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MEMORANDUM

To:	Dr. Robert Law and Willard Potter, de maximus, inc.	**Date:**	September 14, 2016
From:	Wen Ku, Peter Oates, Peter Israelsson, and John Connolly, Anchor QEA, LLC	**Project:**	120980-02.05
Re:	Proposed COPCs to be Calibrated in the Lower Passaic River/Newark Bay Contaminant Fate and Transport Model		

During the modeling meeting on June 28, 2016, representatives of the U.S. Environmental Protection Agency (USEPA) Region 2 and the Cooperating Parties Group (CPG) discussed the chemicals of potential concern (COPCs) to be modeled in the Lower Passaic River/Newark Bay (LPR/NB) contaminant fate and transport (CFT) model. The CPG expressed concern about the level of effort and value of modeling all of the 29 COPCs requested by Region 2 in its comment to the 17-mile Lower Passaic River Study Area (LPRSA) Remedial Investigation (RI) Report (USEPA 2016a; Comment 372). The CPG argued that a number of the listed chemicals were not likely to influence remedial decision-making and including them would not materially strengthen assessments of the robustness of process parameterizations in the model. The CPG advocated focusing on COPCs likely to influence remedial decision-making and additional chemicals that fill gaps in the range of characteristics needed to assess process parameterization robustness. Region 2 agreed in principle and asked the CPG to propose a subset of COPCs to be modeled that takes account of COPC contributions to risk. Region 2 also agreed that the CPG can focus its calibration efforts on a subset of the selected COPCs and treat the remainder as secondary calibration support (per Region 2's approach in the Focused Feasibility Study [FFS; LBG et al. 2014]). In order to reduce the effort on COPC mapping, Region 2 further agreed that the conditional simulation-based mapping need only to be performed for COPCs of main focus in the remediation benefit evaluation; Thiessen polygon-based mapping may be used for the remainder.

This memorandum describes the method used to select the COPCs that the CPG proposes to model. The goal of this selection process is to minimize the number of COPCs required for

calibration while still meeting the needs of the 17-mile LPRSA RI and addressing the concerns raised by Region 2.

COPC Selection Method

The proposed COPCs were selected using the four criteria below:

1. **Risk:** Given that the objective of the modeling is to predict reductions in risk achieved by remedial alternatives, risk is the primary selection criterion. COPCs are chosen for calibration if the baseline human health carcinogenic risk is greater than or equal to 10^{-5} and/or the non-carcinogenic hazardous quotient (HQ) is greater than or equal to 1. This threshold of carcinogenic risk is within the risk range of 10^{-4} to 10^{-6} that Region 2 specified as the remediation goal in the Record of Decision (ROD) for the lower 8.3 miles of the LPR (USEPA 2016b). The threshold of the non-carcinogenic HQ of 1 is also consistent with the ROD. It is assumed that COPCs with risks below these thresholds would not factor strongly into remedial decision-making, under the expectation that the risk they pose would be reduced as a result of the active remediation and/or natural recovery. Thus, those COPCs are not selected for inclusion in the CFT model unless supported by other criteria.

2. **Octanol-water partition coefficient (Kow):** For the hydrophobic organic compounds of primary focus in the LPR/NB model, Kow values are used to characterize sorptive properties in the selection methodology. Sorption affects the extent to which COPC fate is controlled by processes associated with dissolved and sorbed chemical. Region 2 commented that the Kow values for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and tetrachlorobiphenyl (tetra-CB) (i.e., the COPCs calibrated in the draft 17-mile LPRSA RI [Anchor QEA et al. 2015]) are at the low end of the range of values for the 29 dioxin, furan, and polychlorinated biphenyl (PCB) congeners that are targeted for calibration in Region 2's 2006 *Final Modeling Work Plan* (HQI 2006) and thus do not fully explore the model's transport of sorbed chemical. To address Region 2's concern, if the Kow values of the COPCs selected using the risk criteria do not cover a sufficiently broad range of Kow (using values from the FFS/ROD model [LBG et al. 2014]), additional COPCs are chosen to fill out the range. This criterion results

in adding chemicals of lower risk, but higher Kow (and higher organic carbon-water partition coefficient [Koc[1]]).

