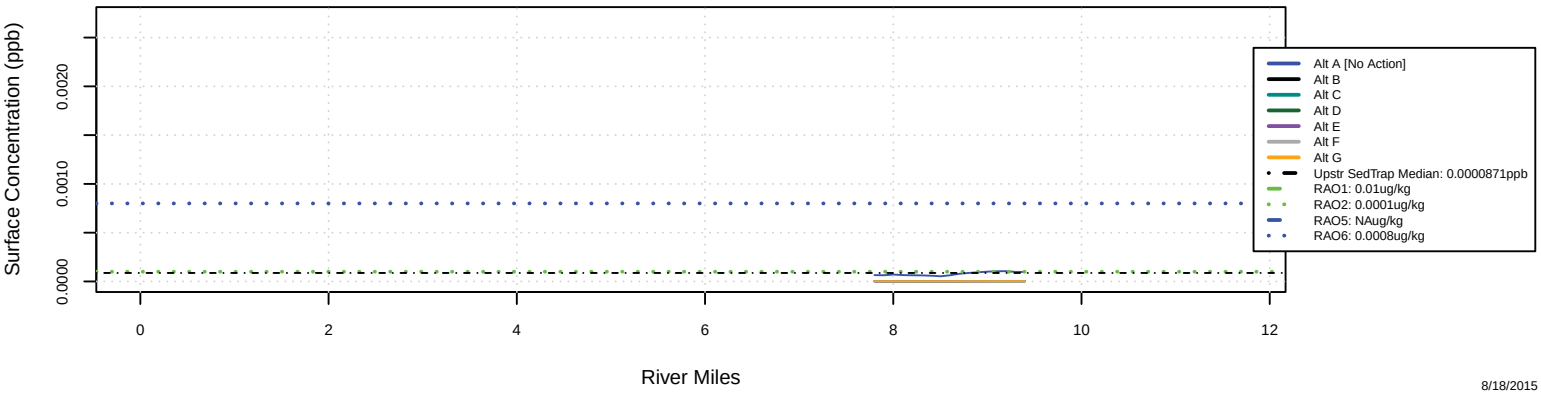

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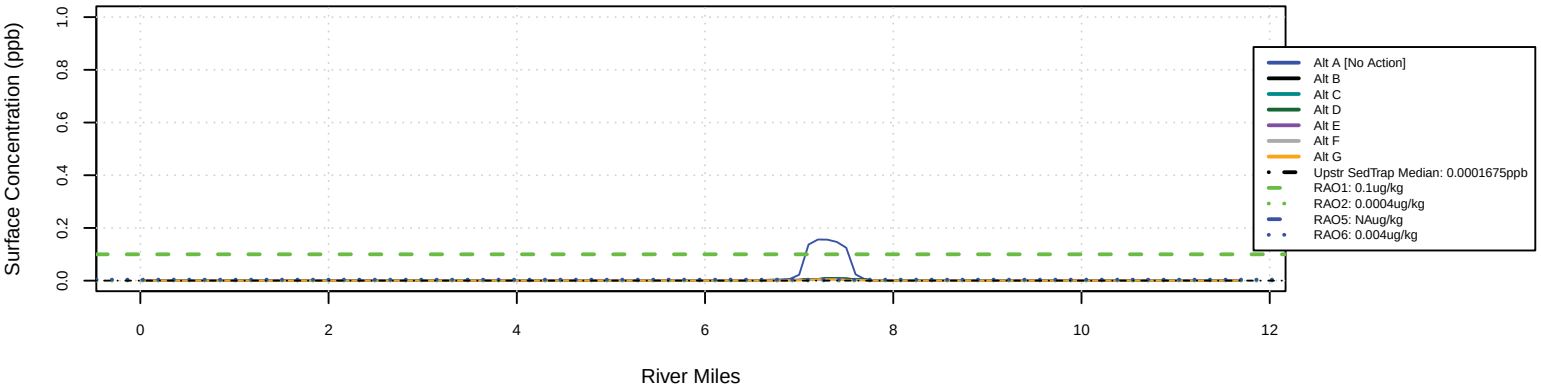

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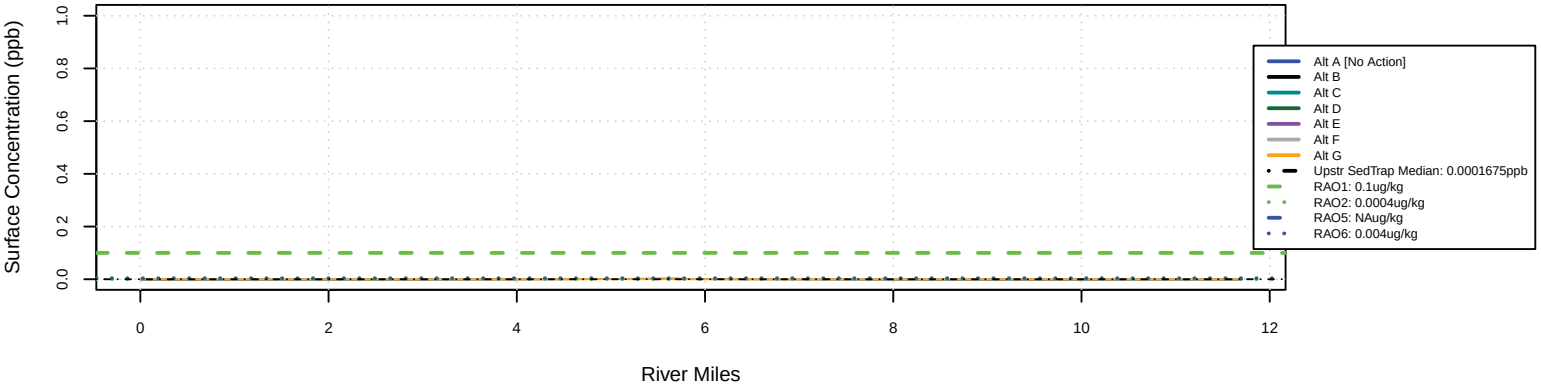

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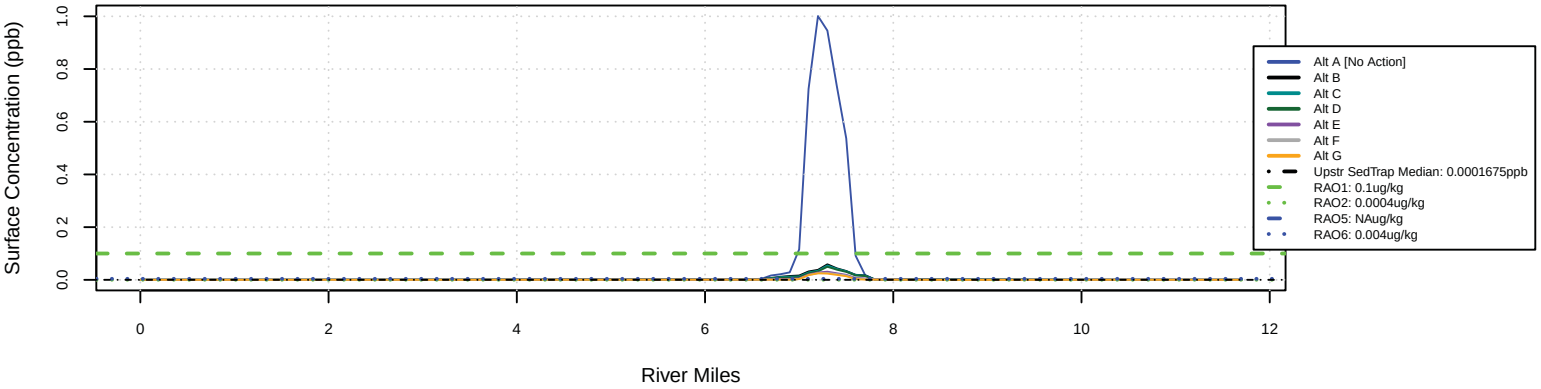

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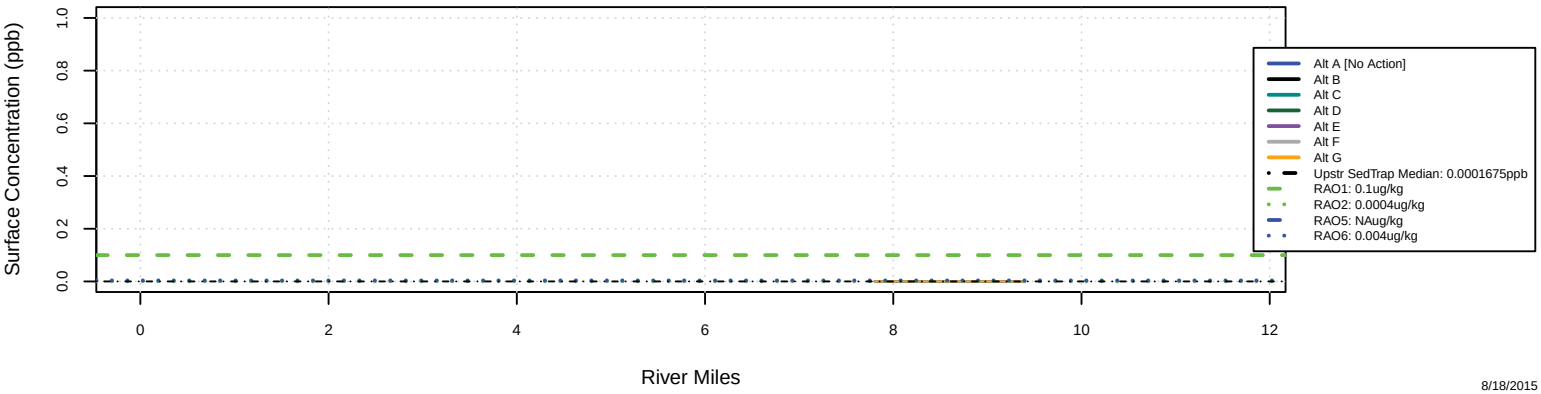

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TAB 4

LWG
LOWER WILLAMETTE GROUP

Chairperson: Bob Wyatt, NW Natural
Treasurer: Frederick Wolf, DBA, Legacy Site Services for Arkema

September 6, 2016

U.S. Environmental Protection Agency, Region 10
ATTN: Harbor Comments
U.S. Environmental Protection Agency
805 SW Broadway, Suite 500
Portland, OR 97205

Re: Lower Willamette Group Comments on Portland Harbor Proposed Plan (Lower Willamette River, Portland Harbor Superfund Site, EPA Docket No: CERCLA-10-2001-0240)

Dear EPA Region 10:

The Lower Willamette Group (LWG) appreciates the opportunity to comment on the U.S. Environmental Protection Agency's (EPA's) June 8, 2016, Proposed Plan and Feasibility Study (FS) for the Portland Harbor Superfund Site (Site).

Introduction

The LWG formed in 2001 as a group of business and government entities who stepped forward to work with EPA to study the risks posed by contamination at the Site and evaluate cleanup alternatives.[1] EPA's common practice at Superfund sites is for the Remedial Investigation (RI) and FS to be developed by potentially responsible parties (PRPs) under EPA oversight.[2] After years of data collection, analysis, and intensive engagement with EPA staff, the LWG presented EPA with a Draft FS in 2012. The LWG continues to stand behind the 2012 LWG Draft FS as a scientifically and legally supported approach to evaluating remediation alternatives for the Site. Over the years that followed, EPA took more active control of the RI/FS and, in the LWG's view, diverged further and further from a scientifically and legally supported approach to cleanup. The LWG expressed significant technical, legal, and policy concerns when EPA produced a Draft FS in 2015. Rather than engage meaningfully with those concerns, EPA formally took over the FS and produced a draft Final FS and Proposed Plan that are even further detached than EPA's 2015 Draft FS from acceptable science and responsible risk characterization and management. In-depth knowledge of the Site and of the technical and legal foundations of its own and EPA's work gives the LWG unique insight and leads the LWG to the conclusion that EPA's selection of Alternative I in the Proposed Plan is incorrect.

[1] Members of the LWG participating in these comments are Arkema Inc., Chevron U.S.A. Inc., Evraz Inc. NA, Gunderson LLC, NW Natural, Phillips 66 Company, Port of Portland, TOC Holdings Co., Union Pacific Railroad Company, Bayer CropScience Inc., BNSF Railway Company and Kinder Morgan.

[2] "The purpose of this memorandum is to reaffirm the EPA's commitment to having potentially responsible parties (PRPs) conduct the remedial investigation/feasibility study (RI/FS) at Superfund sites wherever appropriate." *Promoting Enforcement First for Remedial Investigation/Feasibility Studies at Superfund Sites* (EPA, March 20, 2012).

Executive Summary

The overarching objective of selecting a remedy under the National Contingency Plan (NCP) decision-making process is to identify the cleanup that will be effective and provide "sensible, reliable solutions for identified site problems."[3] Key factors in the decision-making process under the NCP include using a reasonable characterization of risks at the Site (including a consideration of uncertainties) and assessing how well the cleanup will protect people from unacceptable risks and how much it will cost, both in terms of adverse impacts on the community and dollars to be spent. In addition, an important consideration when selecting a remedy is how long it will take before reasonable cleanup goals are achieved.

At this Site, EPA's assessment of risks to human health is based on a series of unrealistic and unsupported assumptions regarding exposure and exposure durations and fails to consider how widely used preparation and cooking methods reduce contaminants in fish tissue. The result is cleanup goals that are not reasonably achievable, because they are based on worst case scenarios, not exposures that are reasonably expected to occur as required by the NCP.

Despite their conservative nature, EPA largely abandoned the Baseline Risk Assessments (BLRAs) in the 2016 draft Final FS by developing preliminary remediation goals (PRGs) inconsistent with the BLRAs, applying remedial action levels (RALs) in areas of the Site where relevant exposures do not occur or where the PRGs are already met, and evaluating the effectiveness of its cleanup alternatives at reducing risk using methodologies that are completely unrelated to the BLRAs. To take but one example of how divorced EPA's remedy selection is from the risk assessments, the EPA approved Baseline Ecological Risk Assessment (BERA) evaluated multiple lines of evidence and concluded that about 4 to 8% of the site presents benthic risk. In 2014 and 2015, EPA and the LWG mapped an approach for applying the BERA in the FS (the Comprehensive Benthic Risk Area [CBRA] approach) that identified approximately 61 acres for the evaluation of active remedies. In the 2016 draft Final FS, however, EPA completely abandoned the BERA and the corresponding EPA/LWG CBRA approach to conclude, without explanation, that benthic risk is present at 1,289 acres, or nearly 60% of the Site. And even with this massive expansion of asserted benthic risk, EPA's preferred remedial alternative fails to address 16% of the 61 acres of benthic risk area identified by the EPA/LWG CBRA approach.

In the face of overwhelming evidence to the contrary, EPA assumed that the complex and dynamic Willamette River is essentially unchanging over time and lacks diversity in its course, assigned prescriptive remediation technologies without accounting for site-specific details, and then incorrectly estimated the probable cost and duration required for implementation of those technologies. As a result, EPA's evaluation of the relative performance of its remedial alternatives is seriously flawed, and its attempt at considering the cost-effectiveness of the alternatives lacks any meaningful foundation.

For example, EPA's evaluation of the protectiveness and "long-term effectiveness" of cleanup alternatives and "cost-effectiveness" is not based on achievement of cleanup goals. Rather, because EPA rejected all methods that might have allowed it to quantify the expected rate of natural recovery of sediments, EPA employs an invented standard—"interim targets" for "risk reduction at construction completion"—to evaluate these criteria and exclude less expensive alternatives from the evaluation for reasons not based on data. EPA rationalizes using these interim targets by stating that protective alternatives would achieve ultimate cleanup goals within a reasonable timeframe (i.e., 30 years) through natural recovery. EPA *assumes* Alternatives E and I will achieve cleanup goals and Applicable or Relevant and Appropriate Requirements (ARARs) in 30 years and *assumes* Alternatives B and D will not. No information in the record supports EPA's assumptions. In the absence of credible information to support its assumptions, EPA has no basis for representing whether alternatives will or will not achieve cleanup goals within a certain time. This critical omission and reliance on assumptions in the long-term effectiveness and cost-effectiveness determinations is arbitrary and capricious. A less expensive alternative that is easier to implement (and therefore quicker to start and finish) may achieve cleanup goals in a comparable or even faster timeframe than a much more complex, disruptive, and expensive alternative.

[3] NCP Preamble, 55 Fed. Reg. 8666, 8700 (March 8, 1990).

The trend shown by the data is decreasing surface sediment and fish tissue concentrations. In 2013, the LWG presented an evaluation of smallmouth bass polychlorinated biphenyl (PCB) tissue measurements made in 2002, 2007, and 2012 that indicate statistically significant declines in tissue concentrations across almost all areas of the Site.[4] Further, 2014 site-wide sediment PCB data[5] show this downward trend in contaminant concentrations in surface sediments due to the effects of natural recovery at the Site. EPA's disregard of recent data in its evaluation of the effectiveness of alternatives undermines the validity of its conclusions.

In addition, EPA's evaluation of cost-effectiveness is superficial and based on inaccurate cost estimates. Cost-effectiveness is not a minor, dispensable factor in the NCP. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that EPA determine that the selected remedy be cost-effective.[6] EPA must compare the cost to effectiveness of each alternative individually and compare the cost and effectiveness of alternatives in relation to one another.[7] Effectiveness means evaluating long-term effectiveness; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness.

In analyzing an individual alternative, the decision-maker should compare, using best professional judgment, the relative magnitude of cost to effectiveness of that alternative. In comparing alternatives to one another, the decision-maker should examine incremental cost differences in relation to incremental differences in effectiveness in order to determine that the effectiveness afforded is proportional to the cost. EPA's inadequate analysis of this important criterion in the Proposed Plan is not sufficient.

Further, EPA substantially underestimated the cost for its Preferred Alternative (Alternative I). EPA estimated Alternative I as $1,173 million compared to LWG's estimate of $2,127 million (non-discounted capital costs and annual expenditures over a 30 year period). In addition to using overly optimistic estimates for dredging and capping production rates, EPA's estimate fails to include reasonable estimates for contingencies, oversight, project management, construction management, water quality control structures, mobilization/demobilization, design, and fees for capping on state lands, as well as several other important categories of cost. The LWG's experienced sediment remediation consultant reviewed EPA's cost estimate and believes the cost is underestimated by about $954 million (non-discounted capital costs and annual expenditures over a 30 year period). A more realistic estimate of the cost to perform EPA's Preferred Alternative is well above EPA's margin of error of +50/-30% accuracy for FS cost estimates, rendering the selection of Alternative I invalid.[8]

Portland Harbor was added to the National Priorities List (NPL) in 2000. Sixteen years later, EPA has identified a preferred cleanup alternative that will not be under construction for at least 5 to 7 years. In the opinion of experienced sediment remediation professionals who have reviewed the Proposed Plan, construction will take 14 years or more to complete, given the constraints on performing intrusive work in designated critical habitat for several endangered species of salmon and steelhead and the physical and logistical complexities presented by an active commercial harbor. Completion of the active phase of the cleanup appears to be decades in the future. This is not an acceptable outcome.

As explained in this letter, because EPA is overly conservative in describing the risks at the Site, has not prioritized which areas of the Site pose the highest risk and should be addressed first, has disregarded recent data, and has evaluated cleanup alternatives in a manner that is arbitrary and capricious, EPA's proposed cleanup will not provide meaningful protection within a reasonable timeframe. Unless EPA addresses the issues raised in these comments when it writes the Record of Decision (ROD), this project, after all of these years and well over $100 million spent to date, will not succeed.

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[4] Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis, a presentation file from Anchor QEA provided to EPA on March 18, 2013. A copy of this presentation file is Attachment 1.

[5] *Sediment sampling data report, Portland Harbor, Portland, Oregon*, prepared for de maximis Inc., (Kleinfelder, May 11, 2015). (Attachment 2)

[6] 42 U.S.C. § 9621(b).

[7] NCP Preamble, 55 Fed. Reg. 8728.

[8] *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, page 2-10 (EPA October 1988).

EPA can and must do better. In its October 19, 2015, letter to the National Remedy Review Board (NRRB), the LWG provided several recommendations on implementing the cleanup, including focusing on the most significant and pervasive risks, reducing the uncertainty about natural recovery, and maximizing flexibility in remedial design and implementation of the cleanup. Our review of the Proposed Plan has not changed those general recommendations. The risks at the Site do not warrant a cleanup with a completion so far in the future.

Comments

In keeping with the LWG's in-depth and long-term engagement with risk assessment and remedial alternatives evaluation at the Site, the following comments are highly detailed, technical explanations of the key deficiencies in EPA's 2016 draft Final FS and Proposed Plan. The choices and decisions EPA makes in the Portland Harbor ROD must be based in reason and science, and EPA must articulate a rational connection between the facts found and the choices it has made.[9] EPA must consider all important aspects of the problem and explain decisions that run counter to evidence before it.[10] And EPA must not rush through the process, "throw darts," "flip a coin," or make a "sudden, knee-jerk decision."[11] As explained below, EPA's 2016 draft Final FS and Proposed Plan contain major technical errors and draw conclusions that are contrary to the facts and data before EPA and that are, without explanation, inconsistent with the NCP, EPA guidance and even EPA's own prior decisions about the Site.[12]

Our comments identify the incorrect assumptions, inaccurate information and flawed analyses supporting EPA's remedial alternatives evaluation and therefore EPA's Preferred Alternative (Alternative I). EPA's approach diverges from legal requirements for remedy selection, including the nine criteria set out in the NCP, and is inconsistent with EPA guidance and EPA practice at other similar sites. EPA did not consider adequately or ignored completely important information, and the conclusions drawn by EPA are unsupported by, or run counter to, the evidence before EPA. In short, the choices and decisions EPA has made in the Proposed Plan are not supported by reasoned, scientific explanation provided in the FS or elsewhere. As a result, it would be arbitrary and capricious for EPA to select the Preferred Alternative identified in the Proposed Plan as the remedy for Portland Harbor.

The LWG's comments are organized around six categories of deficiencies in EPA's approach:

- **Section I**: EPA departed from the previously approved BLRAs and selected Remedial Action Objectives (RAOs) and PRGs that are not risk-based, risk-managed, or achievable.

- **Section II**: EPA took an unprecedented, inappropriate approach to designating "principal threat waste" (PTW) at the Site, which adds significant costs but does not reduce risk.

- **Section III**: EPA oversimplified the complex, dynamic natural processes occurring within and outside of the Site (the conceptual site model), leading it to inappropriately discount relevant new scientific information and the impact of changes over time to remedy evaluation and selection.

- **Section IV**: EPA did not apply, or misapplied, quantitative analysis to the NCP-required remedy selection criteria of protectiveness, long-term effectiveness, short-term effectiveness, and cost.

- **Section V**: Accurate analysis shows that EPA's remedy is not cost-effective—i.e., it does not meaningfully reduce risks when compared to less time- and resource-intensive remedy alternatives—and that EPA has not conveyed to the public accurate information about risk or risk reduction at the Site.

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[9] *United States v. NCR Corp*., 911 F. Supp. 2d 767, 773 (E.D. Wis. 2012) *aff'd sub nom*. United States v. P.H. Glatfelter Co., 768 F.3d 662 (7th Cir. 2014); *United States v. Newmont USA Ltd.*, 504 F. Supp. 2d 1077, 1082 (E.D. Wash. 2007).
[10] *Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S. Ct. 2856, 2867 (1983).
[11] *United States v. NCR Corp*., 911 F. Supp. 2d at 773.
[12] EPA has acknowledged that certain of its FS evaluations were "arbitrary" and that it needs to provide a rationale for its choices. Koch email to McKenna, June 17, 2014. A copy of this email is Attachment 3. As these comments discuss, in many cases, EPA has not met this standard.

- **Section VI:** EPA's remedy selection should include a plan for how cleanup will be implemented through baseline data collection and remedial design and implementation at operable units.

The LWG's comments also provide additional information for the Administrative Record. This information was exchanged between EPA and the LWG during preparation of the RI/FS, provided by the LWG to EPA in the course of the LWG's work on the RI/FS, or previously generated by EPA. The LWG previously recommended that most of these records be placed within the Administrative Record as appendices to relevant LWG deliverables; in most if not all cases, EPA required the LWG to remove the records from the deliverables. We are therefore incorporating these and similar records into our comments on the Proposed Plan for inclusion in the Administrative Record file pursuant to 40 CFR §300.815(b).

I. EPA's Proposed Remedy is Inconsistent with Approved Risk Assessments, is Not Focused on Actual Risk Reduction, and Lacks Any Meaningful Risk Management

In its August 2015 Draft FS, EPA determined that all of the remedial alternatives it evaluated, Alternatives B through G, were protective of human health and the environment and in compliance with ARARs. Yet, EPA indicated to the National Remedy Review Board (NRRB) and Contaminated Sediment Technical Advisory Group (CSTAG) that it favored an alternative that included a relatively high level of mass removal through dredging and upland disposal with an extremely high cost estimate of about $1.5 billion. The LWG commented to the NRRB and EPA that each component of the remedy should be aligned with addressing risks identified in the BLRAs included in the RI and that a remedy tailored to addressing sediment contamination that is actually causing risk would result in a remedy that is protective, effective, implementable, and cost-effective. The primary basis for the LWG's recommendation to ground the remedy in measurable and meaningful risk reduction was EPA's own guidance.

It appears that the LWG's comments caught EPA's attention by demonstrating that EPA was proposing a remedy that was far more expensive with no material increase in risk reduction. However, rather than selecting a remedy in its Proposed Plan more focused on achieving actual risk reduction in a timely and cost-effective manner, EPA without explanation recalculated baseline risk in a manner inconsistent with the EPA-approved BLRAs in order to artificially inflate risk reduction estimates for larger alternatives and claim that now the very same Alternatives B and D that were declared protective in the 2015 Draft FS are no longer protective of the environment.[13]

A. EPA's Declaration that Alternatives B and D May Not Be Protective of the Environment is Arbitrary and Capricious

EPA's Proposed Plan rejects Alternative B and D as not meeting the threshold criteria of protectiveness.[14] EPA has determined that an alternative is protective if it will achieve EPA's PRGs within 30 years.[15] However, because EPA decided that "a long-term model is not available to predict the time to meet the PRGs," EPA assessed protectiveness by "evaluating achievement of interim targets at the end of construction, as well as any additional benefit provided by [institutional controls]."[16] EPA then concludes, "Alternatives B and D may not be protective of the environment because of the timeframe needed to achieve PRGs through MNR and ICs would not provide protection [*sic*] ecological receptors during this time period."[17] As we understand it, EPA reaches this conclusion (which is inconsistent with its conclusion in the 2015 Draft FS that Alternatives B and D *are* protective), based upon its determination in the FS that "post-construction risks are greater than the interim targets thus MNR is unlikely to achieve PRGs within a reasonable time frame due to the uncertainty regarding the effectiveness of MNR with such high remaining contaminant concentration."[18]

EPA's evaluation of interim targets does not address the guidance recommendation that the long-term outcome of remedial alternatives should be assessed quantitatively.[19] EPA's selection of interim targets, generally at 10 times

[13] See, e.g. Proposed Plan, p. 50-51.
[14] Proposed Plan, Table 15.
[15] EPA draft Final FS p. 4-6 ("[A] reasonable time frame…was considered to be 30 years").
[16] EPA draft Final FS p. 4-6.
[17] Proposed Plan, p. 50-51.
[18] EPA draft Final FS p. 4-18. See also EPA draft Final FS p. 4-43.
[19] *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005) (hereafter, the "Sediment Guidance," p. 2-23 and 2-25; *Contaminated Sediments Remediation Guidance* (Interstate Technology and Research Council, 2014) (hereafter, "ITRC") ITRC), p. 61.

the PRGs, is arbitrary and unexplained. In the absence of a quantitative long-term assessment, EPA has no way to determine whether 10 times the PRGs are more likely to be met in 30 years as compared to any other multiplier of the PRG, or any other benchmark based upon, for example, physical properties of the river or chemical properties of a specific contaminant. Despite this arbitrary framework, EPA concludes that only Alternatives B and D "may not be protective of the environment because of the time frame needed to achieve PRGs through MNR." EPA does not explain when it expects Alternatives E and I to achieve the PRGs relative to either Alternatives B and D or its 30 year reasonable timeframe. Nothing in the 2016 draft Final FS or Proposed Plan explains why EPA considers some of the alternatives that meet some ecological risk interim targets protective and others not protective.

EPA acknowledges that concerns about potential risks to human health related to the inability of all of the alternatives to achieve interim targets immediately post-construction can be effectively managed by institutional controls while monitored natural recovery works to attain remedial goals.[20] Ecological exposures, however, cannot be managed through institutional controls. The Proposed Plan concludes that Alternative B does not achieve the RAO 5 (ecological direct toxicity) interim target[21] and that Alternatives, B, D, E, and I may not meet the RAO 6 (ecological bioaccumulation RAO) interim target.[22] The Proposed Plan does not claim that those goals will not be met by the 30-year reasonable timeframe. The actual results of EPA's own analyses indicate that all of these alternatives are in fact protective.

With respect to RAO 5, EPA's 2016 draft Final FS and Proposed Plan approach to benthic risk is entirely inconsistent with the multiple lines of evidence approach used to identify benthic risk areas in the approved BERA and should not be used to conclude that Alternative B is not protective of ecological receptors. Although the BERA concludes (as EPA notes in the Proposed Plan) that "[u]nacceptable risks to benthic invertebrates are located in approximately 4-8 percent of the Site,"[23] the draft Final FS presents benthic risk areas that cover 1,289 acres (or about 59% of the Site).[24]

EPA's large benthic risk areas mapped in the 2016 draft Final FS and Proposed Plan extend into areas shown to lack toxicity based on laboratory toxicity tests and other BERA lines of evidence. EPA and the LWG agree that empirical toxicity testing is one of the most important and direct measures of benthic toxicity available. Figure 1 shows the locations of failing and passing bioassay tests in relationship to "benthic risk" areas mapped on Figure 4.1-1 in the 2016 draft Final FS. EPA identifies broad areas of benthic risk (yellow) in locations that passed bioassay tests (blue dots). Thus, the benthic toxicity that EPA's Proposed Plan assumes exists in these areas in fact does not exist.

EPA determined these broad benthic risk areas by mapping any exceedance of individual benthic PRGs, which are derived from various toxicity models, and by ignoring empirical toxicity data from Portland Harbor. Without explanation, EPA's current approach is exactly the opposite of its own prior instructions to the LWG: "EPA and the LWG recognize that the sediment quality guidelines produced by any model (LRM, FPM or generic SQGs such as PECs or PELs) are intended to be used as a set – not individually."[25] EPA further compounds this error by making numerous errors (or at least unexplained decisions that differ from the EPA-approved BERA) regarding its compilation of the individual benthic PRGs for RAO 5 involving at least PCBs, DDx, and DDT.[26] The overall result of this haphazard approach is that EPA's alternatives require large amounts of active remediation on the basis of RAO 5 while failing to even address all of the EPA/LWG CBRAs previously agreed to as shown in Table 1.

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[20] See Proposed Plan p. 50 (All alternatives other than the no action alternative "in conjunction with MNR and institutional controls, are expected to be protective of human health.").
[21] "Alternative B is the only alternative that does not achieve the interim target of addressing 50 percent of the benthic risk area; all other alternatives achieve the interim target."
[22] "Alternatives B, D, E and I do not achieve the ecological HQ interim target of 10."
[23] BERA, p. 774, Proposed Plan, p. 20.
[24] See, e.g., Table 4.2-7. Pages 11-12 of the Proposed Plan describe the site as 2167 acres.
[25] "Resolution of EPA September 27, 2010 Comments on Benthic Risk Evaluation" in EPA-approved BERA Attachment 1.
[26] See, Windward Environmental's Technical Memorandum *Review of EPA's FS relative to the LWG/EPA agreed comprehensive benthic approach (September 6, 2016)*, Attachment 4.

Figure 1. Comparison of EPA Mapped Areas Above RAO 5 PRGs and Pooled Bioassay Results from the BERA.

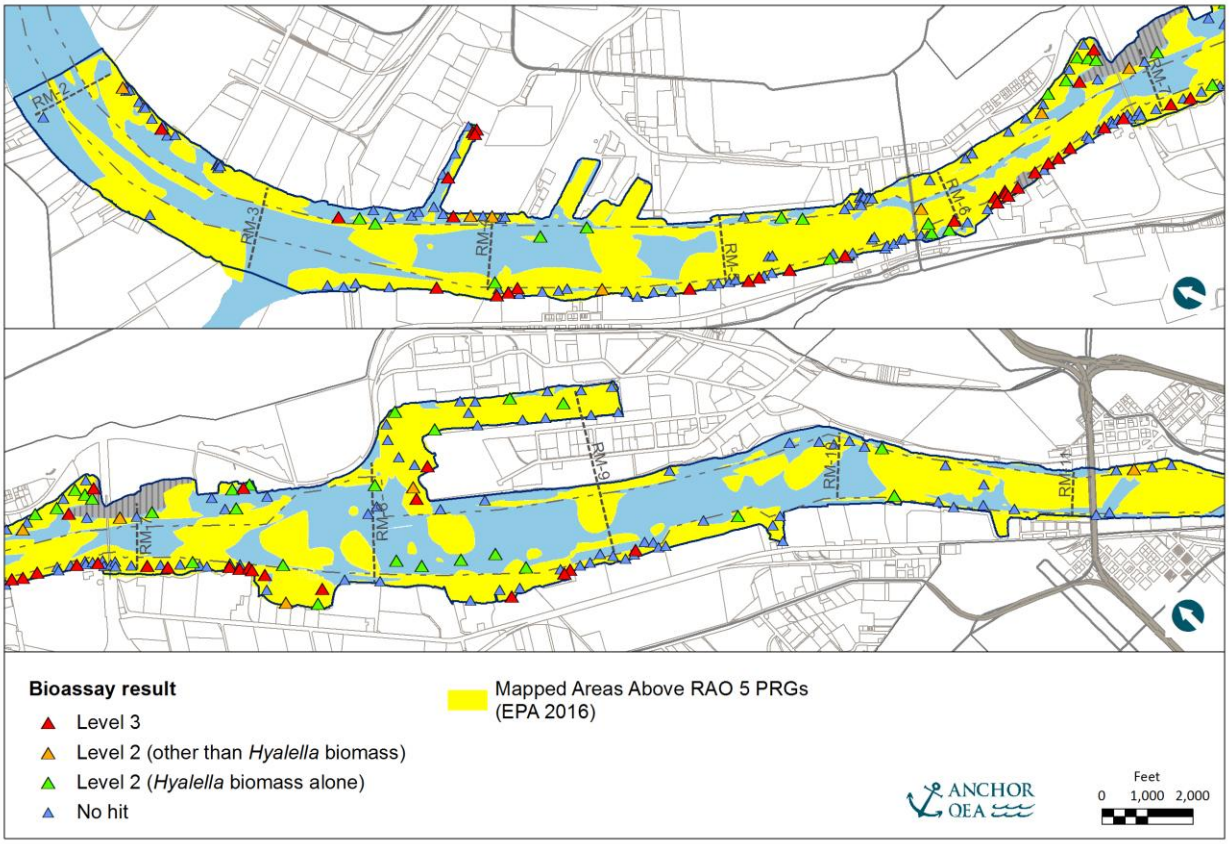

Table 1. Comparison of EPA's 2016 Draft Final FS Alternatives to the CBRAs Directed by EPA in 2014.

