Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

Lower Duwamish Waterway Remedial Investigation

DATA REPORT:
FISH AND CRAB TISSUE COLLECTION AND CHEMICAL ANALYSES
FINAL

Prepared for

The U.S. Environmental Protection Agency
Region 10
Seattle, WA
The Washington State Department of Ecology
Northwest Regional Office
Bellevue, WA

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Acronyms

ACRONYM	Definition
ACG	analytical concentration goal
ARI	Analytical Resources, Inc.
Axys	Axys Analytical Services, Ltd.
COC	chain of custody
Columbia	Columbia Analytical Services
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
Frontier	Frontier Geosciences Inc.
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RL	reporting limit
RI	Remedial Investigation
SDG	sample delivery group
SRM	standard reference material
SVOC	semivolatile organic compound

1.0 Introduction

This data report presents the results of the field collections and chemical analyses of fish and crab tissue conducted as part of the Phase 2 Remedial Investigation (RI) for the Lower Duwamish Waterway (LDW). Six fish species and two crab species were collected from the LDW and analyzed for tissue chemistry. Other species of fish and invertebrates caught while collecting the target species were recorded for the RI biological community discussions. A subset of LDW target species was also collected from two background locations, along with sediment,[1] and analyzed for total and inorganic arsenic for comparison with total and inorganic arsenic concentrations in fish and crab tissue samples collected from the LDW.[2]

The fish and crab tissue Quality Assurance Project Plan (QAPP; Windward 2004b) presented the design for this study, including details on project organization, field data collection, laboratory analyses, and data management. As described in the Phase 2 RI work plan (Windward 2004c), these fish and crab tissue data will be used to support the Phase 2 ecological risk assessment and human health risk assessment in the RI, and may be used to calculate sediment risk-based goals, based on sediment-to-biota relationships.

The remainder of this report is organized into the following sections:

- Section 2 – Field collection and sample processing methods
- Section 3 – Analytical methods
- Section 4 – Chemical analysis results
- Section 5 – References

The text is supported by the following appendices:

- Appendix A – Data tables
- Appendix B – Compositing information
- Appendix C – Data management
- Appendix D – Data validation reports
- Appendix E – Laboratory-reported results
- Appendix F – Field forms, notes, and navigation report
- Appendix G – Chain-of-custody forms

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[1] Co-located sediment was collected from the background locations to verify ambient concentrations of arsenic in background locations where tissue samples were collected.

[2] Collection and analysis of clams from background locations is described in the benthic invertebrate data report (Windward 2004a).

2.0 Fish and Crab Tissue Sampling and Processing

This section describes methods used to collect and process fish and crab tissue samples. The field procedures used to collect the fish and crab samples are described in detail in the QAPP (Windward 2004b). Sections 2.1 and 2.2 present sampling and processing methods for the LDW and background areas, respectively; Section 2.3 describes field deviations from the QAPP. Photocopies of field forms, field notebooks, and navigation notes are presented in Appendix F. Copies of completed chain-of-custody forms used to track sample custody are presented in Appendix G.

2.1 LDW Tissue Sampling and Processing

Fish and crab tissue samples were collected from the LDW during two field events:

- The primary sampling event, August 30 to September 10, 2004
- An earlier sampling event, August 2 to 6, 2004, to collect shiner surfperch,[3] which were not anticipated to be found in the LDW during the September sampling event

This section provides a brief overview of the species targeted for collection in the LDW, sampling areas, sampling methods, and the catch results.

2.1.1 Targeted species and collection areas

As presented in Section 3.1.2 of the QAPP (Windward 2004b), representative species targeted for collection were English sole (≥200 mm), Pacific staghorn sculpin (≥120 mm), shiner surfperch (≥80 mm), and Dungeness crab (≥90 mm). Starry flounder was listed as a potential surrogate species for English sole, should English sole not be present in sufficient numbers to meet sample target goals. Slender crab was chosen as a potential surrogate species for Dungeness crab in areas where sufficient Dungeness crabs were not available. Because a sufficient number of adult striped perch (≥200 mm) and pile perch (≥200 mm) were caught during the sampling effort, fillets from these fish were also collected and composited separately. The minimum target sizes noted above were selected to represent the preferred prey size of piscivorous wildlife receptors of concern, and reasonable size ranges of seafood consumed by humans (Windward 2004b).

Fish and crab tissue samples were collected from four distinct tissue sampling areas (Areas T1, T2, T3, and T4) to account for potential site-specific exposure of fish and crabs to chemicals at a scale smaller than the entire LDW. Shiner surfperch and Pacific staghorn sculpin may have foraging ranges smaller than the specified areas, so each area was further divided into several subareas for sampling these species. Areas T1, T2, and T3 were divided into six subareas (A-F). Area T4 was divided into five

[3] Note that all other target species collected during this additional effort were also processed and available for compositing.

subareas (A-E) because of its shape and the difficulty in sampling upstream of RM 4.8 (Figure 2-1; figures are located in the map folio, bound as a separate volume).

2.1.2 Collection methods

Fish and crabs were collected from locations throughout the LDW using three different collection methods: a high-rise otter trawl for all fish species, shrimp and crab traps for sculpin and crabs, and beach seining for shiner surfperch. The rationale for the sampling locations and the field procedures used to collect the fish and crab samples are described in greater detail in the QAPP (Windward 2004b).

2.1.2.1 High-rise otter trawl

Trawling was conducted in the LDW for five days from August 2 to 6, 2004, (focused on shiner surfperch collection), and for seven days from August 30 to September 8, 2004 for collection of all target fish species. All trawling was conducted using the vessel *R/V Kittiwake*, captained by Charlie Eaton (Bio-Marine Enterprises). Specifications of the high-rise otter trawl are presented in the QAPP (Windward 2004b).

Trawling began and ended within the boundaries of a given subarea, and generally progressed against the flow of the waterway. During ebbing tides, trawls were conducted from downstream to upstream. During flooding tides that caused flow reversal, trawls were conducted from upstream to downstream. Within each subarea, trawling was focused on the portions of the river outside of the navigation channel to capture fish in shallower habitats. However, vessel draft and trawl depth limitations constrained trawling to waters deeper than 6 ft at the time of trawling. If multiple trawls outside the navigation channel failed to yield sufficient numbers of target species, trawls were also conducted within the navigation channel after consultation with the US Environmental Protection Agency (EPA). The numbers of trawls conducted in each subarea, both outside and inside the navigation channel, are shown in Table 2-1, and trawling locations are shown in Figures 2-2 to 2-5 (see map folio). No trawling was conducted in subarea E of Area T4 because of a low footbridge at RM 4.8, and because underwater rocks, root masses, and other debris make trawling infeasible upstream of the bridge (Eaton 2004).

Table 2-1. Trawls conducted inside and outside the navigation channel in each LDW sampling area in both August and September 2004

Area	Subarea	Within Navigation Channel	Outside Navigation Channel	Total
T1	A	–	5	5
	B	1	2	3
	C	–	4	4
	D	1	6	7
	E	–	1	1
	F	–	3	3
T1 Total		**2**	**21**	**23**
T2	A	–	1	1
	B	–	2	2
	C	–	1	1
	D	–	3	3
	E	2	1	3
	F	1	3	4
T2 Total		**3**	**11**	**14**
T3	A	1	5	6
	B	6	8	14
	C	–	4	4
	D	5	3	8
	E	–	5	5
	F	4	4	8
T3 Total		**16**	**28**	**45**
T4	A	3	4	7
	B	4	11	15
	C	2	3	5
	D	2	10	12
T4 Total		**11**	**28**	**39**
Grand Total		**32**	**89**	**121[a]**

Note: Determination of whether trawl transects occurred inside or outside the navigation channel was made by Charlie Eaton in the field based on depth sounder measurements and best professional judgment. Because judgment was used by different people at different times there may be some disagreement between co-occurring trap and trawl locations that are close to the channel edge. Trawl transects in relation to channel bathymetry are shown in Figures 2-2 through 2-5.

[a] A total of 126 trawls were attempted, but because of equipment issues, five trawling efforts were not successfully completed.

2.1.2.2 Shrimp and crab traps

Shrimp and crab traps were deployed in the LDW on nine days during the period from August 30 to September 10, 2004 to collect Pacific staghorn sculpin and crabs. Sculpin and slender crabs were targeted using Ladner 30-in. nestable shrimp traps with 0.5-in. mesh. Dungeness and slender crabs were targeted using Ladner 30-in. rubber-wrapped stainless-steel crab traps. Bait was placed in plastic bait jars that were securely fastened to the inside of the trap. The bait containers had numerous holes, which allowed the scent of the bait to spread without allowing access to the bait itself.

Twelve shrimp traps and 12 crab traps were deployed side by side (on separate floats) within a sampling area, two per subarea,[4] for a given day. Traps were generally placed outside of the navigation channel to capture fish and crabs in shallower habitats. Traps were placed within each subarea using best professional judgment to cover the subarea and allow for vessel navigation in the LDW. If multiple attempts outside the navigation channel failed to yield sufficient numbers of target species, trapping was also conducted within the navigation channel after consultation with EPA. Trap deployment time ranged from approximately two to four hours. The numbers of traps set in each subarea, both outside and inside the navigation channel, are presented in Table 2-2, and locations are shown in Figures 2-6 to 2-9 (see map folio).

Table 2-2. Crab and shrimp traps set inside and outside the navigation channel in each LDW sampling area

Area	Subarea	Inside channel	Outside channel	Total
T1	A	4	0	4
	B	4	0	4
	C	4	0	4
	D	4	0	4
	E	2	2	4
	F	0	4	4
T1 Total		**18**	**6**	**24**
T2	A	4	0	4
	B	2	2	4
	C	1	3	4
	D	1	3	4
	E	0	4	4
	F	1	3	4
T2 Total		**9**	**15**	**24**
T3	A	5	1	6
	B	–	6	6
	C	4	0	4
	D	3	4	7
	E	5	1	6
	F	2	5	7
T3 Total		**19**	**17**	**36**

[4] Four traps were deployed in Area T4E instead of two to compensate for fewer subareas in Area T4, and also because trawling was not possible and beach seining was limited in Area T4E.

AREA	SUBAREA	INSIDE CHANNEL	OUTSIDE CHANNEL	TOTAL
T4	A	3	1	4
	B	1	3	4
	C	1	3	4
	D	3	1	4
	E	–	8	8
T4 Total		8	**16**	**24**
Grand Total		**54**	**54**	**108**

Note: Determination of whether traps were set inside or outside the navigation channel was based on LDW bathymetry contours and best professional judgment. Because judgment was used by different people at different times there may be some disagreement between co-occurring trap and trawl locations that are close to the channel edge. Trap locations in relation to bathymetry are shown in Figures 2-6 through 2-9.

2.1.2.3 Beach seine

A standard beach seine was used to collect shiner surfperch on August 2 and 3, 2004. The beach seine was deployed from shallow low-gradient beaches within each sampling area. Three sites were generally sampled in each sampling area, dispersed throughout the area based on suitable locations. In Area 4, subarea 4E was targeted because this subarea could not be accessed for trawling. Areas and subareas of the LDW in which beach seining was conducted are listed in Table 2-3 and locations are shown in Figure 2-10 (see map folio). All beach seining was conducted under the direction of Jim Shannon (Taylor Associates). Beach seine specifications are presented in the QAPP (Windward 2004b).

Table 2-3. Beach seines conducted in the LDW

AREA	SUBAREA	NUMBER OF SEINES
T1	B	2
	D	1
T2	B	2
T3	A	1
	C	1
	D	1
	F	1
T4	C	2
	E	1
Total		**12**

Upon beach seine retrieval, target species were sorted from non-target species. Target species were processed as described above for traps. Non-target species were identified to the lowest practical taxon, the lengths of the smallest and largest individuals of a given species were measured, numbers of each species were estimated, and these data were recorded on the non-target species tally form. The date, time, location, weather conditions, and catch results were recorded in the field notebook, on the target specimen collection form, and on the non-target species tally form. Completed forms are presented in Appendix F.

2.1.2.4 Field sample processing

Upon completion of an individual trawl, trap or seine, the catch was sorted by species and size into buckets containing site water. Prior to their release within their area of capture, non-target species were identified to the lowest practical taxon, the lengths of the smallest and largest individuals of a given species were measured, numbers of each species were counted (or estimated if a species was present in large numbers), and these data were recorded on the non-target species tally form.

Individual target specimens of fish or crabs were rinsed in site water to remove any foreign material from the external surface. Large fish were killed by placing them in a Ziploc® bag and giving them a sharp blow to the head on the side of the processing table. Small fish were killed by placing them on ice, as recommended by EPA (2000). Crabs were killed by placing them in a cooler with dry ice. Individual specimens of the target species were grouped by species and general size class, and placed in clean holding trays to prevent contamination. All fish were inspected carefully to ensure that their skin had not been damaged by the sampling equipment; specimens with broken skin were not included in tissue composites. Each fish within the selected target species was measured to determine that total length was greater than the minimum target length for that species. Individual specimens of the same species from a particular sampling area and gear deployment (i.e., a single trawl, seine, or trap) were kept together in one large resealable plastic bag with the date, time, effort number, species, and collection method recorded on the outside in indelible ink. All other pertinent information is traceable through the field notebook and collection forms (Appendix F). The bagged and iced fish were transported in coolers to Windward or the Port of Seattle environmental laboratory for final processing.

The date, time, and location of each effort were recorded in the field notebook, the target specimen collection form, the non-target species tally form, and the navigation report. Completed field forms are presented in Appendix F.

2.1.3 Catch results

A total of 1,520 fish and crab specimens of target species and size were collected and processed from 121 successful trawls, 12 successful beach seine sets, and 108 successful shrimp and crab trap sets. Catch results for all target fish and crab species collected and processed from each area and subarea of the LDW are presented in Table 2-4. Catch data, including the sample ID,[5] length, and weight for each target specimen processed, are presented in Appendix F.

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[5] As described in Section 2.1.4.2, the sample ID for each specimen contains characters identifying the area and subarea where the specimen was captured, the collection method, the effort number, and the species.

Table 2-4. Target species catch results for the LDW by area and subarea

Area	Subarea	Pile Perch (≥200 mm)	Striped Perch (≥200 mm)	Pacific Staghorn Sculpin (≥120 mm)	Shiner Surfperch (≥80 mm)	English Sole (≥200 mm)	Starry Flounder (≥200 mm)	Slender Crab (≥90 mm)	Dungeness Crab (≥90 mm)	Total
T1	A	—	—	**23**	**11**	21	—	**20**	3	78
	B	—	—	**7**	**21**	1	—	**7**	**15**	51
	C	—	—	**16**	**12**	22	—	**15**	**13**	78
	D	—	—	**20**	**9**	1	—	**26**	1	57
	E	—	—	**20**	**10**	19	1	**19**	—	69
	F	2	—	**11**	**16**	19	—	**30**	1	79
T1 total		2[a]	0[a]	**97**	**79**	**83**[b]	1[a]	**117**	**33**	412
T2	A	1	—	**16**	**9**	17	—	**15**	—	58
	B	—	—	**7**	**35**	16	—	**16**	—	74
	C	—	—	**12**	**10**	7	—	**11**	—	40
	D	—	—	**21**	**20**	22	—	**9**	—	72
	E	1	—	**16**	**20**	2	—	**18**	1	58
	F	2	—	**15**	**17**	2	—	**13**	—	49
T2 total		4[a]	0[a]	**87**	**111**	**66**[b]	0[a]	**82**	1	351
T3	A	—	—	**18**	**28**	7	1	**10**	1	65
	B	1	—	**24**	**20**	5	3	4	3	60
	C	—	1	**14**	**10**	7	1	—	—	33
	D	3	1	**26**	**47**	5	5	**10**	3	100
	E	3	2	**24**	**32**	6	2	3	4	76
	F	5	2	**28**	**20**	10	7	**6**	**5**	83
T3 total		12[a]	6[a]	**134**	**157**	**40**[b]	19[a]	**33**	16	417

Area	Subarea	Pile Perch (≥200 mm)	Striped Perch (≥200 mm)	Pacific Staghorn Sculpin (≥120 mm)	Shiner Surfperch (≥80 mm)	English Sole (≥200 mm)	Starry Flounder (≥200 mm)	Slender Crab (≥90 mm)	Dungeness Crab (≥90 mm)	Total
T4	A	2	—	**22**	**20**	17	9	2		72
	B	1	—	**31**	**40**	28	7	1	**6**	114
	C	1	—	**22**	**40**	—	10	—	—	73
	D	2	6	**31**	**20**	—	13	—	—	72
	E	—	—	**7**	1	—	1	—	—	9
T4 total		6[a]	6[a]	**113**	**121**	**45** [b]	40[a]	3	6	340
Grand Total		24	12	431	468	234	60	235	56	1,520

Note: This table includes only the number of individuals that met minimum size requirements for each species.Numbers in bold meet or exceed the target number specified in the QAPP

[a] No target numbers were specified in the QAPP for pile perch, striped perch, or starry flounder

[b] Because English sole were composited by area, not subarea, no subarea target catch numbers were specified in the QAPP

A total of 39 species of fish and 29 types of invertebrates classified to the lowest taxonomic level practicable were collected from the LDW, including both target and non-target species. Data on species abundance and occurrence (i.e., number of sampling efforts in which the species was encountered) for each collection method are presented in Table 2-5 for fish and Table 2-6 for invertebrates.

Table 2-5. Numbers of individual fish species captured in the LDW using beach seines, shrimp traps, and trawls

Species	Scientific Name	Beach Seine		Shrimp Trap		Trawls		Grand Total
		# individuals	# seines	# individuals	# traps	# individuals	# trawls	# individuals
Surfperch, shiner	*Cymatogaster aggregata*	1,714	13	6	6	8,688	112	10,408
Flounder, starry	*Platichthys stellatus*	47	7	–	–	5,494	103	5,541
Sculpin, pacific staghorn	*Leptocottus armatus*	33	8	184	72	1,010	105	1,227
Herring, Pacific	*Clupea pallasii pallasii*	805	3	–	–	29	13	834
Sole, English	*Parophrys vetulus*	–	–	–	–	722	88	722
Tomcod, Pacific	*Microgadus proximus*	–	–	–	–	433	72	433
Perch, pile	*Rhacochilus vacca*	–	–	–	–	183	53	183
Smelt, longfin	*Spirinchus thaleichthys*	–	–	–	–	131	31	131
Sole, rock	*Lepidopsetta bilineata*	–	–	–	–	83	26	83
Stickleback, three-spine	*Gasterosteus aculeatus aculeatus*	66	10	–	–	16	6	82
Prickleback, snake	*Lumpenus sagitta*	–	–	–	–	80	27	80
Sculpin, unknown	*Cottus* sp.	2	1	2	2	42	21	46
Salmon, chinook	*Oncorhynchus tshawytscha*	20	7	–	–	4	3	24
Perch, striped	*Embiotoca lateralis*	–	–	–	–	21	10	21
Smelt, surf	*Hypomesus pretiosus*	–	–	–	–	13	2	13
Sole, sand	*Psettichthys melanostictus*	–	–	–	–	12	13	12
Sculpin, torrent	*Cottus rhotheus*	11	3	–	–	–	–	11
Sculpin, roughback	*Chitonotus pugetensis*	–	–	–	–	10	7	10
Sculpin, prickly	*Cottus asper*	–	–	–	–	8	4	8
Flatfish, unknown (hybrids, etc.)		–	–	–	–	4	2	4
Gunnel, saddleback	*Pholis ornata*	2	2	1	1	–	–	3
Sanddab, speckled	*Citharichthys stigmaeus*	–	–	–	–	3	3	3
Sculpin, longfin	*Jordania zonope*	–	–	–	–	3	1	3
Shad	*Alosa sapidissima*	–	–	–	–	3	4	3

Species	Scientific Name	Beach Seine		Shrimp Trap		Trawls		Grand Total
		# individuals	# seines	# individuals	# traps	# individuals	# trawls	# individuals
Poacher, pygmy	*Odontopyxis trispinosa*	–	–	–	–	2	2	2
Rockfish, brown	*Sebastes auriculatus*	–	–	–	–	2	2	2
Sandlance, Pacific	*Ammodytes hexapterus*	1	1	–	–	1	1	2
Poacher, sturgeon	*Podothecus accipenserinus*	–	–	–	–	1	1	1
Sand dab, Pacific	*Citharichthys sordidus*	–	–	–	–	1	1	1
Sculpin, buffalo	*Enophrys bison*	–	–	–	–	1	1	1
Sculpin, great	*Myoxocephalus polyacanthocephalus*	–	–	–	–	1	1	1
Trout, steelhead	*Oncorhynchus mykiss*	–	–	–	–	1	1	1
Tubesnout	*Aulorhynchus flavidus*	–	–	–	–	1	1	1

Note: No fish were captured in crab traps

nc: not calculated because some of the seines, traps, and trawls are associated with more than one species

Table 2-6. Numbers of individual invertebrate species captured in the LDW using beach seines, crab traps, shrimp traps, and trawls

Species	Scientific Name	Beach Seine		Crab Trap		Shrimp Trap		Trawls		Grand Total
		# indiv	# seines	# indiv	# traps	# indiv	# traps	# indiv	# trawls	# individuals
Crab, slender	*Cancer gracilis*			120	54	298	106	524	82	942
Shrimp, crangon	*Crangon* sp.							538	73	538
Shrimp, coonstripe	*Pandalus danae*							314	33	314
Anemone	unknown							81	21	81
Crab, Dungeness	*Cancer magister*			37	21			25	17	62
Sea star	*Pisaster sp.*							50	14	50
Nudibranch	unknown							41	10	41
Nudibranch, striped	*Armina californica*							39	12	39
Sea pen	unknown							38	25	38
Crab, decorator	*Loxorhynchus crispatus*							32	17	32
Sea star, sunflower	*Pycnopodia helianthoides*			3	3			20	14	23

Species	Scientific Name	Beach Seine		Crab Trap		Shrimp Trap		Trawls		Grand Total
		# indiv	# seines	# indiv	# traps	# indiv	# traps	# indiv	# trawls	# individuals
Crab, red rock	*Cancer productus*			9	7	2	2	5	5	16
Clam, cockle	*Clinocardium sp.*	4	2					9	8	13
Jellyfish, unknown	unknown							13	6	13
Clam, bent-nose	*Macoma sp.*							11	5	11
Crab, hermit	*Pagurus sp.*							11	9	11
Sea star, mottled	*Evasterias troschelii*							11	6	11
Seastar, unknown	unknown	1	1	1	1			9	4	11
Crab, kelp	*Pugettia producta*							8	6	8
Shrimp, unknown	unknown							8	2	8
Mussel, blue	*Mytilus edulis*							6	3	6
Crab, black-clawed	*Lophopanopeus bellus*							4	4	4
Urchin	unknown							4	3	4
Worm, polychaete	unknown							4	1	4
Ascidian	unknown							1	1	1
Clam, soft shelled	*Mya arenaria*							1	1	1
Clam, unknown	unknown							1	1	1
Jellyfish, cyanea	*Cyanea sp.*							1	1	1
Worm, tubeworm	unknown							[a]	1	[a]
Total		**5**	**nc**	**170**	**nc**	**300**	**nc**	**1,809**	**nc**	**2,284**

nc - not calculated because some of the seines, traps, and trawls are associated with more than one species

[a] No number specified on non-target species tally form

2.1.4 Sample processing, identification, and compositing

This section presents methods for processing fish and crabs following collection in the field and prior to delivery to the analytical laboratory. Sample identification numbers for individual and composited fish and crab tissue samples are also described, as well as the compositing scheme for each type of fish or crab tissue sample.

2.1.4.1 Post-collection processing

After fish and crabs were collected from the field, the target specimens were transported to either the Windward laboratory or the Port of Seattle environmental laboratory and weighed using an analytical scale accurate to 0.1 g, measured, and individually packaged. Each target specimen was individually wrapped in heavy duty aluminum foil (shiny side out), enclosed in individual resealable plastic bags with an identification label (also enclosed in a resealable bag), and immediately stored in coolers with wet ice. Crabs and fish with spines (e.g., sculpin) were double-wrapped in heavy duty aluminum foil to minimize punctures in the aluminum foil or plastic bag.

All relevant information for each individually wrapped and labeled target specimen, including specimen ID, length, weight, gender (when distinct visual differences were discernable between sexes such as gravid females), sample date, time, and location number were recorded on the target fish and crab species collection forms included in Appendix F. The demands of sample processing made a close inspection of all specimens for external abnormalities impossible.

At the end of each day, all sample labels were checked against field forms, and sample identification (ID) numbers were recorded on chain of custody (COC) forms. COC forms were placed together with samples collected that day into heavy duty plastic garbage bags, which were then sealed and stored overnight at <4 °C in the Windward processing laboratory.

In general, samples collected Monday through Thursday were shipped the following day in coolers from Windward to Axys Analytical Services, Ltd. (Axys). Samples collected on Fridays were frozen and held at Analytical Resources, Inc. (ARI) over the weekend, and were shipped the following Monday. All samples were frozen within 72 hours of collection. Prior to shipping, samples were securely packed inside a cooler with ice packs. The original signed COC forms were placed in a sealable plastic bag, sealed, and taped to the inside lid of the cooler. The coolers were sealed with a custody seal in two locations.

The temperature inside the cooler(s) containing tissue samples was checked upon receipt of the samples at Axys; no coolers exceeded 4° ± 2°C upon receipt. Samples were assigned a specific storage area at Axys. Individual specimens were kept frozen at -20°C until compositing began on November 1, 2004.

All fish and crab tissue preparation, including filleting of fish, dissection of crabs, and homogenization of tissues, was conducted at Axys following standard operating procedures (see Appendix C of the QAPP (Windward 2004b)). Specimens were formed into composite samples prior to homogenization. Large fish were chopped into small pieces and combined in their entirety to form the composite sample. For fillet samples, partially-thawed whole fish were filleted (skin-on) and the fillets were then homogenized. Crabs were dissected and the hepatopancreas and edible meat tissues were combined into the relevant composite samples prior to homogenization. Homogenized composite samples were refrozen and at least 60 g of tissue from each sample was shipped to Columbia Analytical Services (Columbia), and at least 5 g was shipped to Frontier Geosciences Inc. (Frontier). At least 25 g of additional homogenized composite tissue was retained frozen at Axys for potential future analysis of polychlorinated biphenyl (PCB) congeners. Samples were shipped in batches to Columbia and Frontier on November 30 and December 8, 2004.

2.1.4.2 Sample identification

Unique alphanumeric sample ID numbers were assigned to each individual target fish or crab specimen and recorded on the target fish and crab species form (see Appendix F for completed forms).[6] Table 2-7 presents the identification scheme for individual fish and crab specimens.

Table 2-7. Characters used in sample IDs for individual fish and crab specimens

IDENTIFIER	DESCRIPTION
LDW	Identifies the project area
T1, T2, T3, or T4	Identifies the sampling area
A, B, C, D, E, or F	Identifies the sampling subarea
TR, SN, CT, or ST followed by sequential three-digit number	Identifies the collection method (trawl, beach seine, crab trap, or shrimp trap, respectively) and the effort as a unique number over all areas (e.g., the 15th trawl after the start of sampling would be TR015)
PS, ES, SF, SS, SP, PP, DC, or SC	Identifies the species type (Pacific staghorn sculpin, English sole, starry flounder, shiner surfperch, striped perch, pile perch, Dungeness crab, or slender crab, respectively)
Sequential number	Identifies the specimen captured in a given sampling area

For example, the ninth Dungeness crab captured in the 110th trawl of the LDW in Area T3, subarea F was identified as LDW-T3-F-TR110-DC-9. After individual fish and crab specimens were combined to form composite samples, as discussed in the following section, composite sample IDs were assigned as shown in Table 2-8.

[6] No sample ID numbers were assigned to specimens of non-target species.

Table 2-8. Characters used in sample IDs for fish and crab composite tissue samples

IDENTIFIER	DESCRIPTION
LDW	Identifies the project area
T1, T2, T3, or T4, or M	Identifies the sampling area; M identifier was used if specimens from multiple areas were included in the composite sample
A, B, C, D, E, F, or M	Identifies the sampling subarea; M identifier was used if specimens from multiple subareas were included in the composite sample
PS, ES, SF, SS, SP, PP, DC, or SC	Identifies the species type (Pacific staghorn sculpin, English sole, starry flounder, shiner surfperch, striped perch, pile perch, Dungeness crab, or slender crab, respectively)
WB, FL, EM, or HP	Identifies whole body, fillet, edible meat, or hepatopancreas samples, respectively
comp	Indicates that sample was composited
sequential number	Identifies the composite number for a given species and sampling area combination

For example, the second whole-body English sole composite sample, which contained specimens from multiple subareas within Area T1, was identified as LDW-T1-M-ES-WB-comp-2. The subareas of specimens in composite samples that contained specimens from multiple subareas can be determined from the individual specimen IDs for those composite samples, which are presented in Appendix B.

