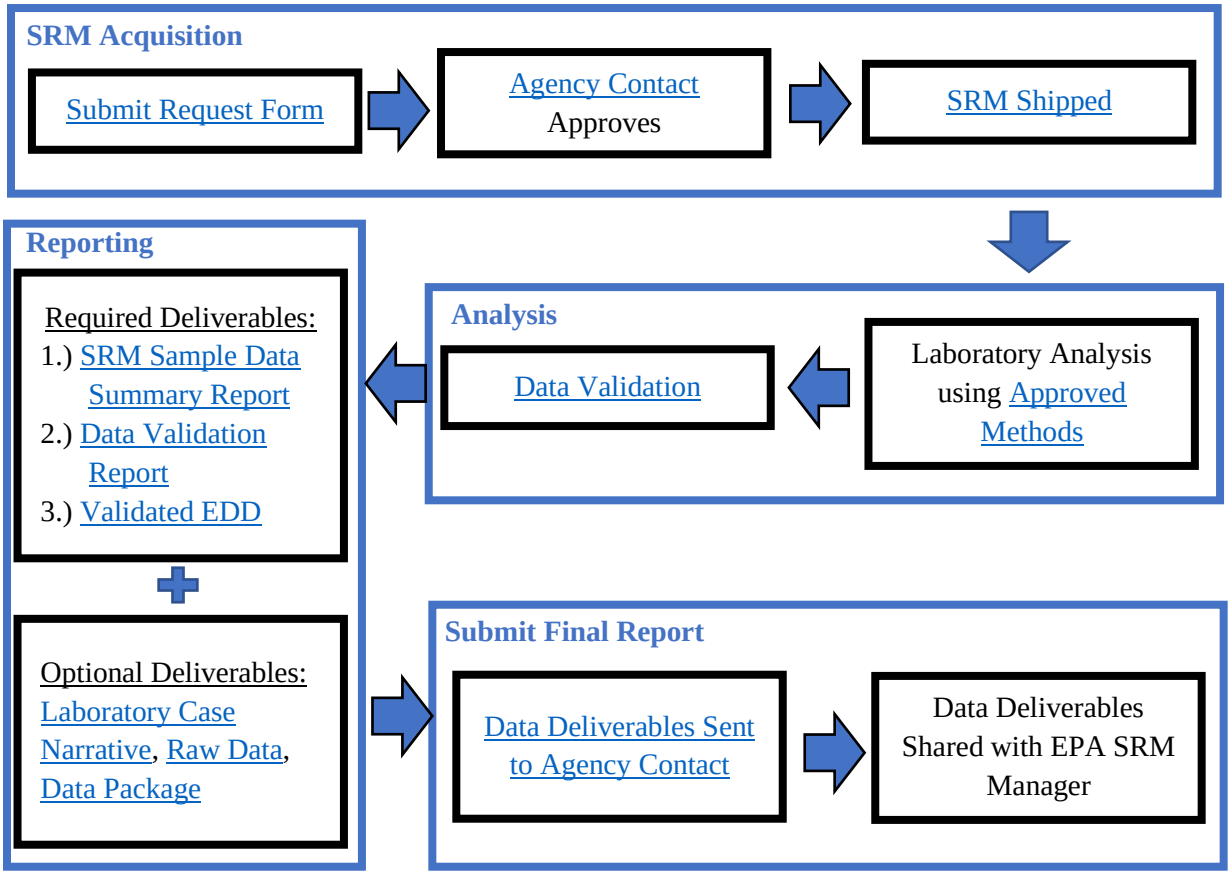
Puget Sound Sediment Reference Material: Guidance and Procedures

Introduction

The Puget Sound Sediment Reference Material (SRM) was prepared from marine sediment collected from Puget Sound. The SRM was developed to assess measurement accuracy and evaluate laboratory performance when analyzing low-level chlorinated dioxins and furans (D/F), and polychlorinated biphenyl (PCB) compounds in sediment samples collected in the Pacific Northwest. The SRM is available free of charge through the agency providing project oversight, though recipients or requestors must pay shipping costs. This document provides instructions for acquisition, analysis, validation, and reporting on the SRM. The guidance and procedures outlined here ensure that all SRM users agree to:

- Submit request form to the appropriate agency contacts
- Use approved methods for analysis
- Verify and validate SRM results
- Report methods used for analysis and quality assurance (QA) / quality control (QC) procedures
- Provide results for inclusion in periodic recalculations of acceptance limits

Procedure



Acquisition

1. From the DMMO website, download the SRM request form.
2. Complete the form and submit to the agency contact.
3. The agency contact reviews, approves, and submits to the EPA Region 10 SRM Manager for processing. Requests are typically processed within a week.

Agency Contacts

The Seattle District US Army Corps of Engineers Dredged Material Management Office (DMMO), Washington Department of Ecology, Washington Department of Natural Resources, and US EPA Region 10 have staff assigned to distribute the SRM in support of agency missions, including regulatory programs. Agency contacts (listed in Table 1) have the authority to review and approve SRM requests and the responsibility to coordinate with and report results to EPA's SRM Manager. Additionally, agency contacts are available to help with any questions about the request form.

Table 1. Agency Contacts

Name	Phone Number	Email
US Army Corps of Engineers, Dredged Materials Management Office (DMMO), Seattle District		
Joy Dunay	(206) 764 – 6083	joy.m.dunay@usace.army.mil
Kelsey van der Elst	(206) 764 – 6945	kelsey.vanderelst@usace.army.mil
Brian Hester	(206) 764 – 6175	brian.w.hester@usace.army.mil
Washington Department of Ecology		
Laura Inouye	(360) 515-8213	lino461@ecy.wa.gov
Washington Department of Natural Resources		
Shannon Soto	(360) 999 – 8094	shannon.soto@dnr.wa.gov
US Environmental Protection Agency, Region 10		
Sarah Burgess	(206) 553 – 6698	burgess.sarah@epa.gov
Whitney Conard	(206) 553 – 0692	conard.whitney@epa.gov
Madi Novak	(503) 326 – 3277	novak.elisabeth@epa.gov
Gerald Dodo, Region 10 Lab Supervisor	(360) 871 – 8728	dodo.gerald@epa.gov
Cindy Fields, QA Manager	(206) 553 – 1893	fields.cindy@epa.gov
Raymond Wu, SRM Manager	(206) 553 – 1413	wu.raymond@epa.gov

Example Request Processes

1. Clean Water Act Section 404 permit applicants for discharge of dredged or fill material would submit the completed request form to the Seattle District Corps of Engineers DMMO contact.
2. A contractor performing work under CERCLA for Superfund sites would submit the completed request form to the EPA Remedial Project Manager who would then submit to an EPA contact.
3. Projects supporting Washington's ambient sediment monitoring program would submit the completed request form to the Ecology contact.
4. Projects involving sediment sampling at locations with sub-tidal lease authorizations from the Washington Department of Natural Resources (WDNR) would submit the completed request form to the WDNR contact.

Shipping

The SRM is stored at the US EPA Region 10 Manchester Environmental Laboratory (MEL) in Port Orchard, Washington. SRM recipients listed on the request form should be prepared to confirm shipping details (including UPS or FedEx account number) if contacted by MEL. When the SRM has been shipped, MEL notifies the EPA Region 10 SRM Manager, the authorized agency contact indicated on the request form, and the destination laboratory. All emails must include the project name as indicated on the request form. The SRM will arrive with specific instructions on handling and storage, data reporting, and chain of custody paperwork.

Storage

The SRM could contain compounds that are light sensitive and should be protected from light during storage. Store the SRM at ≤ 6°C, preferably at < 0°C, until SRM preparation and analysis is to occur. Allow the bottle(s) to reach ambient temperature before opening.

The DMMP allows previously opened SRM bottles to continue to be used if the bottle has been securely stored per the handling and storage requirements. Users must make careful note of the bottle number, and ensure it is reported, along with all other required deliverables as outlined in the Reporting section below.