EPA Draft Final FS Alternative	Percent of EPA/LWG CBRAs Addressed by EPA Alternative
B	59%
C	66%
D	77%
E	83%
F	89%
G	92%
H	100%
I	84%

The EPA/LWG CBRA approach combines multiple lines of evidence, including bioassay toxicity tests. EPA supported this approach for many years before abruptly abandoning it in the final stages of preparation of the 2015 Draft FS. On April 4, 2014, EPA provided final direction to the LWG on mapping the CBRAs developed for the 2012 LWG Draft FS.[27] On February 2, 2015, EPA advised the Oregon Department of Environmental Quality (DEQ) that it was "not doing something new or different than what was done in the final BERA" and that the revised CBRA layers "are part of the Section 3 development of the alternatives, not Section 2, since they are depiction *[sic]*

[27] Burt Shepard email to John Toll, April 4, 2014, Attachment 5.

remedial action areas and not used for development of PRGs."[28] On February 27, 2015, EPA requested that the LWG submit revised text and maps incorporating its April 4, 2014, direction for the CBRAs; the LWG submitted the requested information on April 3, 2015.[29] The 2015 Draft FS, however, makes no mention of the EPA/LWG CBRAs, and the June 2016 draft Final FS maps benthic risk areas by point-by-point application of PRGs. EPA has never explained its changed approach to benthic risk and the corresponding shift from a remedial approach focused on the most certain areas of benthic risk, which (consistent with the findings of the BERA) encompasses a few percent of the Site to a very large percentage of the Site where significant evidence demonstrates limited or no benthic risk. And yet EPA's alternatives (except Alternative H, which covers the entire Site) do not address even the focused areas of elevated benthic risk.[30] Thus, EPA's distinction that Alternative I is protective of benthic risk, while Alternative B is not protective, is even more arbitrary when readily available and technically appropriate information is considered.

Further, EPA's interim target for RAO 5 is arbitrary based upon EPA's own analyses. EPA very simplistically mapped individual benthic PRG exceedances and used a 10 times exceedance factor to identify interim target benthic risk areas. EPA completed this interim target determination by assuming that an alternative would be protective if it is addressed through active remediation of 50% of the 10 times exceedance area. As discussed above, the 10 times exceedance factor is arbitrary and not supported by any long-term assessment of the alternatives. The 50% requirement is a second arbitrary step that is not tied to any quantitative assessment. EPA provides no explanation of why it picked 50% and not 33 or 67%, or any other value between 1 and 100%. EPA's own 2016 draft Final FS Table 4.2-7 illustrates the arbitrary nature of these decisions. In that table, EPA indicates that Alternative B addresses 48% of the 10 times benthic risk area, while Alternative I addresses 64%. Missing the threshold of 50% by a mere 2% implies a level of certainty to the analysis that is implausible, given the arbitrary nature of the threshold in the first place. Indeed, based on Table 4.2-7, Alternative B would actively remediate about 90 acres based on benthic risk, while the EPA-approved BERA concluded there may be as few as 87 acres of benthic risk.[31] The fact that, as discussed above, none of EPA's final alternatives actually address all benthic risk areas identified by the EPA/LWG CBRA approach just underscores the arbitrariness of EPA's approach in the 2016 draft Final FS.

With respect to RAO 6 (ecological bioaccumulation), as noted above, EPA concluded that "Alternatives B, D, E and I do not achieve the ecological HQ interim target of 10." Putting aside EPA's arbitrary decision to single out only Alternatives B and D as not protective, and ignoring the failure of its Preferred Alternative to meet the same interim target, a cursory review of EPA's own results suggests that all of these alternatives are protective. In the 2016 draft Final FS, EPA refers to Figures 4.2-9 through 4.2-17 and Table 4.2-5 to support its conclusions about RAO 6.[32] Based on this information, there are numerous problems associated with concluding any of these alternatives are not protective:

- As EPA notes on page 4-20 of the 2016 draft Final FS, these figures show that only bis-2-ethyhexyl-phthalate (BEHP) exceeds the 10 times threshold in any river mile or Sediment Decision Unit (SDU) examined and only in Swan Island Lagoon (SIL) or portions of SIL in the case of the rolling river mile analysis.

- On an SDU area basis, Table 4.2-5 shows that the BEHP exceeds the threshold by a factor 11 (slightly above the arbitrary threshold of 10) for Alternative B only.

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[28] Koch email to Jennifer Peterson, February 2, 2015, Attachment 6.
[29] Koch email to Toll, February 27, 2015Attachment 7.
[30] *Appendix P, Comprehensive Benthic Approach, Draft Feasibility Study* (Windward Environmental LLC, March 2015), Attachment 8. The LWG's 2012 draft FS addressed all CBRAs, with the exception of the 3 small additional areas resulting from EPA's April 4, 2014 direction and reflected in these revised text and maps submitted April 3, 2015.
[31] *See*, BERA p. 776. EPA concluded that benthic risk is "projected to extend over between 4 and 8% of the surface sediment area within the Study Area." According to the Proposed Plan, the Site covers approximately 2167 acres; four percent of 2167 acres is just under 87 acres. Proposed Plan, p. 11-12.
[32] See e.g., draft Final FS p. 4-20.

- The BEHP Hazard Quotient (HQ) exceedances highlighted in EPA's 2016 draft Final FS for Alternatives D and I are identical, each with an HQ of 19.[33] EPA cannot legitimately conclude with identical HQs in the same small area that Alternative D is not protective but Alternative I is protective.

- The rolling river mile analysis shows the BEHP exceedances (above threshold of 10) only occur for small fractions of a rolling river mile, around river miles 8 and 9.5 within SIL. This strongly suggests that these "exceedances" are due to one or two individual samples at either end of the SIL area. This reason appears insufficient to declare entire site-wide alternatives as not protective, particularly when any concerns (if real) could be addressed by small modifications to the alternatives in these limited areas either in the FS or in remedial design.

- EPA indicates in the 2016 draft Final FS that "…it is unlikely that ENR in SIL would sufficiently reduce the HQs in the long term due to the remaining concentrations outside the SMA." This appears to be a misstatement of EPA's own approach, because SIL is one of the few places in EPA's alternatives where Enhanced Natural Recovery (ENR) is specifically used <u>outside</u> the Sediment Management Area (SMA) boundaries as defined by the RALs.[34] Under EPA's approach, ENR material would be placed throughout SIL outside the SMAs, which would presumably address the one or two samples with relatively high BEHP concentrations on either end of SIL.[35] There is no quantitative analysis of the long-term outcomes for BEHP concentrations for any of these alternatives. Even a simple calculation of the concentration reduction expected from sand ENR placement in SIL would likely show substantial reductions in the specific BEHP exceedances noted by EPA.

- The HQ exceedances highlighted in EPA's 2016 draft Final FS for Alternative B, D, E, and I range from 34 to 15, with Alternatives D and I both having HQs of 19. EPA does not explain how it decided that an HQ of 34 in a very limited area is not likely to achieve protectiveness in 30 years while an HQ of 19 is protective in one case, but not in the other, over the same period.

Further, all these "exceedances" are based on a BEHP PRG that is questionable. EPA's RAO 6 PRG for BEHP is 135 micrograms per kilogram (ppb) and is based on a bioaccumulation endpoint for smallmouth bass tissue, but the PRG cannot be entirely replicated by the LWG based on the information available in the 2016 draft Final FS. As the LWG previously commented on the EPA 2015 Draft FS, taking into account the low frequency of surface water and tissue Toxicity Reference Value (TRV) exceedances, the conservatism of the fish tissue TRV, the absence of a relationship between site sediment and tissue concentrations, and the absence of evidence of BEHP biomagnification, EPA's selection criteria for contaminants of ecological significance do not support its decision to identify BEHP as a contaminant of ecological significance. It does not warrant an RAO 6 PRG.[36] It is also noteworthy that the BERA did not find widespread risks for BEHP. The BERA found smallmouth bass TRV exceedances in 4 of 31 samples in only 3 river miles.[37] The maximum BEHP exceedance occurred at river mile 3.5, which is many river miles downstream of the SIL area that caused EPA's determination that Alternatives B and D are not protective. Finally, the BERA is clear that the smallmouth bass BEHP TRV is based on one highly uncertain study.[38] Thus, determining a precise but arbitrary threshold of 10 times this highly uncertain PRG, and then rigidly applying that threshold to make a site-wide non-protectiveness determination highlights the absence of any reasonable risk management decision framework for the 2016 draft Final FS and Proposed Plan.

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[33] Draft Final FS, p. 4-42 and 4-80.
[34] Draft Final FS p. 4-20. See also Proposed Plan Figures 10a, b, and c, which indicate application of ENR sand outside SIL RAL boundaries.
[35] As noted elsewhere (in this document) it is problematic that EPA did not include ENR in SIL in the calculations of SWAC reductions. In this case, including ENR in SWAC calculations would likely have changed EPA's determinations in the 2016 FS about BEHP exceedances in SIL. EPA replied on July 20, 2016 to LWG clarification requests that, "The post-construction SWACs in the FS do not reflect the placement of ENR as they also do not include MNR." This reply attempts to equate ENR with MNR, but ENR clearly includes active placement of sand material at the time of construction, which is a form of active remediation as indicated by the word "enhanced" in the term ENR.
[36] *See*, "LWG Comments on Revised FS Section 2 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240". Letter from LWG to EPA dated June 19, 2014.
[37] BERA Table 7-7.
[38] BERA Table 7-45.

B. If Alternative B Fails to Meet Chemical-specific ARARs, All Alternatives Do, and EPA Should Waive Them Now

EPA's Proposed Plan states that "Alternative B does not achieve chemical-specific ARARs in a reasonable time frame, but will attain the action-specific and location specific ARARs. All other alternatives will attain their respective Federal and State ARARs."[39] The 2016 draft Final FS states, "Alternative B may not comply with all ARARs…. It is unlikely that chemical-specific ARARs would be achieved in a reasonable time frame."[40] As noted above for EPA's long-term protectiveness evaluations, EPA's conclusion about Alternative B not meeting chemical-specific ARARs "in a reasonable timeframe" is entirely arbitrary, because EPA has no quantitative method to assess the long-term outcomes of the alternatives.[41] This ARAR determination for Alternative B is also arbitrary, because it is based on a flawed EPA analysis of surface water data that is inconsistent with Site technical information and any reasonable conceptual site model (CSM).

EPA supports these conclusions with the following statements on page 4-20 of the 2016 draft Final FS: "Exceedances of water quality criteria for protection of human health from contaminated sediment within the Site would continue for PCBs, cPAHs, and 2,3,7,8-TCDD eq at the completion of construction. There is insufficient surface water data to evaluate the effectiveness of this alternative in meeting the aquatic life water quality criteria for BEHP, PAHs and TBT." On page 4-6 of the 2016 draft Final FS, EPA refers to Appendix K as the source of these determinations. The LWG reviewed Appendix K and found it contains numerous flaws that preclude any accurate conclusions regarding surface water concentrations or compliance with surface water ARARs.[42] In summary, EPA's Appendix K analysis errors include the following:

- EPA used flow weights for averaging surface water data that are the opposite of the actual average annual river flow conditions. EPA assumed 240 days of the year were in a high flow condition, when the U.S. Geological Survey Portland river gauge data show that low flows (less than the long-term average of 33,000 cubic feet per second) occur about 250 days out of the year.

- EPA used river mile 11 West and Navigation Channel data to calculate weighted average surface water concentrations (SWACs) for the Site and for concentrations entering the Site. Using these same data to represent both locations on the river results in inaccurate determinations for both locations.

- Although perhaps a typographical error, EPA indicates it subtracted the concentration entering the Site from the average site concentration to obtain concentrations for the "Downtown Reach." As written, such a calculation would produce the contribution from the Site instead.

- EPA assumes that post-construction surface water concentrations will decrease proportional to the percent reduction in sediment surface-weighted average concentrations (SWACs). This simplistic assumption ignores other contributions to surface water, most notably the upstream concentrations entering the Site. As a result, EPA estimates much greater percent reductions for the alternatives than is possible. For example, EPA calculates 92% reduction in Site surface water concentrations for Alternative G, but correctly accounting for upstream inputs would place this estimate at only about a 50% reduction.

- EPA also ignores within-site upland sources such as National Pollutant Discharge Elimination System (NPDES)-permitted stormwater and NPDES-permitted process and cooling water discharges that are beyond the control of sediment remedies.[43] For example, the annual loading summary provided in Table 6.1-11 of the EPA-approved RI shows that nearly 30% of the PCB load to the Site comes from stormwater.

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[39] Proposed Plan, p. 52. See also Proposed Plan Table 15.
[40] EPA draft Final FS, p. 4-20.
[41] EPA rejected the fate and transport model that the LWG developed with EPA encouragement and EPA input over the course of the RI/FS which, if finalized in EPA's draft Final FS, would have provided the means to assess those outcomes.
[42] See the technical memorandum *Further Evaluation of EPA's Flawed Surface Water Analysis in 2016 draft Final FS Appendix K* (Anchor QEA August 8, 2016), Attachment 9.
[43] NPDES-permitted discharges are exempt from CERCLA remedial action requirements under the "federally permitted release" exemption. 42 USC §9607(j).

> By ignoring these sources, EPA further and incorrectly inflates the erroneous percent reductions achieved by all alternatives.

These flaws cause EPA to systematically over-estimate the percent reduction in surface water concentrations provided by the alternatives. If EPA applied the same subjective judgments in the 2016 draft Final FS text for Alternative B to corrected (lower) reduction estimates for the other alternatives, EPA would conclude that most of the alternatives (likely including Alternative I) do not meet chemical-specific ARARs. Instead of attempting to correct the Appendix K results, EPA should develop a plausible CSM that recognizes the true role of upstream inputs to the Site and NPDES-permitted discharges.[44] A correct CSM for surface water would demonstrate that it is unreasonable to expect sediment remedies to drive improvements in Site surface water concentrations that are unrelated (e.g., upstream watershed sources) to Site sediment issues.

Such a CSM is fully supported by Site and upstream surface water data. The LWG previously submitted to EPA in the 2012 LWG Draft FS (p. 3-11) analyses demonstrating that "upstream background surface water 95th percentile UPL concentrations of arsenic, total PCBs [polychlorinated biphenyls], total PAHs, dieldrin, 4'4-DDT, sum DDT, and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) entering the Site exceeded the respective fish consumption values for these contaminants." The values being referred to here are various state and federal water quality criteria, which EPA has adopted as PRGs in the 2016 draft Final FS (Tables 2.1-4 and 2.2-1) and Table 11 of the Proposed Plan. EPA subsequently rejected the RI surface water upriver statistics (i.e., the upper confidence limit [UPL]).[45] However, even if EPA had examined just the arithmetic mean of upriver surface water data,[46] EPA would have found the concentrations of aldrin, arsenic, BEHP, DDD, DDE, DDT, hexachlorobenzene, PCBs, several polycyclic aromatic hydrocarbons (PAHs), and 2,3,7,8-TCDD toxic equivalent entering the Site exceed both the state and federal fish consumption water quality ceritifcation (WQC) for these contaminants. It is important to note that this list includes all of the focused RAL chemicals (i.e., PCBs, DDx, dioxin/furans, and PAHs). Therefore, a waiver will be needed for these criteria-based surface water PRGs due to upstream inputs, regardless of the exact statistics used to evaluate those upstream inputs. Consequently, no sediment remedy, even combined with source controls within the Site itself, can technically be expected to attain water concentrations lower than incoming upstream conditions for these chemicals.

Per EPA sediment remediation guidance,[47] "RAOs should reflect objectives that are achievable from the site cleanup." This leads to one of two possible EPA management decisions: 1) EPA should remove surface water RAOs from the 2016 draft Final FS, given that site sediments are not the primary cause of surface water ARAR exceedances and therefore sediment remedies alone cannot achieve all of the most important chemical-specific ARARs in surface water; or 2) EPA should waive water quality ARARs for these same chemicals in the ROD. EPA continues to maintain that, "Currently, EPA does not have a basis for waiving any ARARs. Any ARAR waivers would have to be conducted through the remedy selection process and documented in a ROD amendment."[48] If EPA had correctly estimated alternative surface water concentrations (even using the simplistic approach attempted in Appendix K), or simply compared the upstream concentrations to EPA's proposed surface water PRGs, then it would have an obvious available basis for waiving many of the water quality-related ARARs. Instead EPA maintains that site sediment remedies might somehow achieve site surface water reductions below ARARs despite multiple other sources also contributing to those same ARAR exceedances. EPA supports this ongoing bias by conducting obviously flawed analyses, such as Appendix K, and ignoring upstream data and then contending there is no basis for waiving the surface water ARARs.

Although EPA's guidance contemplates that ARAR waivers can be made either at the time of the ROD or later in a ROD amendment, CERCLA Section 121 strongly suggests that this determination should be made at the time of the ROD ("The President may select a remedial action meeting the requirements of paragraph (1) [protectiveness] that

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[44] See Section III, infra.
[45] EPA's rejection of the calculation of upriver statistics was formally disputed by the LWG. See request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7 of the Remedial Investigation; Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240.
[46] See 2011 draft RI, Table 7.2-5a. EPA removed reference to upstream concentrations statistics from later versions of the RI.
[47] Sediment Guidance, p. 2-15.
[48] 2016 draft Final FS p. 2-6.

does not attain a level or standard of control at least equivalent to [an ARAR] if the President finds that . . . ."). The LWG calls upon EPA to make these decisions at the time of the ROD. EPA has the information it needs now to make the waiver determinations. If EPA does not do so, tens or hundreds of millions of dollars may be wasted striving to meet unachievable surface water ARARs that no sediment remedy can meet.

Similarly, Safe Drinking Water Maximum Contaminant Levels (MCLs) that EPA uses as surface water and groundwater PRGs[49] are likely not achievable throughout the spatial extent of some groundwater plumes along the shoreline or out under the river, and achievement of such criteria is not necessary to design and implement groundwater and sediment remedies that are protective of all reasonable and likely future uses of groundwater. EPA should either determine that MCLs are not applicable, relevant or appropriate because MCLs do not apply to the groundwater in this context, or it should waive these water quality criteria ARARs now. MCLs are not applicable, relevant, or appropriately applied to groundwater here because the Oregon statute designates the Lower Willamette River as a potential public and private water supply only following adequate pretreatment[50] and because the federal Safe Drinking Water Act under which MCLs are developed designate that drinking water is appropriately sampled at the point of distribution.[51]

C. EPA's Risk Evaluations in the 2016 Draft Final FS and Proposed Plan, Individually and Collectively, Present an Inaccurate and Biased Picture of Risk Reduction Attainable through Sediment Cleanup at Portland Harbor

1. EPA's development and application of PRGs for the 2016 draft Final FS and Proposed Plan are inconsistent with the BLRAs

EPA's methods and results throughout the 2016 draft Final FS and the Proposed Plan are often inconsistent with the BLRAs, culminating in both a baseline (i.e., no action) and a post-construction risk assessment that departs significantly from the methods and findings of the BLRAs. EPA should address only those potential risks for contaminants, media, and pathways that were clearly found to pose unacceptable risks in the BLRAs, and EPA should further focus on the subset of unacceptable risks that are required for selecting an effective and protective remedy using all of the FS criteria (i.e., EPA should conduct reasonable risk management). Instead, EPA has departed from the BLRAs and applied virtually none of EPA's 11 Risk Management Principles for "making scientifically sound and nationally consistent risk management decisions at contaminated sediment sites."[52] In short, EPA should use a "risk-based framework" to "select site-specific, project-specific, and sediment specific risk management approaches that will achieve risk-based goals" and "ensure that sediment cleanup levels are clearly tied to risk management goals."[53]

The LWG has previously commented that EPA's PRG development procedures were substantially flawed and should be corrected prior to finalization of the FS.[54] The vast majority of errors previously identified persist in the 2016 draft Final FS and are carried through to the PRGs summarized in Table 11 of the Proposed Plan. EPA continues to propose chemicals of concern (COCs) and PRGs under circumstances that are technically inappropriate, scientifically invalid, and inconsistent with guidance. As noted in prior comments, EPA should instead include in the FS only those COCs and PRGs:

- For contaminant/exposure scenario pairs (ecological or human health) for which the EPA-approved BLRAs identified potentially unacceptable risk from in-river media.

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[49] 2016 FS Tables 2.1-4 and 2.2-1.
[50] OAR 340-041-0340, Table 340A.
[51] 40 CFR Part 141, § 141.23(a).
[52] *Principles for Managing Contaminated Sediment Risk at Hazardous Waste Sites*; February 12 2002. OSWER Directive 9285.6-08. See also Sediment Guidance, Appendix A-1. The relevance of this guidance to risk management steps in the FS is reviewed in detail in Sections 10.1 and 10.2 of the LWG's 2012 draft FS.
[53] Sediment Guidance, page 1-5.
[54] "LWG Comments on Revised FS Section 2 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240)". Letter from LWG to EPA dated June 19, 2014; "LWG comments on EPA's Feasibility Study Revised Draft Section 2 Text," March 25, 2015.

- That are calculated consistent with EPA-approved BLRA methods.

- Where there is sufficient scientifically valid information to calculate those PRGs.

- That are technically practicable to achieve or, alternatively, for which acceptable risk levels can be reached through sediment remedial action alternatives evaluated in the FS.

- That reflect a reasonable risk management framework including that: 1) the BLRAs indicate a contaminant is significantly contributing to risk' and 2) evaluation of remedial alternatives with respect to a potential COC or PRG is necessary to select a protective remedy.

- That can be attained through sediment remediation, which would exclude any surface water PRGs based on water quality ARARs with substantial contributions from upstream sources or CERCLA-exempt NPDES-permitted discharges. Instead, EPA should waive these ARAR criteria in the ROD, as they are clearly impracticable to meet due to upstream and likely continued upland sources.

- For matrices that can be directly addressed through sediment remediation, which would exclude PRGs for the fish tissue matrix, given that upstream and upland water sources contribute to unacceptable levels in fish tissue. As noted in the past, the LWG agrees with the concept of using fish tissue levels as monitoring tools for a limited number of COCs but not as performance goals or PRGs for sediment remedies.

EPA's designation of large areas in the navigational channel for cleanup based on petroleum contamination is a clear example of the magnitude of errors resulting from EPA's inexplicable severance of the results of the BLRAs from the 2016 draft Final FS and Proposed Plan. The Baseline Human Health Risk Assessment (BHHRA) is clear that fish consumption risks from cPAHs are likely less than 1% of the total cumulative risks for this pathway, with the remainder coming mostly from PCBs and dioxin/furans.[55] EPA has been unable to develop a technically sound cPAH sediment PRG for fish consumption because there is no observable relationship between sediment sources and PAH concentrations in fish tissue.[56] Because it was unable to link cPAHs in sediment to fish consumption risk, and despite the marginal cPAH fish consumption risk, EPA assigned a shellfish consumption PRG to the navigation channel as a surrogate for fish consumption,[57] even though no shellfish harvesting can occur within the navigation channel. EPA cannot simply assume that a PRG based on bioaccumulation in shellfish is representative or appropriate for protection of humans consuming fish.[58] A "rich and comprehensive" body of scientific literature establishes that vertebrate fish and shellfish metabolize PAHs very differently and that there is "very low risk of exposure to PAHs that are a health concern for humans consuming finfish."[59] In the Lower Duwamish Waterway ROD, in fact, EPA concluded that development of a sediment cPAH PRG for the human health seafood

[55] See Figure 7-3 of the EPA-approved BHHRA.
[56] EPA's own internal reviews indicate this. See EPA memorandum, May 2016 "Evaluation of analyses used to calculate bioaccumulation calculation results Portland Harbor Superfund Site RAC Contract Number EP-W-05-049" to EPA Region 10 Portland harbor RI/FS File from Portland Harbor RI/FS Team (May 2016), Attachment 10. Further, the science is extensive that PAHs do not readily accumulate in vertebrate fish tissue. See Meador et al. 1995, *Reviews of Environmental Contamination and Toxicology* 143:79-164; September 2014 *Toxicological Review of* Benzo(a)pyrene, ORD EPA/635/R-14/312a; Varanasi, et al. 1989, Biotransformation and Disposition of Polycyclic Aromatic Hydrocarbons (PAHs) in Fish: In Varanasi U (ed); Metabolism of Polycyclic Aromatic Hydrocarbons (PAHs) in the Aquatic Environment, CRC Press; and Metabolism of PAHs in Teleost Fish-Scientific Findings, Memorandum from the Northwest Fisheries Science Center of NMFS, available at http://sero.nmfs.noaa.gov/deepwater_horizon/previous_reopening/index.html, October 22, 2010.
[57] 2016 draft Final FS Appendix B, p. B-35.
[58] In response to LWG comments noting this fact, EPA's explanation for such an assumption was, "EPA calculated a PRG for cPAHs to address unacceptable risks associated with consumption of shellfish, and we anticipate that this PRG will also address the unacceptable risks identified in the BHHRA associated with consumption of fish." How or why EPA believed this to be a scientifically appropriate decision was never explained. Koch email to McKenna and Wyatt (April 10, 2015).
[59] *Metabolism of PAHs in Teleost Fish-Scientific Findings*, Memorandum from the Northwest Fisheries Science Center of NMFS (vertebrate fish enjoy "highly efficient metabolism of PAHs" whereas bivalves such as oysters and clams have a "low capacity to metabolize PAHs"). See also, *Metabolism of Polycyclic Aromatic Hydrocarbons (PAHs) in the Aquatic Environment*, CRC Press.

consumption pathway was inappropriate, because no observable relationship exists between cPAH sediment and tissue concentrations.[60]

Even if such a PRG were valid, EPA's further decisions to abandon the site use factor used in the BHHRA for the direct contact cPAH PRG,[61] convert that cPAH PRG to a TPAH PRG based upon an irrelevant correlation calculation,[62] and then use this number as a basis for development of TPAH RALs for application in areas of the Site where no direct contact can occur results in a meaningless alternatives analysis. EPA's own immediate post-construction SWAC estimates[63] indicate that Alternative B SWACs in the navigation channel would be below the cPAH shellfish consumption PRG of 3,950 parts per billion (ppb) for every rolling river mile examined (the maximum SWAC at river mile 5.5 was 3,305 ppb within SDU 6Nav). Because Alternative B meets the cPAH shellfish PRG in the navigation channel immediately after construction, even if the shellfish PRG were a valid surrogate for a fish consumption PRG there would be no additional cPAH risk reduction from any of the other larger alternatives (D through I). Alternative RALs much higher than the Alternative B TPAH RAL (170,000 ppb) might provide a more cost-effective balance of active remediation and natural recovery for cPAHs in the navigation channel, but EPA considers no such alternatives. EPA's alternatives evaluation effectively compares only Alternative B against the "no action" Alternative A before selecting an extensive dredging remedy for the navigation channel. The LWG's estimated cost (based upon review of EPA's dredge volumes) of this unnecessary remediation in SDU 6Nav exceeds $62 million, which would classify this SDU, standing alone, as a mega-site. This outcome is manifestly inconsistent with any reasonable risk management approach, especially where fish consumption risks associated with PAHs account for less than 1% of the fish consumption risk identified in the BHHRA, and therefore, no meaningful or measurable human health risk reduction would be attained.[64]

The LWG's prior comments provide many other examples and detail how EPA's deviation from the BLRAs and failure to apply risk management are clearly inconsistent with EPA guidance.[65] Numerous examples of each of these issues are provided in the LWG's prior comments on 2015 Draft FS Section 2. Table 2 provides a summary of COCs and PRGs that EPA should use. Attachment 11 provides additional comments on EPA's COCs and PRGs contained in the 2016 draft Final FS and corrects the numerous issues and EPA errors identified by the LWG in EPA's most recent PRG tables (Proposed Plan Table 11 and 2016 draft Final FS Table 2.2-1).

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[60] Lower Duwamish Waterway Superfund Site Record of Decision, November 2014, p.75.
[61] This issue is detailed in "LWG Comments on Revised FS Section 2 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240)". June 19, 2014. See also, "LWG comments on EPA's Feasibility Study Revised Draft Section 2 Text," March 25, 2015.
[62] The LWG previously commented on this issue on page 11 of "List of significant comments on EPA Feasibility Study Section 3 and 4 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240)" September 8, 2015.
[63] 2016 FS Appendix J Table J2.3-2i.
[64] TPAHs may be a source of benthic risk, but (for the reasons described above) benthic risk is targeted more precisely through application of the multiple lines of evidence used to evaluate benthic risk in the BERA and as applied in the EPA/LWG CBRA approach.
[65] LWG Comments on Revised FS Section 2 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240", letter from LWG to EPA dated June 19, 2014. "LWG comments on EPA's Feasibility Study Revised Draft Section 2 Text," March 25, 2015.

Table 2. LWG Proposed Remediation Goals

Contaminant	Sediment - In-Water		Sediment-Beach Human Health Direct Exposure Areas	
	Units	Conc.	Units	Conc.
Arsenic	ppm	4	ppm	3 (or site-specific background)
Cadmium	ppm	Rely on EPA/LWG CBRA instead		
Chlordanes	ppb	Need to derive RAO 2 RG using upstream water values		
DDx	ppb	7.5		
DDD	ppb	Rely on EPA/LWG CBRA instead		
DDE	ppb	Rely on EPA/LWG CBRA instead		
DDT	ppb	Rely on EPA/LWG CBRA instead		
Dieldrin	ppb	Need to derive RAO 2 RG using upstream water values		
Lead	ppm	Rely on EPA/LWG CBRA instead		
Mercury	ppm	Rely on EPA/LWG CBRA instead		
PCBs	ppb	(20 or as determined by additional equilibrium evaluations)		
PAHs	ppb	Rely on EPA/LWG CBRA instead		
cPAHs (BaPEq) - human health direct contact unacceptable risk exposure areas	ppb	424	ppb	12
cPAHs (BaPEq) - areas contributing to clam unacceptable risk consumption exposure based on bioaccumulation	ppb	OC-normalized		
Dioxins/Furans (2,3,7,8-TCDD eq)	ppb	0.04		
1,2,3,4,7,8-HxCDF	ppb	Recalculate based on equilibrium		
1,2,3,7,8-PeCDD	ppb	Recalculate based on equilibrium		
2,3,4,7,8-PeCDF	ppb	Recalculate based on equilibrium		
2,3,7,8-TCDF	ppb	Recalculate based on equilibrium		
2,3,7,8-TCDD	ppb	Recalculate based on equilibrium		
TPH-Diesel	ppb	Rely on EPA/LWG CBRA instead		

As discussed above, the LWG disagrees that there should be any surface water PRGs, because it is not possible to achieve them through sediment remedies (any ARARs related to these PRGs should be waived by EPA in the ROD), and there should be no groundwater and riverbank PRGs. To the extent that EPA chooses to proceed with these types of PRGs, specific ongoing concerns associated with EPA's most recent COCs and PRGs include:

- To the extent that any surface water PRGs are noted as "A" for "ARARs" on Proposed Plan Table 11, these should all be the Oregon water quality standard (WQS) rather than the National Recommended Ambient Water Quality Criteria (NRWQC) (e.g., aldrin, arsenic, copper, DDE, pentachlorophenol, BaP, dibenz(a,h)anthracene).

  > "If a State has promulgated a numerical [water quality standard, or "WQS"] that applies to the contaminant and the designated use of the surface water at a site, the WQS will generally be applicable or relevant and appropriate for determining cleanup levels, rather than [the National Recommended Water Quality Criterion or "NRWQC"]. A WQS represents a determination by the State, based on the [NRWQC], of the level of contaminant which is protective in that surface water body, a determination subject to EPA approval." (Emphasis added.) 53 F.R. 51394, 51442 (Dec. 21, 1988, explanation of revisions to the National Contingency Plan). [66]

  The proposed arsenic surface water PRG is a good example of this. Oregon revised its human health water quality criteria for arsenic to 2.1 micrograms per liter (µg/L) on April 21, 2011. In doing so, Oregon evaluated the NRWQC but set its standard higher than the NRWQC based on state-specific reasons, including its development of state-specific bio-concentration factors. EPA approved these criteria on October 17, 2011, making these revised criteria effective under the Clean Water Act. Thus, any discharge to the Willamette River meets the state water quality standard as long as it does not create a concentration in the river in excess of 2.1 µg/L. However, EPA ignored this Oregon standard in its Proposed Plan and has instead proposed a surface water PRG for arsenic of 0.018 µg/L, based on the NRWQC. This means that EPA will require any discharge to the Portland Harbor (e.g., groundwater or discharges from remedial actions) to be cleaned up as if it had to meet a 0.018 µg/L concentration in the river, even though the State of Oregon has said that a concentration of 2.1 µg/L is fully protective. EPA should not so arbitrarily ignore Oregon's protectiveness determination on this issue—that is, set the stage to require very substantial expenditures so that water discharging to the river is more than 100 times cleaner than the surface water standard itself, a standard that Oregon has determined through its EPA-approved water quality standard process is fully protective.

- To the extent that EPA has set surface water PRGs for a class of chemicals on an ARAR basis where Oregon has chosen not to have a WQS for that class, but instead has WQSs for the individual chemicals in the class, it should be removed. For example, Oregon opted to adopt WQSs for individual PAHs rather than cPAHs as a class. EPA should not set a surface water or groundwater PRGs on an ARAR-basis for cPAHs, because it has already set PRGs for the individual chemicals included in that class consistent with Oregon's WQSs.

- In no case should a groundwater PRG be set on an ARAR-basis using a surface WQS or NRWQC. Instead, EPA should rely on the surface water PRG and indicate that groundwater treatment is required if the groundwater would cause the exceedance of that surface water PRG in the surface water.

- To the extent the WQS or NRWQC that are adopted as PRGs have associated limitations, those need to be carried forward into the final PRGs (e.g., some apply only to a dissolved fraction or to a particular valance state). Similarly, to the extent a PRG is based on a particular exposure scenario (e.g., beach direct contact), it should not be applied to different exposure areas. See Table 2 and Attachment 11.

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[66] *See also* Lori Cora letter of February 2, 2010: "If the State's water quality criteria is promulgated after the most recent NRWQC for that contaminant is published, but adopted a criteria less stringent than the NRWQC due to water body-specific reasons, per Subsection 2(B) (i), EPA may determine that the NRWQC is not relevant and appropriate as long as the remedy will be protective using the State promulgated standard."