2.1.4.3 Compositing scheme

Fish and crab tissue samples were chemically analyzed as composite samples created by homogenizing individual specimens together. The compositing plan was agreed upon by EPA, the Washington State Department of Ecology (Ecology), and the Lower Duwamish Waterway Group following a meeting on September 29, 2004 and conference calls on October 8 and October 10, 2004. The numbers and types of composite samples created and chemically analyzed are presented in Table 2-9.

Table 2-9. Number of composite fish and crab tissue samples collected from the LDW

TARGET TISSUE TYPE	SPECIES COLLECTED	TOTAL LENGTH (mm)	SAMPLE TYPE	NUMBER OF COMPOSITE SAMPLES BY AREA			
				T1	T2	T3	T4
English sole	English sole	≥200	whole body	6	6	6	3
			fillet (skin-on)	2	2	2	1
	starry flounder [a]		whole body	0	0	0	3
			fillet (skin-on)	0	0	0	1
Sculpin	Pacific staghorn sculpin	≥120	whole body	6	6	6	6
Perch	shiner surfperch	≥80	whole body	6	6	6	6
	pile perch	≥200	fillet (skin-on)	1			
	striped perch	≥200	fillet (skin-on)	1			

Target Tissue Type	Species Collected	Total Length (mm)	Sample Type	Number of Composite Samples by Area			
				T1	T2	T3	T4
Crab	Dungeness crab	≥90	edible meat	3	0	3	1
			hepatopancreas	1	0	1	1
	slender crab		edible meat	3	6	3	0
			hepatopancreas	1	2	1	0

[a] Starry flounder were collected as a surrogate species for English sole in Area T4 because sufficient numbers of English sole were not caught in all subareas of Area T4

The compositing plan took into consideration both sampling area and specimen size. For English sole, starry flounder, Dungeness crab, or slender crab, specimens were grouped by area for formation of the composite samples, whereas for Pacific staghorn sculpin or shiner surfperch, specimens were grouped by subarea. Pile perch and striped perch samples were composited from specimens collected over the entire LDW because of the limited number of specimens collected.[7]

Composite samples were created such that the size distribution of specimens in each composite sample would be similar across all samples for a given species, and also similar to the size distribution observed in the total population for that species collected from both the LDW and background areas (if background samples were collected for that species). Size distribution was measured by three size categories of equal length ranges.[8] Only two size categories were used for crabs because of the relatively small range in length for each of the crab species. For English sole fillet samples, the size distribution categories were determined using the fish remaining after the whole-body composite samples were formed. Only two size categories were used for English sole fillet samples because of the small range in length following construction of the whole-body composite samples.

Gender considerations were also made in constructing the Dungeness crab composite samples based on the gender ratio and size distributions observed in all areas of the LDW and background locations. Females were more frequently used for the smaller size category (90-145 mm) in each sample because they were generally more abundant in this length range. In the larger size category (145-201 mm), gender ratio was 50:50 where possible.

All specimens were separated into the size categories by area or subarea, depending on the expected species home range, as discussed in the QAPP (Windward 2004b). A targeted number of fish were randomly selected from each size category based on the

[7] Data from the pile perch and striped perch samples will be used to estimate risks to human consumers on a LDW-wide basis.

[8] Size distributions for all species were fairly uniform, with the exception of English sole. For English sole, the range of lengths in the largest size category (≥320 - 418 mm) was slightly larger than the ranges in the two smaller categories (≥200 - 260 mm and ≥260 - 320) because only five fish were ≥380 mm. Therefore, these fish were added to the largest size category.

proportion of fish in that size category. The size categories and targeted number of fish are shown in Table 2-10.

Table 2-10. Compositing scheme for each sample type based on size and area considerations

Species	Tissue Type	Size Category (mm)	Target Number of Specimens from Each Size Category	Target Number of Specimens for Each Composite Sample	Composited by Area or Subarea
English sole	whole body	≥200 - 260	3	5	area
		≥260 - 320	1		
		≥320 - 418	1		
	fillet (skin-on)	≥200 - 260	3	5	area
		≥260	2		
Starry flounder	whole body	≥200 - 260	2	5	area
		≥260 - 320	2		
		≥320 - 390	1		
	fillet (skin-on)	≥200 - 260	2	5	area
		≥260 - 320	2		
		≥320 - 390	1		
Sculpin	whole body	≥120 - 160	4	10	subarea
		≥160 - 200	5		
		≥200 - 240	1		
Shiner surfperch	whole body	≥80 - 102	4	10	subarea
		≥102 - 124	5		
		≥124 - 147	1		
Pile perch	fillet (skin-on)	≥200	1	12	entire LDW
Striped perch	fillet (skin-on)	≥200	1	12	entire LDW
Slender crab	edible meat	≥90 - 103	4	5	area
		≥103 - 120	1		
	hepatopancreas	≥90 - 103	12	15[a]	
		≥103 - 120	3		
Dungeness crab	edible meat	≥90 - 145	1[b]	5	area
		≥145 - 201	4[c]		
	hepatopancreas	≥90 - 145	3	15[a]	
		≥145 - 201	12		

a The compositing scheme for hepatopancreas composite samples included the same 15 individual crabs used to form the edible meat composite samples, each of which contained five individuals.

b Generally females, because they were more abundant in this size range.

c An equal proportion of males and females, where possible.

The remainder of this section presents details on the composite samples created for each target species and tissue type. Appendix B presents length and weight data for each individual specimen included in the composite samples, including gender data for crabs.

English Sole and Starry Flounder

For English sole, the objective was to form six whole-body and two fillet composite samples on an area-wide basis from each of the four LDW sampling areas. In Area T4, no English sole were captured in subareas C, D, and E. Starry flounder were thus used as a surrogate species to form three separate whole-body composite samples and one fillet composite sample for Area T4 to represent an area-wide exposure. All other whole-body and fillet samples were composed of English sole only. Each composite sample consisted of five specimens of either English sole or starry flounder.

As shown in Table 2-10 for English sole whole-body composite samples, three specimens of the smallest length category, and one specimen of the middle and largest length categories, were randomly selected from within each area to constitute each single composite sample.[9] The target numbers of specimens in each size category were not always available; in these cases, the largest specimen from the next smaller category or the smallest specimen from the next larger category was selected. For starry flounder whole-body composite samples, two specimens of the smallest and middle length category, and one specimen of the largest length categories, were randomly selected from within Area T4 to constitute each single composite sample. Table 2-11 summarizes the compositing scheme for English sole and starry flounder whole-body composite samples. Figures 2-11a through 2-11d show locations of trawls and the one beach seine from Area T4 from which the individual English sole and starry flounder specimens contained in each composite sample were collected in each of the LDW areas. Appendix B presents a list of sample IDs for the individual specimens that were used to form each composite sample. The particular trawl or beach seine for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2.

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[9] Gender was not used as a criterion for selection of specimens used in composites because distinct visual differences between the genders were not apparent.

Table 2-11. Compositing information for English sole and starry flounder whole-body samples

Area	Number of Fish Captured (≥200 mm)	Number of Fish per Composite Sample				Average Length[a] (mm)	Average Weight[a] (g)	Sample ID[b]
		≥200 - 260 mm	≥260 - 320 mm	≥320 - 418 mm	Total			
T1	83	3	1	1	5	262	201	LDW-T1-M-ES-WB-comp-1
		3	1	1	5	256	195	LDW-T1-M-ES-WB-comp-2
		3	1	1	5	270	209	LDW-T1-M-ES-WB-comp-3
		3	1	1	5	268	193	LDW-T1-M-ES-WB-comp-4
		3	2	0	5	264	172	LDW-T1-M-ES-WB-comp-5
		3	2	0	5	264	170	LDW-T1-M-ES-WB-comp-6
T2	66	3	1	1	5	262	195	LDW-T2-M-ES-WB-comp-1
		3	1	1	5	259	166	LDW-T2-M-ES-WB-comp-2
		3	1	1	5	252	170	LDW-T2-M-ES-WB-comp-3
		3	2	0	5	249	160	LDW-T2-M-ES-WB-comp-4
		3	2	0	5	261	188	LDW-T2-M-ES-WB-comp-5
		3	2	0	5	259	176	LDW-T2-M-ES-WB-comp-6
T3	40	1	3	1	5	281	241	LDW-T3-M-ES-WB-comp-1
		2	2	1	5	279	217	LDW-T3-M-ES-WB-comp-2
		3	1	1	5	261	206	LDW-T3-M-ES-WB-comp-3
		1	3	1	5	285	204	LDW-T3-M-ES-WB-comp-4
		2	2	1	5	294	254	LDW-T3-M-ES-WB-comp-5
		2	3	0	5	273	226	LDW-T3-M-ES-WB-comp-6
T4	45 English sole (subareas A and B only)	3	1	1	5	263	183	LDW-T4-M-ES-WB-comp-1
		3	1	1	5	275	248	LDW-T4-M-ES-WB-comp-2
		3	1	1	5	276	239	LDW-T4-M-ES-WB-comp-3
	40 starry flounder (subareas A through E)	2	2	1	5	268	224	LDW-T4-M-SF-WB-comp-1
		2	2	1	5	278	310	LDW-T4-M-SF-WB-comp-2
		2	2	1	5	276	300	LDW-T4-M-SF-WB-comp-3

[a] Average length and weight of fish that were included in the composite sample

[b] English sole samples identified with ES in the sample ID; starry flounder samples identified with SF

For English sole fillet composite samples, three specimens of the smallest length category and two of the largest length category were randomly selected from within each area for each composite sample for Areas T1, T2, and T4. Area T3 had 10 fish remaining, all of which were >260 mm. Thus, fish from this area were split into a smaller size group (n=6) and a larger size group (n=4), and fish from each group were randomly allocated to two composite samples. For the one starry flounder fillet composite sample, two specimens each of the smallest and middle length category, and one specimen of the largest length category were randomly selected from within Area T4. Table 2-12 summarizes the compositing scheme for English sole and starry flounder fillet composite samples. Figures 2-12a through 2-12d show locations of trawls from which the individual English sole and starry flounder specimens contained in each composite sample were collected in each of the LDW areas. Appendix B presents a list of sample IDs for the individual specimens that were used to form each composite sample. The particular trawl or beach seine for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2.

Table 2-12. Compositing information for English sole and starry flounder fillet samples

Area	Number of Fish Remaining After Creation of Whole-body Composite Samples (≥200 mm)	Number of Fish per Composite Sample				Average Length[a] (mm)	Average Weight[a] (g)	Sample ID[b]
		≥200 - 260 mm	≥260 - 320 mm	≥320 - 418 mm	Total			
T1	53	3	1	1	5	253	152	LDW-T1-M-ES-FL-comp-1
		3	2	0	5	259	179	LDW-T1-M-ES-FL-comp-2
T2	36	3	2	0	5	256	170	LDW-T2-M-ES-FL-comp-1
		3	2	0	5	245	145	LDW-T2-M-ES-FL-comp-2
T3	10	0	5	0	5	302	256	LDW-T3-M-ES-FL-comp-1
		0	5	0	5	297	268	LDW-T3-M-ES-FL-comp-2
T4	30 English sole (subareas A and B only)	3	2	0	5	227	115	LDW-T4-M-ES-FL-comp-1
	25 starry flounder (subareas A through E)	2	2	1	5	287	305	LDW-T4-M-SF-FL-comp-1

[a] Average length and weight of fish that were included in the composite sample

[b] English sole samples identified with ES in the sample ID; starry flounder samples identified with SF

Pacific Staghorn Sculpin

Six whole-body composite samples of Pacific staghorn sculpin were created for each of the four areas in the LDW for a total of 24 composite samples. For Areas T1, T2, and T3, one composite sample was formed in each of the six subareas. In Area T4, two composite samples were created for subarea D because Area T4 had only five subareas. Subarea D was selected because it had the broadest distribution of sculpin sizes.

Table 2-13 presents compositing information for Pacific staghorn sculpin. Figures 2-13a through 2-13d show locations of trawls, traps, and beach seines from which the individual Pacific staghorn sculpin specimens contained in each composite sample were collected in each of the LDW areas. Appendix B presents a list of sample IDs for the individual specimens that were used to form each composite sample. The particular trawl, trap, or beach seine for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2. Composite samples contained 10 fish each, except in subareas where fewer than 10 fish were collected (i.e., T1B, T2B, T4E). In these subareas, all fish collected from that subarea were included in the composite sample. As presented in Table 2-9, the objective for each composite sample was to include four fish of the smallest length category, five fish of the middle length category, and one fish of the largest length category.[10] When the target number of fish in a size category was not available, the largest fish from the next smaller category or the smallest fish from the next larger category was selected.

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[10] Gender was not used as a criterion for selection of specimens used in composites because distinct visual differences between the genders were not apparent.

Table 2-13. Compositing information for Pacific staghorn sculpin

Area	Subarea	Number of Fish Captured (≥120 mm)	Number of Fish per Composite Sample				Average Length[a] (mm)	Average Weight[a] (g)	Sample ID
			≥120 - 160 mm	≥160 - 200 mm	≥200 - 240 mm	Total			
T1	A	23	4	5	1	10	165	65	LDW-T1-A-PS-WB-comp-1
	B	7	3	4	0	7	170	62	LDW-T1-B-PS-WB-comp-1
	C	16	4	5	1	10	170	64	LDW-T1-C-PS-WB-comp-1
	D	20	4	5	1	10	173	64	LDW-T1-D-PS-WB-comp-1
	E	20	4	5	1	10	169	59	LDW-T1-E-PS-WB-comp-1
	F	11	4	4	2	10	172	70	LDW-T1-F-PS-WB-comp-1
T2	A	16	4	5	1	10	166	56	LDW-T2-A-PS-WB-comp-1
	B	7	2	4	1	7	168	78	LDW-T2-B-PS-WB-comp-1
	C	12	3	7	0	10	173	64	LDW-T2-C-PS-WB-comp-1
	D	21	4	5	1	10	170	69	LDW-T2-D-PS-WB-comp-1
	E	16	4	5	1	10	166	57	LDW-T2-E-PS-WB-comp-1
	F	15	4	6	0	10	166	59	LDW-T2-F-PS-WB-comp-1
T3	A	18	4	5	1	10	166	62	LDW-T3-A-PS-WB-comp-1
	B	24	4	5	1	10	169	61	LDW-T3-B-PS-WB-comp-1
	C	14	4	5	1	10	160	54	LDW-T3-C-PS-WB-comp-1
	D	26	4	5	1	10	165	58	LDW-T3-D-PS-WB-comp-1
	E	24	4	5	1	10	173	67	LDW-T3-E-PS-WB-comp-1
	F	28	3	6	1	10	171	71	LDW-T3-F-PS-WB-comp-1
T4	A	22	4	5	1	10	165	70	LDW-T4-A-PS-WB-comp-1
	B	31	4	5	1	10	162	55	LDW-T4-B-PS-WB-comp-1
	C	22	8	2	0	10	142	34	LDW-T4-C-PS-WB-comp-1
	D	31	5	3	2	10	162	57	LDW-T4-D-PS-WB-comp-1
			5	3	2	10	165	58	LDW-T4-D-PS-WB-comp-2
	E	7	6	2	0	8	143	32	LDW-T4-E-PS-WB-comp-1

[a] Average length and weight of fish that were included in the composite sample

Shiner Surfperch

Six whole-body composite samples of shiner surfperch were created for each of the four areas in the LDW for a total of 24 composite samples. For Areas T1, T2, and T3, one composite sample was formed in each of the six subareas. For Area T4, there were only five subareas, and no sample could be created for E because only one specimen was caught in that subarea. Therefore, two composite samples were created for each of the subareas B and C in Area T4 because these subareas had the most fish available for use in creating additional composite samples.

Table 2-14 presents compositing information for shiner surfperch. Figures 2-14a through 2-14d show locations of trawls and beach seines from which the individual shiner surfperch specimens contained in each composite sample were collected in each of the LDW areas. Appendix B presents a list of sample IDs for the individual specimens that were used to form each composite sample. The particular trawl or beach seine for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2. Composite samples contained 10 fish each, except in subareas where fewer than ten fish were collected (i.e., T1D and T2A). In these cases, all fish collected from that subarea were included in the composite sample. As presented in Table 2-9, the objective for each composite sample was to include four fish of the smallest length category, five fish of the middle length category, and one fish of the largest length category. When the target number of fish in a size category was not available (i.e., all subareas from T1, T2A, T2C, T3C, and T3F), the largest fish from the next smaller category or the smallest fish from the next larger category was selected.

Table 2-14. Compositing information for shiner surfperch

Area	Subarea	Number of Fish Captured (≥80 mm)	Number of Fish per Composite Sample ≥80 - 102 mm	≥102 - 124 mm	≥124 - 147 mm	Total	Average Length[a] (mm)	Average Weight[a] (g)	Sample ID
T1	A	11	4	6	0	10	108	15	LDW-T1-A-SS-WB-comp-1
	B	21	4	6	0	10	105	16	LDW-T1-B-SS-WB-comp-1
	C	12	3	6	1	10	109	15	LDW-T1-C-SS-WB-comp-1
	D	9	3	4	2	9	111	17	LDW-T1-D-SS-WB-comp-1
	E	10	6	3	1	10	103	15	LDW-T1-E-SS-WB-comp-1
	F	16	4	6	0	10	104	11	LDW-T1-F-SS-WB-comp-1
T2	A	9	1	7	2	9	113	20	LDW-T2-A-SS-WB-comp-1
	B	35	4	5	1	10	106	16	LDW-T2-B-SS-WB-comp-1
	C	10	3	6	1	10	111	18	LDW-T2-C-SS-WB-comp-1
	D	20	4	5	1	10	104	15	LDW-T2-D-SS-WB-comp-1
	E	20	4	5	1	10	104	15	LDW-T2-E-SS-WB-comp-1
	F	17	4	5	1	10	109	16	LDW-T2-F-SS-WB-comp-1
T3	A	28	4	5	1	10	107	18	LDW-T3-A-SS-WB-comp-1
	B	20	4	5	1	10	108	17	LDW-T3-B-SS-WB-comp-1
	C	10	6	4	0	10	102	14	LDW-T3-C-SS-WB-comp-1
	D	47	4	5	1	10	106	16	LDW-T3-D-SS-WB-comp-1
	E	32	4	5	1	10	107	17	LDW-T3-E-SS-WB-comp-1
	F	20	4	6	0	10	107	17	LDW-T3-F-SS-WB-comp-1
T4	A	20	4	5	1	10	105	15	LDW-T4-A-SS-WB-comp-1
	B	40	4	5	1	10	104	15	LDW-T4-B-SS-WB-comp-1
			4	5	1	10	104	16	LDW-T4-C-SS-WB-comp-2
	C	40	4	5	1	10	110	17	LDW-T4-C-SS-WB-comp-1
			4	5	1	10	108	15	LDW-T4-C-SS-WB-comp-2
	D	20	4	5	1	10	108	17	LDW-T4-D-SS-WB-comp-1

[a] Average length and weight of fish that were included in the composite sample

Pile Perch and Striped Perch

For pile perch, one LDW-wide composite sample of fillets from 12 fish ≥200 mm was created (one fillet from Area T1, two from Area T2, six from Area T3, and three from Area T4). Twenty-four pile perch were collected; the 12 fish included in the composite sample were selected randomly from each of the four areas, proportional to the number caught in each area. Length and weight data for fish included in this composite sample are presented in Table 2-15. Figure 2-15 shows the trawl locations from which the individual pile perch specimens contained in each composite sample were collected from the entire LDW. Appendix B presents a list of sample IDs for the individual specimens that were used to form the composite sample. The particular trawl for each individual specimen can be inferred its the sample ID, as described in Section 2.1.4.2.

Table 2-15. Pile perch composite fillet sample length and weight data

Sample ID		Minimum	Maximum	Mean
LDW-M-M-PP-FL-comp-1	Length (mm)[a]	209	300	236
	Weight (g)[a]	115	394	184

[a] Whole body lengths and weights of fish that were included in fillet composite samples

For striped perch, one LDW-wide composite sample of fillets from 12 fish ≥200 mm was created. A total of 12 striped perch were caught in the LDW (six in Area T3 and six in Area T4); all these fish were used in the composite sample. Length and weight data for fish included in this composite sample are presented in Table 2-16. Figure 2-16 shows the trawl locations from which the individual striped perch specimens contained in each composite sample were collected from the entire LDW. Appendix B presents a list of sample IDs for the individual specimens that were used to form the composite sample. The particular trawl for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2.

Table 2-16. Striped perch composite fillet sample length and weight data

Sample ID		Minimum	Maximum	Mean
LDW-M-M-SP-FL-comp-1	Length (mm)[a]	205	273	240
	Weight (g)[a]	140	323	246

[a] Whole body lengths and weights of fish that were included in fillet composite samples

Crab

Six composite samples of edible crab meat and two composite samples of hepatopancreas were created in each of three areas: T1, T2, and T3. In Area T4, an insufficient number of crabs were collected to create six edible meat composite samples and two hepatopancreas composite samples, so only one composite sample of each type was created for this area. Crab composite samples consisted of either

Dungeness crabs or slender crabs, depending on the numbers of each species captured per area. As summarized in Table 2-9, all samples from Area T2 consisted of slender crabs and both samples from Area T4 consisted of Dungeness crabs. In Areas T1 and T3, three edible meat composite samples and one hepatopancreas composite sample were created for each of the two crab species.

Table 2-17 presents compositing information for Dungeness crab. Figures 2-17a through 2-17c and Figures 2-18a through 2-18c show locations of trawls and traps from which the individual Dungeness crab specimens contained in each composite sample were collected in each of Areas T1, T3, and T4. Appendix B presents a list of sample IDs for the individual specimens that were used to form each composite sample. The particular trawl or trap for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2. All edible meat composite samples consisted of five crabs. For Areas T1 and T3, hepatopancreas composite samples were created from all Dungeness crabs dissected for edible meat within each area (i.e., 15 crabs). For Area T4, the hepatopancreas composite sample was created from all six Dungeness crabs collected in that area. To the extent possible, the gender ratios in the Dungeness crab composite samples matched the gender ratios in Dungeness crabs from all areas, including background locations (50:50). As presented in Table 2-10, the objective was for each composite sample to include one Dungeness crab (female) of the smaller length category and four Dungeness crabs (two male and two female) of the larger length category. When the target number of Dungeness crabs in a size category was not available (i.e., Area T3), the individuals were allocated to the composite samples by drawing one for each sample from among the three smallest specimens, and three for each sample from among the remaining 13 largest specimens, regardless of gender. The objective for including one smaller female, two larger females, and two larger males could not be met for the LDW samples because few females were caught. Only seven female Dungeness crabs from the entire LDW were available for compositing. These female crabs were evenly distributed among the composite samples in each area as shown in Table 2-17.

Table 2-17. Compositing information for Dungeness crab edible meat and hepatopancreas samples

Area	Number of Crabs Captured (≥90 mm)	Number of Crabs per Composite Sample					Average Length[a] (mm)	Average Weight[a] (g)	Sample ID[b]
		≥90 - 145 mm		≥145 - 201 mm					
		Males	Females	Males	Females	Total			
T1	33	1	0	3	1	5	171	627	LDW-T1-M-DC-EM-comp-1
		1	0	3	1	5	163	577	LDW-T1-M-DC-EM-comp-2
		1	0	3	1	5	172	727	LDW-T1-M-DC-EM-comp-3
		3	0	9	3	15[c]	169	644	LDW-T1-M-DC-HP-comp-1
T3	16	2	1	2	0	5	130	309	LDW-T3-M-DC-EM-comp-1
		2	0	3	0	5	144	427	LDW-T3-M-DC-EM-comp-2
		1	1	3	0	5	150	473	LDW-T3-M-DC-EM-comp-3
		5	2	8	0	15[c]	141	403	LDW-T3-M-DC-HP-comp-1
T4	6	3	1	1	0	5	116	211	LDW-T4-M-DC-EM-comp-1
		3	2	1	0	6[d]	118	223	LDW-T4-M-DC-HP-comp-1

[a] Average length and weight of crabs that were included in the composite sample

[b] Edible meat composite samples were identified with EM in the sample ID; hepatopancreas composite samples were identified with HP

[c] These 15 crabs are the same individuals from which the edible meat samples were taken

[d] Five of these crabs are the same individuals from which the edible meat samples were taken; one additional male crab was added from Area T4 to provide enough tissue for analysis

Table 2-18 presents compositing information for slender crabs. Figures 2-19a through 2-19c and Figures 2-20a through 2-20c show locations of trawls and traps from which the individual slender crab specimens contained in each composite sample were collected in Areas T1, T2, and T3. Appendix B presents a list of sample IDs for the individual specimens that were used to form each composite sample. The particular trawl or trap for each individual specimen can be inferred from its sample ID, as described in Section 2.1.4.2. All edible meat composite samples consist of five crabs each. As presented in Table 2-10, the objective for each composite sample was to include four crabs of the smaller length category and one crab of the larger length category. For Areas T1, T2, and T3, hepatopancreas composite samples were created from all slender crabs dissected for edible meat within each area (i.e., 15 crabs). For Area T1, one additional large crab was used to provide sufficient hepatopancreas tissue for chemical analysis; for Area T3, three additional crabs (one large and two small) were used to provide sufficient tissue for chemical analysis. All slender crabs included in the composite samples were male crabs, because only one female crab was caught that was larger than the minimum size threshold.

Table 2-18. Compositing information for slender crab edible meat and hepatopancreas samples

Area	Number of Crabs Captured (≥90 mm)	Number of Crabs per Composite Sample			Average Length[a] (mm)	Average Weight[a] (g)	Sample ID[b]
		≥90 - 103 mm	≥103 - 120 mm	Total			
T1	117	4	1	5	99	174	LDW-T1-M-SC-EM-comp-1
		4	1	5	97	157	LDW-T1-M-SC-EM-comp-2
		4	1	5	99	169	LDW-T1-M-SC-EM-comp-3
		12	4	16[c]	99	168	LDW-T1-M-SC-HP-comp-1
T2	82	4	1	5	97	162	LDW-T2-M-SC-EM-comp-1
		4	1	5	97	154	LDW-T2-M-SC-EM-comp-2
		4	1	5	98	169	LDW-T2-M-SC-EM-comp-3
		4	1	5	98	167	LDW-T2-M-SC-EM-comp-4
		4	1	5	99	167	LDW-T2-M-SC-EM-comp-5
		4	1	5	97	157	LDW-T2-M-SC-EM-comp-6
		12	3	15[d]	97	162	LDW-T2-M-SC-HP-comp-1
		12	3	15[d]	98	164	LDW-T2-M-SC-HP-comp-2
T3	33	4	1	5	97	147	LDW-T3-M-SC-EM-comp-1
		4	1	5	100	143	LDW-T3-M-SC-EM-comp-2
		4	1	5	97	158	LDW-T3-M-SC-EM-comp-3
		14	4	18[e]	97	150	LDW-T3-M-SC-HP-comp-1

[a] Average length and weight of crabs that were in the composite sample

[b] Edible meat composite samples were identified with EM in the sample ID; hepatopancreas composite samples were identified with HP

[c] Fifteen of these crabs are the same individuals from which the edible meat samples were taken; one additional crab was added from Area T1 to provide enough tissue for analysis

[d] These 15 crabs are the same individuals from which the edible meat samples were taken

[e] Fifteen of these crabs are the same individuals from which the edible meat samples were taken; three additional crabs were added from Area T3 to provide enough tissue for analysis

2.2 BACKGROUND TISSUE SAMPLING AND PROCESSING

Fish and crab tissue samples[11] and sediment samples[12] were collected from two background locations to acquire data on total and inorganic arsenic concentrations, as described in detail in Appendix E of the QAPP (Windward 2004b). Background sampling took place on September 14, 16, and 17 and October 7, 2004. This section provides a brief overview of the targeted species, sampling locations, sampling methods, and catch results.