Analysis

Acceptance limits have been established for the SRM for D/F and/or PCB congener analysis using high resolution gas chromatography / high resolution mass spectrometry (HRGC/HRMS) methods. The SRM may be suitable for Aroclor 1260 analysis using gas chromatography/electron capture detection (GC/ECD) methods. Given that the SRM only has an acceptance limit for one Aroclor mixture, it may not be suitable for all projects performing primarily Aroclor investigations. Acceptance limits for emerging contaminants of concern, such as per-and polyfluoroalkyl substances (PFAS), may be available in the future. Current acceptance limits for D/F and PCB congeners are included in the appendix.

Methods to be used must be clearly defined in the quality assurance project plan or sampling and analysis plan approved by the appropriate agencies. Preferred analytical methods are described in the DMMP User Manual, which is available on the DMMO website.

Data Validation

SRM users may be held to different data validation requirements, depending on their program and project circumstances. Data must be validated to a minimum of EPA Stage 2B, per DMMP User Manual recommendations. Data validation stages are described in *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA 2009). Any validation narrative must indicate the validation stage used.

Reporting

The original SRM requester is responsible for ensuring that all information relative to the SRM, including associated QC sample results and an electronic data deliverable (EDD) containing validated data, is sent to the agency contact. It is the responsibility of the agency contact to submit all project data and validation reports to the EPA Region 10 SRM Manager.

For SRM data meeting established QC requirements, the agency contact will submit the validated EDD, Level 2 laboratory reports containing SRM results and associated QC sample results, and the validation reports relevant to the SRM to the EPA Region 10 SRM Manager. Changes made by the data validator (e.g., modification of data qualifiers) must be clearly indicated in the EDD and validation report.

The following are the minimum required deliverables for SRM data submissions. Also included below are optional deliverables that may or may not be needed depending on the available deliverables.

Required Deliverables

The required deliverables should be provided by the original SRM requester to the agency contact who will share this with the EPA Region 10 SRM Manager. The project name and SRM bottle number should be included in the email subject line.

1. **SRM Sample Data Summary Report** – either a Level 2 laboratory report, or a Contract Laboratory Program Form 1, providing a summary of the analytical parameters, analytical results, reporting limits, and laboratory qualifiers. At a minimum, the sample data summary report should include the following:

    - Identification and quantitation of target analytes including dilution and reanalysis
    - CAS numbers
    - Laboratory name
    - Project number
    - Project name
    - Sample ID number (SRM bottle bar code)
    - Agency sample number (if applicable)
    - Laboratory sample number
    - Date SRM received by the lab

- Date and time of analysis
- For PCB Aroclor data, laboratory reporting limits and method detection limits
- For PCB Congener and D/F data, laboratory reporting limits and estimated detection limits
- Laboratory qualifiers and definitions

2. **Data Validation Report** – report that documents the analytical quality of the SRM data. This report confirms that data validation was completed to at least an EPA Stage 2B, per DMMP User Manual recommendations. The report documents the reasons for any failure to meet method, procedural, or contractual requirements, and provides an evaluation of the impact of such failure on the overall data set.

3. **Validated Electronic Data Deliverable (EDD**) – an electronic, tabular format for sharing, manipulating, and using the data. EDDs should be submitted in Ecology's EIM format.

Optional Deliverables

Laboratory Case Narrative – laboratory report narrative that describes the analytical process used to analyze the samples and any problems encountered in processing the samples, along with corrective action taken and problem resolution. The case narrative should be submitted with the SRM data if there were significant problems during sample analysis that affected the SRM or if there are other observations relevant to the SRM.

Raw Data – laboratory worksheets, records, notes, or instrument printouts that are the result of original observations and activities. The chromatograms and integration reports associated with the SRM should be submitted with the SRM Sample Data Summary Report, if possible.

Data Package – the entire laboratory package including all narratives, sample summary reports, QC reports, calibrations, and raw data. The full data package should only be submitted if there were significant QC failures that affect the SRM result or if the data did not go through the data validation process.

References

US Environmental Protection Agency (USEPA). 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, EPA-540-R-08-005.

Strout, K. 2013. Development and Production of the Puget Sound Sediment Reference Material SR0431.