- As discussed above, MCLs should not be surface water PRGs or groundwater PRGs; if they are, they should be applied at the theoretical point of distribution after treatment, consistent with Oregon and federal law.[67]

- Tapwater Regional Screening Levels (RSLs) should not be groundwater PRGs, and manganese in particular should not be a PRG for the following reasons:

  – Table 11 of the Proposed Plan proposes a groundwater PRG for manganese of 430 µg/L. The origin of this criterion appears to be an EPA RSL for *tapwater*, based on risk to human health.[68]

  – Table 2.2-2 of the EPA draft Final FS indicates that manganese was not found to pose a risk to human health, so it should not have a PRG set based on a human health criterion.

  – The value is an RSL, not an ARAR.[69]

  – The surface water itself already meets this identified PRG; thus, there is no basis for setting a PRG in groundwater for the purpose of protecting the surface water pursuant to RAO 4.[70] This is because manganese is one of the chemicals subject to changes in concentration based on the geochemistry; specifically, the manganese becomes oxidized as it moves into the surface water, and it precipitates out of solution. Thus, groundwater concentrations are not predictive of surface water concentrations.

  – For RAO 4, which appears to be the basis for the proposed groundwater PRG, human use of surface water from the Willamette River requires pre-treatment as discussed above. Manganese is one of the substances that is most clearly controlled by conventional water pretreatment, which includes hardness adjustment/water softening, filtration, and chlorination. Therefore, manganese levels in groundwater/porewater in no way reflect the manganese concentrations that would be present in water used for potable purposes.

  – The current manganese RSL, which is the basis of the Portland Harbor manganese PRG, is derived from an incorrect and unsubstantiated, un-peer-reviewed evaluation of the manganese EPA IRIS assessment and is not appropriate as a PRG.

- Table 11 of the Proposed Plan lists some substances where there is no PRG (e.g., phenanthrene and pyrene). These should be removed.

The Proposed Plan does not explain how water PRGs will be applied. If EPA chooses not to delete them for reasons discussed above, risk-based surface water PRGs should be applied consistent with the exposure scenario that determined the unacceptable risk. If the PRGs are ARAR-based, they should be applied consistent with state procedures to determine water quality standard exceedances.[71] Further, if EPA keeps groundwater PRGs that are

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[67] OAR 340-041-0340, Table 340A; 40 CFR Part 141, Section 141.23(a).
[68] Note that Table 2.1-1 of EPA draft Final FS incorrectly identifies the source of this PRG as an "EPA Regional Screening Level (RSL) for Groundwater." In fact, the current version of the document that EPA references in that table is called the "Regional Screening Level (RSL) Resident *Tapwater* Table" (May 2016 version). The prior November 2015 version to which EPA cites in FS Table 2.1-1 was called the "Regional Screening Level (RSL) Summary Table," but it clearly indicated that the manganese RSL to which EPA refers of 430 µg/L was for "Tapwater."
[69] Table 2.1-1 of EPA draft Final FS specifically identifies the RSL table from which this was taken as a "To Be Considered" criteria, not an ARAR.
[70] See Attachment 12.
[71] ODEQ rules establish that all aquatic protection water quality standards are applied as a 96-hour average concentration, which may not be exceeded more than once every three years. OAR 340-041-8033, Table 30. Oregon guidance establishes that its human health criteria should be evaluated based on the geometric mean of 24-hour composite samples of high and low flow conditions of the waterbody. ODEQ, *Reasonable Potential Analysis Process for Toxic Pollutants*, Feb 13, 2012, at 34 and 80.

based on surface water ARARs, these need to be as measured in the surface water at the point of groundwater discharge,[72] because that is the beneficial use those ARARs are meant to protect.

Finally, we note that Proposed Plan Table 11 attempts to "summarize" the more detailed PRG tables from the 2016 draft Final FS. Proposed Plan Table 11 combines human health and ecological PRGs by media so that the origin and appropriate application of each PRG is lost. For example, Proposed Plan Table 11 cPAH notes a "riverbank soil/sediment" PRG of 12 ppb; which is an incorrect and misleading summary of that PRG. In fact, this particular PRG only applies to very limited beach areas as more accurately described in 2016 FS Table 2.2-1, and does not apply to the vast majority of the Site. EPA appears to have simply picked the lowest available PRG value from the 2016 draft Final FS PRG tables for each matrix "summarized" in Proposed Plan Table 11 without reference to how or where each particular PRG might be applicable or inapplicable to certain evaluations and decisions in remedy design and implementation. This leaves the reader with the false impression that each of these PRGs applies in all situations, which is clearly not the case and would be inconsistent with both the 2016 draft Final FS and the BLRAs.

In summary, EPA should apply the risk management called for by guidance and, in the ROD, select a refined and narrowed subset of PRGs as Remediation Goals (RGs). As explained above, the LWG believes RGs should be established only for sediments and only for COCs for which the EPA-approved BLRAs found significant unacceptable site-related risk and which can be addressed through a sediment remedy. Those proposed RGs are set forth in Table 2 above. Attachment 11 (specifically Table 11a of that attachment) shows in detailed, red-lined form how and why EPA should narrow its list of sediment PRGs contained in Proposed Plan Table 11 to get to the Table 2 list of proposed RGs. Because concentrations of COCs in fish tissue are highly influenced by upstream and NPDES sources that are not subject to the Portland Harbor remedial action, EPA should not set fish tissue PRGs. The LWG does believe it would be useful, however, to set fish tissue monitoring levels and shows in Attachment 11 (specifically Table 11b to that attachment) how EPA should narrow its list of fish tissue PRGs contained in Proposed Plan Table 11 to a meaningful list of fish tissue monitoring concentrations. For the reasons described above, the LWG does not believe EPA should set either surface water or groundwater RGs in the ROD. If EPA should proceed to use any of these values as RGs or as targets, please note that the LWG has also found errors and inconsistencies with the risk assessments in the PRG values that EPA has proposed. These comments are also provided in Attachment 11. Finally, the LWG reiterates its previous comments on EPA's PRG development.[73] Attachment 11 provides a summary of the LWG's position with respect to each PRG, by matrix and by RAO, narrowed to the list of PRGs set forth in EPA's 2016 draft Final FS.

2. EPA's post-construction risk evaluation is not consistent with the BLRAs

EPA conducts a post-construction risk evaluation in the 2016 draft Final FS for each alternative and uses the resulting post-construction risk estimates to evaluate the effectiveness of the various alternatives immediately after construction. EPA's post-construction risk estimates are inconsistent with the BLRAs in numerous respects. These inconsistencies cause EPA to err regarding the relative effectiveness of the alternatives, which in turn, results in EPA selecting an unnecessarily large and expensive preferred alternative (Alternative I).

a. The post-construction risk evaluation assumes different exposure scenarios and spatial scales than the BLRAs

Just as EPA's PRG selection in the 2016 draft Final and Proposed Plan deviates from the BLRAs in multiple respects to drive potentially unnecessary cleanup, EPA's post-construction risk estimates alter exposure scenarios and spatial scales and use inappropriate PRGs to inflate the perceived benefit of more aggressive actions. We have

[72] Except for 303(d) listed chemicals, this would have to include provision for assumed mixing in the water column, consistent with Oregon's rules for allowed mixing zones.

[73] LWG Comments on Revised FS Section 2 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240", letter from LWG to EPA dated June 19, 2014; "LWG comments on EPA's Feasibility Study Revised Draft Section 2 Text", March 25, 2015.

identified the following discrepancies (which are not comprehensive) between the BLRAs and the 2016 draft Final FS post-construction risk evaluation:

- For RAO 1, continued exclusion of the site use factor from the BHHRA for the benzo(a)pyrene equivalent (BaPEq) FS PRG (106 ppb) results in concluding that not even Alternative G will meet this PRG for many half river miles examined (2016 draft Final FS Table J2.2-1c). However, if the BHHRA site use factor is accurately applied (resulting in a PRG of 424 ppb), Alternative B appears to achieve RAO 1 immediately following construction in all but a few half river miles (e.g., around river miles 4, 5, and 6 East and 3, 4, 5, and 6 West).

- For RAO 2 human health fish consumption risks, EPA generated post-construction SWACs on: 1) a 1-river mile basis longitudinally split into the two shoreline areas and the navigation channel for the recreational fisher scenario; 2) a site-wide basis for the subsistence fisher scenario: and 3) an SDU basis (which represents subareas of various inconsistent sizes and shapes) for the recreational fisher scenario.[74] However, in the EPA-approved BHHRA, risks were evaluated by whole river miles with no longitudinal splitting for recreational fish consumption and without reference to SDUs, which did not exist when the BHHRA was completed.

- For RAO 2, the human health post-construction risks for Alternative A (which should be identical to the BHHRA baseline condition) differ from the risks calculated in the BHHRA, which indicates there are inconsistencies. The baseline highest non-cancer risk for a breastfeeding infant in the BHHRA was a Hazard Index (HI) of 10,000 site-wide (for nursing infants of subsistence fishers). The highest 2016 draft Final FS post-construction risk estimates for the same scenario for Alternative A were 3,333 for site-wide, which is substantially less than the BHHRA result. The highest FS HI estimates for Alternative A (254,000 on a river mile scale and 22,589 on an SDU scale) should be equivalent to the BHHRA recreational fisher infant scenario, because EPA calculated them using an ingestion rate of 49 grams per day. However, the maximum recreational fisher infant river mile HI from the BHHRA is 1,000, which is one to two orders of magnitude less that EPA's Alternative A estimates. The reasons for these differences are unclear.

  In addition to questionable assumptions regarding exposure to resident fish, EPA does not take into consideration several key uncertainties in assessing risk, including food preparation and cooking methods (which can reduce PCB concentrations by up to 87%).[75] EPA's assumptions are not merely conservative but are wholly unrealistic, contrary to the "conservative but within a realistic range of exposure scenarios" recommended by the NCP.[76]

- For RAO 2, there is a significant disconnect between the BHHRA and post-construction risks for dioxins/furans (and other inconsistencies with the BHHRA results also likely exist).

  - For a breastfeeding infant, the highest HQs for dioxin/furan TEQ calculated in the BHHRA are 10 on a site-wide basis (tribal fish consumption, whole body diet) and 10 on a river-mile basis (recreational reasonable maximum exposure [RME] consumption, river mile 7). Table J2.3-1a in the 2016 draft Final indicates that the site-wide HQ for the same infant scenario from HxCDF alone (not the entire TEQ) is 785 for Alternative A, almost two orders of magnitude higher.

  - For a child, the highest HQs for dioxin/furan TEQ calculated in the BHHRA are also 10 on a site-wide basis (tribal fish consumption, whole body diet) and 10 on a river-mile basis (recreational RME consumption, river mile 7). Table J2.3-1a in the 2016 draft Final FS shows a site-wide HQ of 23 for just HxCDF.

[74] 2016 FS, p. 4-10.
[75] BHHRA, p. 89. EPA states that on page 49 of the same document that no adjustments were made to contaminant concentrations in raw fish tissue because of the uncertainties associated with preparation and cooking practices.
[76] NCP Preamble, 55 Fed. Reg. 8710.

- The dioxin/furan Reference Dose has changed since the BHHRA was completed but that appears unlikely to account for the difference between the BHHRA and Alternative A post-construction risks.

- In August 2015, EPA acknowledged the inadequacy of HxCDF data in terms of quality and spatial coverage in written correspondence with the DEQ. At that time, EPA was in charge of finalizing its FS and had the authority to require supplemental scientific investigations to address and resolve these concerns. Instead, it chose to develop PRGs and RALs based on data EPA characterized as inadequate. In doing so, EPA abrogated its duty to produce scientifically sound and supportable risk estimates as well as cleanup criteria in the form of supportable PRGs and RALs.[77]

- Additional issues with EPA's dioxin/furan PRGs and post-construction risk approach are detailed in Attachment 11.[78]

- For RAO 5, ecological direct contact risks, multiple issues with EPA's benthic post-construction risk estimates are discussed above.

- For RAO 6, ecological bioaccumulation risks, 2016 draft Final FS SWACs were generated on a rolling 1-river mile basis with longitudinal splitting and on an SDU scale (p. 4-8). Like other post-construction risk estimates, EPA divides the post-construction SWAC by the PRG for each chemical. Importantly, the PRGs for the various RAO 6 chemicals are based on different ecological receptors evaluated in the BERA. These include smallmouth bass tissue for BEHP, sculpin tissue for DDx, sandpiper dietary assessment for DDE, mink for PCBs, and osprey egg assessment for dioxin/furans. These receptors all have widely divergent exposure parameters (including spatial scales) in the BERA and post-construction risks cannot be estimated by applying a "one size fits all" spatial scale to every PRG. Further, none of the BERA-appropriate spatial scales are consistent with longitudinally split river miles or SDUs. EPA does not recognize in the 2016 draft Final FS that this is even an issue and presents no discussion of why blanket application of split river miles and SDU spatial scales are possibly consistent with the various receptor exposures being evaluated.

  - For example, the DDE PRG is based on the BERA spotted sandpiper dietary assessment that was evaluated on a 2-river mile scale of beach sediment. The BERA evaluation spatial scale differs substantially from EPA's longitudinally split river miles or SDUs. EPA's Dioxin/furan PRG is based on the BERA osprey egg assessment, which was evaluated on a much larger scale than 1 river mile, much less longitudinally split river miles, or SDUs.

  - Also, the LWG has previously commented[79] that almost all of the RAO 6 PRGs, and as a result the post-construction risks calculated, are based on inappropriate or inconsistent determinations as compared to the BERA methods. Attachment 11 contains a summary of the most up-to-date comments from LWG on each of the RAO 6 PRGs.

  - As a result, all of the RAO 6 post-construction risk estimates appear to be unsupported and do not present any accurate accounting of the relative ecological risks or risk reductions achieved by any of the alternatives.

- For RAO 9, EPA considers the number of lineal feet of riverbank soils that are addressed by each alternative as a qualitative measure of human health and ecological risk reductions (EPA draft Final FS p. 4-9). Given that the RI and BLRAs include no riverbank soils (as defined in the RI) data and contain no

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[77] See email message E. Allen USEPA to DEQ dated August 20, 2015.
[78] See Technical Memorandum, *Review of Human Health Risk Analyses in the Portland Harbor Feasibility Study and Proposed Plan*" (S), Section 3 (detailing a comparison of EPA's fish consumption risk estimates to BHHRA and 2012 smallmouth bass estimates). A copy of this memorandum is Attachment 14.
[79] LWG Comments on Revised FS Section 2 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240," letter from LWG to EPA dated June 19, 2014. "LWG comments on EPA's Feasibility Study Revised Draft Section 2 Text," March 25, 2015.

> risk assessment of riverbank soils, EPA should not have evaluated these post-construction risks at all. Any "qualitative" assessment is mere conjecture in the absence of actual evaluation of riverbank soils data or baseline risks earlier in the RI/FS process.[80]

Appendix J of the 2016 draft Final FS glosses over many method details; thus, it is not possible to fully comment on EPA's post-construction risk methodology. However, given that it is clear that all of the above aspects are inconsistent with the BLRAs, it is highly likely that other details of the methods, if they were known, would also be inconsistent with the BLRA methods.

b. Inflated SWAC recalculation skews the apparent performance of EPA's alternatives

As noted above, all of EPA's post-construction risk estimates are based on calculating a ratio of the immediate post-construction exposure concentrations in the numerator (SWACs or related tissue concentrations) to the toxicity level (PRGs) in the denominator. EPA presents these ratio results as HQ (non-cancer) or cancer-risk levels for each alternative.[81] As noted above, there are numerous inconsistencies with the BLRAs in EPA's determination and application of the risk-based PRGs in the denominator. This subsection focuses mainly on the numerator (exposure concentration) errors. EPA's FS conclusions rely mainly on post-construction risk estimates for human health fish consumption (RAO 2) and ecological bioaccumulation risks (RAO 6), so discussions here are confined to those scenarios (human health) and receptors (ecological). (In addition, EPA evaluated benthic risk reduction for ecological (RAO 5), and errors associated with this analysis are discussed previously.)

Regarding human health fish consumption (RAO 2), EPA relies on PCB post-construction non-cancer risk estimates for the child[82] (e.g., 2016 draft Final FS Figures 4.2-2 and 4.2-6) and infant scenarios (e.g., 2016 draft Final FS Figure 4.2-4). To simplify the discussion, we focus here on the child scenario errors, but similar errors exist for the infant scenario. EPA presents two types of results: 1) non-cancer HQs and cancer-risk levels;[83] and 2) allowable fish meals, which are calculated through an algebraic rearrangement of the risk equation to solve for the number of meals producing an acceptable risk level under any given post-construction exposure concentration. EPA uses the same flawed exposure concentrations to support both results.

Specifically, EPA graphics (such as 2016 draft Final FS Figures 4.2-2, 4.2-4, and 4.2-6) present baseline (Alternative A) and immediate post-construction risk levels and allowable fish meals for each alternative that depict a sharp decrease in the risk levels between the baseline condition (Alternative A) and the progressively more aggressive alternatives. This steep decrease is caused by EPA's flawed calculation of baseline PCB SWACs for the Site, which EPA newly assumed to be about 208 ppb site-wide.[84] As recently as EPA's 2015 Draft FS and November 2015 NRRB presentation,[85] EPA had been presenting the site-wide SWAC as about 85 to 87 ppb, which is similar to the site-wide SWAC presented in the 2012 LWG Draft FS, the EPA-approved BHHRA and BERA, and essentially all EPA and LWG prior discussions and documents. The 2016 draft Final FS indicates the same FS database was used as the 2015 Draft FS; however, the new SWAC does not involve any new data and is exclusively a reinterpretation of the same data available for many years. In addition, EPA presents a site-wide SWAC of 92 ppb on Figure 3.4-1 (depicting PCB RAL curves) in the 2016 draft Final FS, which is only slightly higher than the

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[80] EPA acknowledges the RI/FS data are insufficient to make an assessment (p. 4-9), but proceeds nonetheless, "A qualitative assessment of protectiveness for river banks is conducted for each alternative as there are no current means to quantitatively assess the effectiveness of the alternative in achieving PRGs in river banks due to uncertainty in contaminant concentrations and locations."

[81] Note that this is a "short cut" method for a residual risk assessment. Typically, such assessments are conducted by calculating post remediation sediment (and other matrices as appropriate) concentrations and then applying those concentrations to forward risk assessment calculations.

[82] EPA's FS and Proposed Plan fail to mention that these risk estimates are for the child scenario, which is more conservative (higher risks) than the adult scenario (e.g., FS Table 4.2-2, Figure 4.2-2, and similar figure titles do not mention whether the risks presented are for adult or child scenarios). EPA typically mentions that "people would be advised to eat no more than 6 fish meals every 10 years" (Proposed Plan p. 58); this makes it unclear which "people" are being evaluated. EPA's widespread use of the child scenario was only discovered through laborious cross checking between EPA's FS main text and appendices and by conducting independent calculations.

[83] EPA focuses on the adult scenario for discussion of cancer risks in the 2016 FS.

[84] This critical information is buried in Draft Final FS, Appendix J, Table J2.3-1a.

[85] "Portland Harbor Remedial Investigation". Presentation to the CSTAG/NRRB, November 18, 2015. Kristine Koch, U.S. EPA, Region 10. Part 2, p. 27.

historical estimates. This SWAC level implies that EPA developed the RAL curves using a different baseline SWAC than the post-construction risk estimates, which is another unexplained inconsistency in EPA's methods.

EPA's new assumed baseline PCB SWAC of about 208 ppb is not mentioned once in the 2016 draft Final FS and Proposed Plan main text, figures, or tables.[86] EPA also does not explain why an upward shift that more than doubles the previously estimated baseline PCB site-wide SWACs is warranted or why this huge inconsistency with the EPA-approved BLRAs is acceptable. EPA generally cites in the FS main text both Appendix I and Appendix J for further information regarding SWAC uncertainties and methods for the post-construction risk assessment. Appendix I of the 2016 draft Final FS presents site-wide PCB SWAC uncertainty analysis results that range from 79 to 205 ppb (p. I-5), and the five methods used produced an average result of 120 ppb (Table I-1). Thus, the 208 ppb SWAC is even above the extreme maximum value from the analyses in Appendix I. Appendix J indicates (p. J-3) that "[s]ite-wide sediment concentrations were calculated for RAO 2 using the post remedial SWACs developed for each SDU and other areas of the river as described in Appendix I. A site-wide average concentration for each COC – represented by the 95 percent upper confidence limit on the mean – was then calculated for each RAO 2 COC using ProUCL." In response to the LWG's questions, this method was later clarified by EPA in an email response: "The figure below was used to develop site-wide SWACs. A SWAC of each area was computed and then put into Pro-UCL to determine the 95th percent UCL on the mean of those SWACs. The SWACs that are used in the FS are provided in Appendix J and K."[87] Despite the confusing and conflicting scattered statements, our current understanding is that the EPA value of 208 ppb derived in Appendix J may be completely separate from the value of 205 ppb described in Appendix I, and they are only coincidentally similar. This remains unclear.

Assuming that this interpretation is correct, the Appendix J method of calculating site-wide SWACs appears fundamentally flawed. EPA is indicating that the Site was cut into 31 subareas, and a SWAC was "computed" (the SWAC method here is unclear) for each subarea. EPA then made the assumption that the SWAC for each subarea was somehow a potentially representative "sample" of the entire Site SWAC, which is clearly an inaccurate and scientifically unsupportable assumption. Empirical data collected over 15 years irrefutably demonstrate that the Site has areas with relatively high and low PCB (and other chemical) concentrations, and the SWAC in any given subarea may have little relationship to the overall surface-weighted average across the entire Site. By selecting the concentration from one subarea to represent all post-construction risk estimates for the entire Site, EPA is deciding that all human health and ecological exposures represented by any particular RAO or scenario occur in that one subarea. In other words, while a given BHHRA scenario may assume a person is catching fish from the entire Site, EPA's FS method reduces this assumption to a person catching fish from just one select subarea for the entire exposure period. And because EPA is using an UPL, this person is assumed to consume only fish from an area with comparatively high concentrations.

A second unstated assumption is that the 31 subareas defined by EPA are a statistically valid way of dividing the Site. EPA clarified that the subareas are based on SDUs, which EPA states were devised to specifically identify the areas of highest COC concentrations on a rolling river mile basis. Obviously, many other methods could be used to define subareas of the Site, each of which would yield different statistics than the one EPA selected. Further, EPA has created an explicitly bimodal distribution of subareas, with some subareas focused on the highest observed concentrations (the SDUs) and remaining subareas focused on the lowest observed concentrations. This method is biased and inherently inaccurate for subsampling Site SWACs, and consequently it is likely that other less biased and more scientifically supportable subsampling methods would produce a lower overall SWAC estimate.

Regardless, it is inappropriate to use any of these new subsampling methods, because they will all create Site SWACs that are inaccurate and inconsistent with those used in the EPA-approved BLRAs, which in turn causes the remedy selection process to diverge from an appropriate focus on reducing risks actually identified in the BLRAs.

EPA's unscientific and artificially inflated new SWACs apply to other COCs as well, as shown in Table 3. An evaluation of EPA's new site-wide SWAC for 2,3,4,7,8-PeCDF clearly illustrates the problems with EPA's new

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[86] Indeed, the 208 ppb PCB SWAC would effectively designate the entire Site as Principal Threat Waste (PTW). *See* 2016 draft Final FS Table 3.2-1 (highly toxic PTW threshold is 200 ppb). Yet 2016 draft Final FS Table 4.2-9 identifies just 172 (out of 2167) acres of the Site as PTW.
[87] Email response number 8 from Kristine Koch on July 20, 2016 regarding LWG's "Request for Clarification."

SWACs. EPA's new site-wide SWAC for 2,3,4,7,8-PeCDF is 0.04 ppb. Out of 374 surface sediment samples analyzed for 2,3,4,7,8-PeCDF, only 10 samples in the entire Site are equal to or greater than 0.04 ppb, and these samples were all collected between river mile 6.7 and 7.3. The LWG calculated SWAC using EPA's 2015 natural neighbor contour surfaces is 0.00588 ppb, which is an order of magnitude less than EPA's new SWAC for this compound. As an additional example, EPA calculates that risk from a single dioxin/furan congener, 1,2,3,4,7,8-Hx CDF, is higher than the total TEQ. This is physically and logically impossible. It was also known to EPA to have been calculated using a flawed characterization and poor data quality.[88] When EPA's own contractor summarized percent contributions to risk from dioxin/furan congeners from actual fish tissue date, the TEQ risk from 1,2,3,4,7,8-Hx CDF was approximately 3 percent.[89]

Table 3. Comparison of EPA's New Site SWACs to Values Estimated by LWG Using EPA's Natural Neighbor Surfaces.

Chemical	Site-Wide SWAC (ppb)	
	Table J2.3-1a (EPA 2016 Draft Final FS)	**SWACs Estimated by LWG Using Natural Neighbor Surfaces Provided by EPA**
PCBs	208	86
DDx	138	30
1,2,3,7,8-PeCDD	0.0003	0.0002
2,3,4,7,8-PeCDF	0.04	0.006
2,3,7,8-TCDD	0.0003	0.0001

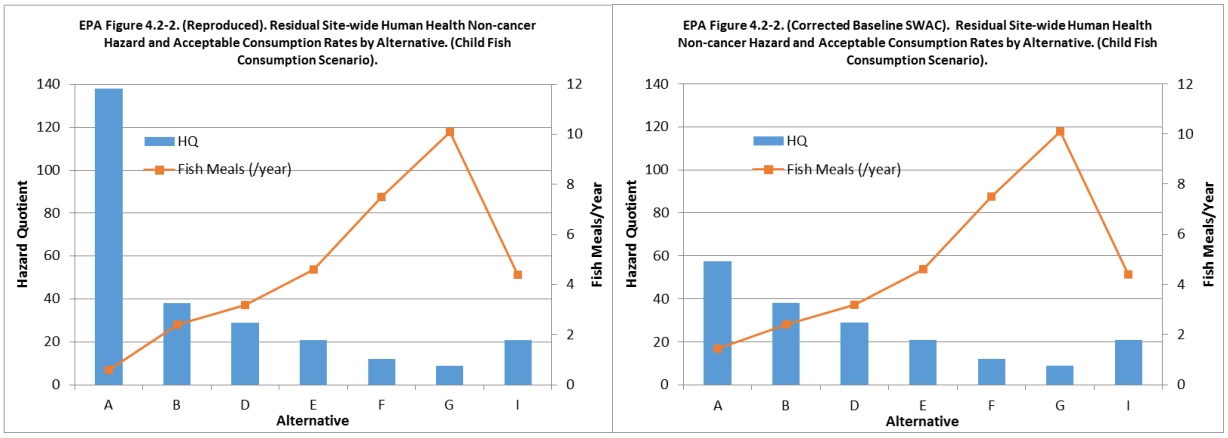
Another issue with EPA's post-construction SWACs is that EPA assumes a "zero" replacement value for areas where active dredging and capping is assumed to take place.[90] That is, the remediated area is assumed to attain a concentration of zero for any evaluated COC immediately after construction is complete. Although this assumption is convenient and simple, it is clearly incorrect for dredge areas, where dredge residuals are known to occur. These residuals can be managed, but it is nearly impossible to reduce post-dredge residual concentrations to zero.[91] The use of zero as a replacement values for dredge areas makes the larger alternatives with more mass removal appear to have greater immediate risk reduction than will actually occur. For example, EPA presents several post-construction SWACs for PCBs that are below EPA's background value of 9 ppb (and the LWG's calculated equilibrium value of 20 ppb). Even if such immediate post-construction concentrations were temporarily achievable, inputs and deposition of sediments from upstream would be expected to quickly return these areas to an equilibrium concentration. Thus, EPA compounds the appearance of steep SWAC declines by simultaneously artificially inflating the baseline SWAC and then over-estimating the SWAC reductions that will occur due to dredging.

The consequences of substantially diverging from the BLRA SWACs at this late date are not considered or discussed anywhere in the 2016 draft Final FS or Proposed Plan. The consequences, combined with other issues like the zero replacement value, are widespread, impacting every post-construction risk estimate presented by EPA and skewing the overall evaluation of the alternatives' effectiveness. Because EPA increases the baseline Alternative A SWACs by a factor of about 2.4, all of EPA's baseline risk estimates are higher than the BHHRA by a

[88] See email message E. Allen USEPA to DEQ dated August 20, 2015.
[89] CDM Smith, "Evaluation of Dioxin/Furan Congeners Against Total Dioxin/Furans, Portland Harbor Superfund Site," December 23, 2014, Table 1 (presenting results by river mile, with the contribution to risk attributed to 1,2,3,4,7,8-Hx CDF by river mile segments ranging from 0 to 20 percent and, once corrected for the fact that the wrong TEF was applied (TEF for 1,2,3,4,7,8-Hx CDF is 0.1, not 0.3, according to https://rais.ornl.gov/documents/dioxin_tef.pdf), averaging approximately 3%).
[90] 2016 draft Final FS p. ES-14.
[91] See discussion in the LWG 2012 draft FS in Sections 6.2.7.3 and 8.2.2.4; Bridges, et al. 2010: Dredging Processes and Remedy Effectiveness: Relationship to the 4 Rs of Environmental Dredging. Todd S. Bridges, Karl E. Gustavson, Paul Schroeder, Stephen J. Ells, Donald Hayes, Steven C. Nadeau, Michael R. Palermo, and Clay Patmont. Integrated Environmental Assessment and Management. February 10, 2010. 2010 SETAC; ITRC p. 181; and "Sediment Monitored Natural Recovery Case Studies." Presentation at the Battelle Eighth International Conference on Remediation and Management of Contaminated Sediments. January 12-15, 2015. Carl Stivers and Clay Patmont of Anchor QEA. (Attachment 13)

similar factor.[92] Figure 2 provides an example of how EPA's post-construction risk figures would change if baseline SWACs consistent with BLRAs were used instead. The risk reduction (HQs) from the baseline condition in Alternative A provided by all the alternatives becomes substantially less, and the graph becomes much less compelling visually. Similarly, the number of allowable fish meals provided by Alternative I (for example) goes from 7 times greater than baseline to only 3 times greater than baseline.

Figure 2. Comparison of EPA's FS Risk Estimates to Corrected Values Using a Baseline SWAC Consistent with the BLRAs.

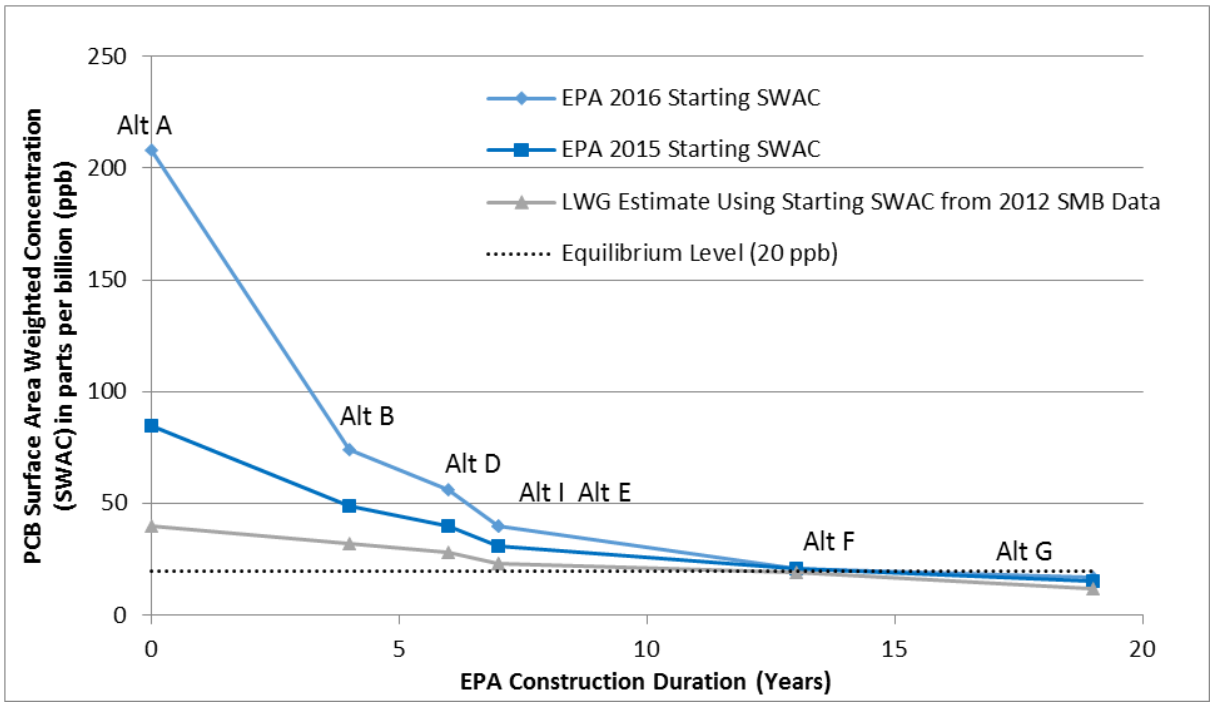


As another example, EPA calculated, using the Food Web Model and the new sediment SWAC of 208 ppb, an average PCB site-wide fish tissue concentration of 521 ppb. The comparable average site-wide fish tissue concentration in the BHHRA, based on actual tissue data collected in 2007 and earlier, is 227 ppb, which equates to a site-wide modeled sediment SWAC of 85 ppb.[93] Using EPA's modeled tissue concentration of 521 ppb, the acceptable consumption rate based on the non-cancer endpoint would be 1.9 fish meals/year for the child scenario; whereas the actual BHHRA tissue concentration of 227 ppb results in an acceptable consumption rate of 4.2 meals/year. The above calculation of 1.9 meals/year for Alternative A (baseline) using EPA's fish tissue concentration is higher than the meals per year shown for Alternative A in EPA's Figure 4.2-2 (reproduced in Figure 2 above), which presents 0.6 fish meal/year for the presumably same scenario. This difference illustrates another error in EPA's calculations that was only discernable through independent calculations. It appears that EPA is using the child scenario but altering the fish meal size from 3.5 ounces to the adult meal size of 8 ounces, which is clearly inconsistent with the BHHRA methods. Putting aside the reasonableness of a child consuming adult meal portions for long periods while still remaining a child, the net result of EPA's poorly explained additional change to the exposure assumptions is to drive allowable fish meals even further down for the baseline condition. Combined with the artificially inflated new SWAC, this meal size change compounds the portrayal of the baseline condition as much worse than the actual BHHRA findings. Again, this further increases the perceived benefit of any SWAC and tissue concentration reductions assumed for the more aggressive alternatives. It should also be noted that even with the change to adult meal size for the child scenario, the LWG could not exactly reproduce EPA's allowable fish meals, which likely indicates other undescribed procedures were employed that create further inconsistencies with the EPA-approved BHHRA.