2.2.1 Targeted species and collection areas

Species targeted for collection at background locations included English sole, shiner surfperch, and crabs. As described in more detail in the QAPP (Windward 2004b), background locations were selected relatively near the LDW to maximize the likelihood that physical, chemical, and geological characteristics would be similar to the LDW. In addition, the potential anthropogenic source of arsenic associated with the aerial plume from the former Asarco smelter in Ruston, Washington was considered in selecting locations. Thus, East Passage (Figure 2-21a; see map folio) was chosen as a location potentially affected by the former Asarco smelter, and the area west of Blake Island (Figure 2-21b; see map folio) was chosen as a location representing naturally occurring arsenic.

2.2.2 Collection methods

Fish and crabs were collected from background locations using a high-rise otter trawl (for the collection of English sole and shiner surfperch) and shrimp and crab traps (for the collection of crabs).

Trawling was conducted at background locations in East Passage and west of Blake Island on each of the four sampling days. Trawling materials and methods and catch processing methods were the same as those described in Section 2.1.2.1. Background trawling locations are shown in Figures 2-21a and 2-21b (see map folio).

Shrimp and crab traps were used to collect Dungeness and slender crabs on each of the four sampling days. Trap deployment, retrieval, and catch processing was conducted as described in Section 2.1.2.2. Background trap locations are shown in Figures 2-21a and 2-21b (see map folio).

Sediment samples were collected using a van Veen grab sampler, as described in detail in the QAPP (Windward 2004b). One composite sediment sample was collected at each background location. This composite sample consisted of sediment from a

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[11] Collection and analysis of clams from background locations is described in the benthic invertebrate data report (Windward 2004a)

[12] Sediment samples were collected to evaluate exposure conditions in background locations where fish and crab samples were collected.

total of five grab samples collected from general trawl locations, as shown in Figures 2-21a and 2-21b (see map folio). The five grab samples from each background area were homogenized on the boat into one composite sample per area.

2.2.3 Catch results

A total of 156 target specimens were collected west of Blake Island from 7 successful trawls and 24 successful shrimp and crab trap sets. A total of 111 target specimens were collected in East Passage from 20 successful trawls and 36 successful shrimp and crab trap sets. Catch results for target fish and crab species collected from background locations are presented in Table 2-19. Catch data, including the sample ID,[13] length, and weight of each target specimen processed are presented in Appendix F.

Table 2-19. Target species catch results for Blake Island and East Passage background locations

Location	Shiner Surfperch (≥80 mm)	English Sole (≥200 mm)	Slender Crab (≥90 mm)	Dungeness Crab (≥90 mm)	Total
Blake Island	61	50	11	34	156
East Passage	17	49	10	35	111

2.2.4 Sample processing, identification, and compositing

Post-collection processing methods for target individual specimens were the same as those described in Section 2.1.4.1 for LDW fish and crab tissue samples. The tissue sample identification scheme was the same as described in Section 2.1.4.2, with the following exceptions:

- the project identifier is either BL for Blake Island or EP for East Passage
- the sample IDs do not contain identifiers for sampling area or subarea because only one area within each background location was sampled

For sediment sample IDs, the first and second set of characters are the same as for the tissue sample IDs: LDW indicates the project, followed by BL for Blake Island or EP for East Passage. The next character is S for sediment, followed by a number indicating the sequence in which the sample was collected. For example, the first sediment sample collected in the background area west of Blake Island area was identified as LDW-BL-S1.

In general, the size distribution of specimens in each composite sample from background locations was similar to the size distribution observed in the total population of fish or crabs collected from both the LDW and background areas, as described in Section 2.1.4.3. However, the shiner surfperch background area samples had much different size distributions than the samples collected in the LDW. Thus,

[13] As described in Section 2.1.4.2, the sample ID for each specimen contains characters identifying the collection method, the effort number, and the species.

for shiner surfperch, the East Passage composite samples are comparable among themselves in size distribution, but have a smaller average length than the LDW samples. The composite samples collected west of Blake Island are comparable among themselves in size distribution, but have a slightly larger average length than the LDW samples. The size categories and target numbers of specimens from each category were the same as those presented in Table 2-10, with the following exceptions:

- for English sole whole-body composite samples from background locations, only four individuals rather than five were used per composite sample because fewer fish were available: two from the smallest length category, one from the middle length category, and one from the largest length category
- for English sole fillet samples from background locations, only four individuals rather than five were used per composite sample: two from the smaller length category and two from the larger length category
- for shiner surfperch, the number of specimens used from each length category per composite sample was different for fish collected west of Blake Island than for LDW fish because of the different size distribution, as described in Section 2.2.4.2.
- for shiner surfperch, the number of specimens used from each length category per composite sample was different for East Passage fish than for LDW fish because fewer fish were caught, as described in Section 2.2.4.2.

The remainder of this section presents details on the composite samples created for each target background species and tissue type. Appendix B presents length and weight data for each individual specimen included in the composite samples.

2.2.4.1 English sole

Table 2-20 presents compositing information for English sole whole-body composite samples collected from the background locations. Two individuals from the smallest length category, one individual from the middle length category, and one individual from the largest length category were randomly selected from each location.

Table 2-20. Compositing information for background English sole whole-body samples

Area	Number of Fish Captured (≥200 mm)	Number of Fish per Composite Sample				Average Length[a] (mm)	Average Weight[a] (g)	Sample ID
		≥200 - 260 mm	≥260 - 320 mm	≥320 - 418 mm	Total			
BL	50	2	1	1	4	287	242	BL-ES-WB-comp-1
		2	1	1	4	298	250	BL-ES-WB-comp-2
		2	1	1	4	280	204	BL-ES-WB-comp-3
		2	1	1	4	269	174	BL-ES-WB-comp-4
		2	1	1	4	276	200	BL-ES-WB-comp-5
		2	1	1	4	279	207	BL-ES-WB-comp-6
EP	49	2	1	1	4	273	230	EP-ES-WB-comp-1
		2	1	1	4	259	165	EP-ES-WB-comp-2
		2	1	1	4	256	171	EP-ES-WB-comp-3
		2	1	1	4	268	194	EP-ES-WB-comp-4
		2	1	1	4	270	212	EP-ES-WB-comp-5
		2	1	1	4	281	201	EP-ES-WB-comp-6

[a] Average length and weight of fish that were included in the composite sample

Table 2-21 presents compositing information for English sole fillet composite samples collected from the background locations. Two individuals from the smaller length category and two individuals from the larger length category were randomly selected from each location.

Table 2-21. Compositing information for background English sole fillet samples

Area	Number of Fish Remaining after Creation of Whole-body Composite Samples (≥200 mm)	Number of Fish per Composite Sample				Average Length[a] (mm)	Average Weight[a] (g)	Sample ID
		≥200 - 260 mm	≥260 - 320 mm	≥320 - 418 mm	Total			
BL	26	2	0	2	4	267	172	BL-ES-FL-comp-1
		2	0	2	4	286	223	BL-ES-FL-comp-2
		2	0	2	4	301	240	BL-ES-FL-comp-3
		2	0	2	4	277	214	BL-ES-FL-comp-4
		2	0	2	4	269	177	BL-ES-FL-comp-5
		2	0	2	4	263	170	BL-ES-FL-comp-6
EP	25	2	0	2	4	221	100	EP-ES-FL-comp-1
		2	0	2	4	220	95	EP-ES-FL-comp-2
		2	0	2	4	223	97	EP-ES-FL-comp-3
		2	1	1	4	238	123	EP-ES-FL-comp-4
		2	1	1	4	233	127	EP-ES-FL-comp-5
		2	1	1	4	246	139	EP-ES-FL-comp-6

[a] Average length and weight of fish that were included in the composite sample

2.2.4.2 Shiner surfperch

Table 2-22 presents compositing information for shiner surfperch whole-body composite samples collected from background locations. Six composite samples were created from the fish collected west of Blake Island, each containing ten shiner surfperch. The number of fish from each length category was different than that used for LDW fish because fish collected west of Blake Island had a different size distribution than LDW fish. Therefore, the six composite samples were created using one fish from the smallest length category, seven fish from the middle length category, and two fish from the largest length category. Only 17 shiner surfperch from East Passage were available for compositing. Three composite samples were created: two composite samples of six fish and one composite sample of five fish. These composite samples were created by randomly allocating the three largest fish to each of the three samples, then randomly distributing the remaining 14 fish among the three samples.

Table 2-22. Compositing information for background shiner surfperch whole-body samples

Area	Number of Fish Captured (≥80 mm)	Number of Fish per Composite Sample				Average Length[a] (mm)	Average Weight[a] (g)	Sample ID
		≥80 - 102 mm	≥102 - 124 mm	≥124 - 147 mm	Total			
BL	61	1	7	2	10	113	20	BL-SS-WB-comp-1
		1	7	2	10	114	20	BL-SS-WB-comp-2
		1	7	2	10	114	21	BL-SS-WB-comp-3
		1	7	2	10	117	21	BL-SS-WB-comp-4
		1	7	2	10	112	20	BL-SS-WB-comp-5
		1	7	2	10	115	22	BL-SS-WB-comp-6
EP	17	5[b]	1	0	6	87	8	EP-SS-WB-comp-1
		3	2	0	5	96	13	EP-SS-WB-comp-2
		4[c]	2	0	6	90	8	EP-SS-WB-comp-3

[a] Average length and weight of fish that were included in the composite sample

[b] Length of one fish was 79 mm

[c] Length of one fish was 78 mm

2.2.4.3 Crabs

For Dungeness crab, three composite samples of edible meat and one composite sample of hepatopancreas were formed for each of the two background locations. Table 2-23 presents compositing information for these samples. All edible meat composite samples consisted of five crabs. Composite hepatopancreas samples were created from all 15 crabs represented in the three edible meat composite samples at each location. As presented in Section 2.1.4.3, the objective for each composite Dungeness crab sample was to include one female crab in the smaller length category, and two male and two female crabs in the larger length category. For two of the samples from East Passage, there were only enough large male crabs to include one in each composite sample.

Table 2-23. Compositing information for background Dungeness crab edible meat and hepatopancreas composite samples

Area	Number of Crabs Captured (≥90 mm)	Number of Crabs per Composite Sample: ≥90 - 145 mm Males	≥90 - 145 mm Females	≥145 - 201 mm Males	≥145 - 201 mm Females	Total	Average Length[a] (mm)	Average Weight[a] (g)	Sample ID[b]
BL	34	0	1	2	2	5	156	521	BL-DC-EM-comp-1
		0	1	2	2	5	169	628	BL-DC-EM-comp-2
		0	1	2	2	5	160	557	BL-DC-EM-comp-3
		0	3	6	6	15[c]	162	569	BL-DC-HP-comp-1
EP	35	0	1	1	3	5	158	523	EP-DC-EM-comp-1
		0	1	1	3	5	157	540	EP-DC-EM-comp-2
		0	1	2	2	5	161	563	EP-DC-EM-comp-3
		0	3	3	8	15[c]	158	542	EP-DC-HP-comp-1

[a] Average length and weight of crabs that were included in the composite sample

[b] Edible meat composite samples were identified with EM in the sample ID; hepatopancreas composite samples were identified with HP

[c] These 15 crabs are the same individuals from which the edible meat samples were taken

For slender crab, three composite samples of edible meat and one composite sample of hepatopancreas were formed for each of the two background locations. Table 2-24 presents compositing information for these samples. As presented in Table 2-10, the objective for each composite slender crab edible meat sample was to include five crabs per sample: four crabs in the smaller length category and one crab in the larger length category. However, only 11 crabs were caught west of Blake Island, so only two or three smaller crabs were included in each sample. Edible meat samples from East Passage each contained five crabs. However, a sufficient number of crabs in the larger length category were not available to include a large crab in each sample. In addition, because only 10 crabs longer than 90 mm were caught in East Passage, five crabs with lengths less than 90 mm were included in the three composite samples to obtain sufficient tissue mass for chemical analysis. Composite hepatopancreas samples were created with all crabs included in the three edible meat samples at each location.

Table 2-24. Compositing information for background slender crab edible meat and hepatopancreas composite samples

Area	Number of Crabs Captured (≥90 mm)	Number of Crabs per Composite Sample			Average Length[a] (mm)	Average Weight[a] (g)	Sample ID[b]
		≥90 - 103 mm	≥103 - 120 mm	Total			
BL	11	2	1	3	99	178	BL-SC-EM-comp-1
		3	1	4	98	170	BL-SC-EM-comp-2
		3	1	4	99	175	BL-SC-EM-comp-3
		8	3	11[c]	99	174	BL-SC-HP-comp-1
EP	10[d]	5[e]	0	5	90	119	EP-SC-EM-comp-1
		4[f]	1	5	93	138	EP-SC-EM-comp-2
		5[g]	0	5	88	112	EP-SC-EM-comp-3
		14	1	15[c]	90	123	EP-SC-HP-comp-1

a Average length and weight of crabs that were included in the composite sample

b Edible meat composite samples were identified with EM in the sample ID; hepatopancreas composite samples were identified with HP

c The 11 crabs from west of Blake Island and the 15 crabs from East Passage are the same individuals from which the respective edible meat samples were taken

d Five of the crabs included were <90 mm; these were included to obtain sufficient tissue for chemical analysis

e Length of one crab was 77 mm and another crab was 81 mm

f Length of one crab was 79 mm

g Two crabs were 79 mm in length

2.3 Field Deviations from the QAPP

Field deviations from the QAPP (Windward 2004b) included only slight modifications to collection and processing methods. These field deviations did not affect the data quality and are discussed in detail below. EPA and Ecology were consulted on deviations that had a significant effect on study design.

- Trawl 88, which occurred in Area 4B, was inadvertently recorded as having occurred in Area 4A on the target collection form. As a result, specimen numbers LDW-T4-A-TR088-PS-163, LDW-T4-A-TR088-ES-39, and LDW-T4-A-TR088-ES-40 were mislabeled. Subsequently, composite samples LDW-T4-A-PS-WB-comp-1 and LDW-T4-M-ES-WB-comp-1 contain one and two individual specimens, respectively, that were selected based on incorrect location information. The incorrectly recorded location information for trawl 88 has no effect on the analytical results for English sole because the composite was created to cover the entire area. Trawl 88 provided one sculpin to the 10 sculpin composite and this addition may have had a minor effect on the analytical results for this composite sample.
- After 48 trap deployments over two days in Area T4, only two crabs had been captured using traps.[14] After consultation with EPA, it was decided that rather than extending the sampling area (as indicated in the QAPP), additional trapping in Area T4 would not result in sufficient crabs to meet target numbers, so trapping in Area T4 was ceased.
- The trawl net had a mesh size of 1.5 in. rather than 1.25 in. This deviation had no significant effect on the ability of the trawl net to capture target species.
- No cod end liner was used in the trawl net. This deviation had no effect on the ability of the trawl net to capture and retain target species.
- Killing of large fish was accomplished by placing the fish in a Ziploc® bag, grasping the fish by the tail, and forcibly hitting its head on the processing table rather than using a designated wooden club or metal rod as specified in the QAPP.
- Post-collection processing occurred at the Port of Seattle Terminal 91 environmental laboratory as well as at Windward
- Fish and crabs were weighed using an electronic balance with accuracy to 0.1 g, rather than a Pesola hand held scale accurate to 0.5 g
- Background sampling was conducted on October 7, in addition to planned sampling within the last two weeks of September, following consultation with EPA on priorities for the final day of background sampling
- Although not specified in the QAPP, one composite hepatopancreas sample was created from crabs collected from each background location

[14] Nine additional crabs were captured in T4 in the trawl.

3.0 Analytical Methods

The methods and procedures used to prepare and chemically analyze the tissue samples are described briefly in this section and in detail in the QAPP (Windward 2004b). This section also discusses laboratory deviations from the QAPP.

Individual fish and crab specimens were shipped to Axys where they were homogenized into composite samples according to the compositing scheme presented in Sections 2.2.3 and 2.2.4. Data on individual specimens in each composite sample are presented in Appendix B. Frozen splits of fish and crab composite samples were shipped on dry ice from Axys to Columbia for analyses of PCB Aroclors, organochlorine pesticides, semivolatile organic compounds (SVOCs), metals, butyltins, lipids, and total solids. Frozen splits of fish and crab composite samples were also shipped on dry ice to Brooks Rand for analysis of inorganic arsenic. Brooks Rand also analyzed the tissue samples they received for total solids. For consistency, the data presented in this report for total solids are from Columbia's analyses so the data for all samples are from the same laboratory. Axys archived the remaining split fish and crab tissue samples for analysis of PCB congeners (potentially only a subset of samples) and for potential dioxin and furan analysis.

Forty-one of the 108 composite tissue samples collected from the LDW are being analyzed for PCB congeners by Axys. The composite samples selected for PCB congener analyses are presented in Table 3-1.

Table 3-1. Composite tissue samples selected for PCB congener analyses

Species	Tissue Type	Sample ID	Area	Subarea
English sole	whole body	LDW-T1-M-ES-WB-comp-2	T1	multiple subareas
English sole	whole body	LDW-T1-M-ES-WB-comp-4	T1	multiple subareas
English sole	whole body	LDW-T2-M-ES-WB-comp-3	T2	multiple subareas
English sole	whole body	LDW-T2-M-ES-WB-comp-5	T2	multiple subareas
English sole	whole body	LDW-T3-M-ES-WB-comp-2	T3	multiple subareas
English sole	whole body	LDW-T3-M-ES-WB-comp-3	T3	multiple subareas
English sole	whole body	LDW-T4-M-ES-WB-comp-1	T4	multiple subareas
English sole	fillet (skin-on)	LDW-T1-M-ES-FL-comp-1	T1	multiple subareas
English sole	fillet (skin-on)	LDW-T1-M-ES-FL-comp-2	T1	multiple subareas
English sole	fillet (skin-on)	LDW-T2-M-ES-FL-comp-1	T2	multiple subareas
English sole	fillet (skin-on)	LDW-T2-M-ES-FL-comp-2	T2	multiple subareas
English sole	fillet (skin-on)	LDW-T3-M-ES-FL-comp-1	T3	multiple subareas
English sole	fillet (skin-on)	LDW-T3-M-ES-FL-comp-2	T3	multiple subareas
English sole	fillet (skin-on)	LDW-T4-M-ES-FL-comp-1	T4	multiple subareas
Starry flounder	fillet (skin-on)	LDW-T4-M-SF-FL-comp-1	T4	multiple subareas
Starry flounder	whole body	LDW-T4-M-SF-WB-comp-1	T4	multiple subareas

SPECIES	TISSUE TYPE	SAMPLE ID	AREA	SUBAREA
Pacific staghorn sculpin	whole body	LDW-T1-D-PS-WB-comp-1	T1	D
Pacific staghorn sculpin	whole body	LDW-T1-F-PS-WB-comp-1	T1	F
Pacific staghorn sculpin	whole body	LDW-T2-C-PS-WB-comp-1	T2	C
Pacific staghorn sculpin	whole body	LDW-T2-F-PS-WB-comp-1	T2	F
Pacific staghorn sculpin	whole body	LDW-T3-D-PS-WB-comp-1	T3	D
Pacific staghorn sculpin	whole body	LDW-T3-E-PS-WB-comp-1	T3	E
Pacific staghorn sculpin	whole body	LDW-T4-C-PS-WB-comp-1	T4	C
Pacific staghorn sculpin	whole body	LDW-T4-D-PS-WB-comp-2	T4	D
Shiner surfperch	whole body	LDW-T1-A-SS-WB-comp-1	T1	A
Shiner surfperch	whole body	LDW-T1-F-SS-WB-comp-1	T1	F
Shiner surfperch	whole body	LDW-T2-B-SS-WB-comp-1	T2	B
Shiner surfperch	whole body	LDW-T2-E-SS-WB-comp-1	T2	E
Shiner surfperch	whole body	LDW-T3-C-SS-WB-comp-1	T3	C
Shiner surfperch	whole body	LDW-T3-E-SS-WB-comp-1	T3	E
Shiner surfperch	whole body	LDW-T3-F-SS-WB-comp-1	T3	F
Shiner surfperch	whole body	LDW-T4-B-SS-WB-comp-1	T4	B
Shiner surfperch	whole body	LDW-T4-D-SS-WB-comp-1	T4	D
Dungeness crab	edible meat	LDW-T1-M-DC-EM-comp-2	T1	multiple subareas
Slender crab	edible meat	LDW-T1-M-SC-EM-comp-2	T1	multiple subareas
Slender crab	edible meat	LDW-T2-M-SC-EM-comp-5	T2	multiple subareas
Slender crab	edible meat	LDW-T2-M-SC-EM-comp-6	T2	multiple subareas
Dungeness crab	edible meat	LDW-T3-M-DC-EM-comp-1	T3	multiple subareas
Slender crab	edible meat	LDW-T3-M-SC-EM-comp-2	T3	multiple subareas
Dungeness crab	edible meat	LDW-T4-M-DC-EM-comp-1	T4	multiple subareas
Slender crab	hepatopancreas	LDW-T1-M-SC-HP-comp-1	T1	multiple subareas
Slender crab	hepatopancreas	LDW-T2-M-SC-HP-comp-2	T2	multiple subareas
Dungeness crab	hepatopancreas	LDW-T3-M-DC-HP-comp-1	T3	multiple subareas
Dungeness crab	hepatopancreas	LDW-T4-M-DC-HP-comp-1	T4	multiple subareas

The composite samples were selected, in consultation with EPA and Ecology, to cover the range of total Aroclor concentrations (based on the PCB Aroclor results presented in Section 4.1.4), and to provide spatial coverage of samples throughout the LDW. Methods used to select samples for PCB congener analysis and PCB congener concentrations in these samples will be reported in an addendum to this data report.

3.1 TISSUE ANALYTICAL METHODS

All composite tissue samples collected from the LDW were analyzed for butyltins, SVOCs (including polycyclic aromatic hydrocarbons [PAHs]), metals (including total arsenic and mercury), PCBs as Aroclors, and organochlorine pesticides. Inorganic arsenic was also analyzed in 38 composite tissue samples collected from the LDW that will be used in the human health risk assessment (i.e., English sole and starry flounder fillet and whole body, crab edible meat and hepatopancreas, shiner surfperch whole body, and pile and striped perch fillet). Samples for inorganic arsenic analysis were randomly selected by tissue type, usually two per sampling area. The list of samples collected from the LDW analyzed for inorganic arsenic is presented in Table 3-2. Composite tissue samples collected from background areas were analyzed for total arsenic, inorganic arsenic, lipids, and percent moisture (see Appendix E). Attachment 1 to the Data Validation Report (Appendix D) provides a complete list of the individual samples in each sample delivery group (SDG) and the analyses performed.

Table 3-2. LDW samples analyzed for inorganic arsenic

Sample Type	Sample ID
English sole whole body	LDW-T1-M-ES-WB-comp-1
	LDW-T1-M-ES-WB-comp-2
	LDW-T2-M-ES-WB-comp-1
	LDW-T2-M-ES-WB-comp-2
	LDW-T3-M-ES-WB-comp-1
	LDW-T3-M-ES-WB-comp-2
	LDW-T4-M-ES-WB-comp-1
English sole fillet (skin-on)	LDW-T1-M-ES-FL-comp-1
	LDW-T1-M-ES-FL-comp-2
	LDW-T2-M-ES-FL-comp-1
	LDW-T2-M-ES-FL-comp-2
	LDW-T3-M-ES-FL-comp-1
	LDW-T3-M-ES-FL-comp-2
	LDW-T4-M-ES-FL-comp-1
Starry flounder whole body	LDW-T4-M-SF-WB-comp-1
Starry flounder fillet (skin-on)	LDW-T4-M-SF-FL-comp-1
Shiner surfperch whole body	LDW-T1-A-SS-WB-comp-1
	LDW-T1-B-SS-WB-comp-1
	LDW-T2-A-SS-WB-comp-1
	LDW-T2-B-SS-WB-comp-1
	LDW-T3-A-SS-WB-comp-1
	LDW-T3-B-SS-WB-comp-1
	LDW-T4-A-SS-WB-comp-1
	LDW-T4-B-SS-WB-comp-1
Pile perch fillet (skin-on)	LDW-M-M-PP-FL-comp-1
Striped perch fillet (skin-on)	LDW-M-M-SP-FL-comp-1
Crab edible meat	LDW-T1-M-DC-EM-comp-1
	LDW-T1-M-SC-EM-comp-1
	LDW-T2-M-SC-EM-comp-1
	LDW-T2-M-SC-EM-comp-2
	LDW-T3-M-DC-EM-comp-1
	LDW-T3-M-SC-EM-comp-1

Sample Type	Sample ID
Crab hepatopancreas	LDW-T1-M-DC-HP-comp-1
	LDW-T1-M-SC-HP-comp-1
	LDW-T2-M-SC-HP-comp-1
	LDW-T2-M-SC-HP-comp-2
	LDW-T3-M-DC-HP-comp-1
	LDW-T3-M-SC-HP-comp-1

Analytical testing adhered to the most recent EPA quality assurance and quality control guidelines and analysis protocols (EPA 2002a; PSEP 1997). The methods of chemical analysis are identified in Table 3-3. All methods selected represent standard methods used for the analysis of these analytes in tissue. Remaining tissue from each composite sample will remain frozen at Axys for one year from the collection date. Individual fish and crabs that were not included in composite samples are being archived frozen at ARI for one year from the collection date.

Table 3-3. Analytical methods for fish and crab tissue analyses

Parameter	Unit	Method	Reference
PCBs as Aroclors	µg/kg ww	GC/ECD	EPA 8082a
PCB congeners[a]	ng/kg ww	HRGC/HRMS	EPA 1668
Organochlorine pesticides	µg/kg ww	GC/ECD	EPA 8081a
SVOCs, including PAHs	µg/kg ww	GC/MS	EPA 8270 SIM
Low-level PAHs	mg/kg ww	GC/MS	EPA 8270 SIM
Arsenic (inorganic)[b]	mg/kg ww	HG-AFS	EPA 1632
Chromium	mg/kg ww	ICP-AES	EPA 6010
Mercury	mg/kg ww	CVAA	EPA 7471
Selenium	mg/kg ww	BHR-AA	EPA 7742
Other metals[c]	mg/kg ww	ICP-MS	EPA 6020
Butyltins (tetrabutyltin, tributyltin, dibutyltin and monobutyltin as ions)	µg/kg ww	GC/FPD	Stallard et al. (1988)
Lipids	% ww	gravimetric	NOAA (1993)
Moisture	% ww	freeze dried	PSEP (1997)

a A subset of fish and crab tissue samples are being analyzed for PCB congeners; aliquots of all homogenized composite tissue samples are being archived frozen by Axys in case additional samples are to be analyzed for PCB congeners or if any samples are to be analyzed for dioxins/furans

b A subset of fish and crab tissue samples were analyzed for inorganic arsenic

c Antimony, total arsenic, cadmium, cobalt, copper, lead, molybdenum, nickel, silver, thallium, vanadium, and zinc

ww – wet weight

SVOC – semivolatile organic compound

PAH – polycyclic aromatic hydrocarbon

GC/ECD – gas chromatography/electron capture detection

HRGC/HRMS – high resolution gas chromatography/high resolution mass spectrometry

GC/MS – gas chromatography/mass spectrometry

SIM – selective ion monitoring

HG-AFS – hydride generation-atomic fluorescence spectroscopy

ICP-AES – inductively coupled plasma-atomic emission spectrometry

CVAA – cold vapor atomic absorption

ICP-MS – inductively coupled plasma-mass spectrometry

GC/FPD – gas chromatography/flame photometric detection

3.2 Sediment Analytical Methods

Two sediment samples were collected from the background areas and analyzed for total arsenic and percent moisture (Table 3-4). Analytical testing adhered to the most recent EPA quality assurance and quality control guidelines and analysis protocols (EPA 2002a; PSEP 1997).

Table 3-4. Analytical methods for sediment analyses

Parameter	Unit	Method	Reference
Arsenic	mg/kg dw	ICP-MS	EPA 6020
Moisture	% ww	oven-dried	PSEP (1986)

dw – dry weight

ICP-MS – inductively coupled plasma mass spectrometry

3.3 Laboratory Deviations from the QAPP

The QAPP (Windward 2004b) required that Windward personnel be present at Axys throughout the homogenization process and to oversee the preparation of the composite samples. The homogenization required several weeks of work. Therefore, Windward personnel oversaw the initial homogenization procedures and confirmed that appropriate methods were used to ensure that correct specimens were included in the composite samples created by Axys.