3. **Frequency of detection:** COPCs with many non-detect samples in the water column and/or sediments are poor candidates for calibration. The frequency of detection is used to choose among COPCs with lower risk but high Kow being considered to fill out the Kow range. The frequency of detection is also used to determine whether a selected COPC will be considered primary or secondary in the calibration process. Although all COPCs will be subject to the same model-data comparison metrics, more weight will be given to the model-data agreement of the primary calibration COPCs when setting parameter values that are not COPC-specific (e.g., sediment mixing). At least 80% of detect samples from the small-volume chemical water column monitoring (sv-CWCM) are needed for a primary calibration COPC. Similarly, at least 80% detect samples in the sediments will be required for a given primary calibration COPC so that reasonable sediment initial conditions can be developed and a reliable long-term trajectory can be derived for the sediment calibration. The availability of high-volume chemical water column monitoring (hv-CWCM) measurements above the detection limit is also considered in selecting additional COPCs, as these data are used to characterize site-specific sorption within the partitioning framework proposed by the CPG at the June 28, 2016 meeting with Region 2.

4. **Correlation among selected COPC congeners:** Correlations among selected COPCs that are congeners of the same chemical group (e.g., PCBs, dioxins, furans) were examined using linear regressions of surface sediment and water column concentrations. Strong correlation of sediment concentrations suggests a corresponding similarity in the pattern of integrated contaminant fluxes to/from the surface sediments over the long term (i.e., reflecting a balance of initial conditions, boundary conditions, and transport mechanisms within the LPR). Likewise, strong correlation in the sv-CWCM data suggests that present-day fluxes to the water

[1] Koc was referenced in Region 2's edits to action items in the draft summary of the June 28, 2016 meeting; the result of the COPC selection presented below would not be altered if based on a Koc range rather than a Kow range.

column are also similar in pattern. Only one congener per set of strongly correlated congeners is selected for simulation in the CFT model; concentrations of the remaining congeners could be predicted from the modeled congener using data regressions if needed for risk assessment.

COPC Selection Results

Table 1 summarizes the CPG risk estimates, chemical properties, and detection frequencies in the sediment and water column data for each of the 48 COPCs included in Region 2's CFT model for the FFS/ROD, among which are the 29 that were the subject of the aforementioned Region 2 comment. Region 2 requested that these 48 COPCs be subjected to the evaluation described herein. The values of Kow and other chemical properties listed in Table 1 are those used in the FFS/ROD model (Table 3-7; LBG et al. 2014). The risk estimates are based on the CPG's baseline human health risk assessment (BHHRA) reasonable maximum exposure (RME) through fish consumption for current and future anglers, and are calculated for individual dioxin/furan congeners and coplanar PCBs congeners rather than on a toxic equivalent basis. The frequencies of detection are reported for the sv-CWCM and hv-CWCM datasets across all LPR/NB stations and for LPR stations alone, and for the surface (top 6 inches) sediment data in the "1995" and "2010" contaminant mapping datasets.[2]

Eight COPCs are proposed for modeling on the basis of the above selection methodology. These COPCs are highlighted in Table 1, which also shows the proposed level of calibration and type of mapping to be used in simulations. The basis of each selection is briefly summarized below:

- Primary COPCs for calibration:
  - 2,3,7,8-TCDD: Risk > 10^{-4}; HQ > 10.
  - Tetra-CB[3]: To estimate total PCBs (via the data-based regression shown in Figure 1), which has risk > 10^{-4}; HQ > 10.

[2] The 1995 and 2010 datasets used for contaminant mapping contain samples collected from 1995 to 1999, and 2005 to 2013, respectively.
[3] It was concluded from regression analysis that only a marginal improvement will likely be achieved in predicting total PCBs by modeling additional PCB homologs, such as tri-CB and penta-CB.

  - 1,2,3,4,6,7,8-HpCDF: High log Kow (8.67) [and log Koc (9.37)] and high frequency of detection. This congener is also one of the five major congeners found in the Phase 1 removal footprint near Lister Avenue.
  - PCB-167: Intermediate log Kow (7.27) [and log Koc (8.44)] and high frequency of detection.

- Secondary COPCs for calibration:
  - PCB-126: Risk > 10^{-4}; HQ > 10.
  - 1,2,3,7,8-PeCDD: Risk between 10^{-5} and 10^{-4}; HQ between 1 and 10.
  - 2,3,4,7,8-PeCDF: Risk between 10^{-5} and 10^{-4}; HQ between 1 and 10.
  - Mercury: As a surrogate for methyl mercury[4], which has HQ between 1 and 10.