Strout, K. 2023. Development and Production of the Puget Sound Sediment Reference Material SR0431 – Advisory Control Limits Update.

Acceptance Limit Assessment

In 2013, lab round-robin analyses of the SRM for PCB Aroclor 1260 and D/F established an initial acceptance limit for each compound (Strout 2013). In 2023, the Quality Assurance Technical Support

(QATS) Laboratory (Las Vegas, Nevada) recalculated advisory control limits by combining the initial 2013 study data with new data that have become available through projects in the Pacific Northwest. A total of 92 PCB Aroclor and 76 D/F samples were used for statistical processing (Strout 2023).

The DMMP reviews data results and reports on a case-by-case basis and considers new values shared from regional projects as advisory. For each individual project, the implications associated with not meeting acceptance limits should be determined by data reviewers on a case-by-case basis and based on the goals of each program/project.

PCB Aroclors

The updated 2023 acceptance limits for Aroclor 1260 were calculated with 99% confidence interval around an updated average of 113 µg/kg resulting in advisory control limits of 62 µg/kg (low) to 164 µg/kg (high).

Dioxins and Furans

The updated 2023 advisory control limits are based on the 99% confidence interval around the average results (Table 2). The updated 2023 advisory control limits have a higher degree of statistical defensibility than the 2013 advisory control limits that were set using arbitrary advisory control limits based on ±50% around the average results.

Table 2. Advisory Control Limits - D/F Analytes

D/F Target Analyte	CAS Number	Average Concentration (ng/kg)	Advisory Control Limits* (ng/kg)	
			Low	High
2,3,7,8-TCDD	1746-01-6	1.04	0.671	1.42
1,2,3,7,8-PeCDD	40321-76-4	1.17	0.562	1.79
1,2,3,4,7,8-HxCDD	39227-28-6	1.51	0.844	2.17
1,2,3,6,7,8-HxCDD	67653-85-7	3.95	2.48	5.42
1,2,3,7,8,9-HxCDD	19408-74-3	2.92	1.85	3.99
1,2,3,4,6,7,8-HpCDD	35822-46-9	103	76.3	129
OCDD	3268-87-9	888	584	1190
2,3,7,8-TCDF	51207-31-9	0.917	0.505	1.33
1,2,3,7,8-PeCDF	57117-41-6	1.10	0.510	1.69
2,3,4,7,8-PeCDF	57117-31-4	0.915	0.421	1.41
1,2,3,4,7,8-HxCDF	70648-26-9	2.95	1.88	4.01
1,2,3,6,7,8-HxCDF	57117-44-9	1.04	0.457	1.61
1,2,3,7,8,9-HxCDF	72918-21-9	0.604	NL	1.24
2,3,4,6,7,8-HxCDF	60851-34-5	1.83	0.655	3.01
1,2,3,4,6,7,8-HpCDF	67562-39-4	19.8	14.2	25.3
1,2,3,4,7,8,9-HpCDF	55673-89-7	1.65	0.957	2.35
OCDF	39001-02-0	60.9	30.1	91.7

*The 2023 Advisory Control Limits for 2,3,7,8-chlorinated D/F analytes are based on updated results and associated statistics using the 99% confidence interval around the average concentrations. The data used to calculate these limits includes the 2013 and 2023 data.

PCB Congeners

In 2023, no updates were made to PCB congener acceptance limits. In 2013, a ten-lab round-robin testing of the SRM was used to calculate an acceptance limit of ±50% action low and action high for each congener. Table 3 contains individually eluting PCB congener acceptance limits while Table 4 contains co-eluting congeners acceptance limits. Co-eluting congeners may vary from those listed in Table 4.