The laboratories followed the methods and procedures described in the QAPP (Windward 2004b), with the following exceptions:

- When analyte concentrations were reported as not detected, the reporting limit was identified as the appropriate value in the electronic data delivery rather than the method detection limit (MDL) as specified in the QAPP. The MDL is used to establish the optimal sensitivity of the method. MDLs are established by analyzing a spiked clean sample, and the MDL value is established through a statistical evaluation of the signal-to-noise ratio observed during the study. The reporting limit (RL) represents the lowest calibration point for the instrument on the day of sample analysis. This value reflects the sensitivity of the instrument on the day of analysis and the lower limit of the linear range of the calibration. Laboratories attempt to quantify analytes that are observed at concentrations between the MDL and the RL; however, the uncertainty associated with the quantified value is large due to the fact that the concentration is below the calibration range of the instrument. Both MDLs and RLs are adjusted for sample dilution and the amount of sample extracted.

- Matrix spike/matrix spike duplicate (MS/MSD) samples were only run for the metals analysis. The laboratory mistakenly believed they did not have sufficient tissue to run MS/MSD samples for the organic analyses. No data qualification resulted from the absence of MS/MSD analysis. The laboratory is currently running MS/MSD samples using archived tissue; the results of these analyses will be provided in the fish and crab tissue data addendum. The results of the MS/MSD analyses will be compared to the project QC criteria. If the MS/MSD, SRM, and LCS results are consistent with the QC criteria, then it is unlikely that the tissue data were influenced by matrix effects. If, however, the MS/MSD results indicate potential matrix effects, then greater uncertainty is associated with the results. The tissue dataset will not be revalidated based on the MS/MSD results because functional guidelines state that no action is taken on MS/MSD data alone.
- In the analysis of inorganic arsenic in tissue samples, no standard reference material (SRM) samples were analyzed because no tissue SRM with a certified value for inorganic arsenic was available

4.0 Chemical Analysis Results

Results of chemical analyses of fish and crab tissue samples collected from the LDW and from background areas are summarized in Sections 4.1 and 4.2.1, respectively. Results of chemical analyses of sediment samples collected from background areas are presented in Section 4.2.2. Complete data tables and raw laboratory data are presented in Appendices A and D, respectively. A detailed discussion of the approach used to average laboratory replicates is presented in Appendix C. Methods for calculating concentrations for total PCBs, total PAHs, and total DDTs are also presented in Appendix C. The number of significant figures shown for each concentration in all results tables in this section was specified by the analytical laboratory, as described in Appendix C. There was no additional manipulation of significant figures.

Quality assurance review of the chemistry data was conducted in accordance with the quality assurance/quality control (QA/QC) requirements and technical specifications of the methods, and the National Functional Guidelines for Organic and Inorganic Data Review (EPA 1999, 2002b). Laboratory Data Consultants (LDC) conducted the data validation. The results of the data validation are discussed in Section 4.3, and presented in full in Appendix D.

4.1 LDW Fish and Crab Tissue Results

Composite tissue samples created from fish and crabs collected in the LDW were analyzed for metals, butyltins, SVOCs, PCBs as Aroclors, organochlorine pesticides, percent moisture, and percent lipids. The results of these analyses are discussed separately below for each tissue type by analyte group.

Forty-one of the 108 samples are also being analyzed for PCB congeners by Axys (see Section 3.0). The PCB congener concentrations in these samples will be reported in an addendum to this data report.

4.1.1 Metals (including mercury and inorganic arsenic)

Table 4-1 presents a summary of all metals analyzed in each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Results are discussed for total arsenic, inorganic arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. Data tables for these metals and the remaining six metals are presented in Appendix A for each composite sample of each tissue type.

Table 4-1. Detection frequencies and concentration summaries of metals in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (mg/kg ww)			Reporting Limit[a] (mg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Antimony						
English sole-whole body	21/21	0.0025 J	0.0111 J	0.0060	na	na
English sole-fillet	2/7	0.0012 J	0.0015 J	0.0014	0.0104	0.0122
starry flounder-whole body	3/3	0.0028 J	0.0070 J	0.0044	na	na
starry flounder-fillet	1/1	0.0036 J	0.0036 J	0.0036	na	na
Pacific staghorn sculpin-whole body	19/24	0.001 J	0.007 J	0.003	0.010	0.011
shiner surfperch-whole body	24/24	0.0017 J	0.0079 J	0.0034	na	na
pile perch-fillet	1/1	0.0016 J	0.0016 J	0.0016	na	na
striped perch-fillet	0/1	nd	nd	nd	0.0114	0.0114
Dungeness crab-edible meat	7/7	0.0015 J	0.0037 J	0.0023	na	na
Dungeness crab-hepatopancreas	3/3	0.0051 J	0.0087	0.0074	na	na
slender crab-edible meat	10/12	0.0009 J	0.0025 J	0.001	0.0079	0.0087
slender crab-hepatopancreas	4/4	0.0025 J	0.0048 J	0.0031	na	na
Arsenic						
English sole-whole body	21/21	2.230	4.3	3.274	na	na
English sole-fillet	7/7	3.97	6.890	5.255	na	na
starry flounder-whole body	3/3	0.793	0.973	0.887	na	na
starry flounder-fillet	1/1	0.899	0.899	0.899	na	na
Pacific staghorn sculpin-whole body	24/24	0.364	1.430	0.738	na	na
shiner surfperch-whole body	24/24	0.715	1.29	0.955	na	na

Analyte	Detection Frequency	Detected Concentration (mg/kg ww)			Reporting Limit[a] (mg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
pile perch-fillet	1/1	0.563	0.563	0.563	na	na
striped perch-fillet	1/1	0.274	0.274	0.274	na	na
Dungeness crab-edible meat	7/7	2.540	6.8	4.210	na	na
Dungeness crab-hepatopancreas	3/3	3.080	4.1	3.750	na	na
slender crab-edible meat	12/12	1.670	3.6	2.612	na	na
slender crab-hepatopancreas	4/4	2.230	3.3	2.645	na	na
Arsenic - inorganic						
English sole-whole body	7/7	0.020	0.090	0.051	na	na
English sole-fillet	6/7	0.003	0.006 J	0.005	0.003	0.003
starry flounder-whole body	1/1	0.090	0.090	0.090	na	na
starry flounder-fillet	0/1	nd	nd	nd	0.003	0.003
shiner surfperch-whole body	8/8	0.020	0.160	0.070	na	na
pile perch-fillet	0/1	nd	nd	nd	0.010	0.010
striped perch-fillet	0/1	nd	nd	nd	0.010	0.010
Dungeness crab-edible meat	2/2	0.010 J	0.010	0.010	na	na
Dungeness crab-hepatopancreas	2/2	0.050	0.090	0.070	na	na
slender crab-edible meat	4/4	0.030	0.030	0.030	na	na
slender crab-hepatopancreas	4/4	0.080	0.330	0.24	na	na
Cadmium						
English sole-whole body	21/21	0.0042 J	0.0151	0.0077	na	na
English sole-fillet	1/7	0.0013 J	0.0013 J	0.0013	0.0042	0.0049
starry flounder-whole body	3/3	0.0044 J	0.0079	0.0062	na	na
starry flounder-fillet	0/1	nd	nd	nd	0.0043	0.0043
Pacific staghorn sculpin-whole body	24/24	0.002 J	0.011	0.005	na	na
shiner surfperch-whole body	24/24	0.0099	0.0240	0.015	na	na
pile perch-fillet	0/1	nd	nd	nd	0.0046	0.0046
striped perch-fillet	0/1	nd	nd	nd	0.0046	0.0046
Dungeness crab-edible meat	7/7	0.0055	0.0295	0.015	na	na
Dungeness crab-hepatopancreas	3/3	0.3020	0.7880	0.6050	na	na
slender crab-edible meat	12/12	0.0169	0.0444	0.0290	na	na
slender crab-hepatopancreas	4/4	0.2700	0.8530	0.4835	na	na
Chromium						
English sole-whole body	18/21	0.08 J	0.39	0.2	0.13	0.14
English sole-fillet	0/7	nd	nd	nd	0.10	0.12
starry flounder-whole body	3/3	0.14	3.74	1.5	na	na
starry flounder-fillet	0/1	nd	nd	nd	0.11	0.11
Pacific staghorn sculpin-whole body	6/24	0.06 J	0.11	0.09	0.10	0.11
shiner surfperch-whole body	23/24	0.08 J	0.45	0.2	0.13	0.13
pile perch-fillet	0/1	nd	nd	nd	0.12	0.12

Analyte	Detection Frequency	Detected Concentration (mg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (mg/kg ww) Minimum	Maximum
striped perch-fillet	0/1	nd	nd	nd	0.11	0.11
Dungeness crab-edible meat	0/7	nd	nd	nd	0.08	0.11
Dungeness crab-hepatopancreas	1/3	0.16	0.16	0.16	0.01	0.08
slender crab-edible meat	0/12	nd	nd	nd	0.07	0.10
slender crab-hepatopancreas	1/4	0.04 J	0.04 J	0.04	0.06	0.07
Cobalt						
English sole-whole body	21/21	0.0242	0.0949	0.0457	na	na
English sole-fillet	7/7	0.0037 J	0.0048	0.0042	na	na
starry flounder-whole body	3/3	0.0496	0.2290 J	0.141	na	na
starry flounder-fillet	1/1	0.0086 J	0.0086 J	0.0086	na	na
Pacific staghorn sculpin-whole body	24/24	0.0182	0.0377	0.0250	na	na
shiner surfperch-whole body	24/24	0.0279	0.0606	0.0417	na	na
pile perch-fillet	1/1	0.0054	0.0054	0.0054	na	na
striped perch-fillet	1/1	0.0071	0.0071	0.0071	na	na
Dungeness crab-edible meat	7/7	0.0338 J	0.0736 J	0.0524	na	na
Dungeness crab-hepatopancreas	3/3	0.1680 J	0.3250 J	0.2253	na	na
slender crab-edible meat	12/12	0.0107	0.0169 J	0.0132	na	na
slender crab-hepatopancreas	4/4	0.0531 J	0.0836 J	0.0681	na	na
Copper						
English sole-whole body	21/21	0.494	3.470	1.79	na	na
English sole-fillet	7/7	0.386	1.390	1.12	na	na
starry flounder-whole body	3/3	0.550 J	2.770	1.35	na	na
starry flounder-fillet	1/1	0.272 J	0.272 J	0.272	na	na
Pacific staghorn sculpin-whole body	24/24	0.67	1.22	0.93	na	na
shiner surfperch-whole body	24/24	0.582	2.190	1.61	na	na
pile perch-fillet	1/1	1.100	1.100	1.100	na	na
striped perch-fillet	1/1	1.250	1.250	1.250	na	na
Dungeness crab-edible meat	7/7	6.570 J	9.340 J	7.794	na	na
Dungeness crab-hepatopancreas	3/3	17.5	33.2 J	24.1	na	na
slender crab-edible meat	12/12	4.430	7.320	6.238	na	na
slender crab-hepatopancreas	4/4	12.4	49.9	26.8	na	na
Lead						
English sole-whole body	21/21	0.0977	0.946	0.373	na	na
English sole-fillet	7/7	0.0119	0.137	0.092	na	na
starry flounder-whole body	3/3	0.035	0.403	0.17	na	na
starry flounder-fillet	1/1	0.006	0.006	0.006	na	na
Pacific staghorn sculpin-whole body	24/24	0.012	0.114	0.054	na	na
shiner surfperch-whole body	24/24	0.0453	0.2610	0.111	na	na
pile perch-fillet	1/1	0.022	0.022	0.022	na	na

Analyte	Detection Frequency	Detected Concentration (mg/kg ww)			Reporting Limit[a] (mg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
striped perch-fillet	1/1	0.023	0.023	0.023	na	na
Dungeness crab-edible meat	7/7	0.012	0.033	0.019	na	na
Dungeness crab-hepatopancreas	3/3	0.037	0.094	0.063	na	na
slender crab-edible meat	12/12	0.0131	0.0503	0.0270	na	na
slender crab-hepatopancreas	4/4	0.0718	0.2690	0.136	na	na
Mercury						
English sole-whole body	21/21	0.005	0.027	0.01	na	na
English sole-fillet	7/7	0.013	0.025	0.017	na	na
starry flounder-whole body	3/3	0.021	0.025	0.023	na	na
starry flounder-fillet	1/1	0.046	0.046	0.046	na	na
Pacific staghorn sculpin-whole body	24/24	0.018	0.039	0.029	na	na
shiner surfperch-whole body	24/24	0.018	0.038	0.027	na	na
pile perch-fillet	1/1	0.040	0.040	0.040	na	na
striped perch-fillet	1/1	0.053	0.053	0.053	na	na
Dungeness crab-edible meat	7/7	0.034	0.062	0.051	na	na
Dungeness crab-hepatopancreas	3/3	0.026	0.036	0.030	na	na
slender crab-edible meat	12/12	0.023	0.060	0.047	na	na
slender crab-hepatopancreas	4/4	0.020	0.025	0.022	na	na
Molybdenum						
English sole-whole body	21/21	0.0121 J	0.0430	0.0201	na	na
English sole-fillet	7/7	0.0046 J	0.0065 J	0.0052	na	na
starry flounder-whole body	3/3	0.0143	0.4100	0.157	na	na
starry flounder-fillet	1/1	0.0036 J	0.0036 J	0.0036	na	na
Pacific staghorn sculpin-whole body	24/24	0.0083 J	0.0162	0.012	na	na
shiner surfperch-whole body	24/24	0.0138	0.0435	0.0207	na	na
pile perch-fillet	1/1	0.0026 J	0.0026 J	0.0026	na	na
striped perch-fillet	1/1	0.0025 J	0.0025 J	0.0025	na	na
Dungeness crab-edible meat	7/7	0.0108	0.0168	0.0126	na	na
Dungeness crab-hepatopancreas	3/3	0.0840	0.1310	0.106	na	na
slender crab-edible meat	12/12	0.0131	0.0171	0.0150	na	na
slender crab-hepatopancreas	4/4	0.0599	0.0936	0.0727	na	na
Nickel						
English sole-whole body	21/21	0.120	0.378 J	0.208	na	na
English sole-fillet	7/7	0.015 J	0.079 J	0.032	na	na
starry flounder-whole body	3/3	0.202	2.060	0.864	na	na
starry flounder-fillet	1/1	0.034 J	0.034 J	0.034	na	na
Pacific staghorn sculpin-whole body	23/24	0.126	0.194	0.160	0.130	0.130
shiner surfperch-whole body	24/24	0.184	0.545 J	0.414	na	na
pile perch-fillet	1/1	0.052	0.052	0.052	na	na

Analyte	Detection Frequency	Detected Concentration (mg/kg ww)			Reporting Limit[a] (mg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
striped perch-fillet	1/1	0.064	0.064	0.064	na	na
Dungeness crab-edible meat	7/7	0.022 J	0.043	0.034	na	na
Dungeness crab-hepatopancreas	3/3	0.082	0.284 J	0.15	na	na
slender crab-edible meat	12/12	0.035 J	0.065	0.050	na	na
slender crab-hepatopancreas	4/4	0.075 J	0.110	0.088	na	na
Selenium						
English sole-whole body	21/21	0.10	0.320	0.19	na	na
English sole-fillet	7/7	0.15	0.210	0.2	na	na
starry flounder-whole body	3/3	0.13	0.16	0.14	na	na
starry flounder-fillet	1/1	0.13	0.13	0.13	na	na
Pacific staghorn sculpin-whole body	24/24	0.14	0.23	0.18	na	na
shiner surfperch-whole body	24/24	0.111	0.219	0.177	na	na
pile perch-fillet	1/1	0.12	0.12	0.12	na	na
striped perch-fillet	1/1	0.10	0.10	0.10	na	na
Dungeness crab-edible meat	7/7	0.11	0.175	0.14	na	na
Dungeness crab-hepatopancreas	3/3	0.23	0.249	0.24	na	na
slender crab-edible meat	12/12	0.160	0.262	0.209	na	na
slender crab-hepatopancreas	4/4	0.133	0.206	0.172	na	na
Silver						
English sole-whole body	21/21	0.0013 J	0.0066	0.0034	na	na
English sole-fillet	0/7	nd	nd	nd	0.0042	0.0049
starry flounder-whole body	3/3	0.0013 J	0.0076 J	0.0040	na	na
starry flounder-fillet	0/1	nd	nd	nd	0.0043	0.0043
Pacific staghorn sculpin-whole body	24/24	0.0015 J	0.0077	0.0042	na	na
shiner surfperch-whole body	24/24	0.0022 J	0.0108	0.0045	na	na
pile perch-fillet	0/1	nd	nd	nd	0.0046	0.0046
striped perch-fillet	0/1	nd	nd	nd	0.0046	0.0046
Dungeness crab-edible meat	7/7	0.0885 J	0.1460	0.109	na	na
Dungeness crab-hepatopancreas	3/3	0.2460 J	0.4270 J	0.3253	na	na
slender crab-edible meat	12/12	0.0431	0.0702	0.0563	na	na
slender crab-hepatopancreas	4/4	0.1120	0.4060	0.2268	na	na
Thallium						
English sole-whole body	7/21	0.0005 J	0.0012 J	0.0006	0.0043	0.0055
English sole-fillet	0/7	nd	nd	nd	0.0042	0.0049
starry flounder-whole body	1/3	0.0006 J	0.0006 J	0.0006	0.0044	0.0045
starry flounder-fillet	0/1	nd	nd	nd	0.0043	0.0043
Pacific staghorn sculpin-whole body	17/24	0.0004 J	0.0007 J	0.0005	0.0042	0.0043
shiner surfperch-whole body	22/24	0.0005 J	0.0017 J	0.0007	0.0047	0.0052
pile perch-fillet	0/1	nd	nd	nd	0.0046	0.0046

Analyte	Detection Frequency	Detected Concentration (mg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (mg/kg ww) Minimum	Maximum
striped perch-fillet	0/1	nd	nd	nd	0.0046	0.0046
Dungeness crab-edible meat	0/7	nd	nd	nd	0.0030	0.0042
Dungeness crab-hepatopancreas	2/3	0.0004 J	0.0005 J	0.0005	0.0032	0.0032
slender crab-edible meat	0/12	nd	nd	nd	0.0027	0.0039
slender crab-hepatopancreas	4/4	0.0004 J	0.0008 J	0.0006	na	na
Vanadium						
English sole-whole body	21/21	0.2 J	0.49	0.4	na	na
English sole-fillet	0/7	nd	nd	nd	0.2	0.25
starry flounder-whole body	3/3	0.2 J	0.5	0.3	na	na
starry flounder-fillet	0/1	nd	nd	nd	0.2	0.2
Pacific staghorn sculpin-whole body	10/24	0.1 J	0.2 J	0.2	0.2	0.2
shiner surfperch-whole body	22/24	0.21 J	1.23	0.42	0.25	0.25
pile perch-fillet	0/1	nd	nd	nd	0.2	0.2
striped perch-fillet	0/1	nd	nd	nd	0.2	0.2
Dungeness crab-edible meat	0/7	nd	nd	nd	0.2	0.21
Dungeness crab-hepatopancreas	1/3	0.2 J	0.2 J	0.2	0.2	0.24
slender crab-edible meat	0/12	nd	nd	nd	0.14	0.20
slender crab-hepatopancreas	3/4	0.11 J	0.14	0.12	0.13	0.13
Zinc						
English sole-whole body	21/21	11.2	14.4	12.6	na	na
English sole-fillet	7/7	7.35	8.89	7.77	na	na
starry flounder-whole body	3/3	15.1	16.1	15.6	na	na
starry flounder-fillet	1/1	7.93	7.93	7.93	na	na
Pacific staghorn sculpin-whole body	24/24	9.95	13.8	11.4	na	na
shiner surfperch-whole body	24/24	17.4	28.0	21.9	na	na
pile perch-fillet	1/1	7.47	7.47	7.47	na	na
striped perch-fillet	1/1	9.33	9.33	9.33	na	na
Dungeness crab-edible meat	7/7	29.0	36.9	33.5	na	na
Dungeness crab-hepatopancreas	3/3	14.8	22.7	17.9	na	na
slender crab-edible meat	12/12	26.1	39.3	34.4	na	na
slender crab-hepatopancreas	4/4	24.4	33.6	27.9	na	na

[a] Reporting limit range for nondetect samples

[b] Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration.

na – not applicable

nd – not detected

J – estimated concentration

Total arsenic was detected in all 108 fish and crab tissue samples at concentrations ranging from 0.274 to 6.89 mg/kg ww. The highest concentration was detected in an

English sole fillet composite sample from Area T1 (6.89 mg/kg ww). The next highest concentration was detected in a Dungeness crab edible meat composite sample from Area T4 (6.8 mg/kg ww).

Inorganic arsenic was detected in all but four of the 38 samples analyzed for inorganic arsenic, at concentrations ranging from 0.003 to 0.33 mg/kg ww. The highest concentration was detected in a slender crab hepatopancreas composite sample collected from Area T3. The next highest concentrations of 0.29 and 0.25 mg/kg ww were detected in slender crab hepatopancreas samples from Areas T2 and T3.

Cadmium was detected in all but nine of the 108 samples analyzed, at concentrations ranging from 0.0013 to 0.853 mg/kg ww. The highest concentration was detected in a slender crab hepatopancreas sample collected from Area T1. The next six highest concentrations were detected in either Dungeness or slender crab hepatopancreas composite samples collected from throughout the LDW at concentrations ranging from 0.27 to 0.788 mg/kg ww. Cadmium concentrations in all remaining fish and crab samples were less than 0.05 mg/kg ww.

Chromium was detected in 52 of the 108 samples at concentrations ranging from 0.04 to 3.74 mg/kg ww. The highest concentration was detected in a starry flounder whole-body composite sample collected from Area T4. Chromium concentrations in all remaining fish and crab samples were less than 0.7 mg/kg ww.

Copper was detected in all 108 samples at concentrations ranging from 0.272 to 49.9 mg/kg ww. The highest concentration was detected in a slender crab hepatopancreas sample collected from Area T1. The next six highest concentrations were detected in either Dungeness or slender crab hepatopancreas samples collected from throughout the LDW at concentrations ranging from 12.4 to 33.2 mg/kg ww.

Lead was detected in all 108 samples at concentrations ranging from 0.006 to 0.946 mg/kg ww. The highest concentration was detected in an English sole whole-body sample collected from Area T2. The next seven highest concentrations were also detected in English sole whole-body composite samples, at concentrations ranging from 0.417 to 0.715 mg/kg ww.

Mercury was detected in all 108 samples at concentrations ranging from 0.005 to 0.062 mg/kg ww. The highest concentration was detected in a Dungeness edible meat composite sample collected from Area T3. The next seven highest concentrations were detected in either Dungeness or slender crab edible meat composite samples collected from Areas T1, T2, and T3, at concentrations ranging from 0.054 to 0.060 mg/kg ww.

Nickel was detected in all but one of the 108 samples at concentrations ranging from 0.015 to 2.06 mg/kg ww. The highest concentration was detected in a starry flounder whole-body composite sample collected from Area T4. The next highest concentrations were detected in 19 shiner surfperch whole-body composite samples collected from throughout the LDW at concentrations ranging from 0.382 to 0.545 mg/kg ww.

Silver was detected in 99 of the 108 samples at concentrations ranging from 0.0013 to 0.427 mg/kg ww. The highest concentration was detected in a Dungeness crab hepatopancreas composite sample collected from Area T1. The next five highest concentrations were detected in either Dungeness or slender crab hepatopancreas composite samples collected from throughout the LDW at concentrations ranging from 0.171 to 0.406 mg/kg ww.

Zinc was detected in all 108 samples at concentrations ranging from 7.35 to 39.3 mg/kg ww. The highest concentration was detected in a slender crab edible meat sample collected from Area T2. The next ten highest concentrations were detected in either Dungeness or slender crab edible meat composite samples collected from throughout the LDW at concentrations ranging from 33.9 to 38.9 mg/kg ww.

4.1.2 Butyltins

Table 4-2 presents a summary of the butyltins analyzed in each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Data tables containing all butyltin results for each composite sample of each tissue type are presented in Appendix A.

Table 4-2. Detection frequencies and concentration summaries of butyltins in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Monobutyltin as ion						
English sole-whole body	4/20	0.58 J	1.0 J	0.87	1.5	1.5
English sole-fillet	0/7	nd	nd	nd	1.5	1.5
starry flounder-whole body	3/3	0.64 J	1.9 J	1.2	na	na
starry flounder-fillet	0/1	nd	nd	nd	1.5	1.5
Pacific staghorn sculpin-whole body	3/24	0.44 J	27	9.3	1.0	1.0
shiner surfperch-whole body	24/24	0.75 J	4.0	2.3	na	na
pile perch-fillet	0/1	nd	nd	nd	1.5	1.5
striped perch-fillet	0/1	nd	nd	nd	1.5	1.5
Dungeness crab-edible meat	0/7	nd	nd	nd	1.5	1.5
Dungeness crab-hepatopancreas	2/3	1.3 J	1.6	1.5	1.5	1.5
slender crab-edible meat	0/12	nd	nd	nd	1.5	1.5
slender crab-hepatopancreas	4/4	1.3 J	1.5	1.4	na	na
Dibutyltin as ion						
English sole-whole body	18/20	0.53 J	4.0	1.8	1.5	1.5
English sole-fillet	3/7	0.55 J	0.70 J	0.60	1.5	1.5
starry flounder-whole body	3/3	2.6	5.8	3.8	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
starry flounder-fillet	1/1	1.2 J	1.2 J	1.2	na	na
Pacific staghorn sculpin-whole body	24/24	2.1	110	8.2	na	na
shiner surfperch-whole body	24/24	6.8	17	10	na	na
pile perch-fillet	1/1	1.5 J	1.5 J	1.5	na	na
striped perch-fillet	1/1	1.3 J	1.3 J	1.3	na	na
Dungeness crab-edible meat	0/7	nd	nd	nd	1.5	1.5
Dungeness crab-hepatopancreas	3/3	7.7	9.1	8.4	na	na
slender crab-edible meat	0/12	nd	nd	nd	1.5	1.5
slender crab-hepatopancreas	4/4	0.85 J	1.4 J	1.2	na	na
Tributyltin as ion						
English sole-whole body	15/20	3.1	9.9 J	5.9	1.5	2.1
English sole-fillet	6/7	1.2 J	2.2	1.6	1.5	1.5
starry flounder-whole body	3/3	11	15	12	na	na
starry flounder-fillet	1/1	4.4	4.4	4.4	na	na
Pacific staghorn sculpin-whole body	24/24	23	80	32	na	na
shiner surfperch-whole body	24/24	33	58	46	na	na
pile perch-fillet	1/1	4.8	4.8	4.8	na	na
striped perch-fillet	1/1	7.0	7.0	7.0	na	na
Dungeness crab-edible meat	7/7	0.81 J	3.3	1.8	na	na
Dungeness crab-hepatopancreas	3/3	16	40	31	na	na
slender crab-edible meat	0/12	nd	nd	nd	1.5	1.5
slender crab-hepatopancreas	2/4	0.50 J	0.55 J	0.53	1.5	1.5
Tetrabutyltin as ion						
English sole-whole body	0/20	nd	nd	nd	1.5	1.5
English sole-fillet	0/7	nd	nd	nd	1.5	1.5
starry flounder-whole body	0/3	nd	nd	nd	1.5	1.5
starry flounder-fillet	0/1	nd	nd	nd	1.5	1.5
Pacific staghorn sculpin-whole body	1/24	66	66	66	1.0	1.0
shiner surfperch-whole body	0/24	nd	nd	nd	1.5	1.5
pile perch-fillet	0/1	nd	nd	nd	1.5	1.5
striped perch-fillet	0/1	nd	nd	nd	1.5	1.5
Dungeness crab-edible meat	0/7	nd	nd	nd	1.5	1.5
Dungeness crab-hepatopancreas	0/3	nd	nd	nd	1.5	1.5
slender crab-edible meat	0/12	nd	nd	nd	1.5	1.5
slender crab-hepatopancreas	0/4	nd	nd	nd	1.5	1.5

[a] Reporting limit range for nondetect samples

[b] Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration

na – not applicable

nd – not detected

J – estimated concentration

Monobutyltin was detected in 34 of 71 fish whole-body composite samples at concentrations ranging from 0.44 to 27 µg/kg ww. Monobutyltin was not detected in any of the 10 fish fillet composite samples or 19 crab edible meat composite samples. Monobutyltin was detected in six of seven crab hepatopancreas composite samples at concentrations ranging from 1.3 to 1.6 µg/kg ww. The highest concentration (27 µg/kg ww) was detected in a Pacific staghorn sculpin whole-body composite sample from Area T4D.