Although PCB-105 and PCB-118 meet the applied risk criteria, they were not selected because of their strong correlation with PCB-167 (see Figure 2; R^2 values are 0.94 or higher).

It is assumed that delineation of active remediation areas for the purpose of constructing Feasibility Study alternatives will be accomplished using the spatial distributions of sediment 2,3,7,8-TCDD and total PCBs, as predicted from tetra-CB concentrations. Consequently, it is proposed that conditional simulation-based mapping be performed only for these two COPCs and that Thiessen polygon-based mapping be performed for the remaining six COPCs that were selected.

References

Anchor QEA (Anchor QEA, LLC), with contributions from AECOM, de maximis, inc., Integral Consulting, mab environmental, LLC, Moffatt & Nichol, and Windward Environmental LLC, 2015. *Remedial Investigation Report.* Remediation Investigation/Feasibility Study. Lower Passaic River Study Area. Prepared for Lower Passaic River Cooperating Parties Group. Draft, February 2015.

HQI (HydroQual Inc.), 2006. *Final Modeling Work Plan.* Lower Passaic River Restoration Project. Mahwah, New Jersey.

[4] Modeling methyl mercury as total mercury with an average conversion factor avoids uncertainty in methyl mercury production/destruction dynamics.

LBG (Louis Berger Group), Battelle, HDR|HydroQual, 2014. *Appendix BIII. Lower Passaic River Contaminant Fate and Transport Model. Remedial Investigation Report for the Focused Feasibility Study of the Lower Eight Miles of the Lower Passaic River.* Prepared for U.S. Environmental Protection Agency, Region 2, and the U.S. Army Corps of Engineers, Kansas City District.

USEPA (U.S. Environmental Protection Agency), 2016a. *EPA Comments to the Draft Lower Passaic River Study Area Remediation Investigation/Feasibility Study Remediation Investigation Report – Section 7 and Modeling Appendices Dated April 2015 and June 2015.* April 2016.

USEPA, 2016b. Record of Decision. Lower 8.3 Miles of the Lower Passaic River. Part of the Diamond Alkali Superfund Site. Essex and Judson Counties, New Jersey. March 2016.

Table 1

Chemical Properties, Estimated Risk, and Data Detection Frequency for COPCs Simulated in Region 2's FFS Contaminant Fate and Transport Model, and Summary of CPG's Proposed Selection for Simulation in the RI/FS Model