[92] There may be other differences between some calculations because EPA used additional methods that are also inconsistent with the BLRAs. A factor of 2.4 is accurate to assess the impact of this one variable (i.e., the new SWAC for PCBs).
[93] See Attachment 14. memorandum "Review of Human Health Risk Analyses in the Portland Harbor Feasibility Study and Proposed Plan" detailing a comparison of EPA's fish consumption risk estimates to BHHRA and 2012 smallmouth bass estimates. See also, "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis." A presentation file from Anchor QEA provided to EPA on March 18, 2013." (Attachment 1)

Figure 3 illustrates the effect of the choice of the baseline site-wide SWAC on the utility of various alternatives, as represented by construction durations,[94] using a "knee of the curve" analysis. Figure 3 presents the knee of the curve when the baseline PCB SWAC is assumed to be 208, 85, and 40 ppb. These are EPA's artificially inflated 2016 draft Final FS SWAC estimate, the SWAC consistent with the EPA-approved BLRAs that EPA used in the 2015 Draft FS, and the SWAC estimated from the 2012 smallmouth fish tissue sampling, respectively.[95] As the initial SWAC decreases, the incremental benefit in terms of SWAC reduction for each successively longer alternative also decreases. The utility of the alternatives as determined by the knee of the curve shifts away from Alternatives F and G and toward Alternatives B and D. In the case of the lowest initial SWAC (gray line), there is virtually no added benefit in moving from Alternative B to I, while the short-term and other duration associated impacts increase substantially. When a higher value is used for the initial conditions, the most aggressive and resource consuming alternatives erroneously appear to provide more benefit. Also note that due to EPA's zero replacement value assumption, the SWACs for the largest alternatives erroneously appear to achieve levels below equilibrium level (black dotted line in Figure 3).

Figure 3. Immediate Post-construction SWACs and EPA Durations.



While EPA has increased the perceived benefit of the larger alternatives (such as Alternative I) by artificially increasing the baseline condition by a factor of 2.4 above the approved BLRAs, the 2012 smallmouth bass data strongly suggest the Site has continued to recover below the BLRA SWACs (i.e., the RI and BLRAs use data that were collected mostly between 2002 and 2008). As noted in the LWG's presentations of the 2012 smallmouth bass data to EPA, that data strongly suggest that some parts of the Site that EPA identifies for active remediation are already approaching equilibrium conditions.[96]

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[94] As EPA's draft Final FS points out, as the durations of the alternatives rise the short-term impacts to the environment and community, the number of feasibility issues, and costs also rise.

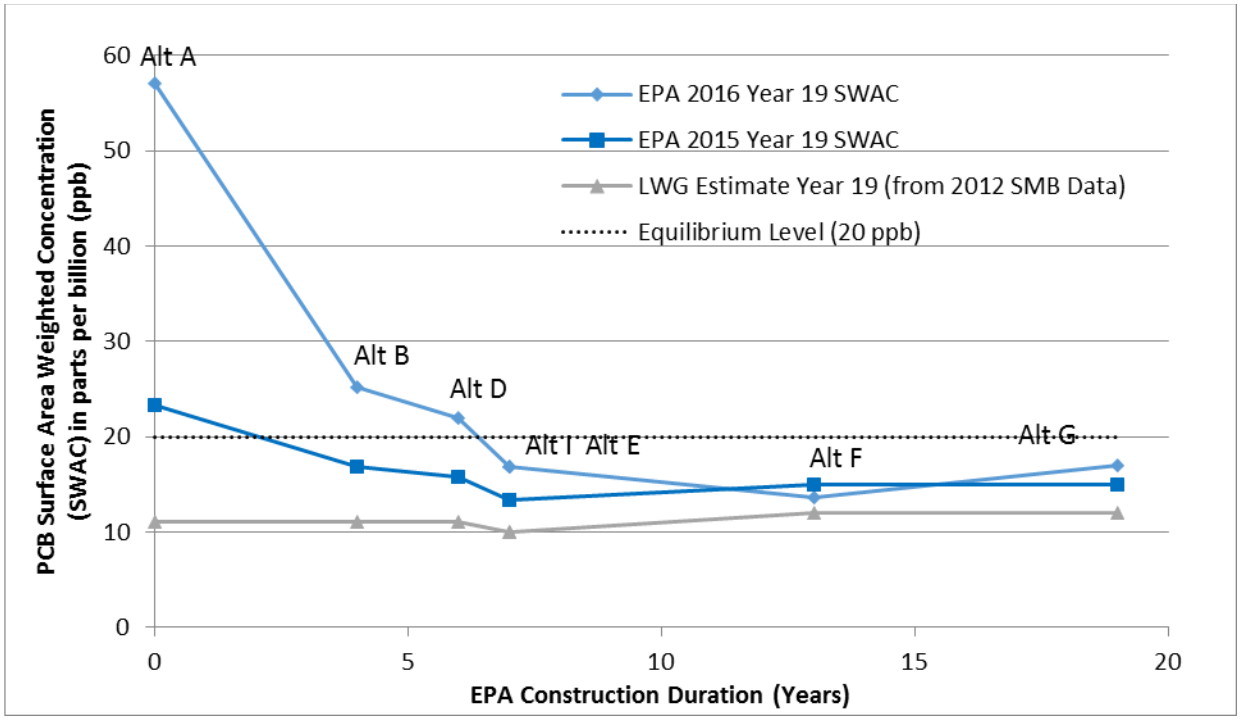
[95] "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis." A presentation file from Anchor QEA provided to EPA on March 18, 2013. (Attachment 1)

[96] See also Kennedy/Jenks Consultants Memo dated March 6, 2013, that summarizes the data that shows a decline in concentrations. Kennedy Jenks' March 6 memo acknowledges it is comparing 2012 discrete samples to earlier composite samples and bases its comparison on means, maximum, and minimum detected concentrations. (Attachment 15)

c. EPA ignores upstream and other external contributions that limit the risk reduction available through sediment cleanup to system equilibrium values

EPA has previously acknowledged that equilibrium is a useful concept for the Site.[97] The LWG has provided EPA with detailed evaluations demonstrating that, due to upstream sources, the Site is unlikely to ever achieve site-wide PCB SWACs less than 20 ppb.[98] Figure 3 shows immediate post-construction SWACs using EPA's incorrect zero replacement value assumption, but as the Site continues to recover over time, presumed additional decreases in Site SWACs provided by longer and larger alternatives will not actually occur. Figure 4 presents estimated SWACs for all alternatives at 19 years after construction starts,[99] which is EPA's assumed construction duration for Alternative G. Figure 4 shows that any perceived benefits of longer and larger alternatives are unlikely, because EPA's analysis does not consider that concentrations cannot decrease below Site equilibrium conditions. For example, using EPA's 2016 SWAC values, the additional 14 years of estimated construction from Alternative G, or 3 years of construction from EPA's Preferred Alternative. would result in a difference in PCB SWAC of only about 5 ppb from Alternative B.[100]

Figure 4. Estimated SWACs 19 Years after Construction Starts.



The equilibrium concept is a critical consideration in evaluating the long-term effectiveness of remedial alternatives in the FS. EPA guidance provides that sediment remedies "should reflect objectives that are achievable from the site

[97] As recently as April 2015, EPA endorsed the concept of equilibrium as a measure of the most a sediment remedy can accomplish and committed to perform an equilibrium evaluation in Section 4 of the FS. "EPA will conduct an equilibrium evaluation in Section 4 of the FS. The most appropriate means to evaluate whether RAOs or PRGs are achievable by any of the alternatives being developed in Section 3 of the FS is to conduct the detailed evaluation in Section 4 of the FS using the first seven NCP criteria. This information will be considered in developing the final remediation goals/cleanup levels." EPA Response to LWG's March 25, 2015 Comments on the Portland Harbor FS Section 2 (April 10, 2015), p. 2. A copy of EPA's response is Attachment 16.

[98] *Sediment Equilibrium Estimates for the Revised Feasibility Study*, (LWG, August 7, 2014). This Technical Memorandum is Attachment 17. The discussion herein focuses on the expected Site equilibrium for PCBs. As addressed in the LWG's memorandum, equilibrium concentrations for a number of COCs (including background sensitive risk-drivers DDX and dioxins/furans) can be predicted, and the LWG specifically provided that analysis to EPA for PCBs and DDX.

[99] See Section V.C. for a description of methods to estimate long-term SWACs. These methods avoid using computer models that EPA has expressed uncertainty about.

[100] See Table 6, infra.

cleanup."[101] Concentrations below equilibrium cannot be achieved by any alternatives, and any comparisons assuming otherwise are fundamentally flawed. Unlike Portland Harbor, equilibrium has been fully integrated into Proposed Plan decisions at other sites. In the Lower Duwamish Waterway (LDW) Proposed Plan, several datasets representing COC concentrations in suspended sediments entering that site from the upstream Green/Duwamish River system were evaluated because they represent "future COC concentrations in the LDW after implementation of cleanup alternatives."[102] This included the use of deposited sediments in an upper turning basin, because "these data provide an indicator of suspended sediments settling within the upper reach of the LDW."[103] The Grasse River ROD indicates, "The selected remedy will comply with all of the listed ARARs in Tables 13-1 through 13-3 except two chemical-specific ARARs which are not expected to be met due to Site background PCB loading conditions. Therefore, because of technical impracticability, those two ARARs are being waived."[104]

D. EPA's Selection of Its Preferred Alternative is Not Based Upon Meaningful Risk Reduction and Fails to Apply Appropriate Risk Management Principles

According to the EPA-approved BHHRA, consumption of resident fish, such as carp and smallmouth bass, represents the majority of potential human health risk at the Site. Calculated site-wide subsistence fisher risks are orders of magnitude higher than other scenarios,[105] and 93% of this risk comes from PCBs.[106]

EPA's BHHRA evaluated the risks to a subsistence fisher eating 228 resident fish meals/year.[107] EPA calculated such high potential risk to subsistence fishers that EPA has determined that, under current conditions, children and other vulnerable populations should eat only 0.6 resident fish meal/year.[108] According to EPA, healthy adults can currently eat 4.3 meals/year.[109] The most aggressive cleanup alternatives evaluated by EPA would allow vulnerable populations to eat 7.5 to 10 meals/year after construction is complete.[110] Healthy adults could eat 38 meals/year after construction of Alternative F, but because the estimated post-construction PCB SWAC of 21 ppb is approximately the equilibrium value, Alternative G would be unlikely to push additional fish consumption using EPA's risk assumptions much, if at all, above the 38 meals/year estimated for Alternative F. EPA's Preferred Alternative would allow 4.4 meals/year for children and 22 meals/year for adults after construction.

Extensive evidence from other sites suggest that fish tissue PCB concentrations will temporarily increase for a period of 3 to 5 years after dredging of contaminated sediments takes place.[111] The dynamic Food Web Modeling of alternatives in the 2012 LWG Draft FS (Appendix Hb) also projects this reaction in fish tissue concentrations during and after dredging. This evidence all indicates that fish consumption risks will increase significantly during construction and will persist for several years after construction is completed to allow time for the fish tissue to respond to the new sediment conditions. Therefore, and as discussed more fully in Section V.C. below, because the fish consumption risk reduction achievable through a sediment cleanup is limited by sediment equilibrium, cleanup alternatives involving longer and more aggressive construction activities are likely to significantly increase fish consumption risks in the short term while resulting in no greater long-term increase in fish meals. In other words, as

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[101] Sediment Guidance, p. 2-15.
[102] *Proposed Plan Lower Duwamish Waterway Superfund Site*, EPA, Region 10. Seattle Washington. February 28, 2013, pp. 26-27.
[103] *Id*.
[104] *Record of Decision Grasse River Superfund Site (a.k.a. Alcoa Aggregation Site) Massena, St. Lawrence County*, New York. EPA, Region II. New York, New York. April 2013, p. 54.
[105] BHHRA page 101; Figure 7-1.
[106] BHHRA p. 4; Figure 7-3; Table 5-74.
[107] Proposed Plan p. 18.
[108] Proposed Plan p.32.
[109] EPA focused on the child fisher non-cancer scenario in the 2016 FS. Consequently, to compare to OHA adult advisories, the LWG estimated adult allowable fish meals using EPA's methods. See "Review of Human Health Risk Analyses in the Portland Harbor Feasibility Study and Proposed Plan," Attachment 14.
[110] Proposed Plan p. 58. As noted previously, EPA does not state these values are based on the child recreational scenario, but independent calculations suggest that this is the scenario that EPA is presenting in the Proposed Plan.
[111] See discussion in the LWG 2012 draft FS in Sections 6.2.7.3 and 8.2.2.4; Bridges, et al. 2010: Dredging Processes and Remedy Effectiveness: Relationship to the 4 Rs of Environmental Dredging. Todd S. Bridges, Karl E. Gustavson, Paul Schroeder, Stephen J. Ells, Donald Hayes, Steven C. Nadeau, Michael R. Palermo, and Clay Patmont. Integrated Environmental Assessment and Management. February 10, 2010. 2010 SETAC; IRTC p. 181; and "Sediment Monitored Natural Recovery Case Studies." Presentation at the Battelle Eighth International Conference on Remediation and Management of Contaminated Sediments. January 12-15, 2015. Carl Stivers and Clay Patmont of Anchor QEA.

shown in Table 8 below, Alternative B, which EPA projects would take 4 years to complete, would allow 4.1 meals/year for children 12 years after construction starts, right about the same time that fish tissue levels for Alternative I, which EPA projects would take 7 years to complete, would likely be settling down to EPA's projected post-construction 4.4 meals/year.[112]

The Oregon Health Agency's current fish consumption health advisories are summarized in Table 4. Table 4 compares these advisories to the results of EPA's 2016 draft Final FS allowable fish meal calculations for each alternative. For the adult scenario, Table 4 shows that EPA's Alternative A, representing the existing condition, provides an allowable number of fish meals (4.3 meals/year) that is substantially less than both of the current Oregon Health Agency (OHA) adult advisories. For the vulnerable population or child scenario, Table 4 shows that EPA would allow children to currently eat a little more fish than the OHA advisory, but only because that advisory is already set at zero.

Table 4. Comparison of EPA 2016 Draft Final FS and Oregon Health Agency Allowable Fish Meals (meals/year).

Estimate Source	Healthy Adults[1]	Vulnerable Populations (including children)[2]
OHA Advisories		
PCBs, Portland Harbor	12	0
Mercury, Willamette River[3]	48	12
EPA 2016 Draft Final FS – EPA assumed immediate post-construction consumption per Appendix J		
Alternative A (no action, assumed current condition)	4.3	0.6
EPA recommendation during construction	[4]	0.6
Alternative B	12	2.4
Alternative D	16	3.2
Alternative E	23	4.6
Alternative F	38	7.5
Alternative G	52	10.1
Alternative I	22	4.4

Notes
1 Because the 2016 draft Final FS focuses on child scenario, EPA adult values are estimated by LWG calculations (see attached memorandum "Review of Human Health Risk Analyses in the Portland Harbor Feasibility Study and Proposed Plan.")
2 OHA "vulnerable" populations include children, women of child bearing age, and people with some types of diseases. EPA child values from Figure 4.2-4 in the 2016 draft Final FS.
3 For mainstem Willamette, which includes Portland Harbor.
4 Page 58 of EPA's Proposed Plan states that "people" would be advised no more than 0.6 meals per year during construction. Based upon the calculations in Appendix J, we interpret "people" to mean children and are therefore unable to determine what EPA recommends for adults.

EPA's 2016 draft Final FS concludes that "the existing [OHA] advisories might not be sufficiently effective in protecting human health since the current recommended rate of one meal per month [12 meals/year] for the general population may not be sufficiently protective of consumers."[113] We are not aware that EPA has previously stated that the OHA fish advisory was not protective for adults, even though EPA approved the BHHRA more than 3 years ago. EPA should consider that the conflict between the OHA advisory and EPA's BHHRA indicates EPA's risk estimates may be incorrect. At a minimum, EPA should coordinate with OHA to provide clear, credible, and consistent public health information. EPA should also explain its advisory in light of the U.S. Food and Drug

[112] See Section V.C, *infra*.
[113] 2016 draft Final FS, p. 4-15.

Administration's threshold for PCBs in fish sold in supermarkets of 2 parts per million (ppm), which is more than 1,000 times higher than EPA's cleanup goal of 0.3 ppb in resident fish tissue.[114]

EPA must also recognize that consumption of resident fish in the Willamette River will continue to be limited by mercury fish tissue concentrations that are unrelated to Portland Harbor (e.g., upstream watershed soils, upstream historic gold mining activities, and regional and global combustion sources) and therefore beyond the scope of the Superfund cleanup to address. Mercury, like PCBs, is also a persistent pollutant that will remain in the river after the cleanup is completed. Accordingly, we assume OHA's fish advisory with respect to mercury will remain in place. To a person eating fish from the Site, there is no real world difference between fishing limitations based on PCBs versus mercury. Both chemicals potentially reduce the amount of fish people can consume. The continuing mercury fish advisory is guidance from a credible health agency that provides important context for sediment remediation risk management decisions and determining the most cost-effective sediment remedy.

E. EPA's Establishment of RAO 9 for Source Control Is Arbitrary and Capricious Because There is No Information in the RI or Risk Assessment to Support It

EPA's Proposed Plan includes an RAO 9 for riverbanks. EPA's reason for including this RAO is that, according to vaguely described information it received from DEQ, some contamination remains in some identified riverbank soils at levels that, if erosion were to occur, might result in recontamination of sediments.[115] EPA states in the Proposed Plan that remediation of contaminated river banks is included "if it is determined that it should be conducted in conjunction with the in-river actions." EPA's Proposed Plan provides Figure 6 and Table 5 as the full extent of its evaluation of why and where such remedial action is required. It adds that "[o]ther river banks may be included in the remedial action, if contamination contiguous with the river sediment is found during remedial design sampling."[116]

In February 2001, a Memorandum of Understanding (MOU) related to the Site was executed among EPA, Oregon DEQ, and several state, federal, and Tribal natural resource trustees. That MOU provided that EPA would be the lead agency for investigating and cleaning up contamination in the river sediment and DEQ, using state cleanup authority, was designated as the lead agency for identifying and controlling upland sources adjacent to or near the river. Pursuant to that MOU, the Portland Harbor Joint Source Control Strategy was finalized by EPA and DEQ in December 2005. Since that time, many owners and operators of facilities along the river, including several LWG members, have been actively involved with DEQ, planning and implementing source control measures. DEQ has provided EPA regular updates on its source control efforts. As of March 2016, DEQ reported it is on track to complete its determinations of the need for source control measures at all upland sites within the Portland Harbor and to have needed measures in place prior to implementation of CERCLA in-water remedies, in order to prevent likely future adverse effects on water or sediment quality.[117]

In the 2016 draft Final FS and Proposed Plan, EPA has ignored many of those fully or partially completed actions and identified groundwater and riverbank concerns. Although the FS states that information received from DEQ was the basis of these concerns, that information must not be current or complete. In some instances, the groundwater and riverbank contamination has already been addressed, and in others property owners have agreed with DEQ to implement remedies at or before the time of the adjacent in-water remedy.[118] There is no reason for EPA to now insert RAO 9 into the FS and Proposed Plan, given the ongoing, successful efforts to control upland sources.

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[114] 21 CFR §109.30.
[115] 2016 draft Final FS, page 1-17.
[116] Proposed Plan at 13.
[117] Portland Harbor Upland Source Control Summary Report (DEQ, March 25, 2016 update), at 119.
[118] For example, as of March 2016, DEQ reported that river bank remedial action at the Evraz Rivergate site had been fully implemented and that the pathway was considered controlled. *Id.* at 101. Figure 6 of the Proposed Plan, however, shows this as a river bank requiring remediation.

At no time during the LWG's development of the RI and risk assessments did EPA suggest that riverbank data should be collected sufficient to support the development and evaluation of riverbank remedial alternatives.[119] EPA's last-minute incorporation of riverbanks in the FS, when no upland media were evaluated in the approved RI or risk assessments, is counter to EPA policy and guidance. "The purpose of the remedial investigation (RI) is to collect data necessary to adequately characterize the site for the purpose of developing and evaluating remedial alternatives."[120] Here, EPA provides no data or analysis related to what riverbank-related remedial actions are to be implemented or what specific areas present unacceptable risks. EPA refers to Appendix A as the data source for its riverbank analysis. Appendix A appears to be a random compilation of various data, some of which has nothing to do with riverbanks. A review of the "matrix code" column finds most entries are blank, and many entries are data that are not from riverbank soils. The entries include tissue, water, porewater, groundwater, outfall, stormwater, and surface water. In summary, no care was used to put this database together, and much of the information appears to have little to do with delineating contaminated riverbanks. Appendix A also contains a disclaimer noting that it is taken exactly as-is from third-party sources with no quality assurance or quality control performed by EPA. Section 2.2.2 of the EPA-approved RI states that EPA Order 5360.1 and Office of Solid Waste and Emergency Response (OSWER) Directive 9355.9-01[121] requires that environmental measurements be of known quality, verifiable, and defensible. The Office of the Inspector General concluded in an audit of Region 9 Superfund sites[122] that data used for cleanup decision-making should be validated using EPA functional guidelines.[123]

Despite all of these inadequacies in the data, EPA relies on the data to identify riverbank areas for remediation and then to assess the relative effectiveness of remedial alternatives. This assessment is not grounded in adequate site specific information and therefore is arbitrary and capricious.

EPA should delete RAO 9 and all evaluations of alternatives based on riverbank contamination and rely upon DEQ to adequately address source control as it is required to do under the 2001 MOU and as it is successfully doing.

F. <u>To the Extent the Plan Intends to Prescribe In-river Actions to Address Groundwater Contamination, it is Arbitrary and Capricious Because There is No Information in the RI or Risk Assessment to Support It</u>

EPA's discussion of groundwater in the Proposed Plan is confusing. On the one hand, it appears that the Plan does not prescribe remedies for groundwater and that it is EPA's intent that the ROD will not address it either:

> "It is EPA's expectation that DEQ's upland source control actions will adequately address groundwater contamination. EPA's RAOs above are focused on containing and reducing migration of COCs from groundwater to surface water and biologically active areas of sediment. Should groundwater not be addressed adequately under DEQ's actions, EPA may, at a future time, determine if action is warranted under CERCLA to further address groundwater contamination."[124]

On the other hand, the Proposed Plan states that reactive caps "may" be required when it is predicted that " flow of groundwater or pore water will release contamination through the cap,"[125] and that

> "[i]t is EPA's expectation that the majority of the current identified groundwater plumes will be addressed by DEQ's actions and the alternatives will only need to address the portion of the plumes that extend into the river. Since the extent of these plumes impacting pore water is not currently known, these areas will

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[119] For the same reason, EPA has no basis for drawing conclusions about any potential risks to the Columbia River associated with potential transport of chemicals from the Portland Harbor Site. The Columbia River was not investigated or evaluated in any part of the RI, BLRAs, or FS.
[120] 40 CFR §300.430.
[121] *Data quality process for Superfund, Interim final*. EPA-540-G93-071. USEPA, 1993.
[122] Environmental data quality at DOD Superfund sites in Region 9.
http://www.epa.gov/oig/reports/1995/ffqar9rp.htm . Office of Inspector General, USEPA, 1995.
[123] U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA 540/R-99/00801. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, October 1999. And USEPA contract laboratory program national functional guidelines for inorganic data review. EPA 540-R-01-008. Office of Emergency and Remedial Response, USEPA, 2002.
[124] Proposed Plan at 22.
[125] Proposed Plan at 27.

> need to be refined during remedial design and at that point it will be determined which residual groundwater plumes will need to be addressed in the river."[126]

EPA goes so far in the Proposed Plan to identify a single commercial product, "AquaGate+10%PAC," to use in reactive caps where groundwater contamination is present.[127]

If EPA's intent was the former, to leave groundwater remedial actions to DEQ under its source control authority or, at the most, to address groundwater in subsequent ROD amendments, then EPA need not address the remainder of comments in this subsection. For purposes of estimating costs, it may have been reasonable for EPA to include some screening level scoping of groundwater measures to account for the cost of some groundwater-focused actions identified during remedial design as having a potential to recontaminate sediments. However, if this is all EPA intended, in the ROD EPA should: 1) remove the groundwater RAOs; and 2) remove the comparative analysis of alternatives criteria related to groundwater RAOs. Groundwater and the potential for any stranded wedges to affect caps should be considered as part of sediment remedial designs and sediment caps should be appropriately designed to address recontamination or groundwater migration issues.

However, if it is EPA's intent to issue a ROD that prescribes groundwater-focused remedial action as actually described in the Proposed Plan, that would be completely unsupported by the RI and Risk Assessments or by any analysis included in EPA's 2016 draft Final FS and Proposed Plan, and would therefore be arbitrary, capricious, and not in accordance with law, for the following reasons:

- The entire extent of the Proposed Plan's discussion of groundwater remediation consists of three isolated paragraphs, one figure, and one table.[128] As quoted above, EPA admits that it does not know the extent of any groundwater plume, because its RI and risk assessments were not intended to investigate or assess any such plumes. Proposed Plan Table 3 is a summary of contaminants of concern in "porewater and transition zone water" with no explanation of where in the site these samples are or where they present risk.

- Proposed Plan Figure 5 is described only as "multiple areas" that "DEQ has identified...with groundwater contamination," with no data or quantitative assessment. There is nothing in the Proposed Plan that provides data or analysis to support the figure, and it is inconsistent with DEQ documentation, ignoring extensive and successful groundwater source control evaluation and remedial action work by DEQ at many of these sites, including the Arkema, Evraz, Gunderson, NW Natural and Time Oil sites.[129]

- EPA does not have any basis in the Administrative Record before it to conclude as it does in Section 3.4.7.3 of the 2016 draft Final FS and page 27 and Figure 10 of the Proposed Plan (and in its discussions of the various alternatives) with respect to groundwater that reactive caps are necessary at any particular site, or type of site, or to specify a particular type of reactive cap:

  - EPA has not evaluated the risks associated with any particular site or in any way (beyond drawing Proposed Plan Figure 5) defined the technical basis for its assumed extent of groundwater "plumes";

  - Without any analysis of appropriate technologies to treat the COCs driving risk, EPA has no basis to prescribe any particular type of reactive cap;

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[126] Proposed Plan at 60.
[127] Proposed Plan at 65.
[128] Proposed Plan at 13, 27 and 60, Table 3 and Figure 5.
[129] As with the vague references to communications with DEQ regarding riverbanks, this information does not appear to be current or accurate. For example, as of March 2016, DEQ has concluded that no source control measures are needed in groundwater for the Evraz Rivergate site and that the potential for recontamination from groundwater at that site is low. *Portland Harbor Upland Source Control Summary Report* (DEQ, March 25, 2016 update), at 101. Nonetheless, Figure 5 of the Proposed Plan shows a groundwater plume encompassing the entire shoreline of the Evraz site. Similarly, with respect to the Time Oil site, the March 2016 DEQ report states that "a pump and treat system is operating to prevent [the pentachlorophenol plume's] migration to the river." *Id.* at 83. Yet EPA's FS identifies the Time Oil pentachlorophenol plume as one of the "known contaminated groundwater plumes currently or potentially discharging to the river." 2016 draft Final FS pages 1-13 – 1-14.

- EPA has, nonetheless, gone so far as to prescribe one particular commercial product for a reactive cap, AquaGate+10%PAC, apparently based on one presentation that this for-profit commercial business provided to EPA in April 2015, without any performance assessment to determine whether this reactive cap product or any other alternative reactive cap products would address particular COCs driving risk at any particular location;

- EPA has failed to address the implementability of its prescribed reactive caps. Rather than prescribe the use of AquaGate+10%PAC, EPA's ROD should simply state that the need for reactive caps will be evaluated at the design stage for any areas with "stranded" groundwater plumes and that any particular cap material and deployment mechanism will be chosen based on that assessment.

In summary, groundwater should be addressed in the ROD by stating that EPA continues to rely upon DEQ to adequately address source control, as it is required to do under the 2001 MOU and as it is successfully doing. If EPA selects any groundwater-focused "in-river actions," they should be only in those areas where the BLRAs identified known in-water risks from the residual impacts of contaminated groundwater discharge and the extent of the action should be determined in the sediment remedial design. EPA should not prescribe sediment remedies that ignore completed or committed upland source control measures.

II. EPA's Principal Threat Waste Approach Leads to Arbitrary and Capricious Remedial Technology Selections, Inconsistent with both EPA Guidance and Practice as to the Appropriate Consideration of Principal Threat Waste

EPA's Proposed Plan addresses three categories of principal threat waste (PTW), which it describes as "PTW source material," "PTW that cannot be reliably contained," and "highly toxic PTW."[130]

EPA's Proposed Plan incorporates an unprecedented approach in its consideration of PTW that leads to prescriptive remedial technology assignments that are inconsistent with EPA guidance and practice. Perhaps more importantly, EPA's PTW approach is unnecessary to making Portland Harbor remedial technology assignments, because it duplicates other proper risk-based alternatives evaluation considerations already taken into account. In particular, EPA's designation of PTW leads to two aspects of its proposed remedial alternative that should be eliminated as unnecessary:

1. Designation of a set of RALs based on PTW (Table 13 of the Proposed Plan)

2. Prescriptive technology assignments based on the PTW designation (Figures 10a, 10b, and 10c of the Proposed Plan)

Between these two results, EPA adds very material costs to its remedy. For example, EPA requires activated carbon or aquablock/organoclay amendment in caps and residual covers in all areas where PTW (as defined by EPA) exists, even if the PTW is removed by dredging. This assumption adds approximately $52 million to the remedy cost. Additionally, EPA has specific ex situ treatment and disposal requirements for certain PTW that would increase disposal costs by as much as $43 million. Both of these are required by EPA without any evaluation of implementability or effectiveness, let alone cost-effectiveness.

A. <u>EPA's Application of PTW Concepts is Inconsistent with Guidance and Practice</u>

EPA has designated large geographic areas as PTW based on its evaluation of the "high toxicity" criterion as compared to the human health fish consumption PRGs.[131] Its designations are inconsistent with its risk assessment and inconsistent with EPA guidance.

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[130] Proposed Plan, p. 14.
[131] Proposed Plan, p. 14.

First, EPA does not accurately assess the presence of greater than 10^{-3} cancer risk at the Site consistent with risk assessments or the intent of EPA guidance.[132] For total PCBs, dioxin/furan TEQ and total 2,4′ and 4,4′-DDD, -DDE, -DDT (DDx), EPA simply multiplied certain 10^{-6} cancer risk PRGs by 1,000 based on human health fish consumption (high consumption rate, mixed diet, fillet only) to determine concentrations associated with 10^{-3} cancer risk. For BaPEq, EPA followed the same procedure using a sediment direct contact PRG for high frequency fisher.

However, before applying such concentrations for PTW identification, even assuming this is an appropriate pathway to evaluate in this context, the presence of actual risks greater than 10^{-3} needs to be determined. In fact, greater than 10^{-3} risk was not found in the BHHRA for dioxin/furan TEQ, total DDx, or BaPEq for any scenario evaluated. Therefore, the definition of highly toxic as described in EPA PTW guidance[133] is only potentially applicable to total PCBs.

That leads to the question of what pathways are relevant for purposes of defining principal threats. For total PCBs, greater than 10^{-3} cancer risk was found in the BHHRA for three fish consumption scenarios: subsistence (mixed diet, fillet), recreational (mixed diet, fillet), and tribal (whole body and fillet). The PTW guidance states:

> "'Source material" is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, to surface water, to air, or acts as a source for <u>direct exposure</u>." [emphasis added].

The fish consumption risks do not represent direct exposures from source materials, but rather integrate contaminant contributions from sediment, surface water, and diet. As a consequence, the sediments by themselves do not directly pose risks greater than 10^{-3}. In addition, contaminants in fish do not represent a reservoir for migration of contamination to other media in any reasonable sense.

Applying the PTW guidance, only contaminants that were actually found to pose greater than 10^{-3} cancer risk in media that potentially represent a source to other media or of direct exposure should be evaluated for the highly toxic aspect of the PTW definition, and only in those areas where that level of risk was found to occur in the BLRAs. No contaminants meet these conditions at the Site. EPA's definition of PTW in this case is particularly inappropriate given 2012 fish tissue data[134] that show PCB concentrations in fish tissue have declined significantly. If these 2012 concentrations are applied to risk estimates using methods consistent with the BHHRA (using the 95% UCL for the site-wide subsistence consumption scenario, fillet tissue), the resulting human health cancer risk for consumption of smallmouth bass is 4×10^{-4}, substantially lower than 10^{-3}. And the end result of EPA defining PTW by these methods is that EPA has designated material containing PCBs at 200 ppb as PTW; a concentration which is 100 ppb <u>below</u> the sediment cleanup objective of 300 ppb applied in the Hylebos Waterway of Commencement Bay. Thus, EPA is adding nearly $100 million to remedial action costs based on its consideration of a risk level that likely no longer exists and concentrations that are below final cleanup levels established at other Region 10 sites.

Regardless of concentration, EPA should not identify materials that can be reliably contained as principal threat waste. EPA's 2016 draft Final FS states, "'[r]eliably contained' was not used in identifying PTW but rather was used to determine what concentrations of PTW could be reliably contained."[135] This clearly contradicts the guidance, which discusses reliably contained as part of PTW identification.[136]

> "Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. *** No 'threshold level' of toxicity/risk has been established to

[132] *A Guide to Principal Threat and Low Level Wastes*. Office of Solid Waste and Emergency Response. Superfund Publication 9380.03-06FS. November 1991.
[133] *Id.*
[134] "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis." A presentation file from Anchor QEA provided to EPA on March 18, 2013. (Attachment 1)
[135] 2016 draft Final FS, page 3-3.
[136] NCP Preamble, 55 Fed. Reg. 8666 at 8703 (March 8, 1990); A Guide to Principal Threat and Low Level Wastes, OSWER Superfund Publication 9380.03-06FS (November 1991).

> equate to 'principal threat.' However, where toxicity and mobility of source material combine to pose a potential risk of 10-3 or greater, generally treatment alternatives should be evaluated. *** Determinations as to whether a source material is a principal or low level threat waste should be based on inherent toxicity as well as consideration of *** the potential mobility of the wastes in the particular environmental setting ***."[137]

The guidance is clear that PTW only exists where the factors of highly toxic or highly mobile *combine* with a condition of not reliably containable. EPA acknowledges (in 2016 draft Final FS Table 3.2-2) that all COCs at the concentrations present in the Site, with just two exceptions (chlorobenzene and naphthalene), *can* be reliably contained.[138] Thus, none of the areas where these contaminants are absent should be designated as PTW. Accordingly, if all PCB, PAH (except naphthalene), and DDx concentrations present at the Site can be reliably contained, then EPA is not required to address them as a PTW. And naphthalene concentrations detected in the RI were not found in the BHHRA to pose a greater than 10^{-3} risk for any media or scenario evaluated and therefore do not constitute PTW.