Dibutyltin was detected in 69 of 71 fish whole-body composite samples at concentrations ranging from 0.53 to 110 µg/kg ww; six of 10 fish fillet composite samples at concentrations ranging from 0.55 to 1.5 µg/kg ww; and all seven crab hepatopancreas composite samples at concentrations ranging from 0.85 to 9.1 µg/kg ww. Dibutyltin was not detected in any of the 19 crab edible meat composite samples. The highest concentration (110 µg/kg ww) was detected in a Pacific staghorn sculpin whole-body composite sample from Area T4D.

Tributyltin was detected in 66 of 71 fish whole-body composite samples at concentrations ranging from 3.1 to 80 µg/kg ww; nine of 10 fish fillet composite samples at concentrations ranging from 1.2 to 7 µg/kg ww; five of seven crab hepatopancreas composite samples at concentrations ranging from 0.50 to 40 µg/kg ww; and seven of 19 crab edible meat composite samples at concentrations ranging from 0.81 to 3.3 µg/kg ww. The highest concentration (80 µg/kg ww) was detected in a Pacific staghorn sculpin whole-body composite sample from Area T4D.

Tetrabutyltin was detected in one of 81 fish tissue composite samples at a concentration of 66 µg/kg ww; and it was not detected in any of the 26 crab tissue samples. The only detected concentration (66 µg/kg ww) was detected in a Pacific staghorn sculpin whole-body composite sample from Area T4D.

4.1.3 PAHs

Table 4-3 presents a summary of PAH results for each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Calculated totals for HPAHs, LPAHs, and all PAHs are also presented in Table 4-3. Methods for calculating totals are presented in Appendix C. Data tables containing PAH results for each composite sample of each tissue type are presented in Appendix A.

Table 4-3. Detection frequencies and concentration summaries of PAHs in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
English sole-whole body						
2-Chloronaphthalene	0/21	nd	nd	nd	290	580
2-Methylnaphthalene	21/21	1.6	10	3.8	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Acenaphthene	21/21	3.5	22	8.2	na	na
Acenaphthylene	21/21	0.56	2.8	1.7	na	na
Anthracene	21/21	0.89	9.0	3.5	na	na
Benzo(a)anthracene	17/21	0.35 J	3.6	1.8	0.50	0.50
Benzo(a)pyrene	14/21	0.49 J	1.8	1.3	0.50	0.72
Benzo(b)fluoranthene	17/21	0.33 J	3.1	1.7	0.50	0.72
Benzo(g,h,i)perylene	17/21	0.21 J	1.2	0.71	0.50	0.72
Benzo(k)fluoranthene	17/21	0.25 J	2.7	1.5	0.50	0.72
Benzofluoranthenes (total-calc'd)[c]	17/21	0.58 J	5.2	3.2	na	na
Chrysene	17/21	0.65 J	9.0	2.9	0.50	0.50
Dibenzo(a,h)anthracene	7/21	0.12 J	0.45 J	0.24	0.50	0.72
Dibenzofuran	21/21	1.6	9.5	3.8	na	na
Fluoranthene	21/21	2.3	11	4.9	na	na
Fluorene	21/21	1.2	6.3	2.9	na	na
Indeno(1,2,3-cd)pyrene	17/21	0.16 J	1.4	0.75	0.50	0.72
Naphthalene	17/21	2.6	12	5.7	4.8	7.8
Phenanthrene	21/21	1.9	13	4.2	na	na
Pyrene	21/21	1.2	7.7	3.1	na	na
Total HPAH (calc'd)[c]	21/21	3.8	35 J	17	na	na
Total LPAH (calc'd)[c]	21/21	11.3	54	25	na	na
Total PAH (calc'd)[c]	21/21	21.8 J	83	42	na	na
English sole-fillet						
2-Chloronaphthalene	0/7	nd	nd	nd	290	580
2-Methylnaphthalene	7/7	0.98 J	2.8	1.9	na	na
Acenaphthene	7/7	2.1	6.6	3.9	na	na
Acenaphthylene	7/7	0.27 J	1.0	0.68	na	na
Anthracene	6/7	0.40 J	1.7	1.2	0.41	0.41
Benzo(a)anthracene	4/7	0.17 J	0.36 J	0.25	0.50	0.50
Benzo(a)pyrene	1/7	0.18 J	0.18 J	0.18	0.50	0.72
Benzo(b)fluoranthene	2/7	0.16	0.19 J	0.18	0.50	0.50
Benzo(g,h,i)perylene	2/7	0.20 J	0.21	0.21	0.50	0.50
Benzo(k)fluoranthene	2/7	0.18	0.22 J	0.20	0.50	0.50
Benzofluoranthenes (total-calc'd)[c]	2/7	0.34	0.41 J	0.38	na	na
Chrysene	4/7	0.12 J	0.33 J	0.24	0.50	0.50
Dibenzo(a,h)anthracene	1/7	0.24	0.24	0.24	0.50	0.50
Dibenzofuran	7/7	0.96	2.9	1.8	na	na
Fluoranthene	3/7	0.82	1.7	1.4	0.87	1.4
Fluorene	7/7	0.72	2.1	1.3	na	na
Indeno(1,2,3-cd)pyrene	2/7	0.19 J	0.21	0.20	0.50	0.50
Naphthalene	7/7	1.7	4.1	3.1	na	na
Phenanthrene	3/7	0.82	2.4	1.6	0.89	1.6
Pyrene	2/7	0.33 J	0.64 J	0.49	0.36	0.91
Total HPAH (calc'd)[c]	4/7	0.69 J	3.8 J	2.3	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Total LPAH (calc'd)[c]	7/7	5.2 J	17.1	11	na	na
Total PAH (calc'd)[c]	7/7	5.2 J	19.0 J	12	na	na
Starry flounder-whole body						
2-Chloronaphthalene	0/3	nd	nd	nd	570	580
2-Methylnaphthalene	3/3	1.7	2.8	2.2	na	na
Acenaphthene	3/3	4.6	9.0	6.4	na	na
Acenaphthylene	3/3	0.38 J	0.56 J	0.47	na	na
Anthracene	2/3	0.59 J	0.77	0.68	0.66	0.66
Benzo(a)anthracene	3/3	0.26 J	0.32 J	0.29	na	na
Benzo(a)pyrene	3/3	0.30 J	0.36 J	0.34	na	na
Benzo(b)fluoranthene	3/3	0.30 J	0.57	0.44	na	na
Benzo(g,h,i)perylene	3/3	0.25 J	0.36 J	0.32	na	na
Benzo(k)fluoranthene	3/3	0.30 J	0.57	0.41	na	na
Benzofluoranthenes (total-calc'd)[c]	3/3	0.60 J	1.14	0.85	na	na
Chrysene	3/3	0.50 J	0.88	0.70	na	na
Dibenzo(a,h)anthracene	1/3	0.14 J	0.14 J	0.14	0.50	0.72
Dibenzofuran	3/3	2.2	4.6	3.2	na	na
Fluoranthene	3/3	2.3	2.4	2.4	na	na
Fluorene	3/3	1.6	3.8	2.5	na	na
Indeno(1,2,3-cd)pyrene	2/3	0.20 J	0.35 J	0.28	0.72	0.72
Naphthalene	2/3	2.4	4.1	3.3	3.1	3.1
Phenanthrene	3/3	1.9	3.8	2.7	na	na
Pyrene	3/3	1.1	1.5	1.3	na	na
Total HPAH (calc'd)[c]	3/3	5.8 J	7.3 J	6.4	na	na
Total LPAH (calc'd)[c]	3/3	11.0 J	22.0 J	15	na	na
Total PAH (calc'd)[c]	3/3	17.3 J	27.8 J	21	na	na
Starry flounder-fillet						
2-Chloronaphthalene	0/1	nd	nd	nd	570	570
2-Methylnaphthalene	1/1	2.0	2.0	2.0	na	na
Acenaphthene	1/1	5.0	5.0	5.0	na	na
Acenaphthylene	1/1	0.44 J	0.44 J	0.44	na	na
Anthracene	1/1	0.51 J	0.51 J	0.51	na	na
Benzo(a)anthracene	1/1	0.34 J	0.34 J	0.34	na	na
Benzo(a)pyrene	1/1	0.37 J	0.37 J	0.37	na	na
Benzo(b)fluoranthene	1/1	0.27 J	0.27 J	0.27	na	na
Benzo(g,h,i)perylene	1/1	0.36 J	0.36 J	0.36	na	na
Benzo(k)fluoranthene	1/1	0.31 J	0.31 J	0.31	na	na
Benzofluoranthenes (total-calc'd)[c]	1/1	0.58 J	0.58 J	0.58	na	na
Chrysene	1/1	0.53 J	0.53 J	0.53	na	na
Dibenzo(a,h)anthracene	0/1	nd	nd	nd	0.71	0.71
Dibenzofuran	1/1	2.3	2.3	2.3	na	na
Fluoranthene	1/1	1.8	1.8	1.8	na	na
Fluorene	1/1	1.6	1.6	1.6	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Indeno(1,2,3-cd)pyrene	1/1	0.32 J	0.32 J	0.32	na	na
Naphthalene	0/1	nd	nd	nd	3.7	3.7
Phenanthrene	1/1	1.7	1.7	1.7	na	na
Pyrene	1/1	1.0	1.0	1.0	na	na
Total HPAH (calc'd)[c]	1/1	5.3 J	5.3 J	5.3	na	na
Total LPAH (calc'd)[c]	1/1	9.3 J	9.3 J	9.3	na	na
Total PAH (calc'd)[c]	1/1	14.6 J	14.6 J	15	na	na
Pacific staghorn sculpin-whole body						
2-Chloronaphthalene	0/24	nd	nd	nd	40	400
2-Methylnaphthalene	0/24	nd	nd	nd	40	400
Acenaphthene	0/24	nd	nd	nd	40	400
Acenaphthylene	0/24	nd	nd	nd	40	400
Anthracene	0/24	nd	nd	nd	40	400
Benzo(a)anthracene	0/24	nd	nd	nd	40	400
Benzo(a)pyrene	0/24	nd	nd	nd	40	400
Benzo(b)fluoranthene	0/24	nd	nd	nd	40	400
Benzo(g,h,i)perylene	0/24	nd	nd	nd	40	400
Benzo(k)fluoranthene	0/24	nd	nd	nd	40	400
Benzofluoranthenes (total-calc'd)[c]	0/24	nd	nd	nd	na	na
Chrysene	1/24	9.0 J	9.0 J	9.0	40	400
Dibenzo(a,h)anthracene	0/24	nd	nd	nd	40	400
Dibenzofuran	0/24	nd	nd	nd	40	400
Fluoranthene	0/24	nd	nd	nd	40	400
Fluorene	2/24	6.5 J	7.7 J	7.1	40	400
Indeno(1,2,3-cd)pyrene	0/24	nd	nd	nd	40	400
Naphthalene	0/24	nd	nd	nd	40	400
Phenanthrene	0/24	nd	nd	nd	15	400
Pyrene	0/24	nd	nd	nd	40	400
Total HPAH (calc'd)[c]	1/24	9.0 J	9.0 J	9.0	na	na
Total LPAH (calc'd)[c]	2/24	6.5 J	7.7 J	7.1	na	na
Total PAH (calc'd)[c]	3/24	6.5 J	9.0 J	7.7	na	na
Shiner surfperch-whole body						
2-Chloronaphthalene	0/24	nd	nd	nd	57	2,900
2-Methylnaphthalene	24/24	2.1	8.8	4.1	na	na
Acenaphthene	24/24	4.8	14	9.5	na	na
Acenaphthylene	24/24	0.55 J	1.4	0.88	na	na
Anthracene	24/24	0.61 J	2.1	1.2	na	na
Benzo(a)anthracene	23/24	0.15 J	1.7	0.57	0.72	0.72
Benzo(a)pyrene	19/24	0.13 J	1.5	0.48	0.72	0.72
Benzo(b)fluoranthene	24/24	0.19 J	2.3	0.69	na	na
Benzo(g,h,i)perylene	8/24	0.16 J	0.99	0.49	0.16	0.67
Benzo(k)fluoranthene	23/24	0.18 J	2.2	0.65	0.72	0.72
Benzofluoranthenes (total-calc'd)[c]	24/24	0.21 J	4.5	1.3	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Chrysene	24/24	0.53 J	5.2	1.4	na	na
Dibenzo(a,h)anthracene	1/24	0.24	0.24	0.24	0.18	0.72
Dibenzofuran	24/24	2.7	7.4	4.9	na	na
Fluoranthene	24/24	3.0	9.4	5.2	na	na
Fluorene	24/24	2.4	7.1	4.5	na	na
Indeno(1,2,3-cd)pyrene	8/24	0.12 J	1.1	0.49	0.13	0.67
Naphthalene	5/24	5.8	8.7	6.9	3.0	5.3
Phenanthrene	24/24	3.8	13	6.9	na	na
Pyrene	24/24	1.3	5.7	2.5	na	na
Total HPAH (calc'd) [c]	24/24	5.6 J	25.8	12	na	na
Total LPAH (calc'd) [c]	24/24	12.6 J	37	24	na	na
Total PAH (calc'd) [c]	24/24	18.8 J	58	36	na	na
Pile perch-fillet						
2-Chloronaphthalene	0/1	nd	nd	nd	580	580
2-Methylnaphthalene	1/1	2.0	2.0	2.0	na	na
Acenaphthene	1/1	5.3	5.3	5.3	na	na
Acenaphthylene	0/1	nd	nd	nd	0.26	0.26
Anthracene	1/1	0.82	0.82	0.82	na	na
Benzo(a)anthracene	1/1	0.13 J	0.13 J	0.13	na	na
Benzo(a)pyrene	0/1	nd	nd	nd	0.50	0.50
Benzo(b)fluoranthene	0/1	nd	nd	nd	0.50	0.50
Benzo(g,h,i)perylene	1/1	0.16 J	0.16 J	0.16	na	na
Benzo(k)fluoranthene	0/1	nd	nd	nd	0.50	0.50
Benzofluoranthenes (total-calc'd) [c]	0/1	nd	nd	nd	na	na
Chrysene	1/1	0.51	0.51	0.51	na	na
Dibenzo(a,h)anthracene	0/1	nd	nd	nd	0.50	0.50
Dibenzofuran	1/1	3.1	3.1	3.1	na	na
Fluoranthene	1/1	3.1	3.1	3.1	na	na
Fluorene	1/1	3.3	3.3	3.3	na	na
Indeno(1,2,3-cd)pyrene	1/1	0.11 J	0.11 J	0.11	na	na
Naphthalene	1/1	1.6	1.6	1.6	na	na
Phenanthrene	1/1	7.3	7.3	7.3	na	na
Pyrene	1/1	1.2	1.2	1.2	na	na
Total HPAH (calc'd) [c]	1/1	5.2 J	5.2 J	5.2	na	na
Total LPAH (calc'd) [c]	1/1	18.3	18.3	18	na	na
Total PAH (calc'd) [c]	1/1	23.5 J	23.5 J	24	na	na
Striped perch-fillet						
2-Chloronaphthalene	0/1	nd	nd	nd	580	580
2-Methylnaphthalene	1/1	0.94 J	0.94 J	0.94	na	na
Acenaphthene	1/1	2.8	2.8	2.8	na	na
Acenaphthylene	0/1	nd	nd	nd	0.26	0.26
Anthracene	0/1	nd	nd	nd	0.41	0.41
Benzo(a)anthracene	1/1	0.069 J	0.069 J	0.069	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
Benzo(a)pyrene	0/1	nd	nd	nd	0.50	0.50
Benzo(b)fluoranthene	0/1	nd	nd	nd	0.50	0.50
Benzo(g,h,i)perylene	0/1	nd	nd	nd	0.50	0.50
Benzo(k)fluoranthene	0/1	nd	nd	nd	0.50	0.50
Benzofluoranthenes (total-calc'd) [c]	0/1	nd	nd	nd	na	na
Chrysene	1/1	0.14 J	0.14 J	0.14	na	na
Dibenzo(a,h)anthracene	0/1	nd	nd	nd	0.50	0.50
Dibenzofuran	1/1	1.6	1.6	1.6	na	na
Fluoranthene	0/1	nd	nd	nd	1.4	1.4
Fluorene	1/1	1.4	1.4	1.4	na	na
Indeno(1,2,3-cd)pyrene	0/1	nd	nd	nd	0.50	0.50
Naphthalene	0/1	nd	nd	nd	1.3	1.3
Phenanthrene	1/1	1.9	1.9	1.9	na	na
Pyrene	0/1	nd	nd	nd	0.48	0.48
Total HPAH (calc'd) [c]	1/1	0.21 J	0.21 J	0.21	na	na
Total LPAH (calc'd) [c]	1/1	6.1	6.1	6.1	na	na
Total PAH (calc'd) [c]	1/1	6.3 J	6.3 J	6.3	na	na
Dungeness crab-edible meat						
2-Chloronaphthalene	0/7	nd	nd	nd	570	570
2-Methylnaphthalene	1/7	1.3 J	1.3 J	1.3	0.57	1.1
Acenaphthene	7/7	0.30 J	0.89	0.56	na	na
Acenaphthylene	6/7	0.20 J	0.46 J	0.26	0.72	0.72
Anthracene	7/7	0.19 J	0.90	0.34	na	na
Benzo(a)anthracene	6/7	0.081 J	0.71 J	0.26	0.72	0.72
Benzo(a)pyrene	2/7	0.29 J	0.59 J	0.44	0.71	0.72
Benzo(b)fluoranthene	3/7	0.12 J	0.40 J	0.26	0.71	0.72
Benzo(g,h,i)perylene	2/7	0.27 J	0.45 J	0.36	0.71	0.72
Benzo(k)fluoranthene	2/7	0.25 J	0.44 J	0.35	0.71	0.72
Benzofluoranthenes (total-calc'd) [c]	3/7	0.12 J	0.84 J	0.49	na	na
Chrysene	6/7	0.13 J	0.80	0.29	0.72	0.72
Dibenzo(a,h)anthracene	1/7	0.13 J	0.13 J	0.13	0.71	0.72
Dibenzofuran	7/7	0.40 J	0.83	0.57	na	na
Fluoranthene	7/7	0.24 J	3.0	0.85	na	na
Fluorene	7/7	0.31 J	0.98	0.56	na	na
Indeno(1,2,3-cd)pyrene	2/7	0.21 J	0.37 J	0.29	0.71	0.72
Naphthalene	0/7	nd	nd	nd	1.5	2.2
Phenanthrene	3/7	0.72	5.9	2.4	0.55	0.75
Pyrene	7/7	0.28 J	2.5	0.73	na	na
Total HPAH (calc'd) [c]	7/7	0.53 J	9.4 J	2.6	na	na
Total LPAH (calc'd) [c]	7/7	0.97 J	9.0 J	2.7	na	na
Total PAH (calc'd) [c]	7/7	1.88 J	18.4 J	5.3	na	na
Dungeness crab-hepatopancreas						
2-Chloronaphthalene	0/3	nd	nd	nd	570	580

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
2-Methylnaphthalene	3/3	2.1	3.4	2.8	na	na
Acenaphthene	3/3	6.5	12	8.4	na	na
Acenaphthylene	3/3	1.7	2.2	1.9	na	na
Anthracene	2/3	3.5	3.7	3.6	0.72	0.72
Benzo(a)anthracene	1/3	1.1	1.1	1.1	0.72	0.72
Benzo(a)pyrene	0/3	nd	nd	nd	0.72	7.2
Benzo(b)fluoranthene	2/3	0.31 J	0.49 J	0.40	7.2	7.2
Benzo(g,h,i)perylene	2/3	0.28 J	0.90	0.59	7.2	7.2
Benzo(k)fluoranthene	2/3	0.54 J	0.60 J	0.57	7.2	7.2
Benzofluoranthenes (total-calc'd)[c]	2/3	0.85 J	1.09 J	0.97	na	na
Chrysene	1/3	1.5	1.5	1.5	0.72	0.72
Dibenzo(a,h)anthracene	0/3	nd	nd	nd	0.72	7.2
Dibenzofuran	3/3	2.4	3.8	3.3	na	na
Fluoranthene	1/3	3.4	3.4	3.4	0.72	0.72
Fluorene	3/3	1.5	3.4	2.5	na	na
Indeno(1,2,3-cd)pyrene	2/3	0.14 J	0.74	0.44	7.2	7.2
Naphthalene	2/3	5.2	5.5	5.4	4.4	4.4
Phenanthrene	3/3	3.0	7.4	4.5	na	na
Pyrene	1/3	1.8	1.8	1.8	0.72	0.72
Total HPAH (calc'd)[c]	2/3	2.73 J	9.1 J	5.9	na	na
Total LPAH (calc'd)[c]	3/3	18.7	30	23	na	na
Total PAH (calc'd)[c]	3/3	18.7	32 J	27	na	na
Slender crab-edible meat						
2-Chloronaphthalene	0/12	nd	nd	nd	57	580
2-Methylnaphthalene	1/12	0.45	0.45	0.45	0.34	0.52
Acenaphthene	5/12	0.13 J	0.18 J	0.15	0.72	0.72
Acenaphthylene	1/12	0.13 J	0.13 J	0.13	0.72	0.72
Anthracene	8/12	0.090 J	0.18 J	0.13	0.72	0.72
Benzo(a)anthracene	2/12	0.12 J	0.16	0.14	0.72	0.72
Benzo(a)pyrene	1/12	0.18	0.18	0.18	0.72	0.72
Benzo(b)fluoranthene	1/12	0.17	0.17	0.17	0.72	0.72
Benzo(g,h,i)perylene	1/12	0.22	0.22	0.22	0.72	0.72
Benzo(k)fluoranthene	1/12	0.16	0.16	0.16	0.72	0.72
Benzofluoranthenes (total-calc'd)[c]	1/12	0.33	0.33	0.33	na	na
Chrysene	2/12	0.14 J	0.17	0.16	0.72	0.72
Dibenzo(a,h)anthracene	1/12	0.20	0.20	0.20	0.72	0.72
Dibenzofuran	8/12	0.097 J	0.19 J	0.14	0.11	0.23
Fluoranthene	12/12	0.18 J	0.80	0.51	na	na
Fluorene	12/12	0.094 J	0.25 J	0.15	na	na
Indeno(1,2,3-cd)pyrene	1/12	0.23	0.23	0.23	0.72	0.72
Naphthalene	1/12	1.5	1.5	1.5	1.4	2.2
Phenanthrene	2/12	0.49	0.67 J	0.58	0.31	0.51
Pyrene	12/12	0.16 J	0.43 J	0.25	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
Total HPAH (calc'd)[c]	12/12	0.34 J	2.09 J	0.91	na	na
Total LPAH (calc'd)[c]	12/12	0.094 J	2.4 J	0.52	na	na
Total PAH (calc'd)[c]	12/12	0.43 J	4.5 J	1.4	na	na
Slender crab-hepatopancreas						
2-Chloronaphthalene	0/4	nd	nd	nd	570	580
2-Methylnaphthalene	2/4	0.94 J	0.97 J	0.96	0.81	0.81
Acenaphthene	4/4	0.44 J	0.67 J	0.54	na	na
Acenaphthylene	1/4	0.61 J	0.61 J	0.61	0.72	0.72
Anthracene	4/4	0.53 J	1.2	0.77	na	na
Benzo(a)anthracene	4/4	0.63 J	0.85	0.76	na	na
Benzo(a)pyrene	0/4	nd	nd	nd	0.72	0.72
Benzo(b)fluoranthene	0/4	nd	nd	nd	0.72	0.72
Benzo(g,h,i)perylene	0/4	nd	nd	nd	0.72	0.72
Benzo(k)fluoranthene	0/4	nd	nd	nd	0.72	0.72
Benzofluoranthenes (total-calc'd)[c]	0/4	nd	nd	nd	na	na
Chrysene	4/4	0.64 J	1.0	0.77	na	na
Dibenzo(a,h)anthracene	0/4	nd	nd	nd	0.72	0.72
Dibenzofuran	4/4	0.32 J	0.51 J	0.43	na	na
Fluoranthene	4/4	1.4	1.9	1.7	na	na
Fluorene	4/4	0.37 J	0.49 J	0.45	na	na
Indeno(1,2,3-cd)pyrene	0/4	nd	nd	nd	0.72	0.72
Naphthalene	0/4	nd	nd	nd	2.2	3.5
Phenanthrene	4/4	1.4	1.6	1.5	na	na
Pyrene	4/4	0.69 J	1.1	0.86	na	na
Total HPAH (calc'd)[c]	4/4	3.5 J	4.8	4.1	na	na
Total LPAH (calc'd)[c]	4/4	2.7 J	4.4 J	3.4	na	na
Total PAH (calc'd)[c]	4/4	6.3 J	9.2 J	7.5	na	na

a Reporting limit range for nondetect samples

b Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration

c Methods for calculating total benzofluoranthenes, total HPAH, total LPAH, and total PAH are presented in Appendix C

na – not applicable

nd – not detected

J – estimated concentration

Total PAHs were detected in all fish and crab tissue samples, except for 21 of the 24 Pacific staghorn sculpin whole-body composite samples, which had detection limits for individual PAH compounds ranging from 40 to 400 µg/kg ww. These samples were not submitted for low level PAH analysis because they will not be used in the human health risk assessment and because the standard RLs met the analytical concentration goals (ACGs) for sculpin (see Appendix D of the QAPP). Detected total PAH concentrations in all other samples ranged from 0.43 to 83 µg/kg ww. The highest total PAH concentration was detected in an English sole whole-body composite sample collected from Area T2. The next three highest total PAH concentrations, ranging from 65 to 75 µg/kg ww, were also detected in English sole whole-body composite samples; these samples were collected from Areas T1 and T2. The 17 lowest total PAH concentrations, ranging from 0.43 to 4.62 µg/kg ww, were detected in Dungeness or slender crab edible meat composite samples collected from all four sampling areas.

4.1.4 Phthalates

Table 4-4 presents a summary of the phthalates analyzed in each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Data tables containing all phthalate results for each composite sample of each tissue type are presented in Appendix A.