Name	Estimated RME Risk[1]		Chemical Properties[2]								% Detection in hv-CWCM Dataset[3]		% Detection in sv-CWCM Dataset[4]		% Detection in Surface Sediments[5]		Proposed Level of Calibration in RI/FS Model	Proposed Type of Mapping in RI/FS Model	Reasons to Include in or Exclude from Proposed Selection for RI/FS Model
	Cancer Risk	Non-Cancer Hazard Quotients (HQ)	Molecular Weight (g/mole)	Log Kow (L/Kg)	Log Koc (L/Kg)	A_{DOC}	ΔH_{OW} (KJ/mole)	K^{salt}	Henry's Constant (Pa m^3/mole)	ΔH_{AW} (KJ/mole)	LPR/ NB	LPR Only	LPR/ NB	LPR Only	1995 Dataset[6]	2010 Dataset[7]			
2378-TCDD	> 10^{-4}	> 10	322.0	6.65	6.81	0.08	0.0	0.35	1.42	0	79%	81%	71%	87%	99%	99%	Primary	CS	Risk
12378-PeCDD	10^{-5} – 10^{-4}	1 – 10	356.4	7.37	7.18	0.08	0.0	0.35	1.38	0	31%	35%	6.0%	7.5%	81%	94%	Secondary	Thiessen	Risk
123478-HxCDD	10^{-6} – 10^{-5}	< 0.1	390.9	8.12	8.20	0.08	0.0	0.35	1.28	0	33%	35%	7.4%	9.8%	92%	95%			Relatively low risk; frequently below detection limit in water column
123678-HxCDD	10^{-6} – 10^{-5}	0.1 – 1	390.9	8.09	8.53	0.08	0.0	0.35	1.35	0	40%	46%	25%	37%	98%	98%			Relatively low risk; frequently below detection limit in water column
123789-HxCDD	10^{-6} – 10^{-5}	< 0.1	390.9	8.10	8.59	0.08	0.0	0.35	1.26	0	44%	58%	28%	33%	95%	97%			Relatively low risk; frequently below detection limit in water column
1234678-HpCDD	< 10^{-6}	< 0.1	425.3	8.82	9.89	0.08	0.0	0.35	1.23	0	65%	77%	80%	87%	99%	100%			Low risk
OCDD	< 10^{-6}	< 0.1	459.8	9.57	10.90	0.08	0.0	0.35	1.21	0	62%	81%	91%	94%	99%	99%			Low risk; strong boundary influence
2378-TCDF	10^{-6} – 10^{-5}	0.1 – 1	306.0	6.54	6.87	0.08	0.0	0.35	2.49	0	81%	77%	31%	40%	99%	97%			Relatively low risk; frequently below detection limit in water column
12378-PeCDF	< 10^{-6}	< 0.1	340.4	7.25	7.28	0.08	0.0	0.35	2.18	0	38%	42%	13%	18%	97%	96%			Low risk
23478-PeCDF	10^{-5} – 10^{-4}	1 – 10	340.4	7.23	7.38	0.08	0.0	0.35	2.36	0	56%	65%	29%	41%	98%	98%	Secondary	Thiessen	Risk
123478-HxCDF	10^{-6} – 10^{-5}	0.1 – 1	374.9	7.96	7.97	0.08	0.0	0.35	2.01	0	58%	73%	66%	77%	99%	99%			Relatively low risk; Kow range covered by other chemicals with higher detection frequency
123678-HxCDF	10^{-6} – 10^{-5}	0.1 – 1	374.9	7.95	8.16	0.08	0.0	0.35	2.06	0	42%	46%	36%	48%	99%	98%			Relatively low risk; frequently below detection limit in water column
123789-HxCDF	< 10^{-6}	< 0.1	374.9	7.95	6.97	0.08	0.0	0.35	1.98	0	1.9%	0%	0.9%	1.1%	90%	37%			Low risk
234678-HxCDF	10^{-6} – 10^{-5}	< 0.1	374.9	7.96	8.04	0.08	0.0	0.35	1.93	0	48%	54%	30%	44%	99%	98%			Relatively low risk; frequently below detection limit in water column