Table 3. Individually Eluting PCB Congeners

Congener Number	*Target Analyte*	Chlorine Level*	Avg	SD	Acceptance Low	Acceptance High
			ng/kg dry weight			
1	2-Chlorobiphenyl	1	23	2.6	**12**	**35**
3	4-Chlorobiphenyl	1	25	8.4	**13**	**38**
4	2,2'-Dichlorobiphenyl	2	114	16.5	**57**	**171**
6	2,3'-Dichlorobiphenyl	2	169	30.4	**85**	**254**
7	2,4-Dichlorobiphenyl	2	17	3.3	**8**	**25**
8	2,4'-Dichlorobiphenyl	2	366	65.5	**183**	**548**
9	2,5-Dichlorobiphenyl	2	20	4.0	**10**	**29**
11	3,3'-Dichlorobiphenyl	2	74	10.5	**37**	**110**
15	4,4'-Dichlorobiphenyl	2	308	36.5	**154**	**462**
16	2,2',3-Trichlorobiphenyl	3	212	21.3	**106**	**318**
17	2,2',4-Trichlorobiphenyl	3	363	31.7	**182**	**545**
19	2,2',6-Trichlorobiphenyl	3	68	9.7	**34**	**102**
22	2,3,4'-Trichlorobiphenyl	3	385	47.8	**192**	**577**
25	2,3',4-Trichlorobiphenyl	3	245	34.8	**122**	**367**
27	2,3',6-Trichlorobiphenyl	3	81	6.5	**40**	**121**
31	2,4',5-Trichlorobiphenyl	3	1132	113.8	**566**	**1697**
32	2,4',6-Trichlorobiphenyl	3	237	30.9	**118**	**355**
35	3,3',4-Trichlorobiphenyl	3	26	4.3	**13**	**39**
37	3,4,4'-Trichlorobiphenyl	3	355	44.7	**178**	**533**
42	2,2',3,4'-Tetrachlorobiphenyl	4	413	55.9	**206**	**619**
46	2,2',3,6'-Tetrachlorobiphenyl	4	75	11.8	**37**	**112**
48	2,2',4,5-Tetrachlorobiphenyl	4	246	44.4	**123**	**369**
52	2,2',5,5'-Tetrachlorobiphenyl	4	3743	447.6	**1871**	**5614**
56	2,3,3',4'-Tetrachlorobiphenyl	4	651	139.8	**326**	**977**
60	2,3,4,4'-Tetrachlorobiphenyl	4	253	124.4	**126**	**379**
63	2,3,4',5-Tetrachlorobiphenyl	4	59	11.4	**30**	**89**
64	2,3,4',6-Tetrachlorobiphenyl	4	659	81.3	**329**	**988**
66	2,3',4,4'-Tetrachlorobiphenyl	4	1654	301.0	**827**	**2481**
67	2,3',4,5-Tetrachlorobiphenyl	4	56	10.2	**28**	**84**
68	2,3',4,5'-Tetrachlorobiphenyl	4	22	4.9	**11**	**34**