Table 4-4. Detection frequencies and concentration summaries of phthalates in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
English sole-whole body						
Bis(2-ethylhexyl)phthalate	0/21	nd	nd	nd	1,100	7,200
Butyl benzyl phthalate	3/21	560 J	650	610	290	1,200
Diethyl phthalate	4/21	100 J	110 J	110	570	1,200
Dimethyl phthalate	0/21	nd	nd	nd	290	580
Di-n-butyl phthalate	0/21	nd	nd	nd	290	1,200
Di-n-octyl phthalate	0/21	nd	nd	nd	290	2,900
English sole-fillet						
Bis(2-ethylhexyl)phthalate	2/7	1,100	1,300 J	1,200	7,200	7,200
Butyl benzyl phthalate	0/7	nd	nd	nd	570	1,200
Diethyl phthalate	1/7	120 J	120 J	120	1,200	1,200
Dimethyl phthalate	0/7	nd	nd	nd	290	580
Di-n-butyl phthalate	0/7	nd	nd	nd	160	1,200
Di-n-octyl phthalate	0/7	nd	nd	nd	1,500	2,900
Starry flounder-whole body						
Bis(2-ethylhexyl)phthalate	0/3	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	0/3	nd	nd	nd	1,200	1,200
Diethyl phthalate	0/3	nd	nd	nd	1,200	1,200
Dimethyl phthalate	0/3	nd	nd	nd	570	580
Di-n-butyl phthalate	0/3	nd	nd	nd	1,200	1,200
Di-n-octyl phthalate	0/3	nd	nd	nd	2,900	2,900
Starry flounder-fillet						
Bis(2-ethylhexyl)phthalate	0/1	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	0/1	nd	nd	nd	1,200	1,200
Diethyl phthalate	0/1	nd	nd	nd	1,200	1,200
Dimethyl phthalate	0/1	nd	nd	nd	570	570
Di-n-butyl phthalate	0/1	nd	nd	nd	1,200	1,200

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Di-n-octyl phthalate	0/1	nd	nd	nd	2,900	2,900
Pacific staghorn sculpin-whole body						
Bis(2-ethylhexyl)phthalate	0/24	nd	nd	nd	490	5,000
Butyl benzyl phthalate	0/24	nd	nd	nd	400	4,000
Diethyl phthalate	5/24	18 J	180	52	21	790
Dimethyl phthalate	0/24	nd	nd	nd	40	400
Di-n-butyl phthalate	1/24	1,300	1,300	1,300	200	1,300
Di-n-octyl phthalate	0/24	nd	nd	nd	400	4,000
Shiner surfperch-whole body						
Bis(2-ethylhexyl)phthalate	5/24	280 J	2,100 J	880	720	7,200
Butyl benzyl phthalate	7/24	300	1,400	820	57	1,200
Diethyl phthalate	13/24	19 J	900 J	160	120	1,200
Dimethyl phthalate	0/24	nd	nd	nd	9.9	2,900
Di-n-butyl phthalate	1/24	2,300	2,300	2,300	57	580
Di-n-octyl phthalate	0/24	nd	nd	nd	290	2,900
Pile perch-fillet						
Bis(2-ethylhexyl)phthalate	0/1	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	0/1	nd	nd	nd	1,200	1,200
Diethyl phthalate	0/1	nd	nd	nd	1,200	1,200
Dimethyl phthalate	0/1	nd	nd	nd	580	580
Di-n-butyl phthalate	0/1	nd	nd	nd	1,200	1,200
Di-n-octyl phthalate	0/1	nd	nd	nd	2,900	2,900
Striped perch-fillet						
Bis(2-ethylhexyl)phthalate	0/1	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	0/1	nd	nd	nd	1,200	1,200
Diethyl phthalate	0/1	nd	nd	nd	1,200	1,200
Dimethyl phthalate	0/1	nd	nd	nd	580	580
Di-n-butyl phthalate	0/1	nd	nd	nd	410	410
Di-n-octyl phthalate	0/1	nd	nd	nd	2,900	2,900
Dungeness crab-edible meat						
Bis(2-ethylhexyl)phthalate	0/7	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	0/7	nd	nd	nd	1,200	1,200
Diethyl phthalate	1/7	190 J	190 J	190	1,200	1,200
Dimethyl phthalate	0/7	nd	nd	nd	570	570
Di-n-butyl phthalate	2/7	240	400 J	320	400	410
Di-n-octyl phthalate	0/7	nd	nd	nd	2,900	2,900
Dungeness crab-hepatopancreas						
Bis(2-ethylhexyl)phthalate	0/3	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	1/3	2,800	2,800	2,800	1,200	1,200
Diethyl phthalate	1/3	180 J	180 J	180	1,200	1,200
Dimethyl phthalate	0/3	nd	nd	nd	570	580
Di-n-butyl phthalate	0/3	nd	nd	nd	570	1,200
Di-n-octyl phthalate	0/3	nd	nd	nd	2,900	2,900
Slender crab-edible meat						

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Bis(2-ethylhexyl)phthalate	0/12	nd	nd	nd	240	7,200
Butyl benzyl phthalate	0/12	nd	nd	nd	120	1,200
Diethyl phthalate	5/12	21 J	180 J	140	120	1,200
Dimethyl phthalate	1/12	7.6 J	7.6 J	7.6	57	580
Di-n-butyl phthalate	0/12	nd	nd	nd	31	580
Di-n-octyl phthalate	0/12	nd	nd	nd	290	2,900
Slender crab-hepatopancreas						
Bis(2-ethylhexyl)phthalate	0/4	nd	nd	nd	7,200	7,200
Butyl benzyl phthalate	3/4	1,700	1,800	1,700	570	570
Diethyl phthalate	3/4	160 J	200 J	180	1,200	1,200
Dimethyl phthalate	1/4	76 J	76 J	76	570	580
Di-n-butyl phthalate	0/4	nd	nd	nd	570	580
Di-n-octyl phthalate	0/4	nd	nd	nd	570	2,900

[a] Reporting limit range for nondetect samples

[b] Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration.

na – not applicable

nd – not detected

J – estimated concentration

Bis(2-ethylhexyl)phthalate was detected in five of 72 fish whole-body composite samples at concentrations ranging from 280 to 2,100 µg/kg ww; two of 10 fillet composite samples at concentrations ranging from 1,100 to 1,300 µg/kg ww; and none of the 26 crab composite samples. The highest concentration (2,100 µg/kg ww) was detected in a shiner surfperch sample from Area T2E.

Butyl benzyl phthalate was detected in 10 of 72 whole-body fish composite samples at concentrations ranging from 300 to 1,400 µg/kg ww; 0 of 10 fish fillet composite samples; 0 of 19 crab edible meat composite samples; and four of seven crab hepatopancreas composite samples at concentrations ranging from 1,700 to 2,800 µg/kg ww. The highest concentration (2,800 µg/kg ww) was detected in a Dungeness crab hepatopancreas composite sample from Area T4.

Diethyl phthalate was detected in 22 of 72 fish whole-body composite samples at concentrations ranging from 18 to 900 µg/kg ww; one of 10 fish fillet composite samples at a concentration of 120 µg/kg ww; six of 19 crab edible meat composite samples at concentrations ranging from 21 to 190 µg/kg ww; and four of seven crab hepatopancreas composite samples at concentrations ranging from 160 to 200 µg/kg ww. The maximum concentration (900 µg/kg ww) was in a shiner surfperch composite sample from Area T3D.

Dimethyl phthalate was detected in 0 of 82 fish composite samples; one of 19 crab edible meat composite samples at a concentration of 7.6 µg/kg ww; and one of seven crab hepatopancreas composite samples at a concentration of 76 µg/kg ww.

Di-n-butyl phthalate was detected in two of 82 fish whole-body composite samples at concentrations of 1,300 and 2,300 µg/kg ww; one of 10 fillet composite samples at a concentration of 160 µg/kg ww; two of 19 crab edible meat composite samples at concentrations of 240 and 400 µg/kg ww; and 0 of 7 crab hepatopancreas composite samples. The maximum concentration (2,300 µg/kg ww) was detected in a shiner surfperch composite sample from Area T3D.

Di-n-octyl phthalate was not detected in any of the 108 fish or crab composite samples.

4.1.5 Other SVOCs

Table 4-5 presents a summary of results for 43 individual SVOCs other than PAHs and phthalates for each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Data tables containing SVOC results for each composite sample of each tissue type are presented in Appendix A.

Table 4-5. Detection frequencies and concentration summaries of other SVOCs in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
English sole-whole body						
1,2,4-Trichlorobenzene	0/21	nd	nd	nd	290	580
1,2-Dichlorobenzene	0/21	nd	nd	nd	290	580
1,3-Dichlorobenzene	0/21	nd	nd	nd	290	580
1,4-Dichlorobenzene	0/21	nd	nd	nd	290	580
2,4,5-Trichlorophenol	0/21	nd	nd	nd	570	2,900
2,4,6-Trichlorophenol	0/21	nd	nd	nd	570	2,900
2,4-Dichlorophenol	0/21	nd	nd	nd	570	1,200
2,4-Dimethylphenol	0/21	nd	nd	nd	570	1,200
2,4-Dinitrophenol	0/21	nd	nd	nd	5,700	12,000
2,4-Dinitrotoluene	0/21	nd	nd	nd	570	1,500
2,6-Dinitrotoluene	0/21	nd	nd	nd	290	1,500
2-Chlorophenol	0/21	nd	nd	nd	570	1,200
2-Methylphenol	0/21	nd	nd	nd	570	1,200
2-Nitroaniline	0/21	nd	nd	nd	1,500	2,900
2-Nitrophenol	0/21	nd	nd	nd	290	2,900
3,3'-Dichlorobenzidine	0/21	nd	nd	nd	15,000	29,000
3-Nitroaniline	0/21	nd	nd	nd	2,900	5,800
4,6-Dinitro-o-cresol	0/21	nd	nd	nd	2,900	5,800
4-Bromophenyl phenyl ether	0/21	nd	nd	nd	290	580
4-Chloro-3-methylphenol	0/21	nd	nd	nd	1,500	2,900
4-Chloroaniline	0/21	nd	nd	nd	1,500	2,900
4-Chlorophenyl phenyl ether	0/21	nd	nd	nd	290	580
4-Methylphenol	0/21	nd	nd	nd	570	1,200

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
4-Nitroaniline	0/21	nd	nd	nd	1,500	2,900
4-Nitrophenol	0/21	nd	nd	nd	2,900	5,800
Aniline	0/21	nd	nd	nd	5,700	12,000
Benzoic acid	14/21	1,900 J	6,500 J	4,900	5,700	5,800
Benzyl alcohol	11/21	79 J	610	170	570	580
bis(2-chloroethoxy)methane	0/21	nd	nd	nd	290	1,500
bis(2-chloroethyl)ether	0/21	nd	nd	nd	290	580
bis(2-chloroisopropyl)ether	0/21	nd	nd	nd	290	580
Carbazole	0/21	nd	nd	nd	1,500	2,900
Hexachlorobenzene	4/21	4.4 JN	6.6 JN	5.7	7.2	10
Hexachlorobutadiene	0/21	nd	nd	nd	290	580
Hexachlorocyclopentadiene	0/21	nd	nd	nd	50,000	72,000
Hexachloroethane	0/21	nd	nd	nd	290	580
Isophorone	0/21	nd	nd	nd	290	580
Nitrobenzene	0/21	nd	nd	nd	290	580
N-Nitrosodimethylamine	0/21	nd	nd	nd	1,500	5,800
N-Nitroso-di-n-propylamine	1/21	270 J	270 J	270	290	580
N-Nitrosodiphenylamine	0/21	nd	nd	nd	290	580
Pentachlorophenol	1/21	1,600 J	1,600 J	1,600	2,900	5,800
Phenol	0/21	nd	nd	nd	710	1,500
English sole-fillet						
1,2,4-Trichlorobenzene	0/7	nd	nd	nd	290	580
1,2-Dichlorobenzene	0/7	nd	nd	nd	290	580
1,3-Dichlorobenzene	0/7	nd	nd	nd	290	580
1,4-Dichlorobenzene	0/7	nd	nd	nd	290	580
2,4,5-Trichlorophenol	0/7	nd	nd	nd	1,500	2,900
2,4,6-Trichlorophenol	0/7	nd	nd	nd	1,500	2,900
2,4-Dichlorophenol	0/7	nd	nd	nd	570	1,200
2,4-Dimethylphenol	0/7	nd	nd	nd	570	1,200
2,4-Dinitrophenol	0/7	nd	nd	nd	5,700	12,000
2,4-Dinitrotoluene	0/7	nd	nd	nd	1,200	1,500
2,6-Dinitrotoluene	0/7	nd	nd	nd	1,200	1,500
2-Chlorophenol	0/7	nd	nd	nd	570	1,200
2-Methylphenol	0/7	nd	nd	nd	570	1,200
2-Nitroaniline	0/7	nd	nd	nd	1,500	2,900
2-Nitrophenol	0/7	nd	nd	nd	1,500	2,900
3,3'-Dichlorobenzidine	0/7	nd	nd	nd	15,000	29,000
3-Nitroaniline	0/7	nd	nd	nd	2,900	5,800
4,6-Dinitro-o-cresol	0/7	nd	nd	nd	2,900	5,800
4-Bromophenyl phenyl ether	0/7	nd	nd	nd	290	580
4-Chloro-3-methylphenol	0/7	nd	nd	nd	1,500	2,900
4-Chloroaniline	0/7	nd	nd	nd	1,500	2,900
4-Chlorophenyl phenyl ether	0/7	nd	nd	nd	290	580

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
4-Methylphenol	0/7	nd	nd	nd	570	1,200
4-Nitroaniline	0/7	nd	nd	nd	2,900	2,900
4-Nitrophenol	0/7	nd	nd	nd	2,900	5,800
Aniline	0/7	nd	nd	nd	5,700	12,000
Benzoic acid	6/7	5,300 J	6,500 J	6,000	5,700	5,700
Benzyl alcohol	0/7	nd	nd	nd	570	580
bis(2-chloroethoxy)methane	0/7	nd	nd	nd	570	1,500
bis(2-chloroethyl)ether	0/7	nd	nd	nd	570	580
bis(2-chloroisopropyl)ether	0/7	nd	nd	nd	290	580
Carbazole	0/7	nd	nd	nd	1,500	2,900
Hexachlorobenzene	1/7	1.1 JN	1.1 JN	1.1	7.2	7.2
Hexachlorobutadiene	0/7	nd	nd	nd	290	580
Hexachlorocyclopentadiene	0/7	nd	nd	nd	50,000	72,000
Hexachloroethane	0/7	nd	nd	nd	290	580
Isophorone	0/7	nd	nd	nd	290	580
Nitrobenzene	0/7	nd	nd	nd	290	580
N-Nitrosodimethylamine	0/7	nd	nd	nd	2,900	5,700
N-Nitroso-di-n-propylamine	0/7	nd	nd	nd	290	580
N-Nitrosodiphenylamine	0/7	nd	nd	nd	290	580
Pentachlorophenol	0/7	nd	nd	nd	2,900	5,800
Phenol	0/7	nd	nd	nd	710	1,500
Starry flounder-whole body						
1,2,4-Trichlorobenzene	0/3	nd	nd	nd	570	580
1,2-Dichlorobenzene	0/3	nd	nd	nd	570	580
1,3-Dichlorobenzene	0/3	nd	nd	nd	570	580
1,4-Dichlorobenzene	0/3	nd	nd	nd	570	580
2,4,5-Trichlorophenol	0/3	nd	nd	nd	2,900	2,900
2,4,6-Trichlorophenol	0/3	nd	nd	nd	2,900	2,900
2,4-Dichlorophenol	0/3	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/3	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/3	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/3	nd	nd	nd	1,200	1,200
2,6-Dinitrotoluene	0/3	nd	nd	nd	1,200	1,200
2-Chlorophenol	0/3	nd	nd	nd	1,200	1,200
2-Methylphenol	0/3	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/3	nd	nd	nd	2,900	2,900
2-Nitrophenol	0/3	nd	nd	nd	2,900	2,900
3,3'-Dichlorobenzidine	0/3	nd	nd	nd	29,000	29,000
3-Nitroaniline	0/3	nd	nd	nd	5,700	5,800
4,6-Dinitro-o-cresol	0/3	nd	nd	nd	5,700	5,800
4-Bromophenyl phenyl ether	0/3	nd	nd	nd	570	580
4-Chloro-3-methylphenol	0/3	nd	nd	nd	2,900	2,900
4-Chloroaniline	0/3	nd	nd	nd	2,900	2,900

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
4-Chlorophenyl phenyl ether	0/3	nd	nd	nd	570	580
4-Methylphenol	0/3	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/3	nd	nd	nd	2,900	2,900
4-Nitrophenol	0/3	nd	nd	nd	5,700	5,800
Aniline	0/3	nd	nd	nd	12,000	12,000
Benzoic acid	3/3	5,000 J	5,800 J	5,500	na	na
Benzyl alcohol	0/3	nd	nd	nd	570	580
bis(2-chloroethoxy)methane	0/3	nd	nd	nd	570	580
bis(2-chloroethyl)ether	0/3	nd	nd	nd	570	580
bis(2-chloroisopropyl)ether	0/3	nd	nd	nd	570	580
Carbazole	0/3	nd	nd	nd	2,900	2,900
Hexachlorobenzene	0/3	nd	nd	nd	7.2	7.2
Hexachlorobutadiene	0/3	nd	nd	nd	570	580
Hexachlorocyclopentadiene	0/3	nd	nd	nd	72,000	72,000
Hexachloroethane	0/3	nd	nd	nd	570	580
Isophorone	0/3	nd	nd	nd	570	580
Nitrobenzene	0/3	nd	nd	nd	570	580
N-Nitrosodimethylamine	0/3	nd	nd	nd	2,900	2,900
N-Nitroso-di-n-propylamine	0/3	nd	nd	nd	570	580
N-Nitrosodiphenylamine	0/3	nd	nd	nd	570	580
Pentachlorophenol	0/3	nd	nd	nd	5,700	5,800
Phenol	0/3	nd	nd	nd	1,500	1,500
Starry flounder-fillet						
1,2,4-Trichlorobenzene	0/1	nd	nd	nd	570	570
1,2-Dichlorobenzene	0/1	nd	nd	nd	570	570
1,3-Dichlorobenzene	0/1	nd	nd	nd	570	570
1,4-Dichlorobenzene	0/1	nd	nd	nd	570	570
2,4,5-Trichlorophenol	0/1	nd	nd	nd	2,900	2,900
2,4,6-Trichlorophenol	0/1	nd	nd	nd	2,900	2,900
2,4-Dichlorophenol	0/1	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/1	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/1	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/1	nd	nd	nd	1,200	1,200
2,6-Dinitrotoluene	0/1	nd	nd	nd	1,200	1,200
2-Chlorophenol	0/1	nd	nd	nd	1,200	1,200
2-Methylphenol	0/1	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/1	nd	nd	nd	2,900	2,900
2-Nitrophenol	0/1	nd	nd	nd	2,900	2,900
3,3'-Dichlorobenzidine	0/1	nd	nd	nd	29,000	29,000
3-Nitroaniline	0/1	nd	nd	nd	5,700	5,700
4,6-Dinitro-o-cresol	0/1	nd	nd	nd	5,700	5,700
4-Bromophenyl phenyl ether	0/1	nd	nd	nd	570	570
4-Chloro-3-methylphenol	0/1	nd	nd	nd	2,900	2,900

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
4-Chloroaniline	0/1	nd	nd	nd	2,900	2,900
4-Chlorophenyl phenyl ether	0/1	nd	nd	nd	570	570
4-Methylphenol	0/1	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/1	nd	nd	nd	2,900	2,900
4-Nitrophenol	0/1	nd	nd	nd	5,700	5,700
Aniline	0/1	nd	nd	nd	12,000	12,000
Benzoic acid	1/1	4,700 J	4,700 J	4,700	na	na
Benzyl alcohol	0/1	nd	nd	nd	570	570
bis(2-chloroethoxy)methane	0/1	nd	nd	nd	570	570
bis(2-chloroethyl)ether	0/1	nd	nd	nd	570	570
bis(2-chloroisopropyl)ether	0/1	nd	nd	nd	570	570
Carbazole	0/1	nd	nd	nd	2,900	2,900
Hexachlorobenzene	0/1	nd	nd	nd	7.2	7.2
Hexachlorobutadiene	0/1	nd	nd	nd	570	570
Hexachlorocyclopentadiene	0/1	nd	nd	nd	72,000	72,000
Hexachloroethane	0/1	nd	nd	nd	570	570
Isophorone	0/1	nd	nd	nd	570	570
Nitrobenzene	0/1	nd	nd	nd	570	570
N-Nitrosodimethylamine	0/1	nd	nd	nd	2,900	2,900
N-Nitroso-di-n-propylamine	0/1	nd	nd	nd	570	570
N-Nitrosodiphenylamine	0/1	nd	nd	nd	570	570
Pentachlorophenol	0/1	nd	nd	nd	5,700	5,700
Phenol	0/1	nd	nd	nd	1,500	1,500
Pacific staghorn sculpin-whole body						
1,2,4-Trichlorobenzene	0/24	nd	nd	nd	40	400
1,2-Dichlorobenzene	0/24	nd	nd	nd	40	400
1,3-Dichlorobenzene	0/24	nd	nd	nd	40	400
1,4-Dichlorobenzene	0/24	nd	nd	nd	40	400
2,4,5-Trichlorophenol	1/24	540 J	540 J	540	79	800
2,4,6-Trichlorophenol	1/24	270 J	270 J	270	79	800
2,4-Dichlorophenol	1/24	220 J	220 J	220	79	800
2,4-Dimethylphenol	1/24	210 J	210 J	210	79	800
2,4-Dinitrophenol	0/20	nd	nd	nd	790	8,000
2,4-Dinitrotoluene	0/24	nd	nd	nd	200	2,000
2,6-Dinitrotoluene	1/24	7.6 J	7.6 J	7.6	200	2,000
2-Chlorophenol	0/24	nd	nd	nd	79	800
2-Methylphenol	0/24	nd	nd	nd	79	800
2-Nitroaniline	0/24	nd	nd	nd	200	2,000
2-Nitrophenol	0/24	nd	nd	nd	40	400
3,3'-Dichlorobenzidine	0/24	nd	nd	nd	2,000	20,000
3-Nitroaniline	0/24	nd	nd	nd	400	4,000
4,6-Dinitro-o-cresol	0/24	nd	nd	nd	790	8,000
4-Bromophenyl phenyl ether	0/24	nd	nd	nd	40	400

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
4-Chloro-3-methylphenol	1/24	860 J	860 J	860	200	2,000
4-Chloroaniline	1/24	79 J	79 J	79	200	2,000
4-Chlorophenyl phenyl ether	1/24	5.1 J	5.1 J	5.1	40	400
4-Methylphenol	4/24	20 J	380 J	110	80	800
4-Nitroaniline	0/24	nd	nd	nd	200	2,000
4-Nitrophenol	1/24	3,300 J	3,300 J	3,300	400	4,000
Aniline	0/24	nd	nd	nd	790	8,000
Benzoic acid	23/24	890	6,800 J	4,800	800	800
Benzyl alcohol	7/24	24 J	2,100	450	40	400
bis(2-chloroethoxy)methane	0/24	nd	nd	nd	40	400
bis(2-chloroethyl)ether	0/24	nd	nd	nd	40	400
bis(2-chloroisopropyl)ether	0/24	nd	nd	nd	40	400
Carbazole	0/24	nd	nd	nd	200	2,000
Hexachlorobenzene	2/24	1.2 JN	1.3 JN	1.3	1.0	1.4
Hexachlorobutadiene	0/24	nd	nd	nd	40	400
Hexachlorocyclopentadiene	0/24	nd	nd	nd	5,000	50,000
Hexachloroethane	0/24	nd	nd	nd	40	400
Isophorone	1/24	7.3 J	7.3 J	7.3	40	400
Nitrobenzene	0/24	nd	nd	nd	40	400
N-Nitrosodimethylamine	0/24	nd	nd	nd	79	800
N-Nitroso-di-n-propylamine	1/24	170 J	170 J	170	40	400
N-Nitrosodiphenylamine	0/24	nd	nd	nd	40	400
Pentachlorophenol	3/24	43 J	2,600 J	1,100	400	4,000
Phenol	2/24	17 J	200 J	110	98	1,000
Shiner surfperch-whole body						
1,2,4-Trichlorobenzene	0/24	nd	nd	nd	57	580
1,2-Dichlorobenzene	0/24	nd	nd	nd	57	580
1,3-Dichlorobenzene	0/24	nd	nd	nd	57	580
1,4-Dichlorobenzene	0/24	nd	nd	nd	57	580
2,4,5-Trichlorophenol	0/22[c]	nd	nd	nd	120	15,000
2,4,6-Trichlorophenol	0/22[c]	nd	nd	nd	120	15,000
2,4-Dichlorophenol	0/24	nd	nd	nd	120	1,200
2,4-Dimethylphenol	0/24	nd	nd	nd	120	1,200
2,4-Dinitrophenol	0/10[c]	nd	nd	nd	5,700	57,000
2,4-Dinitrotoluene	0/24	nd	nd	nd	290	15,000
2,6-Dinitrotoluene	0/22[c]	nd	nd	nd	57	15,000
2-Chlorophenol	0/24	nd	nd	nd	120	1,200
2-Methylphenol	1/24	1,100 J	1,100 J	1,100	120	1,200
2-Nitroaniline	0/22[c]	nd	nd	nd	290	15,000
2-Nitrophenol	0/24	nd	nd	nd	57	5,200
3,3'-Dichlorobenzidine	0/24	nd	nd	nd	2,900	29,000
3-Nitroaniline	0/24	nd	nd	nd	570	29,000
4,6-Dinitro-o-cresol	0/24	nd	nd	nd	1,200	29,000

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
4-Bromophenyl phenyl ether	0/24	nd	nd	nd	57	580
4-Chloro-3-methylphenol	0/24	nd	nd	nd	290	2,900
4-Chloroaniline	0/24	nd	nd	nd	290	2,900
4-Chlorophenyl phenyl ether	0/22[c]	nd	nd	nd	57	2,900
4-Methylphenol	1/24	1,500 J	1,500 J	1,500	120	1,200
4-Nitroaniline	0/13[c]	nd	nd	nd	290	29,000
4-Nitrophenol	0/22[c]	530 J	530 J	530	570	29,000
Aniline	0/24	nd	nd	nd	1,200	12,000
Benzoic acid	14/24	1,200	54,000 J	7,200	2,900	5,800
Benzyl alcohol	3/24	69 J	200 J	120	57	580
bis(2-chloroethoxy)methane	1/24	240 J	240 J	240	57	1,500
bis(2-chloroethyl)ether	0/24	nd	nd	nd	57	580
bis(2-chloroisopropyl)ether	0/24	nd	nd	nd	57	580
Carbazole	2/24	6,000 J	14,000 J	10,000	290	2,900
Hexachlorobenzene	1/24	4.1 JN	4.1 JN	4.1	1.5	4.3
Hexachlorobutadiene	0/24	nd	nd	nd	57	580
Hexachlorocyclopentadiene	0/22[c]	nd	nd	nd	7,200	360,000
Hexachloroethane	0/24	nd	nd	nd	57	580
Isophorone	0/24	nd	nd	nd	57	580
Nitrobenzene	0/24	nd	nd	nd	57	580
N-Nitrosodimethylamine	0/24	nd	nd	nd	120	5,800
N-Nitroso-di-n-propylamine	0/24	nd	nd	nd	57	580
N-Nitrosodiphenylamine	0/22[c]	nd	nd	nd	57	2,900
Pentachlorophenol	3/24	2,200 J	2,400 J	2,300	570	5,700
Phenol	13/24	52 J	670 J	210	150	1,500
Pile perch-fillet						
1,2,4-Trichlorobenzene	0/1	nd	nd	nd	580	580
1,2-Dichlorobenzene	0/1	nd	nd	nd	580	580
1,3-Dichlorobenzene	0/1	nd	nd	nd	580	580
1,4-Dichlorobenzene	0/1	nd	nd	nd	580	580
2,4,5-Trichlorophenol	0/1	nd	nd	nd	2,900	2,900
2,4,6-Trichlorophenol	0/1	nd	nd	nd	2,900	2,900
2,4-Dichlorophenol	0/1	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/1	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/1	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/1	nd	nd	nd	1,200	1,200
2,6-Dinitrotoluene	0/1	nd	nd	nd	1,200	1,200
2-Chlorophenol	0/1	nd	nd	nd	1,200	1,200
2-Methylphenol	0/1	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/1	nd	nd	nd	2,900	2,900
2-Nitrophenol	0/1	nd	nd	nd	2,900	2,900
3,3'-Dichlorobenzidine	0/1	nd	nd	nd	29,000	29,000
3-Nitroaniline	0/1	nd	nd	nd	5,800	5,800

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
4,6-Dinitro-o-cresol	0/1	nd	nd	nd	5,800	5,800
4-Bromophenyl phenyl ether	0/1	nd	nd	nd	580	580
4-Chloro-3-methylphenol	0/1	nd	nd	nd	2,900	2,900
4-Chloroaniline	0/1	nd	nd	nd	2,900	2,900
4-Chlorophenyl phenyl ether	0/1	nd	nd	nd	580	580
4-Methylphenol	0/1	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/1	nd	nd	nd	2,900	2,900
4-Nitrophenol	0/1	nd	nd	nd	5,800	5,800
Aniline	0/1	nd	nd	nd	12,000	12,000
Benzoic acid	1/1	5,700 J	5,700 J	5,700	na	na
Benzyl alcohol	1/1	180 J	180 J	180	na	na
bis(2-chloroethoxy)methane	0/1	nd	nd	nd	580	580
bis(2-chloroethyl)ether	0/1	nd	nd	nd	580	580
bis(2-chloroisopropyl)ether	0/1	nd	nd	nd	580	580
Carbazole	0/1	nd	nd	nd	2,900	2,900
Hexachlorobenzene	0/1	nd	nd	nd	7.2	7.2
Hexachlorobutadiene	0/1	nd	nd	nd	580	580
Hexachlorocyclopentadiene	0/1	nd	nd	nd	72,000	72,000
Hexachloroethane	0/1	nd	nd	nd	580	580
Isophorone	0/1	nd	nd	nd	580	580
Nitrobenzene	0/1	nd	nd	nd	580	580
N-Nitrosodimethylamine	0/1	nd	nd	nd	2,900	2,900
N-Nitroso-di-n-propylamine	0/1	nd	nd	nd	580	580
N-Nitrosodiphenylamine	0/1	nd	nd	nd	580	580
Pentachlorophenol	0/1	nd	nd	nd	5,800	5,800
Phenol	0/1	nd	nd	nd	1,500	1,500
Striped perch-fillet						
1,2,4-Trichlorobenzene	0/1	nd	nd	nd	580	580
1,2-Dichlorobenzene	0/1	nd	nd	nd	580	580
1,3-Dichlorobenzene	0/1	nd	nd	nd	580	580
1,4-Dichlorobenzene	0/1	nd	nd	nd	580	580
2,4,5-Trichlorophenol	0/1	nd	nd	nd	2,900	2,900
2,4,6-Trichlorophenol	0/1	nd	nd	nd	2,900	2,900
2,4-Dichlorophenol	0/1	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/1	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/1	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/1	nd	nd	nd	1,200	1,200
2,6-Dinitrotoluene	0/1	nd	nd	nd	1,200	1,200
2-Chlorophenol	0/1	nd	nd	nd	1,200	1,200
2-Methylphenol	0/1	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/1	nd	nd	nd	2,900	2,900
2-Nitrophenol	0/1	nd	nd	nd	2,900	2,900
3,3'-Dichlorobenzidine	0/1	nd	nd	nd	29,000	29,000