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Name	Estimated RME Risk[1]		Chemical Properties[2]								% Detection in hv-CWCM Dataset[3]		% Detection in sv-CWCM Dataset[4]		% Detection in Surface Sediments[5]		Proposed Level of Calibration in RI/FS Model	Proposed Type of Mapping in RI/FS Model	Reasons to Include in or Exclude from Proposed Selection for RI/FS Model
	Cancer Risk	Non-Cancer Hazard Quotients (HQ)	Molecular Weight (g/mole)	Log Kow (L/Kg)	Log Koc (L/Kg)	A_{DOC}	ΔH_{OW} (KJ/mole)	K^{salt}	Henry's Constant (Pa m^3/mole)	ΔH_{AW} (KJ/mole)	LPR/ NB	LPR Only	LPR/ NB	LPR Only	1995 Dataset[6]	2010 Dataset[7]			
1234678-HpCDF	$< 10^{-6}$	< 0.1	409.3	8.67	9.37	0.08	0.0	0.35	1.75	0	63%	69%	84%	87%	99%	100%	Primary	Thiessen	Low risk but with high Kow and high frequency of detected samples; one of the five major congeners in the Lister Avenue Phase 1 removal fingerprint
1234789-HpCDF	$< 10^{-6}$	< 0.1	409.3	8.67	8.74	0.08	0.0	0.35	1.75	0	33%	35%	16%	23%	98%	95%			Low risk
OCDF	$< 10^{-6}$	< 0.1	443.8	9.37	10.30	0.08	0.0	0.35	1.6	0	42%	46%	76%	78%	99%	100%			Low risk
Mono-CB	–	–	188.7	4.63	6.39	0.08	-22.9	0.35	20.4	50.7	81%	69%	83%	88%	100%	99%			Not needed for adequate estimate of total PCBs
Di-CB	–	–	223.1	5.00	6.04	0.08	-23.5	0.35	23.8	48.7	90%	92%	100%	100%	100%	100%			Not needed for adequate estimate of total PCBs
Tri-CB	–	–	257.5	5.60	6.20	0.08	-24.2	0.35	28.1	42.5	85%	92%	100%	100%	100%	100%			Not needed for adequate estimate of total PCBs
Tetra-CB	–	–	292.0	6.00	6.27	0.08	-24.9	0.35	36	27.7	88%	92%	100%	100%	100%	100%	Primary	CS	To estimate total PCBs
Penta-CB	–	–	326.4	6.45	6.62	0.08	-25.7	0.35	45.2	33.5	96%	100%	100%	100%	100%	100%			Not needed for adequate estimate of total PCBs
Hexa-CB	–	–	360.9	6.85	7.15	0.08	-26.8	0.35	57.5	67.3	94%	100%	100%	100%	100%	100%			Not needed for adequate estimate of total PCBs
Hepta-CB	–	–	395.3	7.22	7.75	0.08	-27.6	0.35	58.1	111	71%	73%	99%	100%	100%	100%			Not needed for adequate estimate of total PCBs
Octa-CB	–	–	429.8	7.63	8.21	0.08	-28.4	0.35	40.8	160	69%	65%	99%	100%	100%	100%			Not needed for adequate estimate of total PCBs
Nona-CB	–	–	464.2	7.99	8.72	0.08	-29.3	0.35	63.8	154	69%	77%	98%	99%	100%	100%			Not needed for adequate estimate of total PCBs
Deca-CB	–	–	498.7	8.18	9.01	0.08	-29.9	0.35	97.5	145	65%	65%	92%	91%	100%	100%			Not needed for adequate estimate of total PCBs
PCB-77	$10^{-6} – 10^{-5}$	< 0.1	292.0	6.36	7.46	0.08	-28.2	0.35	16.7	57.5	100%	100%	99%	99%	98%	99%			Relatively low risk; Kow range covered by other chemicals
PCB-81	$< 10^{-6}$	< 0.1	292.0	6.36	6.69	0.08	-28.2	0.35	25.8	57.5	44%	19%	43%	52%	100%	79%			Low risk
PCB-105	$10^{-5} – 10^{-4}$	0.1 – 1	326.4	6.65	7.64	0.08	-27.9	0.35	33.9	59.5	98%	100%	99%	99%	99%	100%			Risk, but not selected due to strong correlation with PCB-167