Congener Number	*Target Analyte*	Chlorine Level*	Avg	SD	Acceptance Low	Acceptance High
			ng/kg dry weight			
72	2,3',5,5'-Tetrachlorobiphenyl	4	37	7.5	**19**	**56**
77	3,3',4,4'-Tetrachlorobiphenyl	4	135	19.3	**68**	**203**
82	2,2',3,3',4-Pentachlorobiphenyl	5	486	33.3	**243**	**729**
84	2,2',3,3',6-Pentachlorobiphenyl	5	1327	31.5	**664**	**1991**
92	2,2',3,5,5'-Pentachlorobiphenyl	5	1180	72.1	**590**	**1770**
94	2,2',3,5,6'-Pentachlorobiphenyl	5	20	1.6	**10**	**30**
96	2,2',3,6,6'-Pentachlorobiphenyl	5	29	2.0	**14**	**43**
103	2,2',4,5',6-Pentachlorobiphenyl	5	57	3.5	**28**	**85**
114	2,3,4,4',5-Pentachlorobiphenyl	5	68	8.2	**34**	**102**
118	2,3',4,4',5-Pentachlorobiphenyl	5	4021	764.9	**2011**	**6032**
120	2,3',4,5,5'-Pentachlorobiphenyl	5	19	2.3	**9**	**28**
122	2,3,3',4',5'-Pentachlorobiphenyl	5	44	10.0	**22**	**66**
123	2,3',4,4',5'-Pentachlorobiphenyl	5	54	6.1	**27**	**81**
130	2,2',3,3',4,5'-Hexachlorobiphenyl	6	591	50.9	**296**	**887**
131	2,2',3,3',4,6-Hexachlorobiphenyl	6	116	14.0	**58**	**174**
132	2,2',3,3',4,6'-Hexachlorobiphenyl	6	4569	582.7	**2284**	**6853**
133	2,2',3,3',5,5'-Hexachlorobiphenyl	6	179	15.8	**90**	**269**
136	2,2',3,3',6,6'-Hexachlorobiphenyl	6	2141	280.2	**1071**	**3212**
137	2,2',3,4,4',5-Hexachlorobiphenyl	6	223	29.6	**112**	**335**
141	2,2',3,4,5,5'-Hexachlorobiphenyl	6	3657	395.7	**1829**	**5486**
144	2,2',3,4,5',6-Hexachlorobiphenyl	6	862	57.7	**431**	**1293**
146	2,2',3,4',5,5'-Hexachlorobiphenyl	6	2029	303.2	**1014**	**3043**
158	2,3,3',4,4',6-Hexachlorobiphenyl	6	1257	132.4	**628**	**1885**
159	2,3,3',4,5,5'-Hexachlorobiphenyl	6	239	81.5	**119**	**358**
164	2,3,3',4',5',6-Hexachlorobiphenyl	6	1068	118.1	**534**	**1602**
167	2,3',4,4',5,5'-Hexachlorobiphenyl	6	367	14.4	**184**	**551**
170	2,2',3,3',4,4',5-Heptachlorobiphenyl	7	5251	715.7	**2626**	**7877**
172	2,2',3,3',4,5,5'-Heptachlorobiphenyl	7	903	206.0	**452**	**1355**
174	2,2',3,3',4,5,6'-Heptachlorobiphenyl	7	6604	1100.6	**3302**	**9906**
175	2,2',3,3',4,5',6-Heptachlorobiphenyl	7	249	29.0	**125**	**374**
176	2,2',3,3',4,6,6'-Heptachlorobiphenyl	7	806	95.6	**403**	**1209**
177	2,2',3,3',4,5',6'-Heptachlorobiphenyl	7	3630	471.6	**1815**	**5445**
178	2,2',3,3',5,5',6-Heptachlorobiphenyl	7	1237	194.2	**619**	**1856**
179	2,2',3,3',5,6,6'-Heptachlorobiphenyl	7	2719	293.5	**1359**	**4078**
187	2,2',3,4',5,5',6-Heptachlorobiphenyl	7	7316	1289.5	**3658**	**10974**
189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	7	185	11.1	**93**	**278**
190	2,3,3',4,4',5,6-Heptachlorobiphenyl	7	1077	200.7	**539**	**1616**
191	2,3,3',4,4',5',6-Heptachlorobiphenyl	7	217	40.6	**108**	**325**
194	2,2',3,3',4,4',5,5'-Octachlorobiphenyl	8	2624	391.8	**1312**	**3936**
195	2,2',3,3',4,4',5,6-Octachlorobiphenyl	8	1169	163.2	**585**	**1754**
196	2,2',3,3',4,4',5,6'-Octachlorobiphenyl	8	1579	183.8	**789**	**2368**
201	2,2',3,3',4,5',6,6'-Octachlorobiphenyl	8	373	65.6	**187**	**560**
202	2,2',3,3',5,5',6,6'-Octachlorobiphenyl	8	487	51.9	**243**	**730**
203	2,2',3,4,4',5,5',6-Octachlorobiphenyl	8	1829	354.3	**914**	**2743**

Congener Number	*Target Analyte*	Chlorine Level*	Avg	SD	Acceptance Low	Acceptance High
			ng/kg dry weight			
205	2,3,3',4,4',5,5',6-Octachlorobiphenyl	8	143	9.2	**71**	**214**
206	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	9	575	39.2	**288**	**863**
207	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	9	91	18.6	**46**	**137**
208	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	9	124	7.5	**62**	**186**
209	Decachlorobiphenyl	10	97	4.4	**48**	**145**