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
3-Nitroaniline	0/1	nd	nd	nd	5,800	5,800
4,6-Dinitro-o-cresol	0/1	nd	nd	nd	5,800	5,800
4-Bromophenyl phenyl ether	0/1	nd	nd	nd	580	580
4-Chloro-3-methylphenol	0/1	nd	nd	nd	2,900	2,900
4-Chloroaniline	0/1	nd	nd	nd	2,900	2,900
4-Chlorophenyl phenyl ether	0/1	nd	nd	nd	580	580
4-Methylphenol	0/1	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/1	nd	nd	nd	2,900	2,900
4-Nitrophenol	0/1	nd	nd	nd	5,800	5,800
Aniline	0/1	nd	nd	nd	12,000	12,000
Benzoic acid	0/1	nd	nd	nd	12,000	12,000
Benzyl alcohol	0/1	nd	nd	nd	580	580
bis(2-chloroethoxy)methane	0/1	nd	nd	nd	580	580
bis(2-chloroethyl)ether	0/1	nd	nd	nd	580	580
bis(2-chloroisopropyl)ether	0/1	nd	nd	nd	580	580
Carbazole	0/1	nd	nd	nd	2,900	2,900
Hexachlorobenzene	0/1	nd	nd	nd	7.2	7.2
Hexachlorobutadiene	0/1	nd	nd	nd	580	580
Hexachlorocyclopentadiene	0/1	nd	nd	nd	72,000	72,000
Hexachloroethane	0/1	nd	nd	nd	580	580
Isophorone	0/1	nd	nd	nd	580	580
Nitrobenzene	0/1	nd	nd	nd	580	580
N-Nitrosodimethylamine	0/1	nd	nd	nd	2,900	2,900
N-Nitroso-di-n-propylamine	0/1	nd	nd	nd	580	580
N-Nitrosodiphenylamine	0/1	nd	nd	nd	580	580
Pentachlorophenol	0/1	nd	nd	nd	5,800	5,800
Phenol	0/1	nd	nd	nd	1,500	1,500
Dungeness crab-edible meat						
1,2,4-Trichlorobenzene	0/7	nd	nd	nd	570	570
1,2-Dichlorobenzene	0/7	nd	nd	nd	570	570
1,3-Dichlorobenzene	0/7	nd	nd	nd	570	570
1,4-Dichlorobenzene	0/7	nd	nd	nd	570	570
2,4,5-Trichlorophenol	0/7	nd	nd	nd	2,900	2,900
2,4,6-Trichlorophenol	0/7	nd	nd	nd	2,900	2,900
2,4-Dichlorophenol	0/7	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/7	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/7	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/7	nd	nd	nd	1,200	2,900
2,6-Dinitrotoluene	0/7	nd	nd	nd	1,200	2,900
2-Chlorophenol	0/7	nd	nd	nd	1,200	1,200
2-Methylphenol	0/7	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/7	nd	nd	nd	2,900	2,900
2-Nitrophenol	0/7	nd	nd	nd	2,900	2,900

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
3,3'-Dichlorobenzidine	0/7	nd	nd	nd	29,000	29,000
3-Nitroaniline	0/7	nd	nd	nd	5,700	5,700
4,6-Dinitro-o-cresol	0/7	nd	nd	nd	5,700	5,700
4-Bromophenyl phenyl ether	0/7	nd	nd	nd	570	570
4-Chloro-3-methylphenol	0/7	nd	nd	nd	2,900	2,900
4-Chloroaniline	0/7	nd	nd	nd	2,900	2,900
4-Chlorophenyl phenyl ether	0/7	nd	nd	nd	570	570
4-Methylphenol	0/7	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/7	nd	nd	nd	2,900	5,700
4-Nitrophenol	0/7	nd	nd	nd	5,700	5,700
Aniline	0/7	nd	nd	nd	12,000	12,000
Benzoic acid	0/7	nd	nd	nd	12,000	12,000
Benzyl alcohol	0/7	nd	nd	nd	570	1,200
bis(2-chloroethoxy)methane	0/7	nd	nd	nd	570	2,900
bis(2-chloroethyl)ether	0/7	nd	nd	nd	570	1,200
bis(2-chloroisopropyl)ether	0/7	nd	nd	nd	570	570
Carbazole	0/7	nd	nd	nd	2,900	2,900
Hexachlorobenzene	1/7	0.93 JN	0.93 JN	0.93	7.2	7.2
Hexachlorobutadiene	0/7	nd	nd	nd	570	570
Hexachlorocyclopentadiene	0/7	nd	nd	nd	72,000	72,000
Hexachloroethane	0/7	nd	nd	nd	570	570
Isophorone	0/7	nd	nd	nd	570	570
Nitrobenzene	0/7	nd	nd	nd	570	570
N-Nitrosodimethylamine	0/7	nd	nd	nd	2,900	12,000
N-Nitroso-di-n-propylamine	0/7	nd	nd	nd	570	570
N-Nitrosodiphenylamine	0/7	nd	nd	nd	570	570
Pentachlorophenol	0/7	nd	nd	nd	5,700	5,700
Phenol	0/7	nd	nd	nd	1,500	1,500
Dungeness crab-hepatopancreas						
1,2,4-Trichlorobenzene	0/3	nd	nd	nd	570	580
1,2-Dichlorobenzene	0/3	nd	nd	nd	570	580
1,3-Dichlorobenzene	0/3	nd	nd	nd	570	580
1,4-Dichlorobenzene	0/3	nd	nd	nd	570	580
2,4,5-Trichlorophenol	0/3	nd	nd	nd	2,900	2,900
2,4,6-Trichlorophenol	0/3	nd	nd	nd	2,900	2,900
2,4-Dichlorophenol	0/3	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/3	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/3	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/3	nd	nd	nd	1,200	2,900
2,6-Dinitrotoluene	0/3	nd	nd	nd	1,200	2,900
2-Chlorophenol	0/3	nd	nd	nd	1,200	1,200
2-Methylphenol	0/3	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/3	nd	nd	nd	2,900	2,900

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
2-Nitrophenol	0/3	nd	nd	nd	2,900	2,900
3,3'-Dichlorobenzidine	0/3	nd	nd	nd	29,000	29,000
3-Nitroaniline	0/3	nd	nd	nd	5,700	5,800
4,6-Dinitro-o-cresol	0/3	nd	nd	nd	5,700	5,800
4-Bromophenyl phenyl ether	0/3	nd	nd	nd	570	580
4-Chloro-3-methylphenol	0/3	nd	nd	nd	2,900	2,900
4-Chloroaniline	0/3	nd	nd	nd	2,900	2,900
4-Chlorophenyl phenyl ether	0/3	nd	nd	nd	570	580
4-Methylphenol	0/3	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/3	nd	nd	nd	2,900	5,700
4-Nitrophenol	0/3	nd	nd	nd	5,700	5,800
Aniline	0/3	nd	nd	nd	12,000	12,000
Benzoic acid	0/3	nd	nd	nd	12,000	12,000
Benzyl alcohol	0/3	nd	nd	nd	570	1,200
bis(2-chloroethoxy)methane	0/3	nd	nd	nd	570	2,900
bis(2-chloroethyl)ether	0/3	nd	nd	nd	570	1,200
bis(2-chloroisopropyl)ether	0/3	nd	nd	nd	570	580
Carbazole	0/3	nd	nd	nd	2,900	2,900
Hexachlorobenzene	1/3	3.3 JN	3.3 JN	3.3	7.2	15
Hexachlorobutadiene	0/3	nd	nd	nd	570	580
Hexachlorocyclopentadiene	0/3	nd	nd	nd	72,000	72,000
Hexachloroethane	0/3	nd	nd	nd	570	580
Isophorone	0/3	nd	nd	nd	570	580
Nitrobenzene	0/3	nd	nd	nd	570	580
N-Nitrosodimethylamine	0/3	nd	nd	nd	2,900	12,000
N-Nitroso-di-n-propylamine	0/3	nd	nd	nd	570	580
N-Nitrosodiphenylamine	0/3	nd	nd	nd	570	580
Pentachlorophenol	0/3	nd	nd	nd	5,700	5,800
Phenol	0/3	nd	nd	nd	1,500	1,500
Slender crab-edible meat						
1,2,4-Trichlorobenzene	0/12	nd	nd	nd	57	580
1,2-Dichlorobenzene	0/12	nd	nd	nd	57	580
1,3-Dichlorobenzene	0/12	nd	nd	nd	57	580
1,4-Dichlorobenzene	0/12	nd	nd	nd	57	580
2,4,5-Trichlorophenol	0/12	nd	nd	nd	290	2,900
2,4,6-Trichlorophenol	0/12	nd	nd	nd	290	2,900
2,4-Dichlorophenol	0/12	nd	nd	nd	120	1,200
2,4-Dimethylphenol	0/12	nd	nd	nd	120	1,200
2,4-Dinitrophenol	0/12	nd	nd	nd	1,200	12,000
2,4-Dinitrotoluene	0/12	nd	nd	nd	290	2,900
2,6-Dinitrotoluene	0/12	nd	nd	nd	290	2,900
2-Chlorophenol	0/12	nd	nd	nd	120	1,200
2-Methylphenol	0/12	nd	nd	nd	120	1,200

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
2-Nitroaniline	0/12	nd	nd	nd	290	2,900
2-Nitrophenol	0/12	nd	nd	nd	290	2,900
3,3'-Dichlorobenzidine	0/12	nd	nd	nd	2,900	29,000
3-Nitroaniline	0/12	nd	nd	nd	570	5,800
4,6-Dinitro-o-cresol	0/12	nd	nd	nd	570	5,800
4-Bromophenyl phenyl ether	0/12	nd	nd	nd	57	580
4-Chloro-3-methylphenol	0/12	nd	nd	nd	290	2,900
4-Chloroaniline	0/12	nd	nd	nd	290	2,900
4-Chlorophenyl phenyl ether	0/12	nd	nd	nd	57	580
4-Methylphenol	0/12	nd	nd	nd	120	1,200
4-Nitroaniline	0/12	nd	nd	nd	570	5,800
4-Nitrophenol	0/12	nd	nd	nd	570	5,800
Aniline	0/12	nd	nd	nd	1,200	12,000
Benzoic acid	0/12	nd	nd	nd	1,200	12,000
Benzyl alcohol	1/12	12 J	12 J	12	120	1,200
bis(2-chloroethoxy)methane	0/12	nd	nd	nd	290	2,900
bis(2-chloroethyl)ether	0/12	nd	nd	nd	120	1,200
bis(2-chloroisopropyl)ether	0/12	nd	nd	nd	57	580
Carbazole	0/12	nd	nd	nd	290	2,900
Hexachlorobenzene	0/12	nd	nd	nd	1.5	1.5
Hexachlorobutadiene	0/12	nd	nd	nd	57	580
Hexachlorocyclopentadiene	0/12	nd	nd	nd	7,200	72,000
Hexachloroethane	0/12	nd	nd	nd	57	580
Isophorone	0/12	nd	nd	nd	57	580
Nitrobenzene	0/12	nd	nd	nd	57	580
N-Nitrosodimethylamine	0/12	nd	nd	nd	1,200	12,000
N-Nitroso-di-n-propylamine	0/12	nd	nd	nd	57	580
N-Nitrosodiphenylamine	0/12	nd	nd	nd	57	580
Pentachlorophenol	0/12	nd	nd	nd	570	5,800
Phenol	1/12	43 J	43 J	43	150	1,500
Slender crab-hepatopancreas						
1,2,4-Trichlorobenzene	0/4	nd	nd	nd	570	580
1,2-Dichlorobenzene	0/4	nd	nd	nd	570	580
1,3-Dichlorobenzene	0/4	nd	nd	nd	570	580
1,4-Dichlorobenzene	0/4	nd	nd	nd	570	580
2,4,5-Trichlorophenol	0/4	nd	nd	nd	1,200	2,900
2,4,6-Trichlorophenol	0/4	nd	nd	nd	1,200	2,900
2,4-Dichlorophenol	0/4	nd	nd	nd	1,200	1,200
2,4-Dimethylphenol	0/4	nd	nd	nd	1,200	1,200
2,4-Dinitrophenol	0/4	nd	nd	nd	12,000	12,000
2,4-Dinitrotoluene	0/4	nd	nd	nd	1,200	2,900
2,6-Dinitrotoluene	0/4	nd	nd	nd	570	2,900
2-Chlorophenol	0/4	nd	nd	nd	1,200	1,200

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
2-Methylphenol	0/4	nd	nd	nd	1,200	1,200
2-Nitroaniline	0/4	nd	nd	nd	2,900	2,900
2-Nitrophenol	0/4	nd	nd	nd	570	2,900
3,3'-Dichlorobenzidine	0/4	nd	nd	nd	29,000	29,000
3-Nitroaniline	0/4	nd	nd	nd	5,700	5,800
4,6-Dinitro-o-cresol	0/4	nd	nd	nd	5,700	5,800
4-Bromophenyl phenyl ether	0/4	nd	nd	nd	570	580
4-Chloro-3-methylphenol	0/4	nd	nd	nd	2,900	2,900
4-Chloroaniline	0/4	nd	nd	nd	2,900	2,900
4-Chlorophenyl phenyl ether	0/4	nd	nd	nd	570	580
4-Methylphenol	0/4	nd	nd	nd	1,200	1,200
4-Nitroaniline	0/4	nd	nd	nd	2,900	5,800
4-Nitrophenol	0/4	nd	nd	nd	5,700	5,800
Aniline	0/4	nd	nd	nd	12,000	12,000
Benzoic acid	0/4	nd	nd	nd	12,000	12,000
Benzyl alcohol	0/4	nd	nd	nd	570	1,200
bis(2-chloroethoxy)methane	0/4	nd	nd	nd	570	2,900
bis(2-chloroethyl)ether	0/4	nd	nd	nd	570	1,200
bis(2-chloroisopropyl)ether	0/4	nd	nd	nd	570	580
Carbazole	0/4	nd	nd	nd	2,900	2,900
Hexachlorobenzene	0/4	nd	nd	nd	1.5	1.5
Hexachlorobutadiene	0/4	nd	nd	nd	570	580
Hexachlorocyclopentadiene	0/4	nd	nd	nd	72,000	72,000
Hexachloroethane	0/4	nd	nd	nd	570	580
Isophorone	0/4	nd	nd	nd	570	580
Nitrobenzene	0/4	nd	nd	nd	570	580
N-Nitrosodimethylamine	0/4	nd	nd	nd	2,900	12,000
N-Nitroso-di-n-propylamine	0/4	nd	nd	nd	570	580
N-Nitrosodiphenylamine	0/4	nd	nd	nd	570	580
Pentachlorophenol	0/4	nd	nd	nd	5,700	5,800
Phenol	0/4	nd	nd	nd	1,500	1,500

[a] Reporting limit range for nondetect samples

[b] Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration

[c] Rejected values are not included in sample totals

NOTE: Benzidine was not included in this table because all results were rejected

na – not applicable

nd – not detected

J – estimated concentration

Of the individual SVOCs analyzed other than PAHs and phthalates, 21 were detected in at least one fish or crab tissue sample. The remaining SVOCs were not detected in any samples. The nine most frequently detected SVOCs were benzoic acid (62/108), benzyl alcohol (23/108), phenol (16/108), hexachlorobenzene (10/108), pentachlorophenol (7/108), 4-methylphenol (5/108), 4-nitrophenol (3/108), carbazole (2/108), and n-nitroso-di-n-propylamine (2/108). The remaining 12 SVOCs were each detected in only one sample.

Benzoic acid was detected at concentrations ranging from 890 to 54,000 µg/kg ww. The highest concentration (54,000 µg/kg ww) was detected in a shiner surfperch whole-body composite sample collected from Area T3. The next four highest concentrations were detected in shiner surfperch whole-body composite samples collected from Areas T2 and T3, at concentrations ranging from 6,900 to 7,400 mg/kg ww. Benzoic acid was not detected in any crab samples.

Benzyl alcohol was detected at concentrations ranging from 12 to 2,100 µg/kg ww. The highest concentration was in a Pacific staghorn sculpin whole-body composite sample collected from Area T1. All other detected benzyl alcohol concentrations were 610 µg/kg ww or below.

Phenol was detected at concentrations ranging from 17 to 670 µg/kg ww. The highest concentration was detected in a shiner surfperch whole-body sample. The next four highest concentrations were also detected in shiner surfperch whole-body composite samples, at concentrations ranging from 270 to 570 µg/kg ww.

Hexachlorobenzene was detected at concentrations ranging from 0.93 to 6.6 µg/kg ww. The highest concentration of 6.6 µg/kg was detected in two English sole whole-body samples collected from Areas T2 and T3. The next two highest concentrations of 5.1 and 4.4 µg/kg ww were also detected in English sole whole-body composite samples.

Pentachlorophenol was detected at concentrations ranging from 43 to 2,600 µg/kg ww. The highest concentration was detected in a Pacific staghorn sculpin whole-body composite sample collected in Area T1. Maximum concentrations of 4-methylphenol, 4-nitrophenol, and carbazole were detected in fish whole-body composite samples at concentrations of 1,500, 3,300, and 14,000 µg/kg ww, respectively.

Of the 11 SVOCs detected in only one sample, six (2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 4-chloro-3-methylphenol, and 4-chloroaniline) were detected in one Pacific staghorn sculpin whole-body composite sample collected from Area T1 at concentrations ranging from 79 to 860 µg/kg ww. The remaining five SVOCs detected only once were found in fish whole-body composite samples at the following concentrations: 2,6-dinitrotoluene at 7.6 µg/kg ww, 2-methylphenol at 1,100 µg/kg ww, 4-chlorophenyl phenyl ether at 5.1 µg/kg ww, bis(2-chloroethoxy)methane at 240 µg/kg ww, and isophorone at 7.3 µg/kg ww.

4.1.6 PCBs

Table 4-6 presents a summary of the PCB Aroclor and total calculated PCB concentrations analyzed in each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Data tables containing all PCB results for each composite sample of each tissue type are presented in Appendix A.

Table 4-6. Detection frequencies and concentration summaries of PCBs in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
English sole-whole body						
Aroclor-1016	0/21	nd	nd	nd	10	150
Aroclor-1221	0/21	nd	nd	nd	20	290
Aroclor-1232	0/21	nd	nd	nd	10	150
Aroclor-1242	0/21	nd	nd	nd	10	150
Aroclor-1248	21/21	230	1,200	620	na	na
Aroclor-1254	21/21	530	1,900	1,300	na	na
Aroclor-1260	21/21	560	1,900	1,200	na	na
PCBs (total calc'd)	21/21	1,320	4,700	3,100	na	na
English sole-fillet						
Aroclor-1016	0/7	nd	nd	nd	10	15
Aroclor-1221	0/7	nd	nd	nd	20	29
Aroclor-1232	0/7	nd	nd	nd	10	15
Aroclor-1242	0/7	nd	nd	nd	10	15
Aroclor-1248	7/7	140	380	270	na	na
Aroclor-1254	7/7	290	820	570	na	na
Aroclor-1260	7/7	280	810	580	na	na
PCBs (total calc'd)[c]	7/7	710	2,010	1,400	na	na
Starry flounder-whole body						
Aroclor-1016	0/3	nd	nd	nd	15	15
Aroclor-1221	0/3	nd	nd	nd	29	29
Aroclor-1232	0/3	nd	nd	nd	15	15
Aroclor-1242	0/3	nd	nd	nd	15	15
Aroclor-1248	3/3	96	120	110	na	na
Aroclor-1254	3/3	170	250	220	na	na
Aroclor-1260	3/3	180	290	240	na	na
PCBs (total calc'd)	3/3	450	660	570	na	na
Starry flounder-fillet						
Aroclor-1016	0/1	nd	nd	nd	15	15
Aroclor-1221	0/1	nd	nd	nd	29	29
Aroclor-1232	0/1	nd	nd	nd	15	15
Aroclor-1242	0/1	nd	nd	nd	15	15
Aroclor-1248	1/1	98	98	98	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
Aroclor-1254	1/1	170	170	170	na	na
Aroclor-1260	1/1	180	180	180	na	na
PCBs (total calc'd)[c]	1/1	450	450	450	na	na
Pacific staghorn sculpin-whole body						
Aroclor-1016	0/24	nd	nd	nd	10	100
Aroclor-1221	0/24	nd	nd	nd	20	200
Aroclor-1232	0/24	nd	nd	nd	10	100
Aroclor-1242	0/24	nd	nd	nd	10	100
Aroclor-1248	22/24	68	270	140	100	100
Aroclor-1254	24/24	190	880	360	na	na
Aroclor-1260	24/24	250	1,600	460	na	na
PCBs (total calc'd)[c]	24/24	510	2,800	950	na	na
Shiner surfperch-whole body						
Aroclor-1016	0/24	nd	nd	nd	15	150
Aroclor-1221	0/24	nd	nd	nd	29	290
Aroclor-1232	0/24	nd	nd	nd	15	150
Aroclor-1242	0/24	nd	nd	nd	15	150
Aroclor-1248	24/24	110	4,400	400	na	na
Aroclor-1254	24/24	240	7,600	910	na	na
Aroclor-1260	24/24	270	7,100	1,300	na	na
PCBs (total calc'd)[c]	24/24	640	18,400 J	2,600	na	na
Pile perch-fillet						
Aroclor-1016	0/1	nd	nd	nd	15	15
Aroclor-1221	0/1	nd	nd	nd	29	29
Aroclor-1232	0/1	nd	nd	nd	15	15
Aroclor-1242	0/1	nd	nd	nd	15	15
Aroclor-1248	1/1	59	59	59	na	na
Aroclor-1254	1/1	120	120	120	na	na
Aroclor-1260	1/1	120	120	120	na	na
PCBs (total calc'd)[c]	1/1	300	300	300	na	na
Striped perch-fillet						
Aroclor-1016	0/1	nd	nd	nd	15	15
Aroclor-1221	0/1	nd	nd	nd	29	29
Aroclor-1232	0/1	nd	nd	nd	15	15
Aroclor-1242	0/1	nd	nd	nd	15	15
Aroclor-1248	1/1	98	98	98	na	na
Aroclor-1254	1/1	220	220	220	na	na
Aroclor-1260	1/1	310	310	310	na	na
PCBs (total calc'd)[c]	1/1	630	630	630	na	na
Dungeness crab-edible meat						
Aroclor-1016	0/7	nd	nd	nd	15	15
Aroclor-1221	0/7	nd	nd	nd	29	29
Aroclor-1232	0/7	nd	nd	nd	15	15

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Aroclor-1242	0/7	nd	nd	nd	15	15
Aroclor-1248	6/7	40 J	67	59	15	15
Aroclor-1254	7/7	76	120 J	96	na	na
Aroclor-1260	7/7	67	120	94	na	na
PCBs (total calc'd)[c]	7/7	206 J	300	240	na	na
Dungeness crab-hepatopancreas						
Aroclor-1016	0/3	nd	nd	nd	150	150
Aroclor-1221	0/3	nd	nd	nd	290	290
Aroclor-1232	0/3	nd	nd	nd	150	150
Aroclor-1242	0/3	nd	nd	nd	150	150
Aroclor-1248	3/3	600	620	610	na	na
Aroclor-1254	3/3	1,600	1,800	1,700	na	na
Aroclor-1260	3/3	1,800	3,100	2,300	na	na
PCBs (total calc'd)[c]	3/3	4,000	5,500	4,700	na	na
Slender crab-edible meat						
Aroclor-1016	0/12	nd	nd	nd	15	15
Aroclor-1221	0/12	nd	nd	nd	29	29
Aroclor-1232	0/12	nd	nd	nd	15	15
Aroclor-1242	0/12	nd	nd	nd	15	15
Aroclor-1248	1/12	84	84	84	15	15
Aroclor-1254	12/12	61	160 J	110	na	na
Aroclor-1260	12/12	47	150	94	na	na
PCBs (total calc'd)[c]	12/12	108	390 J	210	na	na
Slender crab-hepatopancreas						
Aroclor-1016	0/4	nd	nd	nd	15	15
Aroclor-1221	0/4	nd	nd	nd	29	29
Aroclor-1232	0/4	nd	nd	nd	15	15
Aroclor-1242	0/4	nd	nd	nd	15	15
Aroclor-1248	4/4	270 J	420 J	330	na	na
Aroclor-1254	4/4	620 J	950 J	780	na	na
Aroclor-1260	4/4	600	820	720	na	na
PCBs (total calc'd)[c]	4/4	1,490 J	2,190 J	1,800	na	na

[a] Reporting limit range for nondetect samples

[b] Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration.

[c] Methods for calculating total PCBs are presented in Appendix C

na – not applicable

nd – not detected

J – estimated concentration

The only Aroclors detected in fish and crab tissue samples were 1248, 1254, and 1260. Aroclors 1254 and 1260 were detected in all samples. Aroclor 1248 was detected in all but two of the 92 fish tissue samples and in all but 12 of the 26 crab tissue samples. Total PCB concentrations (based on Aroclor sums) ranged from 450 to 18,400 µg/kg ww in fish whole-body samples, 300 to 2,101 µg/kg ww in fish fillet composite samples, 108 to 390 µg/kg ww in crab edible meat composite samples, and 1,490 to 5,500 µg/kg ww in crab hepatopancreas composite samples.

Table 4-7 presents total PCB concentrations in each fish and crab composite tissue sample by tissue type, area, and subarea. Among the English sole whole-body composite samples, the highest concentration (4,700 µg/kg ww) was detected in a sample collected from Area T1 and the lowest concentration (1,320 µg/kg ww) was detected in a sample collected from Area T3. Total PCB concentrations in all seven English sole fillet composite samples were lower than those in the whole-body composite samples collected from their respective areas, with the exception of one fillet composite sample from Area T3 that had a concentration of 1,640 µg/kg ww, which was higher than the lowest whole-body concentration of 1,320 µg/kg ww in Area T3. Total PCB concentrations in starry flounder composite samples were lower than in English sole composite samples of the same tissue type in Area T4.