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Name	Estimated RME Risk[1]		Chemical Properties[2]								% Detection in hv-CWCM Dataset[3]		% Detection in sv-CWCM Dataset[4]		% Detection in Surface Sediments[5]		Proposed Level of Calibration in RI/FS Model	Proposed Type of Mapping in RI/FS Model	Reasons to Include in or Exclude from Proposed Selection for RI/FS Model
	Cancer Risk	Non-Cancer Hazard Quotients (HQ)	Molecular Weight (g/mole)	Log Kow (L/Kg)	Log Koc (L/Kg)	A_{DOC}	ΔH_{OW} (KJ/mole)	K^{salt}	Henry's Constant (Pa m^3/mole)	ΔH_{AW} (KJ/mole)	LPR/ NB	LPR Only	LPR/ NB	LPR Only	1995 Dataset[6]	2010 Dataset[7]			
PCB-114	$10^{-6} – 10^{-5}$	< 0.1	326.4	6.65	7.57	0.08	-27.9	0.35	36.7	59.5	85%	77%	91%	95%	95%	97%			Relatively low risk; Kow range covered by other chemicals
PCB-118	$10^{-5} – 10^{-4}$	1 – 10	326.4	6.74	7.65	0.08	-27.9	0.35	36.3	59.5	98%	100%	99%	98%	100%	100%			Risk, but not selected due to strong correlation with PCB-167
PCB-123	$< 10^{-6}$	< 0.1	326.4	6.74	7.34	0.08	-27.9	0.35	36.7	59.5	88%	85%	91%	94%	92%	97%			Low risk
PCB-126	$> 10^{-4}$	> 10	326.4	6.89	7.42	0.08	-29.8	0.35	21.3	60.5	52%	35%	45%	57%	42%	90%	Secondary	Thiessen	Risk
PCB-156	$10^{-6} – 10^{-5}$	0.1 – 1	360.9	7.18	8.37	0.08	-29.4	0.35	37	62.4	77%	85%	93%	94%	98%	98%			Relatively low risk; Kow range covered by other chemicals
PCB-157	$< 10^{-6}$	< 0.1	360.9	7.18	8.37	0.08	-29.4	0.35	37	62.4	77%	85%	93%	94%	94%	98%			Low risk
PCB-167	$10^{-6} – 10^{-5}$	0.1 – 1	360.9	7.27	8.44	0.08	-29.4	0.35	39.2	62.4	88%	88%	97%	99%	97%	99%	Primary	Thiessen	Relatively low risk, but intermediate Kow and high frequency of detected samples
PCB-169	$10^{-6} – 10^{-5}$	< 0.1	360.9	7.42	7.35	0.08	-31.3	0.35	23.4	63.4	7.7%	15%	17%	27%	6%	17%			Relatively low risk; frequently below detection limit in water column
PCB-189	$10^{-6} – 10^{-5}$	< 0.1	395.3	7.71	8.33	0.08	-31.0	0.35	28.8	65.3	56%	58%	51%	65%	89%	96%			Relatively low risk; Kow range covered by other chemicals with higher detection frequency
2,4'-DDD	$< 10^{-6}$	< 0.1	320.1	6.08	6.41	0.08	0.0	0	0.85	0	NS	NS	88%	95%	8%	94%			Low risk
2,4'-DDE	$< 10^{-6}$	< 0.1	318.0	6.72	7.07	0.08	0.0	0	4.61	0	NS	NS	56%	67%	8%	90%			Low risk
2,4'-DDT	$< 10^{-6}$	< 0.1	354.5	6.60	6.85	0.08	0.0	0	2.86	0	NS	NS	29%	45%	0%	78%			Low risk
4,4'-DDD	$10^{-6} – 10^{-5}$	0.1 – 1	320.1	6.18	6.42	0.08	0.0	0	0.74	0	NS	NS	93%	99%	75%	90%			Relatively low risk; Kow range covered by other chemicals
4,4'-DDE	$10^{-6} – 10^{-5}$	0.1 – 1	318.0	6.79	7.26	0.08	0.0	0	4.63	0	NS	NS	86%	92%	80%	96%			Relatively low risk; Kow range covered by other chemicals
4,4'-DDT	$< 10^{-6}$	< 0.1	354.5	6.73	7.38	0.08	0.0	0	2.36	0	NS	NS	63%	74%	58%	83%			Low risk
Cadmium	$< 10^{-6}$	< 0.1	112.4	–	–	–	0.0	0	0.000329	0	NS	NS	100%	100%	96%	96%			Low risk
Mercury	$< 10^{-6}$	0.1 – 1	200.6	–	–	–	0.0	0	729	0	NS	NS	100%	100%	94%	99%	Secondary	Thiessen	As a surrogate for methyl mercury, for reasons noted below

Table 1

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	Cancer Risk	Non-Cancer Hazard Quotients (HQ)	Molecular Weight (g/mole)	Log Kow (L/Kg)	Log Koc (L/Kg)	A_{DOC}	ΔH_{OW} (KJ/mole)	K^{salt}	Henry's Constant (Pa m^3/mole)	ΔH_{AW} (KJ/mole)	LPR/ NB	LPR Only	LPR/ NB	LPR Only	1995 Dataset[6]	2010 Dataset[7]			
Methyl Mercury	$< 10^{-6}$	1 – 10	215.6	–	–	–	0.0	0	0.000329	0	NS	NS	95%	100%	NS	99%			Non-cancer risk. Model as total mercury with an average conversion factor, to avoid uncertainty in methyl mercury production/destruction dynamics

Notes:
The highlighted rows are the proposed chemicals of potential concern (COPCs) for the contaminant fate and transport modeling.
Percent detection for polychlorinated biphenyl (PCB) homologs in surface sediments does not include those derived from total PCBs.

CS = conditional simulation
CWCM = chemical water column monitoring
FFS = Focused Feasibility Study
hv = high volume
LPR = Lower Passaic River
– = not available
NB = Newark Bay
NS = not sampled
RI/FS = Remedial Investigation/Feasibility Study
RME = reasonable maximum exposure
sv = small volume

1. Based on RME fish consumption risks/hazards in the CPG baseline human health risk assessment, provided by AECOM.
2. Chemical properties from Table 3-7 of the 2014 USEPA FFS model report (LBG et al. 2014, Appendix BIII).
3. Based on all contaminant data from all stations measured in the hv-CWCM program.
4. Excluding data measured in the tributaries, upstream Dundee Dam, Hackensack River, and the Kills.
5. Surface sediments denotes the top 6-inches of sediment.
6. The "1995" contaminant mapping dataset contains samples collected from 1995 to 1999.
7. The "2010" contaminant mapping dataset contains samples collected from 2005 to 2013.