Similarly, the 2016 draft Final FS and the Proposed Plan provide no discussion or explanation of how material with sediment concentrations above the EPA-identified highly toxic thresholds or the presence of "globules or blebs"[139] of non-aqueous phase liquid (NAPL) pose a risk of migration without any knowledge as to what the globules or blebs consisted of or whether such substances are naturally occurring.[140] EPA's interpretation of any trace evidence of NAPL as PTW is devoid of scientific justification and is inconsistent with situations described in the guidance, such as "pools of NAPLs submerged beneath ground water or in fractured bedrock, NAPLs floating on ground water" or where physical processes are likely to mobilize "source materials" as defined in the guidance.[141] EPA had the responsibility and opportunity to require scientific investigation of globules and blebs as part of the RI or as a supplemental RI. Except at the Gasco Sediment Site (where extensive investigations have defined areas of "substantial product" consistent with the consent order for that site), EPA chose not to do so and to rely entirely on unsupported speculation for its decision making instead. The 2016 draft Final FS interpretation is also inconsistent with the final remedy selected by EPA at the McCormick and Baxter site within Portland Harbor, where sediments containing NAPL were reliably contained using conventional and active capping technologies.[142]

Finally, the 2016 draft Final FS and Proposed Plan state that "All PTW treated ex-situ is assumed to be disposed at a RCRA Subtitle C facility." This assumption is inconsistent with the detailed waste disposal decision and treatment framework identified in the Gasco Sediment Site Statement of Work and FS dataset.[143] A total of 22 toxicity characteristic leaching procedure (TCLP) samples were collected as part of the FS and Gasco Sediments Site investigations to support waste disposal determinations (i.e., Subtitle C versus Subtitle D) and only three samples exhibited concentrations exceeding the TCLP Allowable Limits, all for benzene. Bench-scale testing showed that addition of a minimum 5% Portland cement reduced the benzene concentrations below the TCLP Allowable Limits. Both the 2016 draft Final FS and Proposed Plan assume all PTW is treated ex situ (e.g., with Portland cement);

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[137] Id. at 2.
[138] The LWG disagrees this determination is correct. The LWG 2012 draft FS conducted the same analysis (Appendix Hc) using more appropriate technical procedures and determine that all materials and chemicals at the Site are reliably containable through readily available sediment capping technologies. Importantly, these exceptions were based on preliminary cap modeling that used "representative site conditions" for model input parameters. These "representative" model input parameters do not exist at all sites. For example, they have been demonstrated not to exist at the Gasco site based on site-specific data collection performed under oversight by DEQ and in coordination with EPA. Consistent with the Proposed Plan text, it will be important to perform site-specific cap modeling evaluations during remedial design to determine cap protectiveness. Proposed Plan p. 15.
[139] Draft Final FS, page 3-3.
[140] We also note that EPA's PTW-NRC footprint is mapped inconsistently between the FS and Proposed Plan. EPA provided a later clarification (July 20, 2016 email from Kristine Koch) that one map represents "subsurface NRC" and the other "surface NRC," but the FS and Proposed Plan do not ever use these terms, and it is entirely unclear how these different types of NRC are relevant to EPA's PTW evaluations, if at all.
[141] *A Guide to Principal Threat and Low Level Wastes*, OSWER Superfund Publication 9380.03-06FS (November 1991)
[142] *Third Five-Year Review Report for McCormick & Baxter Creosoting Company Superfund Site*. (Oregon Department of Environmental Quality and U.S. Environmental Protection Agency. September 26, 2011).
[143] Administrative Settlement Agreement and Order on Consent for Removal Action for the Gasco Sediment Site, U.S. EPA Region 10 CERCLA Docket Number 10-2009-0255 (September 9, 2009).

therefore, the Proposed Plan should assume that all ex situ treated PTW material may be disposed of at a Subtitle D facility. Otherwise, the need for treatment of sediments destined for an upland landfill should be based on acceptance criteria of that facility.

B. EPA's Designation of PTW is Unnecessary and Legally Inappropriate Given the Balanced Evaluation of the NCP Evaluation Criteria that is Required

Moreover, even if EPA concludes that any areas of the Site contain PTW, which we believe would be inconsistent with guidance, that does not justify EPA's creation of a distinct PTW RAL set or prescriptive technology assignments based on the presumed presence of PTW. According to EPA's PTW guidance, "the principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification requirement."[144] The NCP itself notes that even duly designated PTW is appropriately contained, rather than removed or treated, when it "poses a relatively low long-term threat or where treatment is impracticable."[145] EPA's Sediment Guidance confirms that this is most often the appropriate, practicable approach at sediment sites: "Based on available technology, treatment is not considered practicable at most sediment sites," and "[i]t should be recognized that in-site containment can also be effective for principal threat wastes, where that approach represents the best balance of the NCP nine remedy selection criteria."[146]

EPA's alternatives evaluation for Portland Harbor demonstrates that virtually all material at the Site can be reliably contained, and where EPA's analysis indicates it may not be contained, the material does not represent a direct 10^{-3} or greater cancer risk. Accordingly, EPA should eliminate the designation of any PTW areas. This outcome would be consistent with EPA's treatment of the same issue at the Lower Duwamish Waterway Superfund site and other similar sediment cleanup sites.[147]

III. EPA's Conceptual Site Model is Inadequate

The purpose of a CSM in environmental remediation is to aid site managers in understanding and directly accounting for contaminant sources, environmental fate and transport processes, and exposure pathways and receptors. "For sediment sites, perhaps even more so than for other types of sites, the CSM can be an important element for evaluating risk and risk reduction approaches…A good CSM can be a valuable tool in evaluating the potential effectiveness of remedial alternatives... [t]he CSM should capture in one place the pathways remedial actions are designed to interdict to reduce exposure of human and ecological receptors to contaminants."[148] "Because of the inherent complexity of these projects, site characteristics (such as source areas, transport mechanisms, background and upstream areas, and key site features) should be clearly identified in a CSM before evaluating and selecting remedial alternatives."[149] Therefore, to be an effective tool in decision-making, a CSM must provide the framework for establishing testable hypotheses related to the behavior of the system and how it will react to any given alternative.

The CSM should be developed iteratively, as more data and site information become available (for example, during the course of the RI).[150] The CSM should reflect the best and most recent understanding of site conditions and dynamics. A more dynamic site will require a more elaborate and detailed CSM. The Lower Willamette River is a highly complex and dynamic system, and the CSM must account for this complexity.

Given the complex and dynamic nature of the Site and the clear need for a robust CSM as recommended by EPA's Sediment Guidance, EPA's reduction of 15 years of data collection and evaluation to two sentences and a one-page

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[144] *Id.* at 2.
[145] 40 CFR §300.430(a) (1) (iii) (B).
[146] Sediment Guidance at p 7-4.
[147] See, *LWG Response to EPA's Principal Threat Waste Approach* (August 7, 2014).
[148] Sediment Guidance, p. 2-7.
[149] ITRC, p. 6.
[150] "As a site CSM is refined, professional judgment must be used to determine the additional data needed for remedy selection." ITRC, p. 4.

sketch[151] is inexplicable by any scientific or technical measure. EPA's sketch compares poorly to the description in guidance of a CSM. "Project managers may find it useful to develop several CSMs that highlight different aspects of the site. At complex sediment sites, often three CSMs are developed: 1) sources, release and media, 2) human health, and 3) ecological receptors. For sites with more than one contaminant that are driving the risks, especially if they behave differently in the environment (e.g., PCBs vs. metals), it is often useful to develop a separate CSM for different contaminants or groups of contaminants."[152] "The first step in the remedial evaluation framework is to review the CSM to understand the relationship between sources, migration pathways, and receptors and to understand the physical conditions and contaminant properties governing exposure and risk at the site. Information presented in the CSM should support identification of the site-specific characteristics needed in the evaluation of remedial technologies."[153]

EPA's CSM sketches some of the site receptors and processes as though the Site exists in a permanent condition of uniformity and steady state, despite the Willamette River being a very dynamic system. EPA errs by considering site processes through the lens of a closed system in which outside sources and forces are largely irrelevant, thereby defeating the very purpose of a CSM.[154] At best, EPA's Portland Harbor CSM is a static snap shot of the Site that offers no explanation of the complex behaviors of the Site. Site-specific hypotheses cannot be deduced from a sketch. The sketch does not allow its users to coherently understand the effects of changes in surface chemistry of the sediments, surface water quality, or tissue concentrations over time. It also cannot adequately address the effects of source control over time, the effects of human activity, or the relative benefits associated with different remedial alternatives.

To formulate and implement effective remedial alternatives at Superfund sites, site-specific conditions must be well characterized and incorporated into a CSM demonstrating that observed conditions can be accurately extrapolated to the system as it may vary physically, biologically, and temporally. NRC guidance appropriately states the importance of conducting risk management decisions "on a site-specific basis…incorporat[ing] all available scientific information" because "[w]ithout a valid conceptual model of the site, it is not possible to define how a management option can successfully meet the risk-reduction goals and objectives."[155] At contaminated sediment sites in particular, "the development of an accurate conceptual site model, which identifies contaminant sources, transport mechanisms, exposure pathways, and receptors at various levels of the food chain" is "especially important...because the interrelationship of soil, surface and groundwater, sediment, and ecological and human receptors is often complex."[156] EPA's Technical *Resource Document on Monitored Natural Recovery* explains that an evaluation of the feasibility of monitored natural recovery (MNR) (and presumably other proposed remedial alternatives) "is best achieved through the development of a CSM that adequately captures the physical, chemical, and biological processes that control contaminant fate, transport, and bioavailability."[157]

Neither the RI nor EPA's FS contains a coherent, complete and accurate CSM that identifies and addresses site-specific context and conditions in sufficient detail to adequately describe the dynamic complexity present at the Site. The result is an inability to rationally develop and evaluate resource intensive and technically challenging remediation alternatives at the Site.

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[151] 2016 draft Final FS p. 1-21, "The CSM integrates the information gathered to date and provides a coherent hypothesis of the contaminant fate and transport at the Site. Figure 1.2-26 provides a simplified visual summary of this hypothesis, including the complete human and ecological exposure pathways."
[152] Sediment Guidance, p. 2-7.
[153] ITRC, p. 19.
[154] "The CSM and site geomorphology help determine the degree of site characterization required to properly evaluate remedial technologies. Understanding the relationship between contaminant sources, transport mechanisms, exposure media, and factors that control contaminant distribution and potential exposure is critical to developing a focused site characterization approach. For example, sediment transport is often controlled by infrequent, high energy events. " ITRC, p. 21.
[155] *A Risk-Management Strategy for PCB-Contaminated Sediments*. (Committee on Remediation of PCB-Contaminated Sediments, Board on Environmental Studies and Toxicology, Division on Life and Earth Studies, National Research Council, May 2001).
[156] Sediment Guidance, p. ii.
[157] *Resource Document on Monitored Natural Recovery* (EPA 2014), Section 1.3.2, p. 6.

A. Errors that Result from the Use of EPA's CSM

There are numerous examples of important dynamic processes that have been overlooked or poorly evaluated in the development of EPA's CSM. Appropriate evaluation of these processes is critical to understanding source dynamics; rate and extent of physical, chemical, and biological transformations; exposure; and how the system will react to any given remedial alternative.

1. Non-steady State Conditions and Aggregation of Data

Due to EPA's nearly non-existent CSM, for many analyses EPA inappropriately aggregates extensive data collected over the course of a decade, which erroneously portrays a highly dynamic system as unchanging and uniform.

There were multiple rounds of data collected at the Site during sampling events over an approximately 10-year period of time, and some data included in the RI/FS database predate this period by another 5 years (back to 1997). It is potentially appropriate for some RI/FS purposes to aggregate these data and plot them on maps and figures, such as portraying the general nature and extent of contamination in relative terms (i.e., to discern relatively high and low concentration areas). However, such simple aggregation is fatally flawed for any evaluations where an appropriately developed CSM would indicate dynamic changes over time (e.g., evaluating potential natural recovery or long-term outcomes of remedial alternatives).

An appropriate CSM would emphasize that Site river sediments have dynamic characteristics and parameters including chemical concentrations that likely increase or decrease over time. By continually aggregating synoptic data without regard to sampling year, any sense of time dependent variation present in these data was lost in EPA's evaluations. There are numerous examples of 2016 draft Final FS statements and conclusions that are incorrect or misleading due to the insufficient CSM that fails to recognize dynamic and changing site conditions. A few examples include:

- Groundwater and riverbank source descriptions (e.g., FS pp. 1-13 through 1-19) and plume maps do not consider source controls implemented at many upland sites in the last five years or so.

- For unexplained reasons, EPA uses only the 2007 and 2012 fish tissue data (and ignores the 2002 tissue data) in its very limited evaluation of tissue contaminant trends (FS pp. 3-34), which essentially halves the available time period that can be evaluated. EPA's discussion is heavily focused on finding any potential evidence of a "zero" trend, which is a bias caused by EPA's simplistic and static CSM.[158]

- EPA's effectiveness evaluations focus almost exclusively on SWACs immediately post-construction (p.3-65, 4-6, 4-10 and elsewhere), and no quantitative estimates of long-term alternative outcomes are included. As described elsewhere in this document,[159] EPA could have easily devised empirically based estimates of long-term outcomes of the alternatives without resorting to complex computer models.

- EPA states that "Sediment trend data do not exist for this Site; insufficient biota and water trend data exist…" (p. 4-4).[160] If EPA had adopted the CSM formulated early in the RI/FS process, any trend data deficiencies now perceived by EPA would have been addressed. In fact, the LWG provided such

[158] EPA provides no details in the 2016 FS of its fish tissue statistical analysis, but a memorandum titled "MNR Evaluation – Fish Contaminant Concentrations," May 2016 is within EPA's Administrative Record for the Site. The LWG found EPA's statistical analysis to be flawed in several respects including that EPA's statistical model lacks power for detecting declines in fish tissue concentrations, is overly simplistic for the task, confounds the analysis by normalizing by non-correlated lipid contents, and ignores 2002 data for poorly explained reasons. See LWG memorandum, *Comments on EPA MNR Evaluation Using Fish Contaminant Concentrations*, (September 6, 2016) (Attachment 18) EPA's results disagree with the LWG's findings as previously provided to EPA in "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis," a presentation file from Anchor QEA provided to EPA on March 18, 2013 (Attachment 1).
[159] See Section V.C.
[160] Note that the LWG disagrees with this statement, and the LWG 2012 draft FS Section 6.2 provides a good example of using the available data to understand Site trends to the maximum extent practicable. The LWG's conclusion, which was later verified by the 2012 smallmouth bass tissue data, was that Site concentrations are declining measurably in just the last 10 years.

> supporting information as far back as the Programmatic Work Plan stage, and when the LWG requested collecting time series surface sediment data to fill part of this data gap, EPA rejected that request.[161]

Probably the least defensible use of the static Site bias portrayed by EPA's insufficient CSM appears a little later on page 4-4 of the 2016 draft Final FS.

> "EPA has concluded that the HST model predictions are inconsistent with the CSM for this Site, as it shows significant concentration reductions occurring within the first 10 years for the No-Action alternative. However, given that the majority of the contamination was released into the river 30-80 years ago and similar reductions have not been observed, the model results appear inconsistent with the empirical data collected during the RI."

We are unaware of chemistry data from 30 to 80 years ago that EPA has compared to data collected during the RI/FS to reach this "empirical" conclusion, and no such data appears in the Administrative Record for the Proposed Plan. However, a significant amount of information collected during the RI demonstrates that river conditions have changed over time. For example, EPA's RI found that, "Concentrations of total PCBs, DDx, total PAHs, hexachlorobenzene, total chlordanes, aldrin and dieldrin, gamma-HCH, lead, and TBT are higher in subsurface than in surface sediments, indicating that historical inputs were likely greater than current inputs."[162]

The dynamics of sediment surface chemistry also have a direct effect on the calculation of RALs and evaluations of natural recovery. When sediment surface chemistry is dynamic over time, the RAL will also vary depending on the time and rate of natural recovery estimated, because RALs define the dividing line between areas that will be actively remediated versus areas that will undergo natural recovery. In turn, these time-dependent RALs and their linkage to natural recovery estimates are one of the key characteristics of the selected remedy (i.e., they define where active remediation will take place).

Yet, EPA devotes about three pages of its FS (starting at p. 3-32) to a discussion of the processes affecting RAL selection and natural recovery. As described in guidance, "Using MNR as a remedy at a contaminated sediment site requires a thorough understanding of the sources, exposure pathways, and receptors in the CSM. Site managers must be able to predict, with some degree of certainty, that contaminant concentrations will decline or be effectively addressed within a specific time frame." Guidance also states that natural recovery evaluations at contaminated sediment sites should be based on multiple lines of evidence.[163] Many of these lines of evidence were collected as part of the Portland Harbor RI/FS process and provide a strong empirical basis for the occurrence of natural recovery in Portland Harbor. Section 6.2.2 of the LWG 2012 Draft FS provides a detailed evaluation of each of these lines of evidence, which were summarized in past LWG FS comments.[164] These important lines of evidence include:

- Sources are being progressively controlled. DEQ's latest source control report indicates DEQ has completed source control evaluations and implemented (or will implement) controls on one or more potential pathways at approximately 149 of 171 sites examined in detail to date.[165]

- The aggregate information from five multi-beam surveys indicates widespread deposition of sediments across many areas of the Site. Although EPA's FS emphasizes the uncertainties of these data, for reasons

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[161] Letter from EPA to LWG dated January 2, 2008, regarding "Portland Harbor Superfund Site; Administrative Order on Consent for Remedial Investigation and Feasibility Study; Docket No. CERCLA-10-2001-0240. Round 3B Comprehensive Sediment and Bioassay Field Sampling Plan – Addendum 1: Fate and Transport Modeling – Estimation of Temporal Chemistry Changes in Surface Sediments."
[162] RI, page 10-4.
[163] Sediment Guidance; Magar et al. 2009 (Magar, V., D. Chadwick, T. Bridges, P. Fuchsman, J. Conder, T. Dekker, J. Stevens, K. Gustavson, and M. Mills. 2009. Technical Guide: Monitored Natural Recovery at Contaminated Sediment Sites. Environmental Security Technology Certification Program (ESTCP), Project ER-0622.); ITRC 2014.
[164] Letter to EPA, September 8, 2015, Re: List of significant comments on EPA Feasibility Study Section 3 and 4 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240).
[165] Portland Harbor Upland Source Control Summary Report (DEQ, March 25, 2016 update), at 108.

detailed in past comments, the LWG disagrees that these data present substantial uncertainties about deposition.

- Sediment trap and suspended sediment data clearly show that incoming settling sediment has substantially lower contaminant concentrations than most of the site bedded sediment, which will drive bedded sediment concentrations lower over time.

- Radio-isotope coring data, although limited, indicates deposition rates consistent with other measures such as the bathymetry time series.

- Site surface sediment grain sizes are fine-grained across the majority of the Site, strongly indicating a long-term depositional environment exists in these areas.

- Surface to subsurface sediment concentration ratios in most areas of the Site indicate newer surface strata contain lower concentrations than older subsurface strata, which illustrates that surface sediment concentrations are decreasing over time.

- Surface sediment concentrations measured over time (i.e., time series) indicate surface sediments have decreasing contaminant concentrations. The 2012 Draft FS data are somewhat limited, but new PCB data collected in 2014 by other parties provide additional useful information and suggest that PCB sediment concentrations are continuing to decline.[166]

- Smallmouth bass PCB tissue measurements made in 2002, 2007, and 2012 indicate statistically significant declines in tissue concentrations across almost all areas of the Site.[167] Despite uncertainties expressed in EPA's FS, differences in sampling and compositing schemes across the years can be controlled to determine statistically valid results.

- Comparisons of sediment profile images collected in 2001 (by the LWG) and 2013 (by other parties)[168] indicate that much of the Site now has well established Stage 3 benthic communities indicating stable and recovering substrates.

- Simple modeling (such as EPA's SEDCAM modeling, which was never included in EPA's FS) and complex modeling (such as the 2012 Draft FS QEA FATE model and coupled dynamic Food Web Model) all generally indicate recovery of surface sediments over a reasonable timeframe toward a relatively consistent range of potential equilibrium levels.

One of the most important rules of environmental data analysis is the evaluation of time series data to establish the dynamics of site processes (e.g., the rate and extent of changes in physical, chemical, and biological systems). EPA failed to conduct this evaluation, and the assumption of a steady state and uniform Site was mistakenly accepted as valid for the vast majority of the EPA's FS analyses.

2. Role of Surface Water Chemistry and Variation

EPA's CSM fails to consider the non-steady state dynamics of PCBs and DDx in surface water. This causes EPA to ignore the likely effects of water quality on fish tissue concentrations for hydrophobic COCs. Using DDx as an example, the RI demonstrates that variation in Site sediment concentrations explains about 33% of the variation of DDx in resident fish tissue.[169] Obviously, there are other factors that control the remaining 67% of the observed

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[166] *Sediment sampling data report, Portland Harbor, Portland, Oregon*, prepared for de maximis Inc., (Kleinfelder, May 11, 2015) (Attachment 2).
[167] "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis." A presentation file from Anchor QEA provided to EPA on March 18, 2013. (Attachment 1)
[168] *Characterization of the Lower Willamette River with sediment profile imaging Changes in space & time,* prepared for de maximis, Inc. (Germano & Associates, Inc. June 2014.). (Attachment 19)
[169] Integral 2016 *Review of EPA's Food Web Model* C167-1504. Prepared for Legacy Site Services LLC, Exton, PA. Integral Consulting Inc., Portland, OR. August 30, 2016. (Attachment 20)

variation, which are not addressed by EPA's sketch CSM. This error leads to the unsupportable premise that sediment remediation alone can result in acceptable levels of DDx in tissue, a premise that ignores eight rounds of surface water data that demonstrate significantly higher concentrations of DDx are entering the Site during times of high winter flow than are present during the summer or fall. A similar relationship exists for PCBs. Further, none of the surface water samples for DDx or PCBs taken during either high or low flow conditions entering the Site from upstream obtained during the RI were below EPA's New/Updated CWA 304(a) Human Health Criteria and Oregon's water quality standards. These errors could have been avoided had EPA followed standard practice that "… all sediment sites should include the development of a CSM that identifies watershed inputs and characterizes background conditions."[170]

The CSM also fails to account for the endogenous risk (or risk arising from factors outside the domain of the CSM), including the contribution of upstream chemical inputs to surface water PRG exceedances and ongoing human health fish consumption risks. For example, as discussed in Section I.D and Table 4, the current OHA mercury fish consumption advisory for vulnerable populations on the Lower Willamette River allows only 12 resident fish meals/year. Because this advisory is due to mercury sources upstream of the Site, the advisory is expected to continue after any Portland Harbor sediment remediation is implemented. EPA's FS focuses on (flawed) post-construction risk estimates for the child fish consumption scenario (a vulnerable population). EPA estimates that under the most aggressive alternative (Alternative G), a child will be able to consume 10 fish meals/year, while Alternative B allows 2.4 meals/year. Thus, none of EPA's alternatives result in actual increase in the amount of fish people can consume above the current OHA fish consumption advisory. Similarly, the difference between the smallest and largest alternatives is just a few fish meals per year. Consequently, any perceived benefit to allowable fish consumption from the more aggressive alternatives does not actually exist.

In fact, even if every grain of sediment was removed from the Site and replaced with the cleanest sand available, resident fish tissue would still be adversely impacted by mercury, PCBs, and other contaminants from upstream sources. Contrary to guidance, the CSM sketch fails to address this key relationship between upstream water quality and marginal risk reductions and, as a consequence, the utility of the alternatives.

3. Importance of Non-steady State Chemical Processes

Some of the COCs associated with site sediments are chlorinated organic compounds (e.g., PCBs, DDx, and dioxin/furans). Current scientific literature demonstrates chlorinated compounds can undergo biotic and abiotic changes when present in sediments, surface water, and groundwater. Such processes include aerobic and anaerobic reactions (i.e., in the presence and absence of oxygen). Potentially important biogeochemical recovery pathways observed at other sites are not identified or operationalized in the CSM sketch or discussed elsewhere in EPA's FS. "At a minimum, the CSM should address the following: source(s), nature and extent of contamination, sediment transport pathways and mechanisms, sediment deposition rate; exposure pathways associated with chemical contamination, and the potential for in situ degradation...."[171] Section 2.6 of the LWG 2012 FS provides a good example of such a CSM.

a. Role of Spatial Complexity

Data obtained during the RI demonstrate the Site is complex and varies substantially over space for many parameters relevant to sediment remediation (sediment concentrations, grain size, organic carbon content, deposition rates, erosive forces, varying sources, water movements and currents, etc.). Given there is no CSM that discusses this complexity, particularly with regards to spatial variations in sediment grain size and organic carbon content, EPA erred when it calculated background concentrations for the Site. This error was the subject of a formal dispute by the LWG,[172] where LWG requested retaining the previously calculated RI background values for multiple

[170] ITRC, p. 59.
[171] ITRC, p. 69. [emphasis added]
[172] Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7 of the Remedial Investigation; Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240. The LWG requested that, "the full data set with consideration of organic carbon correction be retained as the selected set of background values and applied in the FS. These values are shown in the "all data" columns of Table 7.3-1b (and the related Appendix H Table H-2b) of the RI Section 7 revision agreed to by EPA and the LWG on December 12, 2013."

chemicals including a value of 16 ppb for PCBs. In addition, the LWG submitted a technical memorandum regarding equilibrium conditions,[173] which represent the lowest likely achievable sediment concentrations at the Site due to ongoing upstream inputs of COCs. This memorandum concludes that the appropriate site-wide equilibrium value for PCBs is 20 ppb. Both these documents address issues of sediment spatial variations, particularly for organic carbon content.

EPA rejected the LWG's position that EPA used background data outlier identification methods that are only appropriate for parameters whose latent distribution is normal. Because river sediment grain size and organic carbon content are highly varied over space due to natural processes and concentrations of organic compounds in sediments co-vary with grain size and carbon content, the concentration of compounds (including PCBs and DDx) cannot be normally distributed at the sampling spatial scales associated with the upstream (reference area) data. Thus, EPA's application of outlier methods associated with assumed normal distributions combined with inappropriate data censoring led EPA to artificially low background values (e.g., 9 ppb for PCBs) that are not likely achievable by any sediment remedy. Both an appropriate background analysis and incorporation of equilibrium concepts indicate that EPA should be using a background value more in the 20 ppb range for PCBs. EPA's error could have been avoided had the CSM properly addressed spatial complexity of sediment and other parameters both at the Site and upstream of the Site.

4. Effect of Inadequate CSM on Alternatives Selection

The absence of a coherent and complete CSM results in the selection of the wrong alternative. EPA assumes that time zero (immediate post-construction) SWACs are a good measure of risk reduction for all alternatives measured against arbitrary interim targets, which ignores any reasonable CSM conclusions regarding the dynamic nature (and overall declining concentrations of chemicals) of the system. Thus, EPA assumes that the Preferred Alternative will achieve faster and more cost-effective risk reduction, when in fact smaller, less resource-intensive alternatives will achieve similar risk reduction in a similar time period (and at much lower cost), if the dynamic nature of MNR (both during remedy construction and after) is properly taken into account. See Section V.C of this document for a more detailed discussion on the appropriate alternative selection taking into account expected system changes over the long term.

IV. EPA's Alternatives Evaluation is Incomplete, Misleading, and Almost Entirely Qualitative

An appropriate alternatives evaluation must fairly and carefully weigh the costs[174] against the benefits[175] of the alternatives both individually and relative to one another. "The evaluation should consider both positive effects, such as long-term effectiveness as measured through risk reduction, and negative effects, such as the adverse effects associated with implementation."[176] This evaluation should also demonstrate how the alternatives' dollar costs are proportional to their effectiveness (benefit) in reducing risk. The NCP states, "Each remedial action selected shall be cost-effective, provided that it first satisfies the threshold criteria set forth in § 300.430(f)(1)(ii)(A) and (B)…A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." The evaluation should also fully and transparently assess each of the FS criterion contained in the NCP (40 CFR Section 300.430(e)(9)). Unfortunately, EPA's alternatives evaluation has almost no comparison of the overall costs and benefits of the alternatives and fails to fully evaluate many of the FS criterion. Further, where costs (including impacts) or benefits (effectiveness) are discussed independent of each other, EPA:

- Develops alternatives that prescribe technology assignments, which precludes any meaningful comparison of the effectiveness of different technologies.

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[173] *Sediment Equilibrium Estimates for the Revised Feasibility Study*, an LWG Technical Memorandum submitted to EPA on August 7, 2014.
[174] Including the wider sense of the term "costs" such as environmental and community negative impacts due to remedy implementation.
[175] Per the NCP, benefits are measured through effectiveness criteria: "Cost-effectiveness is determined by evaluating the following three of the five balancing criteria noted in § 300.430(f) (1)(i)(B) to determine overall effectiveness: long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness.
[176] ITRC p. 52.

- Fails to evaluate alternatives consistent with any coherent CSM (as already discussed in Section III).
- Presents flawed post-construction risk estimates to support effectiveness and protectiveness determinations.
- Presents no quantitative or detailed short-term effectiveness evaluation.
- Presents no quantitative or detailed long-term effectiveness evaluation.
- Ignores valuable recent data that would aid in long-term effectiveness evaluations.
- Systematically underestimates the costs and durations of the alternatives.
- Fails to fully consider many implementability challenges.

The result is a defective alternatives evaluation that leads to the ultimate error: selecting the wrong remedial alternative.[177]

A. EPA's Prescriptive Technology Assignments Preclude Meaningful Comparison of the Effectiveness of Different Technologies

EPA's 2016 draft Final FS and Proposed Plan continue to prescriptively assign technologies on the basis of a generic scoring matrix and decision trees without consideration of site-specific factors. EPA's approach prevents meaningful comparison of the performance of various technologies in the FS, because all alternatives employ the same technologies in the same geographic areas.[178] And because the technology assignment is based on FS-level information and screening evaluations, the prescriptive set of evaluation criteria will not appropriately or accurately predict the most appropriate technology assignments or configurations for remedial design based on design-level engineering evaluations and data available at the time of design, including data collected post-ROD. For example, the FS assignments are based on overall general assumptions regarding slopes, presumed erosion and deposition zones, and required depths of removal to reach protective levels. However, real designs implemented throughout the country at other sites (and within Portland Harbor to date) have varied, often substantially, from the FS-assumed criteria and are known to be effective. With respect to riverbank contamination and presumed groundwater contamination, the FS technology assignments are based solely on those general broad designations, without consideration of which COCs are present and conditions of exposure.[179]

EPA's selected remedy should build in the flexibility needed to evaluate the likely performance of technologies against RAOs in the context of the complexities of each particular SDU and within SDUs. EPA should clearly explain the conditions under which changes to major alternative elements (e.g., changes in technologies assignments, methods to address PTW, methods for determining treatment and disposal requirements, and requirements for rigid containment) might be considered or allowed based upon site-specific engineering evaluations and newly developed information.[180]

Attachment 21 provides a decision framework EPA could include in the ROD to specify how technology assignments would be finalized or refined on a site-specific basis. Subject to some general rules (i.e. dredging will typically be required for active remediation in the navigation channel or future maintenance dredge areas and capping will typically be required around permanent structures), dredging or capping at a specific location would be

[177] Table 15 of the Proposed Plan summarizes EPA's comparison evaluation of alternatives.
[178] 2016 draft Final FS, p. ES-17: "Alternative A is a No Action Alternative, Alternatives B through I that apply the same suite of remedial technologies and process options to varying degrees based on Site-specific characteristics: containment, sediment/soil treatment (in-situ and ex-situ), sediment/soil removal, sediment/soil disposal, MNR/ENR, and institutional controls" (emphasis added).
[179] By contrast, the Corps of Engineers capping guidance document provides design level guidance of modeling and assessment methods to determine the concentration of contaminants of concern that can be safely isolated by capping.
[180] The Lower Duwamish Proposed Plan had an entire subsection that described some of the issues with design implementation and what factors and remedy components would have to be worked out in more detail in design. Proposed Plan, Lower Duwamish Water Superfund Site, https://www3.epa.gov/region10/pdf/sites/ldw/pp/ldw_pp_022513.pdf, §10.1, page 89.

determined by application of demonstration criteria through engineering evaluations during remedial design.[181] Such an approach is consistent with guidance, which clearly indicates both dredging and capping are feasible under a wide range of highly overlapping conditions, and many design options and components exist so that either capping or dredging can be tailored to be highly effective and protective under the same conditions.[182]

B. EPA's FS Presents Flawed Post-construction Risk Estimates

As discussed in Section I.A., EPA fails to maintain consistency with the BERA regarding benthic risk areas, and as a result, all FS estimates of the alternatives' ability to reduce benthic risks are incorrect. As demonstrated in Section I.C.1. EPA uses many PRGs that are inconsistent with the BLRAs and factors in virtually no risk management decisions, resulting in risk estimates that are misaligned with the findings of the BLRAs. As discussed in Section 1.C.2, EPA's incorrect PRGs combined with artificially inflated baseline SWACs create much higher estimates of baseline risks for Alternative A in the FS as compared to the baseline risks in the BLRAs. This approach also creates the appearance of greater risk reductions for the other alternatives than are possible, including unrealistic numbers of increased allowable fish meals as discussed in Section I.D. The overall result of these problems is that EPA repeatedly identifies large areas that are designated for active sediment cleanup where risks are either not present or cannot be meaningfully reduced through a sediment cleanup. A prime example of this is the application of PAH RALs in the navigation channel with no clear benefit as described in Section I.C.1.

Because of EPA's continual and compounding disregard for the methods and findings of the BLRA, all of the risk estimates presented in the 2016 draft Final FS are incorrect and generally portray inflated baseline risks and greater risk reductions than are possible or achievable. EPA cannot use the incorrect risk estimates to determine the relative effectiveness or risk reduction of any of the alternatives. And EPA has no foundation to reasonably decide whether any of its alternatives meet the threshold criteria of protectiveness or compliance with ARARs.

C. No Quantitative or Detailed Short-term Effectiveness Evaluation

As the LWG has previously commented,[183] guidance strongly recommends a comprehensive and quantitative evaluation of dredge release impacts:

- "Generally, the project manager should assess all causes of resuspension and realistically predict likely contaminant releases during a dredging operation."
- "To the extent possible, the project manager should estimate total dredging losses on a site-specific basis and consider them in the comparison of alternatives during the feasibility study."
- "Dredging residuals have been underestimated at some sites, even when obvious complicating factors are not present."
- "Project managers should be aware that most engineering measures implemented to reduce resuspension also reduce dredging efficiency. Estimates of production rates, cost, and project time frame should take these measures into account."