* number of chlorine substituents

Table 4. Co-eluting PCB Congeners

Congener Number	Co-eluting Pairs	Cl Level*	Avg	SD	Acceptance Low (-50%)	Acceptance High (+150%)	Co-eluting Sets
			ng/kg dry weight				
12	3,4-Dichlorobiphenyl	2					
13	3,4'-Dichlorobiphenyl	2	70	9.3	**35**	**105**	12/13
18	2,2',5-Trichlorobiphenyl	3					
30	2,4,6-Trichlorobiphenyl	3	615	78.3	**307**	**922**	18/30
20	2,3,3'-Trichlorobiphenyl	3					
28	2,4,4'-Trichlorobiphenyl	3	1436	149.8	**718**	**2154**	20/28
21	2,3,4-Trichlorobiphenyl	3					
23	2,3,5-Trichlorobiphenyl	3	545	49.8	**273**	**818**	21/23
26	2,3',5-Trichlorobiphenyl	3					
29	2,4,5-Trichlorobiphenyl	3	506	47.9	**253**	**759**	26/29
40	2,2',3,3'-Tetrachlorobiphenyl	4					
41	2,2',3,4-Tetrachlorobiphenyl	4					
71	2,3',4',6-Tetrachlorobiphenyl	4	717	125.8	**359**	**1076**	40/41/71
44	2,2',3,5'-Tetrachlorobiphenyl	4					
47	2,2',4,4'-Tetrachlorobiphenyl	4					
65	2,3,5,6-Tetrachlorobiphenyl	4	2026	194.2	**1013**	**3039**	44/47/65
45	2,2',3,6-Tetrachlorobiphenyl	4					
51	2,2',4,6'-Tetrachlorobiphenyl	4	224	37.0	**112**	**336**	45/51
49	2,2',4,5'-Tetrachlorobiphenyl	4					
69	2,3',4,6-Tetrachlorobiphenyl	4	1550	185.4	**775**	**2325**	49/69
50	2,2',4,6-Tetrachlorobiphenyl	4					
53	2,2',5,6'-Tetrachlorobiphenyl	4	242	35.5	**121**	**363**	50/53
59	2,3,3',6-Tetrachlorobiphenyl	4					
62	2,3,4,6-Tetrachlorobiphenyl	4					
75	2,4,4',6-Tetrachlorobiphenyl	4	142	22.5	**71**	**213**	59/62/75
61	2,3,4,5-Tetrachlorobiphenyl	4					
70	2,3',4',5-Tetrachlorobiphenyl	4					