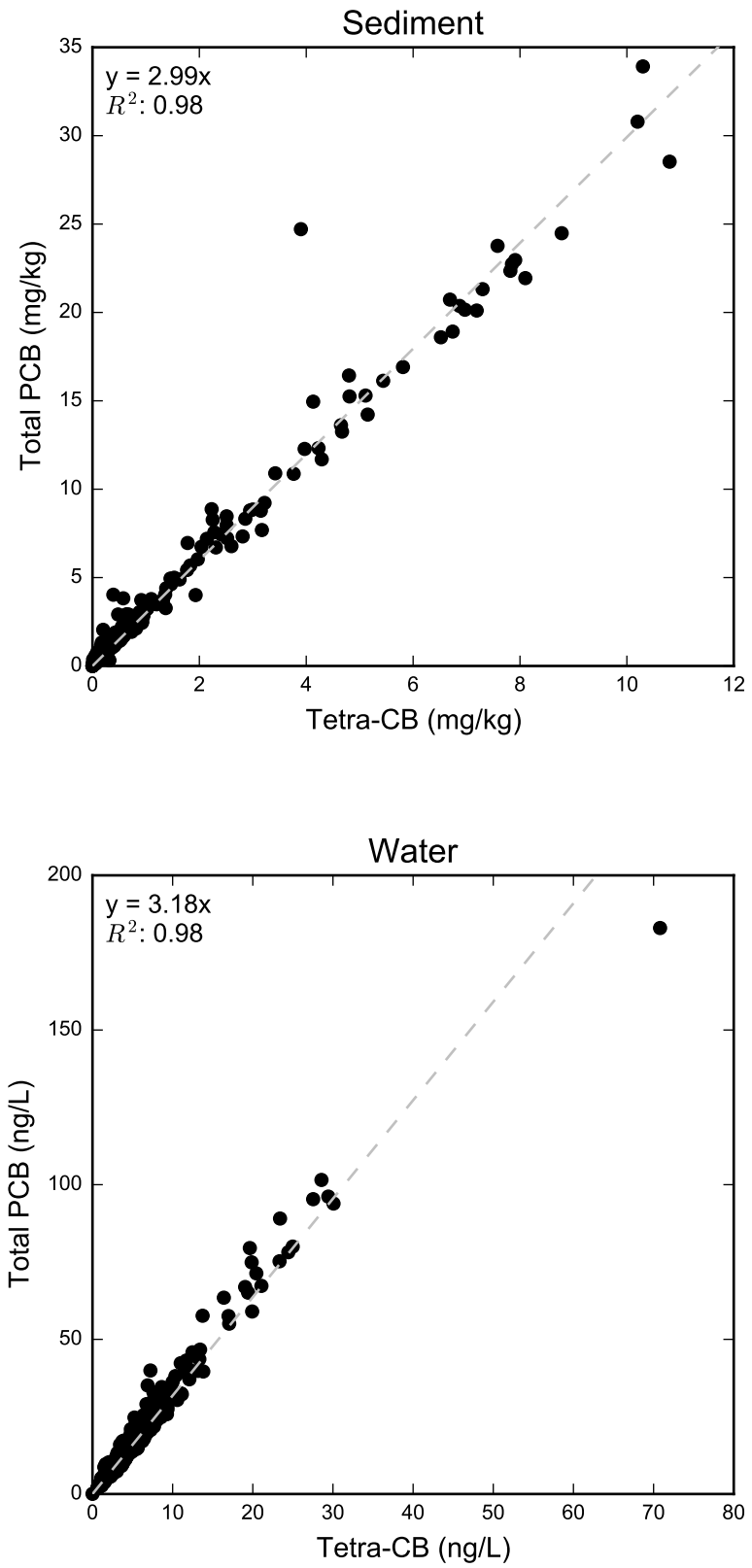

Figure 1
Correlations of Total PCB with Tetra-CB in Surface (Top 6 inches) Sediments and Water Column in Lower Passaic River and Newark Bay

Dashed line represents linear regression without an intercept. Non-detect samples removed.
Data sources: Sediment data collected during 2005-2013; water column data collected from sv-CWCM during 2011-2013.