[181] Attachment 21 builds on a capping demonstration decision tree developed by EPA in late 2015 for the FS but ultimately not included in the final FS.

[182] For example, EPA's Sediment Guidance, page iii states: "When evaluating alternatives with respect to effectiveness and permanence, it is important to remember that each of the three potential remedy approaches may be capable of reaching acceptable levels of effectiveness and permanence…" See also p. 3-2, "However, due to the limited number of approaches that may be available for contaminated sediment, generally project managers should evaluate each approach carefully, including the three major approaches (MNR, in-situ capping, and removal through dredging or excavation) at every sediment site at which they might be appropriate." See also p. 7-5, "Project managers should note that these characteristics are not requirements. It is important to remain flexible when evaluating sediment alternatives and when considering approaches that at first may not appear the most appropriate for a given environment. When an approach is selected for a site that has one or more site characteristics or conditions appearing problematic, additional engineering or ICs may be available to enhance the remedy."

[183] Letter to EPA, September 8, 2015, Re: List of significant comments on EPA Feasibility Study Section 3 and 4 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240)

- "The strategy for the project manager should be to minimize the resuspension levels generated by any specific dredge type, while also ensuring that the project can be implemented in a reasonable time frame."

EPA provides some discussion of dredge residuals and releases, but no new quantitative evaluations were added since the LWG's comments were submitted on the 2015 Draft FS. The general discussion provided in FS Appendix O and page 3-23 continues to rely on the findings of one project (Hudson River Phase 2) as the basis for its assumption that contaminant releases during dredging in Portland Harbor will be only 1% of the total contaminant mass dredged. This is three times lower than the 3% release rate recommended by the LWG in the 2012 Draft FS based on a review of numerous other recent contaminated sediment dredge projects. EPA further uses this one project to assume that most releases greater than 1% can be eliminated by quickly covering dredge residuals by applying daily clean cover. This assumption will require additional equipment to be available to place these materials or the dredge production rates need to be reduced, which is inconsistent with the 2016 draft Final FS-assumed 24 hours a day, 6 days a week dredging production rate (see Section IV.F). Thus, EPA is establishing a 1% release rate for Portland Harbor based on one project (Hudson River Phase 2) that appears to be one of the lowest release rates documented to date. Further, EPA is applying this optimistic release rate from a site that is entirely different both chemically and physically from Portland Harbor, which includes 10 river miles of highly varying physical and chemical conditions. Regardless of these general discussions, EPA never applies the assumed 1% release rate in any type of quantitative evaluation of dredging releases or the associated increases in fish tissue concentrations as documented on many other projects.[184] These projects document that fish tissue PCB levels typically increase dramatically during contaminated sediment dredging events and stay elevated for 3 to 5 years afterward. None of these likely impacts are quantified or factored into EPA's assumptions about allowable fish meals during and shortly after the construction period.

EPA also states on page 3-24 of the 2016 draft Final FS that residual covers should be applied on a daily basis, a requirement without precedent for a project of this scale. EPA also discusses many other water quality best management practices (BMPs), silt curtains, sheetpile walls, and other dredging water quality controls that are assumed to be employed either all the time or under various conditions. However, contrary to guidance (cited above) the effect of daily covers and this wide array of dredging controls on alternative costs and durations are not quantified or even discussed. The effects of all these controls on alternative cost, duration, and implementability are substantial and are not demonstrated in the 2012 LWG Draft FS to provide additional risk reduction.

For example, EPA assumes sheetpile barrier walls will be used anywhere that trace or greater levels of NAPL is present in water depths up to 50 feet (see 2016 draft Final FS Appendix O). Yet, the 2016 draft Final FS FS fails to incorporate into each alternative's duration the time to install and remove sheetpile walls or factor in the lower dredging production rates that occur in and around the confined space created. The costs of sheetpiles that EPA uses ($2,750 per linear foot) would not be sufficient for water depths approaching 40 to 50 feet; these depths would require a much more expensive cofferdam-type system and require site-specific engineering analyses to determine if they are even feasible. EPA also continues to depict (2016 draft Final FS FS Figure 3.4-33) sheetpiles in greater than 50 feet of actual water depth, which is technically infeasible. Figure 3.4-33 also implies that sheetpiles will be installed in the navigation channel, which would not be permitted by the U.S. Army Corps of Engineers (USACE) or U.S. Coast Guard, because it presents a hazard to navigation in an active vessel traffic lane. Sheetpiles would also impact or prevent ongoing shoreline water dependent operations and nearshore fish migration. EPA also fails to discuss that driving sheetpile walls can transport sediment contamination deeper into clean subsurface sediments or that removal of the sheetpile walls after construction will cause contaminated sediment releases as well. Finally, EPA never quantifies whether the additional cost of sheetpiles (including the impact of slower construction times on costs) is justified by their assumed additional effectiveness.

Other types of construction and short-term impacts could occur with all the alternatives, such as:

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[184] See discussion in the LWG 2012 draft FS in Sections 6.2.7.3 and 8.2.2.4; Bridges, et al. 2010: Dredging Processes and Remedy Effectiveness: Relationship to the 4 Rs of Environmental Dredging. Todd S. Bridges, Karl E. Gustavson, Paul Schroeder, Stephen J. Ells, Donald Hayes, Steven C. Nadeau, Michael R. Palermo, and Clay Patmont. Integrated Environmental Assessment and Management. February 10, 2010. 2010 SETAC; ITRC p. 181; and "Sediment Monitored Natural Recovery Case Studies." Presentation at the Battelle Eighth International Conference on Remediation and Management of Contaminated Sediments. January 12-15, 2015. Carl Stivers and Clay Patmont of Anchor QEA.

- Potential risks to both construction workers and the general public from sediment removal, transload, transportation, and treatment

- Community impacts from multi-year dredging, capping, and transload operations on the river (e.g., recreational uses, light, and noise)

- Increased greenhouse gas and air pollution discharges

- Impacts to the community and commerce from increased river vessel traffic, community road truck traffic, and potential increased train traffic

EPA only briefly discusses these issues, and when they are discussed, EPA quickly transitions to biased explanations of how these impacts can be avoided or minimized (e.g., FS pages 4-34 through 4-38). Although EPA mentions that short-term impacts will be greater for larger alternatives, the pervasive explanations of minimization measures misleadingly makes these impacts all appear relatively inconsequential.

EPA does not perform any type of quantitative evaluation of dredge releases or other short-term impacts. Almost all of EPA's alternative comparison conclusions rest on simple comparisons of construction durations and the amount of materials handled. We note that EPA made numerous comments on the 2012 LWG Draft FS indicating that document spent too much time discussing durations of the alternatives,[185] even though that document included quantitative estimates of dredge releases, worker risks, community impacts, and air emissions, all of which are important to remedial alternatives evaluation and selection.

In comparison to the 2012 LWG Draft FS, EPA's short-term impact conclusions rely on little more than conjecture about construction durations. For example, EPA notes that "since Alternative I also involves less construction than Alternative E, Alternative I would have less short-term impact on the community, workers, and the environment." However, EPA's Proposed Plan Table 15 shows that Alternatives E and I receive the same overall short-term effectiveness score of "better," as does Alternative D. Alternative B, which has shorter durations and less material transport, recieves a score of "moderate" for unclear reasons. (No alternative receives the "best" score here, which is inconsistent with the other criteria scoring.) Regardless of the approach to evaluating short-term effectiveness, sound policy demands that risk be evaluated holistically and not in baseline and post-construction silos. If the objective is to prevent environmental morbidity and mortality, then the possible tradeoff related to occupational and implementation related injuries, disease, and deaths caused by the cleanup activities themselves must be explicitly taken into consideration in the cost-benefit analysis of the remedial alternatives.

D. <u>No Quantitative or Detailed Long-term Effectiveness Evaluation</u>

As discussed previously, EPA made the determination that no quantitative long-term modeling of the alternatives or natural recovery was possible for the Site. EPA's Sediment Guidance addresses the role of quantitative estimates in making these critical decisions:

> "The time needed until protection is achieved can be difficult to assess at sediment sites, especially where bioaccumulative contaminants are present. Generally, for sites where risk is due to contaminants in the food chain, time to achieve protection can be estimated using models. These models may have significant uncertainty, but may be useful for predicting whether or not there are significant differences between times to achieve protection using different alternatives. When comparing time to achieve protection from MNR to that for active remedies such as capping and dredging, it is generally important to include the time for design and implementation of the active remedies in the analysis."

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[185] "For example, the comparative evaluation of alternatives overemphasizes duration of cleanup in the evaluation of short-term impacts…" and "The FS bases a significant portion of the overall effectiveness evaluation on the duration of the cleanup." Letter from EPA to LWG December 18, 2012 regarding, Portland Harbor Superfund Site, Administrative Order on Consent for Remedial Investigation and Feasibility Study: Docket No. CERCLA-10-2001-0240 EPA Comments on the Portland Harbor Rl/FS Draft Feasibility Study (March 30, 2012).

This guidance is particularly relevant for large and complex sites like Portland Harbor where uncertainties are often greater and quantitative estimates help to understand those site uncertainties and better support appropriate remedy decision-making. For example, EPA Region 10 recently completed decision-making using such quantitative approaches for the similarly complex Lower Duwamish Waterway Superfund site.[186]

The absence of quantitative evaluations is the result of rejecting empirical data collection and modeling studies that the LWG conducted in coordination with EPA and under its interim approvals and for the express purpose of informing the RI/FS.[187] EPA's ultimate rejection of LWG's proposed QEAFATE model only came after years of discussion and refinements to that model based on EPA's detailed comments. EPA made little earnest attempt to replace that model with another form of quantitative long-term estimate. For example, EPA rejected its own SEDCAM modeling results and USACE particle tracking models and then failed to consider simple quantification techniques like the half-life estimates discussed in Section V.C.

As a result, and despite the fact that EPA acknowledges that natural recovery is occurring at the Site,[188] EPA is reduced to assuming that:

- Immediate post-construction sediment SWACs are the only available means to quantify the long-term effectiveness of the alternatives, which EPA acknowledges is not an actual long-term measure of the alternatives.

- These immediate post-construction SWACs will remain constant for all alternatives until construction commences, despite EPA identifying the need for multiple years of post-ROD assessment and pre-design data collection and the fact that alternatives that involve more construction will likely take longer to design than alternatives that require less construction.

- SWACs will remain constant during the time of construction even though some areas will not be actively remediated and will obviously undergo natural recovery to the extent that is expected for any given area.

- Immediate post-construction SWACs are static relative to each other even over long periods of time. For example, EPA assumes the estimated post-construction SWACs for Alternative B, with an estimated 4-year construction period, can somehow be compared directly to Alternative I, with an estimated 7-year construction period, or Alternative H, with an estimated 62-year construction period.

These assumptions greatly simplify the alternatives analyses, but they have no basis in reality and are directly contrary to guidance.

The assumption that SWACs remain constant until construction commences is particularly problematic. EPA describes the construction timeframes for all alternatives to be preceded by a "Year 0" condition.[189] This Year 0 is described as including the following work:

- Establishment of initial conditions: "Monitoring (sampling) of sediment, water, biota, and pore water will need to be the first phase, and it will encompass the entire Site to establish a baseline and delineate the SMAs for construction. It is expected that <u>this phase will take 3 to 5 years</u>."

- Construction of an on-site material handling/treatment facility

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[186] Record of Decision. Lower Duwamish Waterway Superfund Site. EPA, Region 10. November 2014.
[187] During this same period, EPA was only able to express ever increasing uncertainty about every empirical data collection effort it approved and oversaw, including one of the most detailed time series bathymetry data sets (showing widespread deposition) ever collected for a sediment Superfund site, high resolution grain size sampling, sediment trap and suspended sediment data, subsurface sediment concentration profiles, radio-isotope cores, disaggregated surface sediment data, time series fish tissue data (including the 2012 smallmouth data collection EPA itself conceived and attempted to execute), and other data.
[188] 2016 draft Final FS p. 3-33.
[189] 2016 draft Final FS p. 3-41 (emphasis added).

- Start-up activities and mobilization, including pre-design investigations
- And the first year of construction: "Year 0 is the first year of construction."

This conceptual timeline does not include any explicit time for completion of the ROD and Consent Decrees. It also does not include time for remedial design, which usually proceeds in at least three EPA review steps (e.g. 30, 70, 100% design). At the most optimistic, the assumptions lead to construction starting no sooner than 5 to 7 years from the ROD. Given EPA assumes that the PRGs will be achieved in 30 years (and as discussed in Section V.C, this equates to a natural recovery half-life of about 10 years), the Site sediment concentrations will have decreased by at least an additional 25% before construction starts. Thus, once initial conditions are set, it will be time to conduct another round of initial condition sampling. More importantly, EPA does not appear to have given any meaningful consideration to pre- or post-construction time periods when evaluating the relative performance of its alternatives. EPA should provide a realistic vision and timeframe for implementation of its alternatives, including the time prior to construction. EPA should clearly identify in its alternatives development and decision trees that sediment management areas and technology assignments and process options will be refined and adjusted through site-specific remedial design and implementation, because the Site is sure to have changed substantially in the time between the ROD and construction.

EPA converted immediate post-construction SWACs to risk estimates by comparing PRGs, many of which are inconsistent with the risk assessments, using spatial scales that are also inconsistent with the risk assessments. EPA also made analogous estimates for fish tissue and surface water that rely on the same immediate post-construction SWACs, and as a result, these estimates are equally useless to assess long-term effectiveness of the alternatives. Some of the problems associated with the tissue estimates are discussed in Section I.C.2.b, and the additional errors involved in EPA's surface water estimates from Appendix K are discussed in Section I.B and are not repeated here.

Rather than actually quantitatively evaluating long-term effectiveness, EPA's new approach for the 2016 draft Final FS uses interim targets, which are basically 10 times its PRGs. EPA then compared immediate post-construction risks to these interim targets for evaluating the "overall protection of human health and the environment" for each alternative. EPA states that if alternatives meet these interim targets, it is reasonable to assume the PRGs will be met through subsequent natural recovery in 30 years.[190] This assumption is justified only by saying that it is "commensurate with the site-specific contaminants and conditions." Particularly in the absence of a coherent CSM, EPA cannot simultaneously claim that it cannot quantitatively estimate MNR and then decide that MNR will work in 30 years. This global assumption also hides a second and equally important and unsupported assumption that EPA's PRGs can eventually be achieved through a sediment remedy. As the equilibrium analyses discussed above demonstrate, many of EPA's PRGs are not achievable even over the very long term. EPA never explains why these assumptions and flawed associated analyses are technically superior to either the LWG's effectiveness evaluations or its own prior evaluations in the 2015 EPA Draft FS.

Even within EPA's interim targets approach to evaluating effectiveness, there are internal inconsistencies. For example, the Preferred Alternative does not meet the interim targets for RAOs 1, 2, and 6 (Proposed Plan pp. 51-52). Likewise, Figure 4.2-4 of the 2016 draft Final FS shows none of the alternatives meet the interim targets (except Alternative G) ,and Figure 4.2-2 shows a similar result (no alternatives except Alternatives F and G meet the interim target). And for most of the other RAOs, there is either "insufficient information" to determine whether Alternative I meets EPA's interim targets, or only qualitative comparisons between alternatives, such as "[p]ost-construction, the estimated contaminated groundwater area addressed by each alternative increases as the footprint of the SMAs increases."

[190] Draft Final FS p. 4-6: "As a long-term model is not available to predict the time to meet the PRGs, interim targets for risks and HIs were established to evaluate the potential for achievement of PRGs in a reasonable time frame, which was considered to be 30 years, commensurate with the site-specific contaminants and conditions. These interim targets are higher than residual risks once PRGs are achieved, and assume that further reductions will be achieved through MNR."

Ultimately, EPA simply abandons any effort to consider long-term effectiveness beyond its assumed construction durations. EPA notes in the Proposed Plan that Alternatives D, E, and I have roughly the same MNR footprint.[191] However, Alternative D is ranked *low* and Alternatives E and I are ranked *moderate* in Proposed Plan Table 15. To the extent this conclusion is based on EPA's stated goal in the Proposed Plan (page 63) to "maximize permanence through removal of highly contaminated sediment" this conclusion is directly contradictory to guidance, which is clear that mass removal is not an appropriate way to evaluate sediment remediation alternatives; rather the evaluation must address reduction in risk.[192]

Finally, EPA's FS does not quantify or otherwise estimate the performance of enhanced natural recovery (ENR) in SIL SDU either in terms of sediment SWACs or post-construction risks. EPA identified ENR as an applicable technology for SIL in all alternatives considered in the FS, with ENR covering more than 60% of the SDU for Alternative I. ENR is a commonly employed remedial alternative for contaminated sediment sites. It refers to accelerating the natural recovery process by engineering means and includes adding a thin layer of clean sediment and/or additives to enhance contaminant degradation. The 2016 draft Final FS concludes that ENR is expected to meet RAOs in SIL. It provides that the thickness and composition of the ENR layer will be determined during remedial design but that a 12-inch layer is expected to be sufficient.

Despite EPA's conclusions regarding the applicability and effectiveness of ENR in the SIL environment, EPA has arbitrarily ignored the impact of ENR on reducing PCB SWACs and corresponding risks. That is, SWAC and risk calculations reported for the SIL area by EPA in the FS simply do not reflect any benefit expected to be achieved by ENR. EPA's failure to evaluate the impact of ENR on risk results in an incomplete analysis of effectiveness for all alternatives and therefore prevents a meaningful comparison among the alternatives in accordance with the NCP. It is also contrary to EPA's 2015 Draft FS, which explicitly considered the effect of ENR on the SWAC. EPA has failed to provide any reason for its change in position from the 2015 Draft FS. Furthermore, ENR (including the potential for an additive to enhance contaminant degradation or sequestration) contributes significantly to the overall costs of a remedy. Therefore, its effect on risk reduction must be considered when evaluating the cost-effectiveness of remedial alternatives.

E. <u>EPA Ignores Recent Data that Aid in Long-term Effectiveness Evaluations</u>

There is substantial evidence that important chemical characteristics of the Lower Willamette River have changed significantly since the RI.[193] Analyses of the 2012 smallmouth bass data (submitted to EPA) strongly suggest the Site is already approaching equilibrium levels in some areas of the Site. Because that analysis also suggests that the half-life of the process is about 10 years, which is consistent with the recovery rate that EPA must have used as the basis for its assumption that a PCB PRG of 9 ppb can be reached in 30 years,[194] it appears likely that a large proportion of the surface sediments at the Site will be at or near equilibrium levels by the time of remedy implementation, thus eliminating the need for an aggressive cleanup approach such as Alternative I. As noted above, based on a realistic assessment of EPA's timeframe until construction start, Site concentrations are likely to be around 25% lower than the already much lower 2012 estimate. The 2014 PCB sediment data yield similar conclusions.

Because of the relationship between RALs and natural recovery (RALs delineate active construction areas from natural recovery areas), RALs are sensitive to SWAC changes caused by natural recovery. As the Site recovers before construction, the same RALs will delineate ever smaller areas of active construction until equilibrium is reached. Failure to recognize these ongoing processes will cause errors in the selection of the most cost-effective alternative as well as in the assignment of remedial technologies in the absence of flexibility during remedial design to adjust to changing river conditions. Yet, EPA's 2016 draft Final FS and Proposed Plan provide no clear

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[191] Proposed Plan, p. 61.
[192] Sediment Guidance, p.7-1 and p. 7-16.
[193] "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis," a presentation file from Anchor QEA provided to EPA on March 18, 2013.
[194] Using Alternative I (the preferred alternative), EPA estimates a post-construction SWAC of 40 ppb at construction completion, which is 7 years after construction started. In order to reach a level of 9 ppb in the 23 years remaining within EPA's 30-year assumption, the site-wide concentration would need to halve every 10 years. This equates to 20 ppb at 17 years after construction started and 10 ppb at 27 years after construction started. Consequently, 9 ppb would be achieved at about 28 years after construction started.

description of how any future design adjustments might impact alternative selection now, what site-specific remedy adjustments will be allowed in the remedial design phase, how those adjustments would be determined, and what procedural steps would be needed (e.g., part of design decisions, Explanation of Significant Difference, or ROD amendments). Instead, the Proposed Plan describes technology assignments based on FS-level screening criteria that apparently will be entirely prescriptive during remedial design regardless of how the Site might evolve over time.

F. EPA Systematically Underestimates Costs and Durations

EPA's estimated costs for performing each of the alternatives continue to omit significant cost elements, including EPA's anticipated "initial conditions" sampling, sufficient pre-remedial engineering design investigations, Oregon Department of State Lands access, lease and easement fees, and agency oversight and participation costs (which alone have amounted to more than 27% of the LWG'S RI/FS costs to date). EPA also dramatically underestimates other cost elements on the basis of unrealistic and, in some cases, impossible assumptions about dredge and cap production rates and volumes, remediation waste processing, engineering design, construction management, BMPs EPA intends to require, and the present value of money (including the cost of financial assurance).

As EPA itself notes, "[c]ost is a central factor in all Superfund remedy selection decisions." Cost estimates are developed at different stages of the Superfund process and are dependent on and have a direct relationship with project definition and design. The cost estimate of the Preferred Alternative is usually transferred from the FS to the Proposed Plan and further included in the ROD, subject to any modifications resulting from the public comment process or the availability of new information.

During the FS phase, cost estimates are developed for the purpose of "comparing remedial alternatives during the remedy selection process...." Cost estimates are prepared during the "development and screening of alternatives" stage, as well as during the "detailed analysis of alternatives" stage. "Screening-level cost estimates are used to screen out disproportionately expensive alternatives in determining what alternatives should be retained for detailed analysis," while estimates generated during the "detailed analysis" stage are "used to compare alternatives and support remedy selection." EPA's *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* describes data sources that should be used to generate cost estimates, which include "cost curves, generic unit costs, vendor information, standard cost estimating guides, historical cost data, and estimates for similar projects, as modified for the specific site."

Overall, properly evaluating the cost and cost-effectiveness of each remedial alternative is crucial to ensuring compliance with CERCLA and NCP directives. Regardless of the relevant FS stage, cost estimates "should clearly present" the "expected accuracy range of the cost estimate." The expected accuracy range of cost estimates generated during the "screening of alternatives" phase is -50 to +100%, while the expected accuracy range of cost estimates generated during the "detailed analysis of alternatives" phase is -30 to +50%.

1. Correcting Significant Errors in EPA's Cost Estimates Results in Cost and Duration Projections more than Double EPA's Estimates

An accurate estimate demonstrates that EPA's proposed remedy is more likely to cost close to $1.8 billion (net present value)—more than double EPA's estimate of $811 million (net present value). Attachment 22 presents a side-by-side comparison of EPA's approach to major cost items with LWG's approach.[195] This comparison is summarized in Table 5. The areas of difference most significant to the overall discrepancy between EPA's and the LWG's cost estimates include production rates, volume estimates for capping, use of sheetpile walls, mobilization and demobilization, and design and contingency cost percentages.

EPA's June 2016 cost estimate reduced the publicly announced cost of the remedy without actually changing many significant elements of the remedy. When EPA presented its Preferred Alternative to the NRRB in November 2015, it estimated a cost of $1.5 billion. When EPA proposed virtually the same alternative on June 8, 2016, the cost was

[195] The LWG follows EPA's approach of using a certain cost for each line item. In fact, of course, there is variability and uncertainty in each cost projection. Attachment 23, LWG memorandum on EPA Cost Sensitivity Evaluation (September 6, 2016) evaluates the impacts of these uncertainties.

$811 million—nearly a 50% decrease from what EPA had estimated in November. A couple of material, but isolated, changes to the remedy approach contributed to the decrease (such as the assumed method of PTW ex situ treatment). But without any other significant changes to the key drivers of remedy cost—like significant changes in the volume of material to be dredged and disposed of—it was not clear how the remedy cost estimate decreased by hundreds of millions of dollars.

EPA did choose estimates at the low end of EPA-recommended ranges for many cost assumptions. For contingency assumptions, EPA modified contingency percentages to the low end of the recommended range on the grounds of the remedy's high cost and the detailed technology assignment modeling in the FS. In reality, the size, uncertainty and complexity of Portland Harbor warrants contingency percentages at least in the middle of the range. For remedial design, EPA guidance recommends 6% of capital cost, yet EPA selected 2%. Reasonable estimates for these two factors alone contribute an additional $375 million to the remedy cost estimate.

Table 5. Comparison of EPA and LWG Cost Approach.

Capital Costs			
Item	**EPA**	**LWG**	**Difference**
Direct Costs			
Mobilization/Demobilization	$9,045,000	$42,784,000	$33,700,000
Debris Removal and Disposal	$3,827,000	$3,779,000	$0
Obstruction Removal and Relocation	$15,146,000	$14,955,000	-$200,000
Erosion/Residual Control Measures (Dredge Water Quality Controls)	$25,228,000	$136,546,000	$111,300,000
Dredging of Contaminated Sediments (Open Water)	$38,183,000	$28,889,000	-$9,300,000
Dredging of Contaminated Sediments (Confined)	$2,897,000	$63,343,000	$60,400,000
Excavation of Riverbanks	$533,000	$3,337,000	$2,800,000
Dewatering and Water Treatment for Dredging Operations	$7,261,000	$31,465,000	$24,200,000
Subtitle C/TSCA Disposal	$68,536,000	$81,961,000	$13,400,000
Subtitle D Disposal	$280,706,000	$302,648,000	$21,900,000
Mitigation	$36,408,000	$62,900,000	$26,500,000
DSL Costs	-	$8,616,000	$8,616,000
Sand Placement for Technology Assignments	$20,353,000	$38,678,000	$18,300,000
Beach Mix Placement for Technology Assignments	$3,635,000	$11,425,000	$7,800,000
Armor Placement for Technology Assignments	$5,803,000	$16,473,000	$10,700,000
Reactive/GAC Placement for Technology Assignments	$44,759,000	$94,945,000	$50,200,000
Geofabric for Riverbanks	$303,000	$304,000	$0
Organoclay Mat Placement for Technology Assignments	$1,173,000	$1,159,000	$0
Transload Facility Development	$10,529,000	$37,660,000	$27,100,000
Subtotal	**$574,325,000**	**$981,867,000**	**$407,500,000**
Contingency	$114,865,000	$392,747,000	$277,900,000
Direct Cost Subtotal	**$689,190,000**	**$1,374,614,000**	**$685,400,000**
Indirect Costs			
Remedial Design	$13,784,000	$100,000,000	$86,200,000
Project Management	$13,784,000	-	$36,399,000
Responsible Party Oversight and Project Management	-	$29,432,000	
Agency Oversight and Project Management	-	$16,848,000	
Engineering Support During Construction	-	$9,204,000	
Contractor Project Management	-	$15,375,000	
Construction Management	$20,676,000	-	
Special Insurance and Bonding	-	$68,731,000	$68,731,000

Capital Costs			
Item	**EPA**	**LWG**	**Difference**
Indirect Cost Subtotal	**$48,244,000**	**$239,590,000**	**$191,300,000**
TOTAL CAPITAL COST	**$737,434,000**	**$1,614,204,000**	**$876,800,000**
NPV Cost	**$811,299,000**	**$1,772,629,000**	**$961,300,000**

Estimated Removal Volume (cy)	1,752,000	2,080,000	328,000
Estimated Total Cap Volume (cy)	814,000	1,230,000	416,000
Estimated Duration (Seasons)	7	15	8

Other Capital Costs			
Item	**EPA**	**LWG**	**Notes**
Establish Institutional Controls	$3,726,000	$11,020,000	EPA over construction duration; LWG Year 0
Initial MNR Monitoring	$10,197,000	$10,795,000	EPA/LWG Year 0
Periodic Costs			
Item	**EPA**	**LWG**	**Notes**
Long-term Monitoring and MNR	$38,426,000	$45,137,000	EPA/LWG Years 2, 4, 6, 8, 10, 14, 18, 22, 26, 30
Long-term O&M (Caps) and Institutional Controls	$5,972,000	-	EPA every 5 years
Long-term O&M (Caps)	-	$13,303,000	LWG years 5 and 10 only
Long-term Institutional Controls	-	$650,000	LWG every year after 5 years of construction
Long-term Institutional Controls	-	$50,000	LWG every 5 years
5-year Site Review	$308,000	$341,000	EPA/LWG every 5 years

Notes:
CY - cubic yard
DMM - dredge material management
DSL - Oregon Department of State Lands
EPA - U.S. Environmental Protection Agency
GAC - granular activated carbon
LWG - Lower Willamette Group
MNR - monitored natural recovery
NPV - net present value
O&M - Operations and Maintenance
TSCA - Toxic Substances Control Act

EPA's cost estimates also do not include any specific estimate of the costs for oversight of remedy implementation by EPA, DEQ, and the PRPs performing the remedy. EPA assumed rough total percentages for project management and construction management costs, totaling approximately $34.3 million for Alternative I. Based on historical agency oversight costs charged to the LWG during the RI/FS process, plus costs based on similar projects for responsible party oversight and contractor/construction management, the LWG's estimate for this cost category is double what EPA assumed.

The present value cost of a remedy that takes close to a decade, or more, to construct is heavily influenced by the discount rate. For Portland Harbor, EPA used a 7% discount rate, as suggested by 2000 guidance.[196] In its recent

[196] *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. USEPA 540-R-00-002 OSE 9355.0-75. July 2000.

Lower Duwamish Waterway FS, EPA used the discount rate of 2.3%, taken from the Office of Management and Budget Circular A-94, per EPA guidance.[197] The equivalent treasury rate for 2016 is 1.5%, which is a much more appropriate discount rate at a site where the PRPs include the United States, the State of Oregon, municipalities, public utilities, and many parties whose principal or only source of funding for cleanup are insurance funds outside their investment control. It is also the rate that EPA would presumably use in calculating required financial assurance: "The Agency believes that [financial assurance] based on a 7% discount rate could be insufficient to perform the work because funds called in from FA mechanisms are typically deposited into 'special accounts' or standby trusts, which are unlikely to grow at this annualized real rate."[198] The cost of EPA's typically required financial assurance mechanisms, such as trust funds, letters of credit, and surety bonds, far more accurately reflects actual remediation costs than hypothetical available returns on investment in the financial market. The consequence is to skew present value cost estimates low, particularly for alternatives of long duration, and make highly dredging-intensive remedies appear more cost-effective relative to other alternatives with shorter construction durations. Many other contributing factors are explained in detail in Attachments 22 and 23.

Construction durations are also significantly underestimated in EPA's analysis. Anchor QEA, LLC's review demonstrates that EPA's dredge production volumes, based on assumptions of 24 hours a day, 6 days a week dredging using incorrect dredging technology and less constrained offloading capacity, are significantly higher than what is feasible in Portland Harbor. The LWG assumed 1,600 cubic yards per day of dredging and 104 construction days per season, while EPA assumed 5,100 cubic yards per day of dredging and 122 construction days per season. As a result of these and other assumptions, the LWG assumes that construction durations for each alternative are roughly double what EPA assumed—meaning that Alternative I would take 14 years, not 7 years, to construct.

G. EPA Fails to Fully Consider Many Implementability Challenges

Just as EPA fails to accurately describe short-term impacts and realistic durations associated with the alternatives, it also fails to thoroughly describe and consider parameters associated with the implementability of the remedial alternatives. This includes, but is not limited to:

- Identifying and staging realistic sediment transload and water and sediment treatment facilities
- Evaluating whether dredge production rates included in the EPA 2016 draft Final FS can be maintained over the entire project schedule (e.g., contingencies for weather and equipment maintenance or breakdown and repair)
- Obtaining community acceptance, particularly of short-term impacts such as noise, light, and vehicle traffic
- Placing obstructions to the navigation channel and the requirements to move the dredge and its support vessels and structures to allow for the passage of ship traffic on an ongoing and continuous basis. (An illustration of the impact of passing vessels on dredging can be found at http://dofnw.com/animation/)
- Potentially treating large quantities of sediment

V. EPA Has Failed to Perform Even a Perfunctory Cost-effectiveness Analysis

CERCLA requires that remedies be cost-effective. In the Proposed Plan, EPA failed to perform even a perfunctory cost-effectiveness analysis and only purported to compare Alternatives E and I. A factually supported, quantitative analysis of cost-effectiveness, based on measures of effectiveness that are consistent with the NCP, reveals that the increased cost of dredging-intensive remedies, including Alternatives E and I, is not proportional to increased effectiveness when compared with less costly alternatives. EPA's has failed to demonstrate that Alternative I is cost-effective.

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[197] Final Feasibility Study, Lower Duwamish Waterway Group (October 31, 2012), Appendix I, page I-5.
[198] *Guidance on Financial Assurance in Superfund Settlement Agreements and Unilateral Administrative Orders* (EPA, April 6, 2015).