Congener Number	Co-eluting Pairs	Cl Level*	Avg	SD	Acceptance Low (-50%)	Acceptance High (+150%)	Co-eluting Sets
			ng/kg dry weight				
74	2,4,4',5-Tetrachlorobiphenyl	4					
76	2,3',4',5'-Tetrachlorobiphenyl	4					
83	2,2',3,3',5-Pentachlorobiphenyl	5					
99	2,2',4,4',5-Pentachlorobiphenyl	5	2548	373.6	**1274**	**3821**	83/99
85	2,2',3,4,4'-Pentachlorobiphenyl	5					
116	2,3,4,5,6-Pentachlorobiphenyl	5					
117	2,3,4',5,6-Pentachlorobiphenyl	5	737	29.5	**368**	**1105**	85/116/117
86	2,2',3,4,5-Pentachlorobiphenyl	5					
87	2,2',3,4,5'-Pentachlorobiphenyl	5					
97	2,2',3,4',5'-Pentachlorobiphenyl	5					
108	2,3,3',4,5'-Pentachlorobiphenyl	5					
119	2,3',4,4',6-Pentachlorobiphenyl	5					
125	2,3',4',5',6-Pentachlorobiphenyl	5	3337	142.6	**1668**	**5005**	86/87/97/108/119/125
88	2,2',3,4,6-Pentachlorobiphenyl	5					
91	2,2',3,4',6-Pentachlorobiphenyl	5	674	49.9	**337**	**1011**	88/91
90	2,2',3,4',5-Pentachlorobiphenyl	5					
101	2,2',4,5,5'-Pentachlorobiphenyl	5					
113	2,3,3',5',6-Pentachlorobiphenyl	5	6957	787.6	**3478**	**10435**	90/101/113
93	2,2',3,5,6-Pentachlorobiphenyl	5					
95	2,2',3,5',6-Pentachlorobiphenyl	5					
98	2,2',3,4',6'-Pentachlorobiphenyl	5					
100	2,2',4,4',6-Pentachlorobiphenyl	5					
102	2,2',4,5,6'-Pentachlorobiphenyl	5	5608	516.7	**2804**	**8412**	93/95/98/100/102
107	2,3,3',4',5-Pentachlorobiphenyl	5					
124	2,3',4',5,5'-Pentachlorobiphenyl	5	249	105.2	**124**	**373**	107/124
110	2,3,3',4',6-Pentachlorobiphenyl	5					
115	2,3,4,4',6-Pentachlorobiphenyl	5	6488	384.7	**3244**	**9733**	110/115
128	2,2',3,3',4,4'-Hexachlorobiphenyl	6					
166	2,3,4,4',5,6-Hexachlorobiphenyl	6	1354	167.1	**677**	**2031**	128/166
129	2,2',3,3',4,5-Hexachlorobiphenyl	6					
138	2,2',3,4,4',5'-Hexachlorobiphenyl	6					
160	2,3,3',4,5,6-Hexachlorobiphenyl	6					
163	2,3,3',4',5,6-Hexachlorobiphenyl	6	14189	1183.2	**7094**	**21283**	129/138/160/163
134	2,2',3,3',5,6-Hexachlorobiphenyl	6					
143	2,2',3,4,5,6'-Hexachlorobiphenyl	6	657	45.0	**329**	**986**	134/143
135	2,2',3,3',5,6'-Hexachlorobiphenyl	6					
151	2,2',3,5,5',6-Hexachlorobiphenyl	6					
154	2,2',4,4',5,6'-Hexachlorobiphenyl	6	6326	374.1	**3163**	**9488**	135/151/154
139	2,2',3,4,4',6-Hexachlorobiphenyl	6					
140	2,2',3,4,4',6'-Hexachlorobiphenyl	6	115	18.7	**58**	**173**	139/140
147	2,2',3,4',5,6-Hexachlorobiphenyl	6					
149	2,2',3,4',5',6-Hexachlorobiphenyl	6	14314	1582.6	**7157**	**21471**	147/149

Congener Number	Co-eluting Pairs	Cl Level*	Avg	SD	Acceptance Low (-50%)	Acceptance High (+150%)	Co-eluting Sets
			ng/kg dry weight				
153	2,2',4,4',5,5'-Hexachlorobiphenyl	6					
168	2,3',4,4',5',6-Hexachlorobiphenyl	6	13913	1343.2	**6956**	**20869**	153/168
156	2,3,3',4,4',5-Hexachlorobiphenyl	6					
157	2,3,3',4,4',5'-Hexachlorobiphenyl	6	891	52.1	**446**	**1337**	156/157
171	2,2',3,3',4,4',6-Heptachlorobiphenyl	7					
173	2,2',3,3',4,5,6-Heptachlorobiphenyl	7	1794	202.8	**897**	**2691**	171/173
180	2,2',3,4,4',5,5'-Heptachlorobiphenyl	7					
193	2,3,3',4',5,5',6-Heptachlorobiphenyl	7	12396	1530.7	**6198**	**18594**	180/193
183	2,2',3,4,4',5',6-Heptachlorobiphenyl	7					
185	2,2',3,4,5,5',6-Heptachlorobiphenyl	7	4184	665.7	**2092**	**6277**	183/185
197	2,2',3,3',4,4',6,6'-Octachlorobiphenyl	8					
200	2,2',3,3',4,5,6,6'-Octachlorobiphenyl	8	496	106.0	**248**	**744**	197/200
198	2,2',3,3',4,5,5',6-Octachlorobiphenyl	8					
199	2,2',3,3',4,5,5',6'-Octachlorobiphenyl	8	3260	626.4	**1630**	**4890**	198/199

* number of chlorine substituents