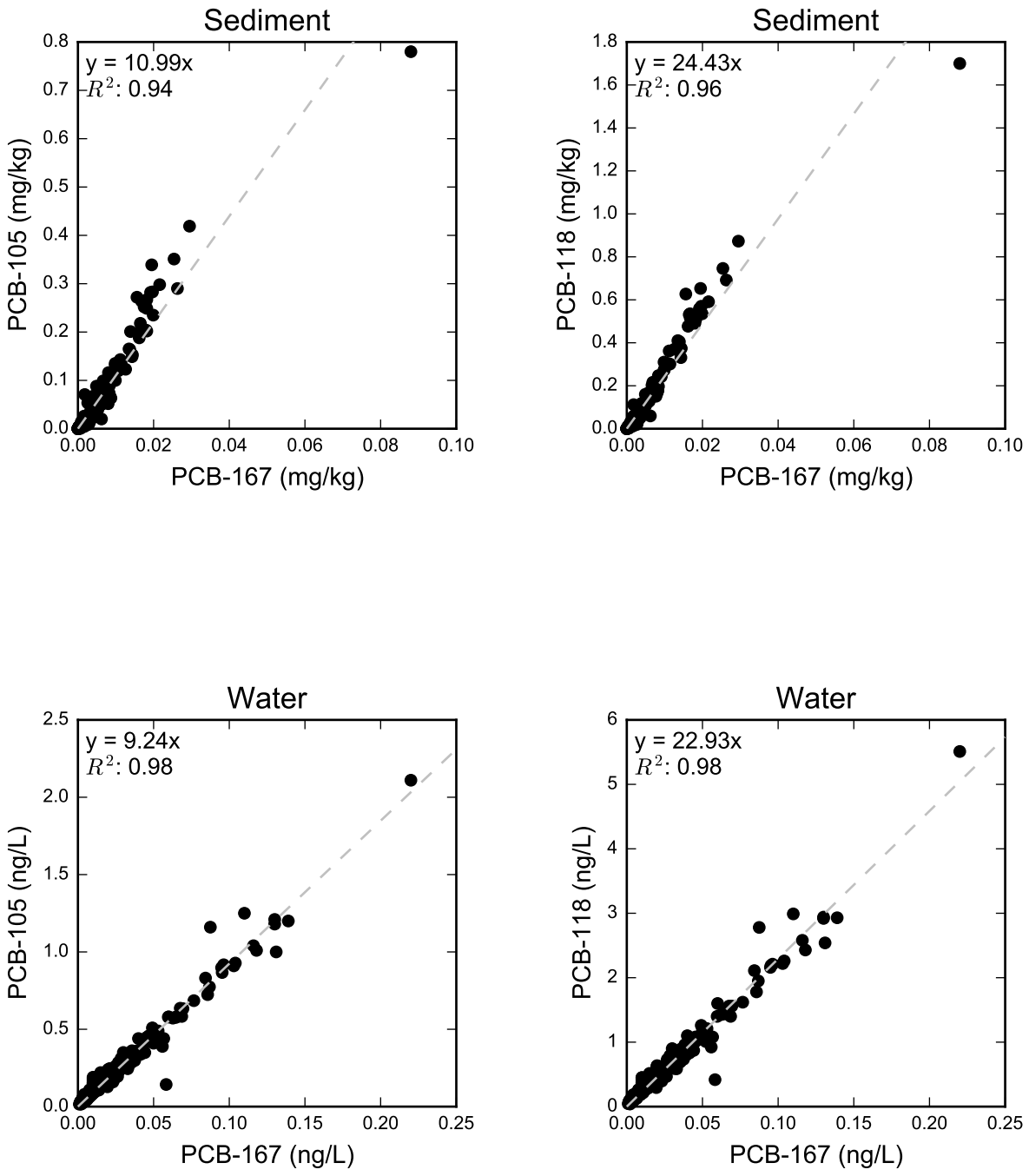

Figure 2
Correlations of PCB-105 and PCB-118 with PCB-167 in Surface (Top 6 inches) Sediments and Water Column in Lower Passaic River and Newark Bay

Dashed line represents linear regression without an intercept. Non-detect samples removed.
Data sources: Sediment data collected during 2005-2013; water column data collected from sv-CWCM during 2011-2013.