A. CERCLA, the NCP, and EPA Guidance Require that Remedies Be Cost-effective

Cost plays an integral role in the Superfund remedy selection process, as demonstrated by CERCLA, the NCP, and EPA's own guidance.[199] CERCLA requires EPA to choose a remedy "that is protective of human health and the environment, *that is cost-effective*, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable."[200]

To that end, the NCP places emphasis on cost-effectiveness at various stages throughout the remediation process. The NCP preamble explains, "[i]n analyzing an individual alternative, the decision-maker should compare...the relative magnitude of cost to effectiveness of that alternative. In comparing alternatives to one another, the decision-maker should examine incremental cost differences in relation to incremental differences in effectiveness."[201] Furthermore, "if the difference in effectiveness is small but the difference in cost is very large, a proportional relationship between the alternatives does not exist," and "[t]he more expensive remedy may not be cost-effective."[202]

With respect to the development and screening of remedial alternatives during the FS, the NCP allows for the elimination of alternatives that are not cost-effective. Specifically, the NCP provides: "[t]he costs of construction and any long-term costs to operate and maintain the alternatives shall be considered. Costs that are grossly excessive compared to the overall effectiveness of alternatives may be considered as one of several factors used to eliminate alternatives. Alternatives providing effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated."[203]

Cost-effectiveness is also emphasized during the detailed analysis of alternatives stage of the FS, with cost being listed as one of the nine criteria required to be evaluated for each alternative.[204] With respect to the selection of a remedy, the NCP requires that "[e]ach remedial action selected *shall* be cost-effective," so long as the threshold criteria of protectiveness and compliance with ARARs are met.[205] "Cost-effectiveness is determined by evaluating the following three of the five balancing criteria… to determine overall effectiveness: long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost-effective."[206] "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness."[207]

EPA guidance reinforces the need to weigh remedial alternative cost against incremental risk reduction, stating that "[t]he evaluation of an alternative's cost-effectiveness is usually concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs when compared to other available options."[208] A "[c]areful evaluation of site risks…help[s] to prevent implementation of costly remediation programs that may not be warranted."[209]

B. EPA Failed to Perform Even a Perfunctory Cost-effectiveness Analysis in the Proposed Plan

The Proposed Plan presents a "Rationale for Selecting the Preferred Alternative," which would be the appropriate section to compare and contrast the cost-effectiveness of the remedial alternatives. However, EPA fails to perform

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[199] EPA, *The Role of Cost in the Superfund Remedy Selection Process*, Publication 9200.3-23FS, 1 (Sept. 1996).
[200] 42 U.S.C. § 9621(b)(1) (emphasis added).
[201] 55 Fed. Reg. 8728.
[202] *Id*.
[203] 40 CFR § 300.430(e)(7)(iii). As the LWG previously commented, EPA's screening out of Alternative C in 2015 Draft FS Section 3 is inconsistent with guidance. Alternative C provides moderately better risk reduction than Alternative B at moderately additional cost. See Section 3 and 4 comments submitted by LWG to EPA on October 9, 2015.
[204] 40 CFR § 300.430(e)(9)(ii).
[205] 40 CFR 300.430(f)(1)(ii)(D) (emphasis added); *see also U.S. v. Am. Cyanamid Co.*, 786 F.Supp. 152 (D.R.I. 1992) ("The NCP directs EPA to prospectively choose a remedial action that EPA believes will clean-up the site for the least cost.").
[206] 40 CFR Section 300.430(f)(1)(ii)(D).
[207] *Id*.
[208] EPA, *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, OSWER 9355.0-85, 7-3 (Dec. 2005).
[209] EPA, *The Role of Cost in the Superfund Remedy Selection Process*, Publication 9200.3-23FS, 2 (Sept. 1996).

this required exercise. EPA Region 10 has previously stated that the correct place for cost-effectiveness evaluations, per the NCP, is after the FS (e.g., in the Proposed Plan).[210]

The Proposed Plan only compares Alternatives E and I. It does not measure, graph, evaluate, or compare the cost-effectiveness between or among any of the other alternatives. Alternatives B, D, F, and G are dismissed in two cursory sentences. Alternatives B and D because they "may not be [sic] meet the first threshold criteria,"[211] and Alternatives F and G because they "involve a significantly greater amount of construction area, time, impact to the environment and the community and cost more." [212] EPA's Proposed Plan ignores the NCP and guidance requirements that EPA compare all alternatives' "incremental cost differences in relation to incremental differences in effectiveness,"[213] and thereby fails to satisfy CERCLA's requirement that the selected remedy be cost-effective.

Even as to the very similar Alternatives E and I, EPA's limited reference to cost-effectiveness is insufficient to comply with CERCLA and the NCP's requirements that the selected remedy be cost-effective. The Proposed Plan devotes less than a page to the comparison between Alternatives E and I, summarily concluding that "Alternative I… is a more cost-effective alternative because it involves approximately 40 fewer acres of dredging in the navigation channel… and is approximately $58M less than Alternative E while achieving the same risk reduction."[214]

As demonstrated below, if EPA had performed a cost-effectiveness analysis among the alternatives, it would be apparent that Alternative I is not cost-effective relative to lower cost alternatives that achieve the same levels of effectiveness.

C. Major Deficiencies in EPA's Effectiveness Analysis Must Be Corrected to Rationally Evaluate Cost-effectiveness

To perform the NCP-required analysis of incremental cost differences in relation to incremental differences in effectiveness, EPA must have a valid analysis of short- and long-term effectiveness, which are two of the three balancing criteria used to determine overall effectiveness. Overall effectiveness is compared to cost to ensure that the remedy is cost-effective.[215]

EPA scarcely addresses these required elements of overall effectiveness, as discussed in Section IV. Instead, EPA's effectiveness analysis is limited to comparing SWACs (and resulting expected fish tissue concentrations) immediately after construction. The Proposed Plan provides that "[t]he effectiveness of each remedial alternative is evaluated in part by comparing each alternative's post-construction [SWAC] to the PRGs for each RAO in the SDUs."[216] This comparison is intended to "provide [] an assessment of how the different alternatives reduce sediment contaminant concentrations, which can then be used to calculate reductions in contaminant concentrations in fish tissue."[217]

It is inappropriate for EPA to evaluate overall effectiveness based only on SWACs immediately after construction, because EPA fails to consider the post-construction natural recovery and ENR that EPA suggests will meet PRGs in the long term. As discussed in Section IV.D, to analyze relative long-term effectiveness, EPA abandons quantitative estimates based on a calibrated and validated long-term model, and then replaces those estimates with the assumption that the Site will recover in 30 years, which is an assumption for which EPA does not provide a rationale.

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[210] Kristine Koch of EPA provided this answer in response to questions during EPA and LWG FS rollout meetings on August 3, 2015 about the absence of cost-effectiveness discussions in the 2016 FS.
[211] We disagree. See Section I.A, supra.
[212] Proposed Plan at 66.
[213] 55 Fed. Reg. 8728.
[214] Proposed Plan at 67.
[215] 40 CFR § 300.430(f)(1)(ii)(D).
[216] Proposed Plan at 49.
[217] Proposed Plan at 49.

Setting aside questions about the validity of predictive long-term models, the analysis below provides long-term SWAC estimates that are consistent with EPA's assumption that Alternative I would meet PRGs in 30 years. This analysis was accomplished by calculating the PCB half-life in Site sediments that would achieve EPA's PCB PRG of 9 ppb[218] in 30 years for Alternative I, which works out to a half-life of about 10 years.[219] This half-life was then applied to each alternative for comparative purposes. In addition to being derived from EPA's conclusion, this estimated rate of natural recovery is supported by empirical data from smallmouth bass fish tissue collected in 2002, 2007, and 2012.[220] Recent 2014 PCB sediment data appear to confirm the validity of this half-life estimate.[221] So, although EPA does not provide any explicit rationale for the 30-year recovery assumption in the Proposed Plan, that assumption appears consistent with valid estimates of the Site recovery rate based on empirical data that do not rely on predictive models.

Table 6 depicts SWAC estimates using this method, from the completion of construction of each alternative (according to EPA's estimates) to Year 30. Table 6 uses EPA's very optimistic construction durations (based on continuous dredging) and conservative initial condition SWAC of 208 ppb for PCBs (EPA 2016 SWAC), which is much higher than the SWAC of 85 ppb used in the EPA 2015 Draft FS (EPA 2015 SWAC). As discussed in Section I.C.2.b, the EPA 2016 SWAC results in risks that are inconsistent with the BLRAs and actual initial conditions are likely much lower. Table 6 also factors in the LWG's estimated Site PCB equilibrium of 20 ppb, which is the lowest likely achievable Site concentration based on the LWG's analysis of upstream PCB inputs to the Site.[222]

Table 6 demonstrates that Alternatives B and D reach a SWAC within 20% of EPA's post-construction SWAC estimate for Alternatives E and I (40 ppb) by Years 11-13—just 4 to 6 years after EPA estimates construction of Alternatives E and I would be complete. (EPA's accepted analytical accuracy for most organic compounds is at least 20%, and it is higher for most PCB measurements.[223]) Further, as noted by the green highlighted cells in Table 6, Alternatives E and I would be within the Site equilibrium range (20 to 24 ppb) as little as 1 year sooner than Alternative D and as little as 3 years sooner than Alternative B.

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[218] Note that the LWG disagrees that a long-term concentration of 9 ppb PCBs is actually achievable. The analysis below also considers that the long-term PCB equilibrium for the Site is likely to be no lower than 20 ppb (as supported by the analysis in "Sediment Equilibrium Estimates for the Revised Feasibility Study" (LWG, August 7, 2014.)

[219] Using Alternative I (the preferred alternative), EPA estimates a post-construction SWAC of 40 ppb at construction completion, which is 7 years after construction started. In order to reach a level of 9 ppb in the 23 years remaining within EPA's 30-year assumption, the site-wide concentration would need to halve every 10 years. This equates to 20 ppb at 17 years after construction started and 10 ppb at 27 years after construction started. Consequently, 9 ppb would be achieved at about 28 years after construction started.

[220] "Lower Willamette River Smallmouth Bass Data Monitored Natural Recovery Analysis." A presentation file from Anchor QEA provided to EPA on March 18, 2013. (Attachment 1)

[221] *Sediment sampling data report, Portland Harbor, Portland, Oregon*, prepared for de maximis Inc., (Kleinfelder, May 11, 2015). (Attachment 2)

[222] *Sediment Equilibrium Estimates for the Revised Feasibility Study* (LWG, August 7, 2014).

[223] Kennedy/Jenks and Integral, 2005. Portland Harbor RI/FS Round 2 Surface Sediment PCB Congeners Sample Selection Memo. Prepared for the Lower Willamette Group, Portland, OR. June 10, 2005; USEPA 2008. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. OSWER 9240.1-48; USEPA-540-R-08-01.]

Table 6. PCB SWACs (ppb) Comparison Using EPA's 24 hour/day Assumption for Alternative Durations (using EPA's 2016 initial SWAC of 208 ppb).

EPA Alternatives	Years																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A (no action)	208	194	180	168	156	145	135	126	117	109	101	94	88	82	76	71	66	61	57	53	49	46	43	40	37	35	32	30	28	26
B				74	69	64	60	56	52	48	45	42	39	36	34	31	29	27	25	23	22	20	20	20	20	20	20	20	20	20
D						56	52	49	45	42	39	36	34	32	29	27	25	24	22	20	20	20	20	20	20	20	20	20	20	20
E/I							40	37	35	32	30	28	26	24	23	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20
F													23	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
G																			20	20	20	20	20	20	20	20	20	20	20	20

Notes

	Duration of alternative construction
XX	Year construction is completed and EPA estimated SWAC at that time.
XX	Using an estimated natural recovery rate, the years that the alternative achieves a concentration approximately equivalent to the LWG-estimated site-wide equilibrium concentration of 20 ppb within a factor of plus 20% (i.e., plus or minus 20% is the EPA acceptable analytical accuracy for organic compounds). This equates to a concentration range of 20 to 24 ppb (i.e., 24 ppb is plus 20% of the equilibrium value of 20 ppb).

Measures of effectiveness over time depend significantly on the accuracy of construction duration estimates. As discussed in Section V.F, the LWG concludes that construction of EPA's alternatives is likely to take twice as long as EPA estimates. Table 7 uses the same methodology described above but assumes construction durations twice as long as EPA's, such that Alternatives E and I would be complete in Year 14. In addition, Table 7 initial SWACs are based on the EPA 2015 FS initial SWAC of 85 ppb, which is consistent with the BLRAs.

Table 7 demonstrates that Alternatives B and D reach a SWAC within 20% of EPA's post-construction SWAC estimate (from EPA's 2015 Draft FS) for Alternatives E and I (31 ppb) by approximately the same time that Alternatives E and I complete construction. Further, Alternatives B, D, E, and I all enter the equilibrium range (green range from 20 to 24 ppb) at about the same time (as does the no action Alternative A). This indicates that, when uncertainties associated with construction duration are accounted for, Alternatives B and D are equally effective as Alternative I, while including far less active remediation and construction.

Taking into account EPA's own 30-year recovery assumption and acknowledging the uncertainties associated with construction duration, Alternative I is highly unlikely to achieve measurably lower SWACs meaningfully sooner than other, less costly alternatives.

Further, the real world consequences of these differences in SWACs are minimal. Table 8 depicts the fish meals per month that children could safely consume (non-cancer risk) at various years after the start of remedy construction.[224] Table 8 uses EPA's starting SWAC of 208 ppb and assumed construction durations based on work proceeding 24 hours per day. Similar to the SWAC analyses above, Alternatives E and I would attain 4.3 fish meals per year immediately after construction by Year 7, and Alternative B and D would achieve the same level of fish consumption in just a few years later (by Years 11 to 13).[225]

However, Alternatives E and I would require much lower fish consumption levels[226] during an additional 3 years of construction as compared to Alternative B. Factoring in fish meals during construction, the <u>average</u> fish meals per year allowed under each alternative over the entire 30-year period shown in Table 8 would be:

- Alternative A – 2.7 fish meals/year
- Alternative B – 5.6 fish meals/year
- Alternative D – 5.9 fish meals/year
- Alternatives E and I – 6.6 fish meals/year
- Alternative F – 5.7 fish meals/year
- Alternative G – 4.1 fish meals/year

[224] As noted previously, EPA focuses many of the 2016 draft Final FS and Proposed Plan discussions on allowable fish meals for "people" based on a non-cancer endpoint, but in fact, these estimates are based on the child scenario, not the adult scenario.
[225] And, as noted in Section IV.C above, fish tissue concentrations are likely to remain elevated for 3-5 years following construction, minimizing the window of differential allowable fish consumption between the alternatives even further.
[226] EPA Proposed Plan page 58 indicates EPA assumed only 0.6 fish meals per year could be consumed during construction.

Table 7. PCB SWACs (ppb) Comparison Using LWG's 12 hour/day Assumption for Alternative Durations (using EPA's 2015 Initial SWAC of 85 ppb).

EPA Alternatives	Years																																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
A (no action)	85	79	74	69	64	59	55	51	48	45	41	39	36	33	31	29	27	25	23	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
B								49	46	42	40	37	34	32	30	28	26	24	22	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
D												40	37	35	32	30	28	26	24	23	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
E/I														31	29	27	25	23	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
F																										21	20	20	20	20	20	20	20	20	20	20	20
G																																				15	20

Notes

Duration of alternative construction

XX Year construction is completed and EPA estimated SWAC at that time.

XX Using an estimated natural recovery rate, the years that the alternative achieves a concentration approximately equivalent to the LWG-estimated site-wide equilibrium concentration of 20 ppb within a factor of plus 20% (i.e., plus or minus 20% is the EPA acceptable analytical accuracy for organic compounds). This equates to a concentration range of 20 to 24 ppb (i.e., 24 ppb is plus 20% of the equilibrium value of 20 ppb).

* Half-life set to rate that would achieve background PCB PRG of 9 ppb in 30 years (without applying the equilibrium asymptote at 20 ppb, which is consistent with EPA's approach). Based on EPA's text on page 4-6: "As a long-term model is not available to predict the time to meet the PRGs, interim targets for risks and HIs were established to evaluate the potential for achievement of PRGs in a reasonable time frame, which was considered to be 30 years, commensurate with the site-specific contaminants and conditions." This assumption is similar to the estimated natural recovery rate based on average smallmouth bass fish tissue half-lives using 2002, 2007, and 2012 data. Also, recent 2014 PCB sediment data appear to be approximately equivalent to this half-life.

Table 8. Fish Meals per Year (Non-cancer Child) Comparison Using EPA's 24 hour/day Assumption for Alternative Durations (using EPA's 2016 initial SWAC of 208 ppb).

EPA Alternatives	Years																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A (no action)	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.4	3.7	4.0	4.3	4.7	5.1	5.5	5.9	6.4	7.0
Alt B	0.6	0.6	0.6	2.2	2.3	2.5	2.7	3.0	3.2	3.5	3.8	4.1	4.4	4.8	5.2	5.6	6.1	6.6	7.2	7.8	8.4	9.1	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Alt D	0.6	0.6	0.6	0.6	0.6	2.9	3.2	3.5	3.7	4.1	4.4	4.8	5.2	5.6	6.1	6.6	7.1	7.7	8.3	9.0	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Alts E/I	0.6	0.6	0.6	0.6	0.6	0.6	4.3	4.6	5.0	5.5	5.9	6.4	6.9	7.5	8.1	8.8	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Alt F	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	8.0	8.6	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Alt G	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3

Notes

	Duration of alternative construction (EPA Proposed Plan p. 58 indicates EPA will allow 0.6 fish meals per year during construction phase).
XX	Year construction is completed and EPA estimated allowable fish meals per year at that time.
XX	Using an estimated natural recovery rate, the years that the alternative achieves a number of fish meals approximately equivalent to the LWG-estimated site-wide equilibrium concentration of 20 ppb within a factor of plus 20% (i.e., plus or minus 20% is the EPA acceptable analytical accuracy for organic compounds).

Following EPA's assumptions, EPA's Alternative I would only allow an average of one additional fish meal per year over the entire 30-year period as compared to Alternative B, but with substantially greater and longer environmental and community impacts from construction. Further, this analysis does not account for the fact that fish consumption would likely need to be lower during construction than EPA assumes, because EPA did not quantify that dredging releases typically cause elevated fish tissue concentrations during and a few years after construction.[227] Thus, the real difference between Alternatives B and I's average fish meals per year over 30 years would be less than one additional fish meal per year.

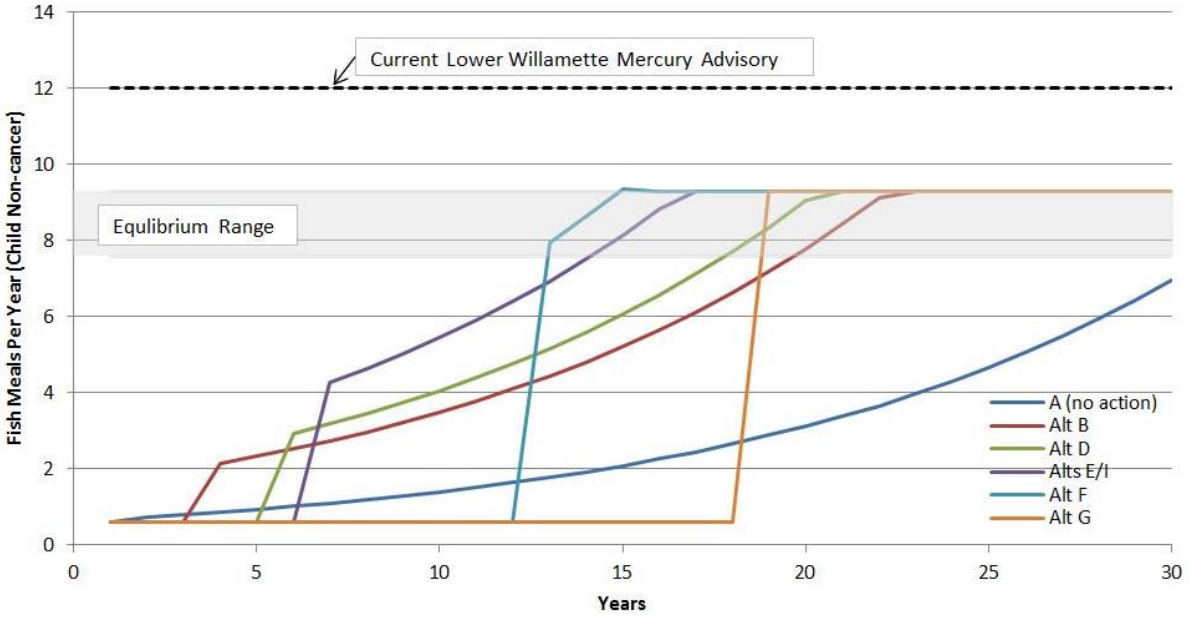
Finally, EPA acknowledges but fails to quantify or evaluate that "Estimating the number of acceptable fish meals at the end of construction is not a precise calculation, but rather is a prediction that has some degree of uncertainty."[228] Thus, the uncertainty around the calculated SWACs and related numbers of fish meals provided by various alternatives means that the results are likely to be highly overlapping. Just accounting for the different estimates in construction durations results in no difference in the SWACs achieved over time by the alternatives as demonstrated in Tables 6 and 7. For example, in Table 6 (24 hour/day construction) Alternative B reaches the equilibrium range of 20 to 24 ppb by Year 20, while Alternative I reaches the same range by Year 14, but in Table 7 (12 hour/day construction) Alternative B and Alternative I both reach the same concentration range by Year 18. Calculating fish meals is an additional highly uncertain step beyond the SWAC uncertainty, and as a result, there is no real or measurable difference between any of the alternatives in terms of the number of fish people will be able to consume over the 30-year evaluation period proposed by EPA. EPA should compare real world outcomes of different alternatives (e.g., average additional fish meals per year), quantify the uncertainties in those outcomes, and provide some estimate of the time it takes different alternatives to achieve them.

Figure 6 shows fish meals per year that can be consumed by adults for each remedy, over time, in the context of the current Portland Harbor mercury fish advisory and the estimated equilibrium range.

[227] See discussion in Sections I.C. and IV.C; LWG 2012 draft FS in Sections 6.2.7.3 and 8.2.2.4; Bridges, et al. 2010: Dredging Processes and Remedy Effectiveness: Relationship to the 4 Rs of Environmental Dredging. Todd S. Bridges, Karl E. Gustavson, Paul Schroeder, Stephen J. Ells, Donald Hayes, Steven C. Nadeau, Michael R. Palermo, and Clay Patmont. Integrated Environmental Assessment and Management. February 10, 2010. 2010 SETAC; IRTC p. 181; and "Sediment Monitored Natural Recovery Case Studies." Presentation at the Battelle Eighth International Conference on Remediation and Management of Contaminated Sediments. January 12-15, 2015. Carl Stivers and Clay Patmont of Anchor QEA.

[228] Proposed Plan p. 58.

Figure 6. Fish Meals/Year (child non-cancer scenario) for 2016 Draft Final FS Alternatives using EPA's Initial SWACs and Construction Durations. ("Years" represent years from construction start.)



As Figure 6 shows, all alternatives are likely to attain the equilibrium range (gray zone) supported number of fish meals within about the same 6-year period, which will still be less than the current mercury advisory for the same population (i.e., child/vulnerable). Given the uncertainties in this calculation, the actual real world outcomes in terms of fish meals per year for these alternatives is likely to be highly overlapping.

The cost-effectiveness analysis that follows uses these rational and accurate analyses, primarily of long-term effectiveness, to display what the cost-effectiveness analysis missing from EPA's Proposed Plan would show.

D. <u>Alternatives E and I are Not Cost-effective</u>

The following figures demonstrate that if EPA had performed an appropriate cost-effectiveness analysis, it would be apparent that Alternatives E and I are not cost-effective relative to other alternatives.

Figure 7 shows the relative additional effectiveness (as represented by SWACs) of each successively larger alternative, as compared to incremental increases in the costs of those alternatives. (Cost estimates are based on EPA's FS, which as noted in Section IV.F, significantly underestimate the true costs of the alternatives.) The red line is based solely on SWACs immediately after construction, the right most part of the line begins with EPA's unrealistically high initial condition SWAC of 208 ppb for Alternative A.

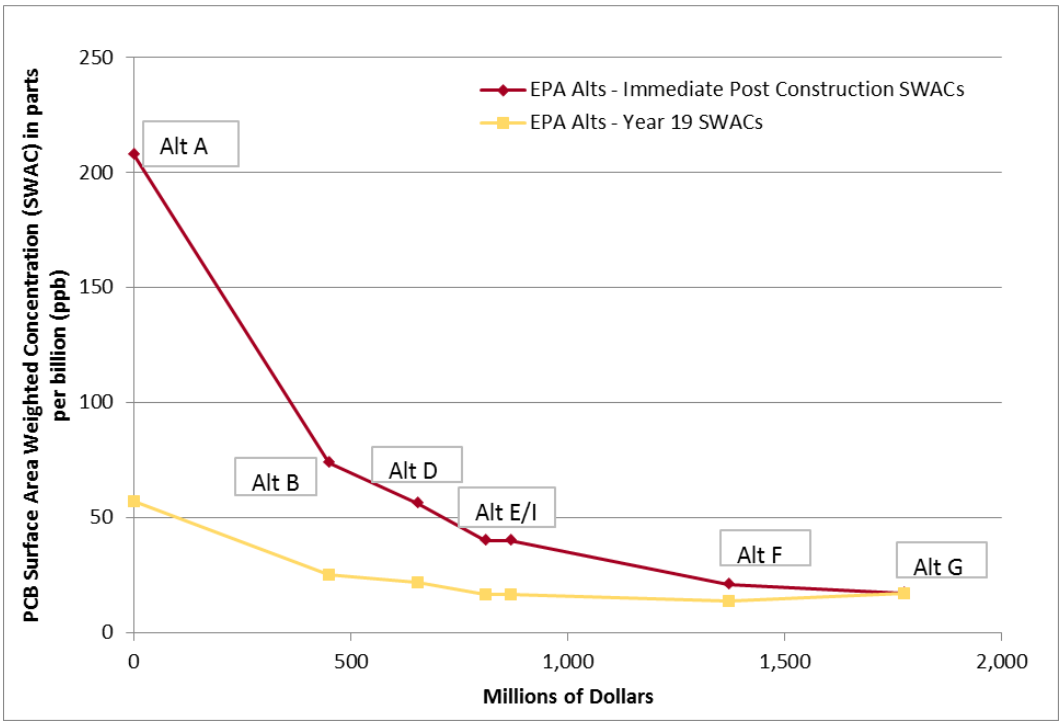
EPA focuses solely on the red line that implies relatively steep reductions in SWACs across the range of alternatives' costs. With this focus, EPA ignores the criterion of long-term effectiveness in evaluating overall effectiveness of the alternatives. A more appropriate way to evaluate cost-effectiveness among alternatives is to also evaluate the SWACs several years after construction.

The yellow line on Figure 7 shows the same alternatives evaluated 19 years after the construction of any alternative is started, given that Alternative G is estimated by EPA to be complete by Year 19 based on an optimistic 24 hour per day construction assumption. (The SWACs shown on the yellow line are the same as those presented in Table 6 above for Year 19 using the methods described there.) Clearly, the yellow (Year 19) line is much less steep than the red (immediate post construction) line, indicating that relatively little additional long-term SWAC reduction is achieved with each successively more costly alternative. Examining Year 19 SWACs, EPA's alternatives are at or near an asymptote of virtually no additional SWAC reduction by about the end of construction of Alternative D, if

not Alternative B. It is worth comparing the weaker cost-effectiveness performance of EPA's alternatives as compared with the integrated alternatives from the 2012 LWG Draft FS. The integrated alternatives were designed to reduce risk faster, at lower cost. Figure 8 adds the LWG alternatives to compare with EPA's alternatives.[229] Examining Year 19 (yellow and blue lines), both EPA and the LWG's alternatives are at or near an asymptote of virtually no additional SWAC reduction by about Alternative D, if not Alternative B. The 2012 LWG Draft FS integrated alternatives perform better than EPA's alternatives by using both immediate post-construction SWACs (green line) and Year 19 SWACs (blue line), because lower SWACs are achieved at substantially lower costs. Figure 9 depicts the same information using the cost estimates developed by the LWG and summarized in Table 5.

Figure 10 shows the same relationship between SWAC reductions and costs, as measured by dividing the alternative's total cost by the PCB SWAC reduction achieved (i.e., cost in millions of dollars to achieve each incremental ppb reduction in the SWAC). Because this measure is very sensitive to the amount of SWAC reduction, Figure 10 uses an initial SWAC (Alternative A) of 85 ppb (instead of EPA's inflated 208 ppb) to compare EPA and the LWG's alternatives. (As noted elsewhere, EPA's 2015 Draft FS used 85 ppb and up to that time EPA and the LWG were in agreement for many years that the baseline SWAC for the Site was about 85 ppb.) As expected, EPA's Preferred Alternative (red and yellow bars) achieves each increment of SWAC reduction for a higher unit cost than EPA's Alternative B (red and yellow bars) either on an immediate post-construction or Year 19 basis. Similarly, all of EPA's alternatives are equally or less cost-effective (all red and yellow bars) as compared to similar LWG integrated alternatives (all blue and green bars). Unit cost measures are consistent with the NCP and show that EPA's larger alternatives (all alternatives from Alternative E upward) have substantially higher costs per unit of effectiveness as measured by SWAC reductions.[230] As noted above, EPA's costs appear to be optimistically low. Consequently, EPA's alternatives would all be even less cost-effective if more realistic (higher) alternative costs were used in any of these figures.

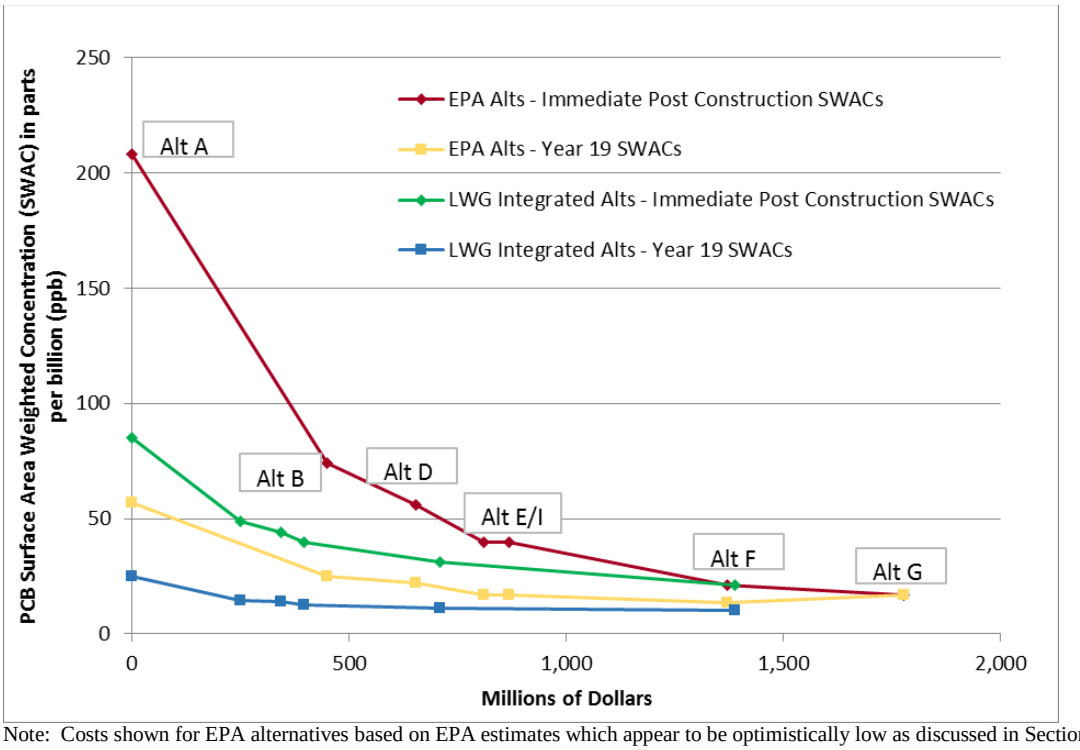
Figure 7. Comparison of EPA Alternative SWACs and Costs, Immediate Post Construction and 19 Years After Construction Start.



Note: Costs shown based on EPA estimates which appear to be optimistically low as discussed in Section V.F

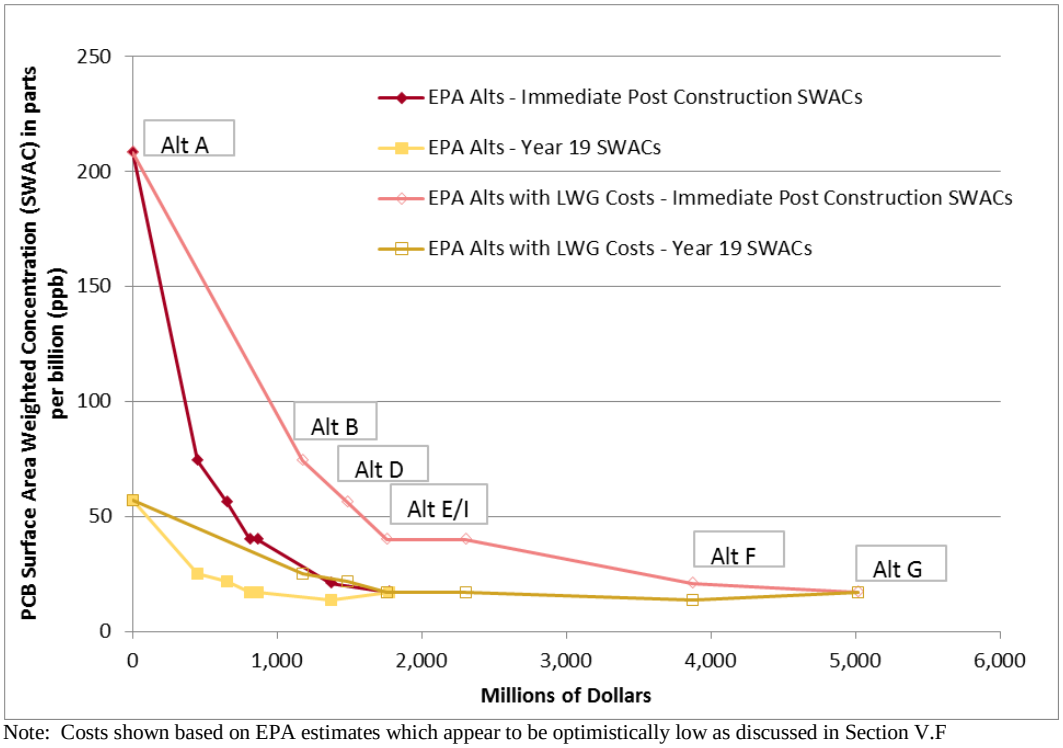
[229] The SWAC for LWG Alternative A is 85 ppb consistent with the LWG 2012 Draft FS and EPA 2015 FS as noted elsewhere.
[230] 55 Fed. Reg. 8728 ("if the difference in effectiveness is small but the difference in cost is very large, a proportional relationship between the alternatives does not exist," and "[t]he more expensive remedy may not be cost-effective").

Figure 8. Comparison of EPA and LWG Integrated Alternative SWACs and Costs, Immediate Post Construction and 19 Years after Construction Start.



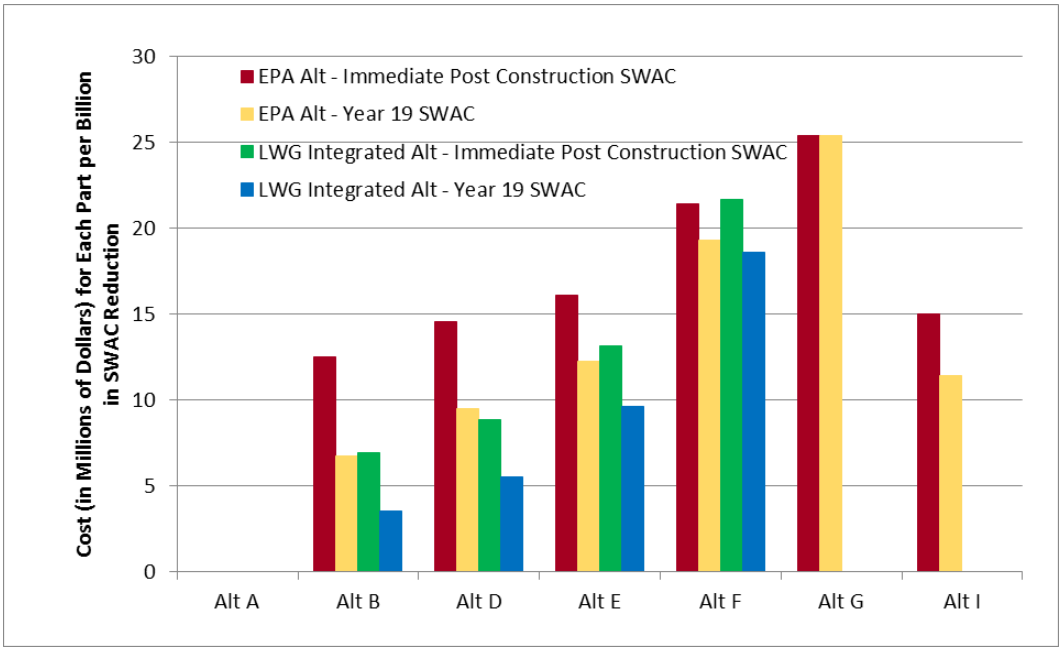
Note: Costs shown for EPA alternatives based on EPA estimates which appear to be optimistically low as discussed in Section V.F

Figure 9. Comparison of EPA and LWG Integrated Alternative SWACs and Costs, Immediate Post Construction and 19 Years after Construction Start. LWG Estimated Costs for EPA's Alternatives Shown.



Note: Costs shown based on EPA estimates which appear to be optimistically low as discussed in Section V.F

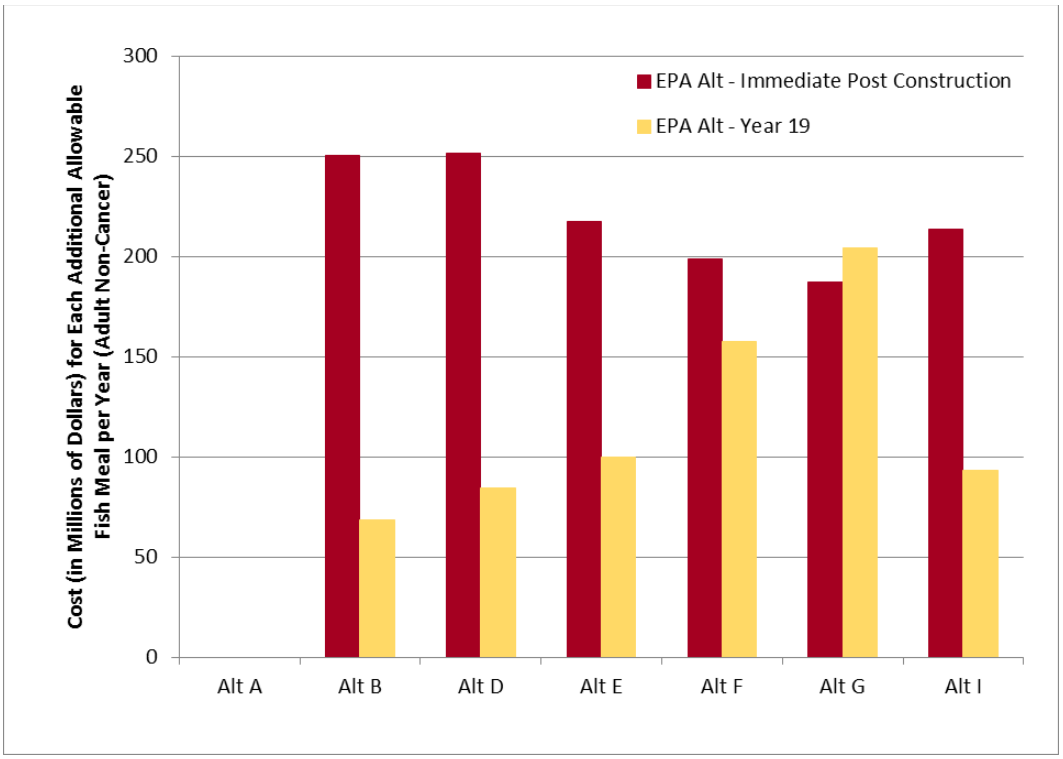
Figure 10. Cost for Each Part per Billion in PCB SWAC Reduction for EPA and LWG Alternatives.



Note: Costs shown based on EPA estimates which appear to be optimistically low as discussed in Section V.F

By way of further analysis in terms of cost versus risk reduction, Figure 11 reflects the unit costs of the alternatives for each additional allowable fish meal per year (beyond that provided by baseline conditions) for adult non-cancer risks consistent with the fish meal calculation assumptions in Table 8. Based on Year 19 allowable consumption rates (yellow bars), Figure 11 demonstrates that the larger alternatives have relatively higher unit costs for each additional fish meal allowed per year, and EPA's Preferred Alternative has a higher unit cost than Alternative B. Figure 11 also illustrates the dangers of EPA's sole focus on immediate post-construction conditions (red bars). The red bars imply lower unit costs for additional allowable fish meals with the larger alternatives, but this is only true if ongoing natural recovery after the construction period is ignored. Similar to effectiveness measured by SWAC reduction, effectiveness measured by additional allowable fish meals over the long term shows that Alternative I is equally or less effective than the much less costly Alternatives B and D. Also, as noted above, if EPA's entire 30-year period is examined (the period EPA assumes it will take until attainment of the PRGs), the average allowable annual fish meals for Alternative I (average of 31 fish meals/year) is only three more meals than for Alternative B (average of 28 fish meals/year).

Figure 11. Cost for Each Additional Allowable Fish Meal per Year for EPA Alternatives, Immediate Post Construction and at Year 19 after Construction Start.

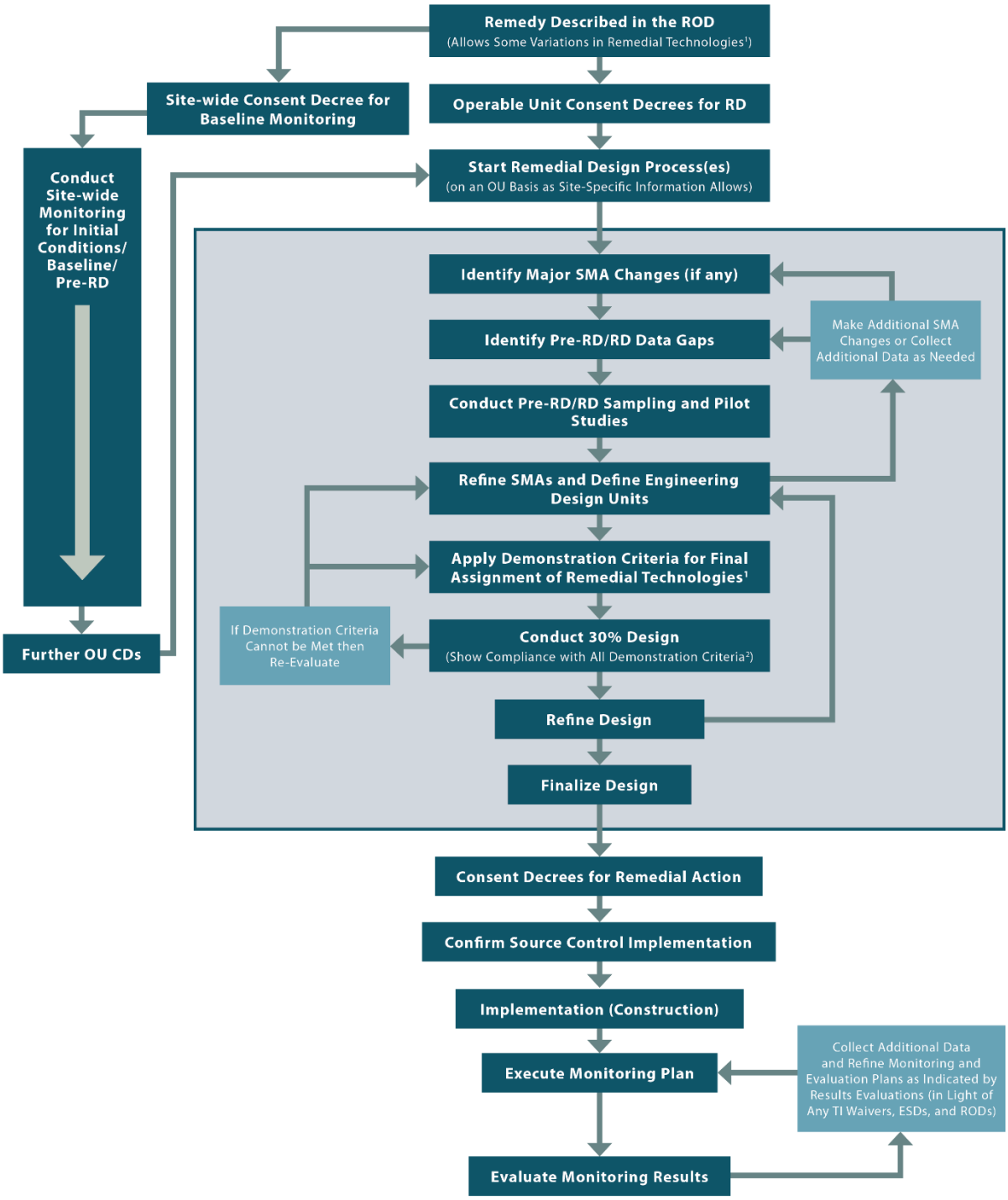


Note: Costs shown based on EPA estimates which appear to be optimistically low as discussed in Section V.F

VI. EPA's Remedy Selection Should include a Plan for How Cleanup will be Implemented Through Baseline Data Collection and Remedial Design and Implementation at Operable Units

Notably missing from EPA's Proposed Plan is a procedural and technical implementation roadmap of how cleanup of Portland Harbor will be accomplished. Having a clear understanding of that roadmap is critical to timely and successful cleanup. The LWG recommends that the ROD define a procedural process similar to Figure 12.

Figure 12. LWG Recommended Iterative Remedial Design/Remedial Action Approach



EPA should manage implementation of cleanup through the identification of operable units. After appropriate data needs are filled and pre-remedial engineering design studies are completed, some operable units may be ready to move into remedial design sooner than others. Remediation in operable units is a key CERCLA program management principle supporting EPA's "bias for action."

The National Contingency Plan provides:

> (ii) *Program management principles.* EPA generally shall consider the following general principles of program management during the remedial process:
>
> (A) Sites should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of total site cleanup.[231]

Contemporaneous initiation of cleanup at some operable units while others undergo additional assessment is entirely consistent with the NCP:

> While the bias for action promotes multiple actions of limited scale, the program's ultimate goal continues to be to implement final remedies at sites. The scoping section of today's rule has been amended to make clear that the lead agency shall conduct strategic planning to identify the optimal set and sequence of actions necessary to address the site problems. Such actions may include, as appropriate, removal actions, interim actions and other types of operable units. Site management planning is a dynamic, ongoing, and informal strategic planning effort that generally starts as soon as sites are proposed for inclusion on the NPL and continues through the RI/FS and remedy selection process and the remedial design and remedial action phases, to deletion from the NPL.[232]

EPA's Sediment Guidance recommends exactly this approach: "Project managers may also consider separating the management of source areas from other, less concentrated areas by establishing separate operable units (OUs) for the site."[233]

---

[231] 40 CFR §300.430(a)(1)(ii). The preamble to the 1990 revisions to the NCP explains,

> A bias for action is consistent with EPA's long-standing policy of responding by distinct operable units at sites as appropriate, rather than waiting to take one consolidated response action. The 1985 NCP originally codified this policy that remedial actions may be staged through the use of operable units.
>
> ***
>
> Consistent with the bias for action principle in today's rule, EPA will implement remedial actions in phases as appropriate using operable units to effectively manage site problems or expedite the reduction of risk posed by the site.
>
> ***
>
> EPA supports the operable unit concept as an efficient method of achieving safer and cleaner sites more quickly while striving to implement total site cleanups. Although the selection of each operable unit must be supported with sufficient site data and alternatives analyses, EPA allows the ROD for the operable unit to use data and analyses collected from any RI/FS performed for the site.

55 Fed. Reg. 8666, 8704-05.

[232] 55 Fed. Reg. at 8706. See also, 53 Fed. Reg. at 51423: "Where problems are reasonably severable, phased responses implemented through a sequence of operable units may promote more rapid risk reduction."

[233] EPA, *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, p. 2-22. EPA's decision to approach other large and diverse Superfund sites as a monolithic whole has been criticized by the scientific community. A 2005 report by the National Academies of Science reviewing EPA's work in the Coeur d'Alene River Basin concluded that EPA's decision to treat a large and diverse area as a single operable unit resulted in a slower, less effective and more uncertain cleanup:

> By combining these different problems into one OU and subjecting them to the process established in the NCP, EPA must attempt to answer all the questions for all the problems before it can attempt to remedy any of them. As a result, the agency must delay action on addressing the more tractable problems until it has all the information it needs to decide what to do about those that are less easily addressed, or, alternatively, it must propose remedies for some of the problems with inadequate information.
>
> ***
>
> As an area increases in complexity, the certainty of cost, volume, and remedial efficacy estimates decreases as does the certainty that selected decisions will be conducted. In reality, these large geographically complex sites like the Coeur d'Alene River basin cannot be

Breaking up the site into operable units would allow EPA to get cleanup started in areas where more information exists while less well-defined areas or areas of lower risk proceed on a parallel path through collection of baseline or "initial conditions" assessment. Figure 12 depicts our recommended programmatic approach to remedial design and implementation at Portland Harbor, which could allow different areas of the Site to move at different rates based upon site-specific information and information to be developed after the ROD.

VII. The Administrative Record, As Supplemented by These Comments, Demonstrates that EPA's Selection of its Preferred Alternative Would Be Arbitrary and Capricious

Appendix A provides additional information for the Administrative Record. This information was exchanged between EPA and the LWG during preparation of the RI/FS, provided by the LWG to EPA in the course of the LWG's work on the RI/FS or previously generated by EPA. The LWG previously recommended that most of these records be placed within the Administrative Record as appendices to relevant LWG deliverables; in most, if not all, cases, EPA required the LWG to remove the records from the deliverables. We are therefore incorporating these and similar records into our comments on the Proposed Plan for inclusion in the Administrative Record file pursuant to 40 CFR §300.815(b). The LWG and its members submitted Freedom of Information Act requests to EPA on March 9, 2016 (as clarified April 4, 2016) and August 11, 2016. EPA has not completed its responses to these requests. The LWG and its members may request that the Administrative Record be supplemented by information EPA provides after the public comment period closes.

Conclusion

EPA has departed so significantly from the baseline risk assessments that it cannot accurately describe the risk reduction attained by each of its alternatives. The unrealistic assumptions EPA has made about the practical and engineering details of its alternatives, together with the simplifying assumptions it has made about the physical, chemical, and temporal properties of the Site, limit EPA to subjective and conclusory evaluations of the performance of those alternatives at attaining its inaccurate risk reduction estimates, and they prevent a meaningful assessment of the impacts of those alternatives on the community and the environment. These errors, compounded with EPA's incomplete and imprecise cost estimating, make it impossible for EPA to shine any real light on why it is making the decision it proposes to make, or how that decision is more than throwing darts at the wall, flipping a coin, or making a sudden knee-jerk decision. A thoughtful review of the evidence before EPA leads instead to the conclusion that less aggressive, shorter duration alternatives, based on site-specific information and current data, are protective, would be as effective at reducing risks identified in the baseline risk assessments, would result in less short-term risk to people and the environment, and would attain the amount of risk reduction achievable through sediment remedies in about the same amount of time and at far less cost than EPA's Preferred Alternative.

In its October 19, 2015, letter to the NRRB, the LWG provided several recommendations on implementing the cleanup, including focusing on the most significant and pervasive risks, selecting cleanup goals that are aligned with the risk assessments and are achievable, treating principal threat waste only where it is more cost-effective than other disposal options, reducing the uncertainty about natural recovery, and maximizing flexibility in remedial design and implementation of the cleanup. Our review of the Proposed Plan has not changed those general recommendations:

- Reasonable PRGs based on appropriate risk management.
- RALs that are appropriately applied to surface sediments consistent with the methods and results of the BLRAs and that focus on active remediation of the highest contaminant concentrations:
  - PCB RAL of 1,000 ppb

---

remediated in a short time frame, and efforts to describe the entirety of the problem and chart a path to completion (as attempted in the Superfund process) become less realistic with increasing complexity of the site.

National Academy of Science, *Superfund and Mining Megasites Lessons Learned from the C'oeur d'Alene River Basin* (2005), pp. 420-21.

  - DDE RAL of 1,000 ppb
  - cPAH (as BaPEq) RAL of 20,000 ppb
  - Designated CBRAs consistent with the multiple lines of evidence evaluation of benthic toxicity in the BERA

- Flexible technology assignments assigned to SMAs or operable units, with an appropriate balance of removal and in-place technologies at the harbor-wide scale (e.g., capping, in situ treatment, and EMNR). We anticipate this will equate to approximately 50% dredging and 50% in-place technologies (by site-wide acreage). Technology assignment must take into account that the longer it takes to implement the remedy, the longer the impact to the river and the fish, and the longer it takes the system to recover.

- No identified PTW. Substantial product at the Gasco Sediment Site will be managed consistent with the 2009 Gasco Consent Order.

- Appropriate application of in situ and ex situ treatment of a significant volume of materials at the Site through application of the above appropriate RALs and technology assignments.

- Use of operable units to manage the Site based on localized chemical and physical characteristics.

- Exclude riverbank soils remedies (leaving those to be designed and implemented through either DEQ upland source control program or future sediment remedial designs).

- Refinement of technology assignment and process options in remedial design (e.g., types of dredging and dredge BMPs types of treatment, and habitat and flood mitigation methods).

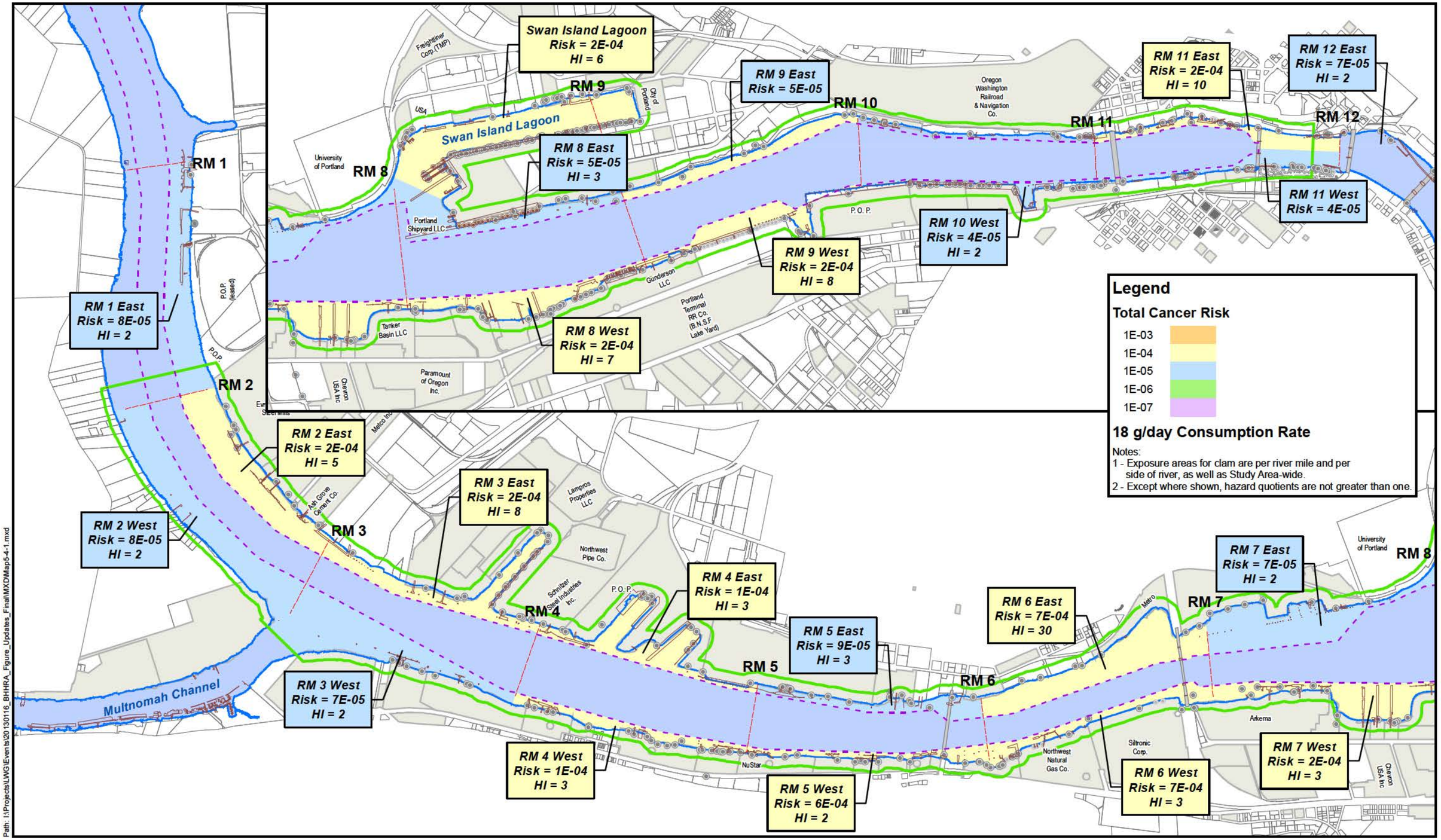
As discussed in these comments, such an alternative would be protective and compliant with ARARs and would be a cost-effective, implementable remedy. The areal extent of SMAs developed under this alternative would be defined based upon evaluation of data collected through additional baseline sampling and during remedial design, and the general balance of technology assignments would be refined or modified during remedial design as appropriate based upon site-specific engineering evaluations and design data. The LWG believes this remedy could be implemented through settlement within a reasonable timeframe following the ROD.

Sincerely,

The Lower Willamette Group

cc: Kristine Koch, US. Environmental Protection Agency, Region 10
Sean Sheldrake, U.S. Environmental Protection Agency, Region 10
Confederated Tribes and Bands of the Yakama Nation
Confederated Tribes of the Grand Ronde Community of Oregon
Confederated Tribes of Siletz Indians of Oregon
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Warm Springs Reservation of Oregon
Nez Perce Tribe
Oregon Department of Fish & Wildlife
United States Fish & Wildlife
Oregon Department of Environmental Quality

TAB 5



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Kennedy/Jenks Consultants
Engineers & Scientists

LWG
LOWER WILLAMETTE GROUP

FEATURE SOURCES:
Transportation, Property, or Boundaries: Metro RLIS.
Channel & River Miles: US Army Corps of Engineers.
Bathymetric Information: David Evans and Associates, Inc.

0 1,000 2,000 Feet

Map Features

- River Miles
- Navigation Channel
- River Edge +13 ft NAVD
- Study Area

Outfalls

- Outfall
- Dock Drain
- Roof Drain

- Bridges
- Docks and Structures
- Waterfront Taxlots
- Upland ECSI Sites (2008)

Map 5-4-1
Portland Harbor RI/FS
Final Remedial Investigation Report
Appendix F: BHHRA
March 28, 2013

Risks from Clam Consumption, RME

TAB 6

DHS
Oregon Department of Human Services

FAX COVER SHEET

Oregon State Public Health
Environmental & Occupational Epidemiology
503-731-4025
Fax: 503-872-5398

Date: 6/13/07	**Sender:** Julie Early
To: Cindy	**Office Name:**
Office Name:	**Address:** 800 NE Oregon St., #827
Address:	**City:** Portland
State: **Zip:**	**State:** OR **Zip:** 97232
Phone No.:	**Phone No.:** 503-731-4025
Fax No.: 503-295-4901	**Fax No.:** 503-872-5398
	Total Pages:

Re: Linntn Comm. Center Report – Portland Harbor

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Let me know if you have any ?'s.

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1 [redacted] : Living in camp trailer and an old car. Came from Texas a few months ago. Move around every few days. Park on vacant industrial land and old roads and parks located between Willbridge and St. Helens. Fish in superfund area in Multnomah Channel and in the Willamette . Their estimated age is about forty or fifty. Found parked on road off Marina Way. Don't know how long they will stay in area. They had been catching crawdads and sturgeon wanted to know the best fishing places. Mostly cook in frying pan on cook stove or boil. Make "fish head soup". (soup made with the boiled heads of any kind of fish. They catch the fishermen before they discard the fishheads and ask for the heads. The heads are boiled and seasoned in a milky broth , eyeballs and all.) They say it's really good.

2 [redacted]: Live in a car. Move around up and down the river. Early teens late twenties. Fish for trout, sturgeon, steelhead bass squawfish. Catch squawfish for money. Bathe with river water. Do not drink river water. Park in abandoned industrial lots, sides of old roads. Move around every night. If park in same place every night police come. Don't know how long will stay in area but probably for summer. The "state" buys the squawfish for money. They pull in with a van at Diddlers Beach by the airport that has ice chests. If the squawfish are over 9" long they pay $6.00. If you have over 100 they pay $10. Cook fish over campfires on a grill or in a frying pan.

3 [redacted]. fishes off the shore for sturgeon, steelhead, salmon, bass crawdads whatever he can catch. Lives "up there" (off Skyline in Forest Park?). Would not disclose exact location where he camps. Fishing at beach in Linnton. "Lives in woods." " Don't always live in woods". Bathes and swims in river. Drinks creek water sometimes and buys water. Eats whatever he catches. Cooks the fish however he can. Sometimes buys bricquets and lighter fuel when its raining and too hard to start a fire. Puts net out for crawdads, pulls net up to the top of the water for a couple of days to let the clean water run through them for a couple of days before he eats them. "Otherwise they taste like mud" He boils them "like lobster".

4 [redacted] on trail off Newberry Rd. Catches catfish to sell to Vietnamese. Eats bass salmon and sturgeon. Fishes in Linnton area. bathes in creek. Just moved camp. Temporarily staying in Forest Park. Bathes in river when camped by river.

5 [redacted] stays in his boat at (b) (6) [redacted]. Takes people fishing for money. Eats all fish, crawfish. Bathes in river, buys water. Eats "whatevers running". Cooks on a stove in his boat. Mostly fries his catch. Does not eat "junk fish".

6 [redacted] approximately fifty years old Lives in (b) (6) [redacted]. Blue tarps are visible from road. Digs in trash at 7-11 for bottles for money. Friends give him fish or he eats fish with friends at their camps. Does not fish himself. Very uncommunicative. Very reclusive. Lives under tarps at side of (b) (6) [redacted] for years. Rides bike. Took 5 pamphlets to give to his friends"vietnam vets that live in the woods" " wont tell nothing else about them."

7 [redacted] stays in (b) (6) [redacted]. Fishes with John on Willamette and Multnomah Channel. Squawfish to sell. Eats sturgeon, bass catfish, "whatever is biting". Bathes in river. Gets $6 to $7 apiece for squawfish, Shad.

8 [redacted] lives in (b) (6) [redacted] when he is homeless or can't find friends to live with. Probably spends winters in houses when he can. Uses drugs. Fishes for bass whatever he can catch. Lives in tent on river bank when no one will let him stay at their house.

9 [redacted] would not disclose exact location of camp but live up trail on (b) (6) [redacted] (b) (6) [redacted] There is a set of stairs and then a trail Each has own shelter behind the police impound lot. Fish for whatever they can catch. Wont eat squawfish, carp or suckers. Suckers are too bony. Drinks from creeks. Wont eat shad.

10 [redacted], just passing through. Stays in trees north of power poles Catches anything he can. Eats anything edible. Clams, carp, shad, suckers bathes in river. Throws out three of four lines pulls in with hands.

11 [redacted]. lives off river and in (b) (6) [redacted]. Catches whatever he can. Throws back carp suckers. Uses crawdads and clams for bait. Does not drink river water. Drinks from little creeks running into the Willamette.

12 [redacted] " a little nuts" fishes camps out on river bathes in river. Lives by power poles in camp most of the time. " Does not handle society well." Eats clams crawdads bass anything he can beg or catch. Drinks from creeks.

13 [redacted] lives in (b) (6) [redacted]. Bathes in creek. "Fishes every once in awhile" Mostly catfish. Drinks from creeks bathes in creeks. Occassionally catches bass. Sometimes eats clams because easy to find and hungry.

14 [redacted]: Fishes in Linnton. (b) (6) [redacted]. Uncommunicative. Met on railroad tracks.

15 [redacted]: [redacted] (b) [redacted] (b) (6) [redacted] (b) [redacted] (b) (6) [redacted] .. Kept several cars running and would move them around to keep police at bay. . (b) (6) [redacted] that lived with them in the vehicles. The state has towed their vehicles several times. Somehow they get them or others back. [redacted] (b) [redacted] . (b) [redacted] (b) (6) [redacted] (b) (6) [redacted] several hours on Sunday evenings to mop the gym floor and clean the bathrooms. . The state towed the bus and most of the vehicles away again about in February. (b) (6) [redacted] then began living in the back of a small white pickup with tarps and a makeshift camper. (b) (6) [redacted]

(b) (6) [redacted]. They do not fish. They eat fish when it is given to them by fishermen.. The steel yard is by a beach on the Willamette that is frequently used by fishermen. They cooked it and all their food in pans on a stove they had set up by the school bus. I do not know how they cook now, but probably set their stove up by the pickup.

16 [redacted] stays in his boat. He moves it up and down the river and channel. He bathes in the river. He usually cooks on a small camp stove.

17 [redacted] stays in a friends garage. He fishes on the east side of the river by the power poles. He uses a camp stove and frying pan. He eats whatever he catches. Does not eat suckers.

18 Two women met on railroad tracks by Linnton. Temporarily camped near Willbridge. Came to Portland to get married. Asked about good fishing spots.

19 Fat Man and girlfriend. Fish for everything. Whatever is biting. Currently camping at power poles. Always leave a big mess when they move camp. Have been around for years. Eat anything. Don't eat "junk fish" carp, squawfish or suckers. Haul water in plastic containers from gas station. Bathe in river. Usually fry fish. Sometimes barbecue depending on weather. Sometimes use wood, sometimes briquets. (b) (6) [redacted]

20 [redacted] stays in (b) (6) [redacted]. Fishes at power poles. Can't drive van due to DUI. Fishes for bass, catfish, squawfish for money. Uses a little fishing pole. Cooks on little campstove.

21 [redacted] move camps up and down river all the way from St. Helens to Willbridge. Fish for sturgeon, catfish, bass, croppie, squawfish for money.

22 [redacted] lives on (b) (6) [redacted]. He has a camp made of tarps. He cooks on fires. Bathes in river. Fishes for edible fish only. No suckers or carp. Sometimes drinks from river but heats the water good. .

23 [redacted] (b) (6) [redacted] The "cops" tore his camp down last winter. Lived with girlfriend. When they tore his camp down he moved his camp to a (b) (6) [redacted]. He uses a rope to get to his camp. Sometimes works as a pipefitter. Has money. He "just loves camping by river". "Doesn't like to be part of society." Relies on river for food. Does not eat "junk fish". Uses crawdads for bait.

Amanda Guay
Dept. of Human Services
800 NE Oregon Street
Portland, Oregon 97232-2162

Pat Wagner
Linnton Community Center
10614 NW St. Helens Rd.
Portland, Oregon 97231

JUN 1 8 2004

June 6, 2004

Dear Amanda Guay,

This project was done in the winter and spring months. In the beginning I attempted to carry the project out myself with the help of (b) (6), a man that has lived and been homeless off and on in the Linnton area for years. (b) has a severe problem with alcohol. (b) lived in a camp on the river last summer and is as well acquainted with the transient population and their habits as a person can be. This approach did not work very well. People avoided me and would not talk. I sometimes felt afraid because the few I was involved with were not friendly or interested in talking with me.

After we realized this was not working (b) and I evaluated and changed our approach to the camp visits.. (b) made the visits by himself because the people would not communicate with me around. (b) enjoys their company. (b) had to spend time visiting them, drinking with them and fishing with them to get some of them to talk. Sometimes he spent the night with them around their campfires. . Even with this approach many did not want to answer many questions. (b) spent countless hours hiking the back trails and abandoned roads and railroad tracks where he had seen homeless people fishing and camping. (b) would just head out with his pockets full of beer and his fishing pole and would run into some that he has known for quite some time or strike up conversations with new people. He could not take notes during the conversations. (b) wrote notes in a notebook he kept in his pocket after he parted ways with the people. This project occurred between February and June.

(b) carried pamphlets in his pockets and would convey the information in the pamphlets about safe fish consumption when the time was appropriate and when he was most likely to get a positive reception. He tried to question them on their habits as best he could without pushing too hard and having them pull away and becoming uncommunicative. He gave each of these people pamphlets and sometimes extras for their friends. (b) said most seemed receptive to the information.

This population is mostly very transient. This project would have best been carried out during the summer months as that is when the population of homeless increases

In response to the questions provided by David Stone Ph.D

Most homeless people spoke to reported not seeing homeless children.

The following businesses have reported to me about homeless children.
Frank Berg, Plant Leader from OWENS CORNING 11910 NW St. Helens Rd. Portland, Oregon Phone: 273-1465, an industry with lots of riverfront property in the Superfund area reports having to tear down a camp with parents and a little girl about three or four years of age a couple of times. He eventually fenced his property to keep them off because it "broke his heart" when the little girl said" Do we have to move again Daddy."

RK Storage, a steel industry on NW Front Avenue, employees, Eric and others have reported the (b) (6) for garbage and not taking care of their children to the police multiple times. At one point (b) (6) . (b) (6)

Enclosed is a newspaper article about one homeless family. Kuney Construction workers observed this man and his child hiking back up into the woods many times. As with most homeless families they were very secretive and elusive.

The police from North Precinct that covers the Linnton area will tell you that there are a very few homeless children living along the river or in Forest Park on occasion. They say that the parents hide their children during the day and only let them out at night. Speak to Sgt. Karl McDade of North precinct about this.

Crawfish, Crayfish and Crawdads are just different names for the same thing.

2000 copies of printed brochures were divided among the ARCO store, Seven Eleven, Freds Marina store, Linnton Feed Store and the Texaco in the Linnton area. . These are the places people buy bait and snacks for fishing trips. Brochures were posted in the windows and on some doors of these businesses. Store employees agreed to give the brochures to people purchasing bait.

Pat Wagner

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ADDENDUM

As this project progressed in the spring we remembered from past summers groups of Hispanic men that migrate to work on Sauvie Island in the farmers fields during the spring and summer months. One large group of these men reside communally in a large house near the Sauvie Island Bridge every summer. When we went to Krugers Farm we observed about five or six Mexican men in the back of a pickup truck just returning from a fishing trip. They did not speak English well enough to communicate effectively with us but indicated they had been fishing in the river nearby.

We did our best to have our brochure translated to the Spanish language and are currently making 1000 copies to be distributed to the farmers, markets and stores on Sauvie Island. There are more brochures than currently needed, however, this population is transient and the brochures should last throughout the summer.