Table 4-7. Concentrations of total PCBs in LDW fish and crab samples

Tissue Type	Area	Subarea	Sample ID	Total PCBs [a] (µg/kg ww)	Lipid (%)	Lipid-normalized PCBs [b] (mg PCBs/ kg lipid)
English sole - whole body	T1	Multiple subareas	LDW-T1-M-ES-WB-comp-1	2,700	4.3	63
			LDW-T1-M-ES-WB-comp-2	3,000	5.0	60
			LDW-T1-M-ES-WB-comp-3	4,200	6.8	62
			LDW-T1-M-ES-WB-comp-4	4,200	5.7	74
			LDW-T1-M-ES-WB-comp-5	3,100	5.3	58
			LDW-T1-M-ES-WB-comp-6	4,700	6.3	75
	T2	Multiple subareas	LDW-T2-M-ES-WB-comp-1	4,200	8.7	48
			LDW-T2-M-ES-WB-comp-2	3,900	6.6	59
			LDW-T2-M-ES-WB-comp-3	4,200 J	7.6	55
			LDW-T2-M-ES-WB-comp-4	3,600	6.2	58
			LDW-T2-M-ES-WB-comp-5	3,900	7.6	51
			LDW-T2-M-ES-WB-comp-6	3,300	5.7	58
	T3	Multiple subareas	LDW-T3-M-ES-WB-comp-1	3,500	6.6	53
			LDW-T3-M-ES-WB-comp-2	1,870	4.7	40
			LDW-T3-M-ES-WB-comp-3	4,300	5.5	78
			LDW-T3-M-ES-WB-comp-4	1,720	3.5	49
			LDW-T3-M-ES-WB-comp-5	1,320	2.6	51
			LDW-T3-M-ES-WB-comp-6	2,700	6.2	44
	T4	Multiple subareas	LDW-T4-M-ES-WB-comp-1	1,800	5.9	31
			LDW-T4-M-ES-WB-comp-2	1,660	6.2	27
			LDW-T4-M-ES-WB-comp-3	1,640	4.8	34
Starry flounder - whole body	T4	Multiple subareas	LDW-T4-M-SF-WB-comp-1	660	2.1	31
			LDW-T4-M-SF-WB-comp-2	450	2.1	21
			LDW-T4-M-SF-WB-comp-3	600	2.5	24

Tissue Type	Area	Subarea	Sample ID	Total PCBs [a] (µg/kg ww)	Lipid (%)	Lipid-normalized PCBs [b] (mg PCBs/ kg lipid)
English sole - fillet	T1	Multiple subareas	LDW-T1-M-ES-FL-comp-1	1,600	3.1	52
			LDW-T1-M-ES-FL-comp-2	1,330	2.6	51
	T2	Multiple subareas	LDW-T2-M-ES-FL-comp-1	2,010	3.4	59
			LDW-T2-M-ES-FL-comp-2	1,840	4.3	43
	T3	Multiple subareas	LDW-T3-M-ES-FL-comp-1	850	1.6	53
			LDW-T3-M-ES-FL-comp-2	1,640	3.6	46
	T4	Multiple subareas	LDW-T4-M-ES-FL-comp-1	710	1.7	42
Starry flounder - fillet	T4	Multiple subareas	LDW-T4-M-SF-FL-comp-1	450	2.6	17
Pacific staghorn sculpin - whole body	T1	A	LDW-T1-A-PS-WB-comp-1	580	2.1	28
		B	LDW-T1-B-PS-WB-comp-1	620 J	2.3	27
		C	LDW-T1-C-PS-WB-comp-1	750 J	1.8	42
		D	LDW-T1-D-PS-WB-comp-1	750	2.4	31
		E	LDW-T1-E-PS-WB-comp-1	790	2.4	33
		F	LDW-T1-F-PS-WB-comp-1	860	2.4	36
	T2	A	LDW-T2-A-PS-WB-comp-1	620	2.2	28
		B	LDW-T2-B-PS-WB-comp-1	710	2.4	30
		C	LDW-T2-C-PS-WB-comp-1	660 J	2.7	24
		D	LDW-T2-D-PS-WB-comp-1	660	2.3	29
		E	LDW-T2-E-PS-WB-comp-1	1,260	2.3	55
		F	LDW-T2-F-PS-WB-comp-1	720	1.8	40
	T3	A	LDW-T3-A-PS-WB-comp-1	830	2.1	40
		B	LDW-T3-B-PS-WB-comp-1	1,220	1.9	64
		C	LDW-T3-C-PS-WB-comp-1	810	1.8	45
		D	LDW-T3-D-PS-WB-comp-1	2,800	1.8	160
		E	LDW-T3-E-PS-WB-comp-1	1,180	2.0	59
		F	LDW-T3-F-PS-WB-comp-1	2,300	1.9	120

TISSUE TYPE	AREA	SUBAREA	SAMPLE ID	TOTAL PCBs [a] (µg/kg ww)	LIPID (%)	LIPID-NORMALIZED PCBs [b] (mg PCBs/ kg lipid)
Pacific staghorn sculpin - whole body (cont'd)	T4	A	LDW-T4-A-PS-WB-comp-1	660	2.4	28
		B	LDW-T4-B-PS-WB-comp-1	780	2.2	35
		C	LDW-T4-C-PS-WB-comp-1	510	1.3	39
		D	LDW-T4-D-PS-WB-comp-1	1,330	2.5	53
		D	LDW-T4-D-PS-WB-comp-2	710	2.2	32
		E	LDW-T4-E-PS-WB-comp-1	670	1.8	37
Shiner surfperch - whole body	T1	A	LDW-T1-A-SS-WB-comp-1	970	5.0	19
		B	LDW-T1-B-SS-WB-comp-1	1,120 J	2.7	41
		C	LDW-T1-C-SS-WB-comp-1	1,670	4.1	41
		D	LDW-T1-D-SS-WB-comp-1	1,830	3.3	55
		E	LDW-T1-E-SS-WB-comp-1	1,270	2.3	55
		F	LDW-T1-F-SS-WB-comp-1	1,460	2.8	52
	T2	A	LDW-T2-A-SS-WB-comp-1	1,590	4.4	36
		B	LDW-T2-B-SS-WB-comp-1	1,570	2.5	63
		C	LDW-T2-C-SS-WB-comp-1	1,260	2.6	48
		D	LDW-T2-D-SS-WB-comp-1	1,450	3.8	38
		E	LDW-T2-E-SS-WB-comp-1	18,400 J	5.6	330
		F	LDW-T2-F-SS-WB-comp-1	1,620	4.9	33
	T3	A	LDW-T3-A-SS-WB-comp-1	1,280	3.7	35
		B	LDW-T3-B-SS-WB-comp-1	2,600	5.6	46
		C	LDW-T3-C-SS-WB-comp-1	1,410	3.4	41
		D	LDW-T3-D-SS-WB-comp-1	4,000	3.8	110
		E	LDW-T3-E-SS-WB-comp-1	8,800	3.1	280
		F	LDW-T3-F-SS-WB-comp-1	4,900	4.6	110

Tissue Type	Area	Subarea	Sample ID	Total PCBs [a] (µg/kg ww)	Lipid (%)	Lipid-normalized PCBs [b] (mg PCBs/ kg lipid)
Shiner surfperch - whole body (cont'd)	T4	A	LDW-T4-A-SS-WB-comp-1	640	3.0	21
		B	LDW-T4-B-SS-WB-comp-1	960	3.3	29
		B	LDW-T4-B-SS-WB-comp-2	880	5.6	16
		C	LDW-T4-C-SS-WB-comp-1	920	5.3	17
		C	LDW-T4-C-SS-WB-comp-2	660	3.2	21
		D	LDW-T4-D-SS-WB-comp-1	710	4.3	17
Pile perch - fillet	All areas	T1-F, T2-E,F, T3-D,E,F, T4-A,C	LDW-M-M-PP-FL-comp-1	300	1.1	27
Striped perch - fillet	T3 and T4	T3-C,D,E,F, T4-D	LDW-M-M-SP-FL-comp-1	630	1.4	45
Dungeness crab - edible meat	T1	Multiple subareas	LDW-T1-M-DC-EM-comp-1	207 J	0.34	61
			LDW-T1-M-DC-EM-comp-2	206 J	0.39	53
			LDW-T1-M-DC-EM-comp-3	290	0.28	100
	T3	Multiple subareas	LDW-T3-M-DC-EM-comp-1	226	0.23	98
			LDW-T3-M-DC-EM-comp-2	300	0.40	75
			LDW-T3-M-DC-EM-comp-3	212	0.47	45
	T4	Multiple subareas	LDW-T4-M-DC-EM-comp-1	240 J	0.72	33
Dungeness crab - hepatopancreas	T1	Multiple subareas	LDW-T1-M-DC-HP-comp-1	4,000	4.6	87
	T3	Multiple subareas	LDW-T3-M-DC-HP-comp-1	4,500	6.3	71
	T4	Multiple subareas	LDW-T4-M-DC-HP-comp-1	5,500	7.9	70
Slender crab - edible meat	T1	Multiple subareas	LDW-T1-M-SC-EM-comp-1	390 J	0.74	53
			LDW-T1-M-SC-EM-comp-2	220	0.54	41
			LDW-T1-M-SC-EM-comp-3	210 J	0.43	49
	T2	Multiple subareas	LDW-T2-M-SC-EM-comp-1	180	0.23	78
			LDW-T2-M-SC-EM-comp-2	210 J	0.41	51
			LDW-T2-M-SC-EM-comp-3	260 J	0.43	60
			LDW-T2-M-SC-EM-comp-4	108	0.47	23
			LDW-T2-M-SC-EM-comp-5	230 J	0.34	68
			LDW-T2-M-SC-EM-comp-6	180 J	0.26	69

Tissue Type	Area	Subarea	Sample ID	Total PCBs [a] (µg/kg ww)	Lipid (%)	Lipid-normalized PCBs [b] (mg PCBs/ kg lipid)
Slender crab - edible meat (cont'd)	T3	Multiple subareas	LDW-T3-M-SC-EM-comp-1	146	0.52	28
			LDW-T3-M-SC-EM-comp-2	168	0.51	33
			LDW-T3-M-SC-EM-comp-3	220	0.45	49
Slender crab - hepatopancreas	T1	Multiple subareas	LDW-T1-M-SC-HP-comp-1	1,490 J	1.9	78
	T2	Multiple subareas	LDW-T2-M-SC-HP-comp-1	1,950 J	2.7	72
			LDW-T2-M-SC-HP-comp-2	2,190 J	3.6	61
	T3	Multiple subareas	LDW-T3-M-SC-HP-comp-1	1,640	2.2	75

[a] Methods for calculating total PCBs are presented in Appendix C.

[b] Lipid-normalized concentrations (in units of mg PCBs/kg lipid) represent the wet-weight total PCB concentration (in units of mg/kg ww) divided by the decimal fraction corresponding to the percent lipid (e.g., 2.0% lipid = 0.02).

Among the Pacific staghorn sculpin whole-body composite samples, the two highest PCB concentrations (2,800 and 2,300 µg/kg ww) were detected in composite samples of sculpin collected from Area T3. The composite sample with the lowest concentration (510 µg/kg ww) was collected from Area T4.

Among the shiner surfperch whole-body composite samples, the highest concentration (18,400 µg/kg ww) was detected in a composite perch sample collected from Area T2. The next three highest concentrations (8,800, 4,900, and 4,000 µg/kg ww) were detected in samples collected from Area T3. The lowest concentrations, ranging from 640 to 960 µg/kg ww, were all detected in composite samples of perch collected in Area T4.

The highest PCB concentrations in crab composite samples were detected in the three Dungeness crab hepatopancreas composite samples: 5,500 µg/kg ww in the composite sample from Area T4, 4,500 µg/kg ww in the composite sample from Area T3, and 4,000 µg/kg ww in the composite sample from Area T1. Concentrations in the four slender crab hepatopancreas composite samples ranged from 1,490 to 2,190 µg/kg ww; the two highest concentrations (2,190 and 1,950 µg/kg ww) were detected in the composite samples collected from Area T2. Among the edible meat composite samples of both Dungeness and slender crabs from all areas, concentrations ranged from 108 to 390 µg/kg ww.

Also reported in Table 4-7 are both the lipid concentrations (in percent) and the lipid-normalized PCB concentrations (in mg PCB/kg lipid) in each fish and crab composite tissue sample by tissue type, area, and subarea. Lipid concentrations in fish whole body and fillet samples and in crab hepatopancreas samples ranged from 1.1% in a pile perch fillet sample to 8.7% in an English sole whole body sample. Lipid concentrations in crab edible meat samples ranged from 0.23 to 0.74%. The highest lipid-normalized PCB concentration (330 mg PCB/kg lipid) was detected in a shiner surfperch whole body sample collected from Area T2. The next highest concentration (280 mg PCB/kg lipid) was also detected in a shiner surfperch whole body sample, collected from Area T3. The lowest lipid-normalized PCB concentration (16 mg PCB/kg lipid) was detected in a shiner surfperch whole body sample collected from Area T4.

4.1.7 Pesticides

Table 4-8 presents a summary of organochlorine pesticide results for each tissue type, including the number of detections, the range of detected concentrations, and the range of reporting limits for samples reported as non-detects. Calculated totals for DDT isomers are also presented in Table 4-8. Methods for calculating totals are presented in Appendix C. Data tables containing pesticide results for each composite sample of each tissue type are presented in Appendix A.

Table 4-8. Detection frequencies and concentration summaries of organochlorine pesticides in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
English sole-whole body						
2,4'-DDD	0/21	nd	nd	nd	6.2	88
2,4'-DDE	0/21	nd	nd	nd	2.9	18
2,4'-DDT	21/21	54 JN	130 JN	87	na	na
4,4'-DDD	21/21	6.7 JN	20 JN	11	na	na
4,4'-DDE	19/21	7.7 JN	20 JN	14	12	14
4,4'-DDT	21/21	42 JN	110 JN	73	na	na
DDTs (total-calc'd)[c]	21/21	113 JN	280 JN	180	na	na
Aldrin	1/21	6.2 JN	6.2 JN	6.2	7.2	10
Dieldrin	0/21	nd	nd	nd	2.0	10
alpha-BHC	0/21	nd	nd	nd	1.0	10
beta-BHC	8/21	4.0 JN	8.4 JN	5.6	7.2	10
delta-BHC	0/21	nd	nd	nd	1.0	10
gamma-BHC	2/21	2.3 JN	4.3 JN	3.3	7.2	10
alpha-Chlordane	7/21	3.8 JN	6.6 JN	5.4	1.0	10
gamma-Chlordane	20/21	22 JN	53 JN	37	56	56
alpha-Endosulfan	13/21	2.1 JN	6.6 JN	3.7	7.2	10
beta-Endosulfan	4/21	6.5 JN	18 JN	12	7.2	10
Endosulfan sulfate	0/21	nd	nd	nd	1.0	10
Endrin	2/21	2.8 JN	14 JN	8.4	1.7	12
Endrin aldehyde	1/21	5.5 JN	5.5 JN	5.5	1.3	10
Endrin ketone	0/21	nd	nd	nd	1.9	10
Heptachlor	2/21	5.7 JN	6.8 JN	6.3	1.0	10
Heptachlor epoxide	12/21	12 JN	45 JN	28	7.2	10
Methoxychlor	0/21	nd	nd	nd	1.0	23
Mirex	0/21	nd	nd	nd	1.0	10
Toxaphene	0/21	nd	nd	nd	370	1,800
English sole-fillet						
2,4'-DDD	0/7	nd	nd	nd	3.8	7.8
2,4'-DDE	0/7	nd	nd	nd	1.0	7.2
2,4'-DDT	7/7	20 JN	50 JN	39	na	na
4,4'-DDD	7/7	2.3 JN	6.6 JN	4.5	na	na
4,4'-DDE	4/7	2.6 JN	12 JN	6.6	4.3	7.2
4,4'-DDT	7/7	12 JN	40 JN	28	na	na
DDTs (total-calc'd)[c]	7/7	37 JN	103 JN	75	na	na
Aldrin	0/7	nd	nd	nd	1.0	7.2
Dieldrin	0/7	nd	nd	nd	5.0	7.2
alpha-BHC	1/7	0.38 JN	0.38 JN	0.38	7.2	7.2
beta-BHC	2/7	1.6 JN	2.2 JN	1.9	7.2	7.2
delta-BHC	0/7	nd	nd	nd	1.0	7.2
gamma-BHC	0/7	nd	nd	nd	1.0	7.2

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
alpha-Chlordane	1/7	0.60 JN	0.60 JN	0.60	7.2	7.2
gamma-Chlordane	7/7	10 JN	28 JN	19	na	na
alpha-Endosulfan	4/7	1.7 JN	4.4 JN	2.7	7.2	7.2
beta-Endosulfan	1/7	6.9 JN	6.9 JN	6.9	7.2	7.2
Endosulfan sulfate	0/7	nd	nd	nd	1.0	7.2
Endrin	0/7	nd	nd	nd	1.0	7.2
Endrin aldehyde	1/7	8.1 JN	8.1 JN	8.1	1.6	7.2
Endrin ketone	0/7	nd	nd	nd	1.5	7.2
Heptachlor	0/7	nd	nd	nd	1.0	7.2
Heptachlor epoxide	0/7	nd	nd	nd	2.9	7.2
Methoxychlor	0/7	nd	nd	nd	1.0	7.2
Mirex	0/7	nd	nd	nd	1.0	7.2
Toxaphene	0/7	nd	nd	nd	310	440
Starry flounder-whole body						
2,4'-DDD	0/3	nd	nd	nd	7.2	7.2
2,4'-DDE	1/3	5.1 JN	5.1 JN	5.1	7.2	7.2
2,4'-DDT	3/3	23 JN	40 JN	31	na	na
4,4'-DDD	3/3	3.4 JN	4.4 JN	4.0	na	na
4,4'-DDE	3/3	6.7 JN	8.6 JN	7.9	na	na
4,4'-DDT	3/3	18 JN	27 JN	23	na	na
DDTs (total-calc'd)[c]	3/3	51 JN	80 JN	68	na	na
Aldrin	0/3	nd	nd	nd	7.2	7.2
Dieldrin	0/3	nd	nd	nd	7.2	7.2
alpha-BHC	0/3	nd	nd	nd	7.2	7.2
beta-BHC	1/3	4.0 JN	4.0 JN	4.0	7.2	7.2
delta-BHC	0/3	nd	nd	nd	7.2	7.2
gamma-BHC	0/3	nd	nd	nd	7.2	7.2
alpha-Chlordane	0/3	nd	nd	nd	7.2	7.2
gamma-Chlordane	3/3	6.3 JN	11 JN	8.3	na	na
alpha-Endosulfan	0/3	nd	nd	nd	7.2	7.2
beta-Endosulfan	0/3	nd	nd	nd	7.2	7.2
Endosulfan sulfate	0/3	nd	nd	nd	7.2	7.2
Endrin	2/3	0.86 JN	2.8 JN	1.8	7.2	7.2
Endrin aldehyde	1/3	7.1 JN	7.1 JN	7.1	7.2	7.2
Endrin ketone	0/3	nd	nd	nd	7.2	7.2
Heptachlor	0/3	nd	nd	nd	7.2	7.2
Heptachlor epoxide	1/3	7.9 JN	7.9 JN	7.9	7.2	7.2
Methoxychlor	0/3	nd	nd	nd	7.2	7.2
Mirex	0/3	nd	nd	nd	7.2	7.2
Toxaphene	0/3	nd	nd	nd	360	360
Starry flounder-fillet						
2,4'-DDD	0/1	nd	nd	nd	7.2	7.2
2,4'-DDE	0/1	nd	nd	nd	7.2	7.2

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
2,4'-DDT	1/1	31 JN	31 JN	31	na	na
4,4'-DDD	1/1	3.0 JN	3.0 JN	3.0	na	na
4,4'-DDE	1/1	5.9 JN	5.9 JN	5.9	na	na
4,4'-DDT	1/1	18 JN	18 JN	18	na	na
DDTs (total-calc'd)[c]	1/1	58 JN	58 JN	58	na	na
Aldrin	0/1	nd	nd	nd	7.2	7.2
Dieldrin	0/1	nd	nd	nd	7.2	7.2
alpha-BHC	0/1	nd	nd	nd	7.2	7.2
beta-BHC	0/1	nd	nd	nd	7.2	7.2
delta-BHC	0/1	nd	nd	nd	7.2	7.2
gamma-BHC	0/1	nd	nd	nd	7.2	7.2
alpha-Chlordane	0/1	nd	nd	nd	7.2	7.2
gamma-Chlordane	1/1	6.2 JN	6.2 JN	6.2	na	na
alpha-Endosulfan	0/1	nd	nd	nd	7.2	7.2
beta-Endosulfan	0/1	nd	nd	nd	7.2	7.2
Endosulfan sulfate	0/1	nd	nd	nd	7.2	7.2
Endrin	1/1	1.0 JN	1.0 JN	1.0	na	na
Endrin aldehyde	0/1	nd	nd	nd	7.2	7.2
Endrin ketone	0/1	nd	nd	nd	7.2	7.2
Heptachlor	0/1	nd	nd	nd	7.2	7.2
Heptachlor epoxide	0/1	nd	nd	nd	7.2	7.2
Methoxychlor	0/1	nd	nd	nd	7.2	7.2
Mirex	0/1	nd	nd	nd	7.2	7.2
Toxaphene	0/1	nd	nd	nd	360	360
Pacific staghorn sculpin-whole body						
2,4'-DDD	1/24	23 JN	23 JN	23	2.4	16
2,4'-DDE	0/24	nd	nd	nd	1.0	12
2,4'-DDT	24/24	19 JN	120 JN	43	na	na
4,4'-DDD	23/24	1.1 JN	7.3 JN	2.8	2.8	2.8
4,4'-DDE	21/24	3.4 JN	29 JN	6.4	3.5	5.6
4,4'-DDT	23/24	11 JN	99 JN	33	20	20
DDTs (total-calc'd)[c]	24/24	33 JN	220 JN	84	na	na
Aldrin	0/24	nd	nd	nd	1.0	1.0
Dieldrin	1/24	0.82 JN	0.82 JN	0.82	1.0	2.0
alpha-BHC	3/24	0.20 JN	0.66 JN	0.47	1.0	1.0
beta-BHC	7/24	0.27 JN	1.0 JN	0.57	1.0	2.0
delta-BHC	0/24	nd	nd	nd	1.0	1.0
gamma-BHC	1/24	5.6 JN	5.6 JN	5.6	1.0	1.0
alpha-Chlordane	8/24	1.1 JN	7.3 JN	2.1	1.0	2.7
gamma-Chlordane	24/24	5.5 JN	27 JN	11	na	na
alpha-Endosulfan	11/24	1.0 JN	3.6 JN	1.7	1.0	10
beta-Endosulfan	5/24	4.7 JN	6.4 JN	5.8	1.1	13
Endosulfan sulfate	0/24	nd	nd	nd	1.0	1.0

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
Endrin	1/24	36 JN	36 JN	36	1.0	4.1
Endrin aldehyde	6/24	1.2 JN	4.8 JN	2.0	1.0	5.3
Endrin ketone	1/24	0.60 JN	0.60 JN	0.60	1.0	16
Heptachlor	2/24	2.1 JN	2.7 JN	2.4	1.0	1.9
Heptachlor epoxide	0/24	nd	nd	nd	1.0	1.0
Methoxychlor	0/24	nd	nd	nd	1.0	4.2
Mirex	0/24	nd	nd	nd	1.0	1.0
Toxaphene	0/24	nd	nd	nd	160	1,900
Shiner surfperch-whole body						
2,4'-DDD	1/24	57 JN	57 JN	57	1.5	41
2,4'-DDE	2/24	3.2 JN	110 JN	57	1.5	16
2,4'-DDT	24/24	18 JN	440 JN	78	na	na
4,4'-DDD	22/24	1.3 JN	8.5 JN	4.8	3.5	4.7
4,4'-DDE	17/24	4.4 JN	15 JN	9.1	3.7	8.1
4,4'-DDT	24/24	14 JN	470 JN	90	na	na
DDTs (total-calc'd)[c]	24/24	35 JN	1,020 JN	190	na	na
Aldrin	1/24	1.4 JN	1.4 JN	1.4	1.5	3.7
Dieldrin	0/24	nd	nd	nd	1.5	7.2
alpha-BHC	2/24	0.45 JN	0.46 JN	0.46	1.5	7.2
beta-BHC	16/24	2.5 JN	15 JN	8.2	1.5	5.1
delta-BHC	0/24	nd	nd	nd	1.5	1.5
gamma-BHC	7/24	0.59 JN	5.1 JN	2.2	1.5	2.8
alpha-Chlordane	16/24	0.60 JN	3.6 JN	1.9	1.5	7.2
gamma-Chlordane	24/24	4.1 JN	330 JN	32	na	na
alpha-Endosulfan	11/24	2.0 JN	6.3 JN	3.4	1.5	9.9
beta-Endosulfan	14/24	2.0 JN	44 JN	11	2.4	11
Endosulfan sulfate	0/24	nd	nd	nd	1.5	1.5
Endrin	8/24	2.2 JN	40 JN	7.9	1.5	72
Endrin aldehyde	3/24	5.3 JN	78 JN	30	1.5	6.5
Endrin ketone	0/24	nd	nd	nd	1.5	15
Heptachlor	1/24	9.7 JN	9.7 JN	9.7	1.5	6.8
Heptachlor epoxide	5/24	3.4 JN	10 JN	7.2	1.5	6.0
Methoxychlor	0/24	nd	nd	nd	1.5	7.2
Mirex	0/24	nd	nd	nd	1.5	1.5
Toxaphene	0/24	nd	nd	nd	190	4,800
Pile perch-fillet						
2,4'-DDD	0/1	nd	nd	nd	7.2	7.2
2,4'-DDE	0/1	nd	nd	nd	7.2	7.2
2,4'-DDT	1/1	6.0 JN	6.0 JN	6.0	na	na
4,4'-DDD	0/1	nd	nd	nd	7.2	7.2
4,4'-DDE	1/1	1.0 JN	1.0 JN	1.0	na	na
4,4'-DDT	1/1	3.2 JN	3.2 JN	3.2	na	na
DDTs (total-calc'd)[c]	1/1	10.2 JN	10.2 JN	10	na	na

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
Aldrin	0/1	nd	nd	nd	7.2	7.2
Dieldrin	0/1	nd	nd	nd	7.2	7.2
alpha-BHC	0/1	nd	nd	nd	7.2	7.2
beta-BHC	0/1	nd	nd	nd	7.2	7.2
delta-BHC	0/1	nd	nd	nd	7.2	7.2
gamma-BHC	0/1	nd	nd	nd	7.2	7.2
alpha-Chlordane	0/1	nd	nd	nd	7.2	7.2
gamma-Chlordane	1/1	3.9 JN	3.9 JN	3.9	na	na
alpha-Endosulfan	0/1	nd	nd	nd	7.2	7.2
beta-Endosulfan	0/1	nd	nd	nd	7.2	7.2
Endosulfan sulfate	0/1	nd	nd	nd	7.2	7.2
Endrin	1/1	0.89 JN	0.89 JN	0.89	na	na
Endrin aldehyde	0/1	nd	nd	nd	7.2	7.2
Endrin ketone	0/1	nd	nd	nd	7.2	7.2
Heptachlor	0/1	nd	nd	nd	7.2	7.2
Heptachlor epoxide	0/1	nd	nd	nd	7.2	7.2
Methoxychlor	0/1	nd	nd	nd	7.2	7.2
Mirex	0/1	nd	nd	nd	7.2	7.2
Toxaphene	0/1	nd	nd	nd	360	360
Striped perch-fillet						
2,4'-DDD	0/1	nd	nd	nd	7.2	7.2
2,4'-DDE	0/1	nd	nd	nd	7.2	7.2
2,4'-DDT	1/1	13 JN	13 JN	13	na	na
4,4'-DDD	0/1	nd	nd	nd	7.2	7.2
4,4'-DDE	1/1	1.5 JN	1.5 JN	1.5	na	na
4,4'-DDT	1/1	11 JN	11 JN	11	na	na
DDTs (total-calc'd)[c]	1/1	26 JN	26 JN	26	na	na
Aldrin	0/1	nd	nd	nd	7.2	7.2
Dieldrin	0/1	nd	nd	nd	7.2	7.2
alpha-BHC	0/1	nd	nd	nd	7.2	7.2
beta-BHC	0/1	nd	nd	nd	7.2	7.2
delta-BHC	0/1	nd	nd	nd	7.2	7.2
gamma-BHC	0/1	nd	nd	nd	7.2	7.2
alpha-Chlordane	0/1	nd	nd	nd	7.2	7.2
gamma-Chlordane	1/1	5.9 JN	5.9 JN	5.9	na	na
alpha-Endosulfan	0/1	nd	nd	nd	7.2	7.2
beta-Endosulfan	0/1	nd	nd	nd	7.2	7.2
Endosulfan sulfate	0/1	nd	nd	nd	7.2	7.2
Endrin	1/1	2.4 JN	2.4 JN	2.4	na	na
Endrin aldehyde	0/1	nd	nd	nd	7.2	7.2
Endrin ketone	0/1	nd	nd	nd	7.2	7.2
Heptachlor	0/1	nd	nd	nd	7.2	7.2
Heptachlor epoxide	0/1	nd	nd	nd	7.2	7.2

Analyte	Detection Frequency	Detected Concentration (µg/kg ww) Minimum	Maximum	Mean[b]	Reporting Limit[a] (µg/kg ww) Minimum	Maximum
Methoxychlor	0/1	nd	nd	nd	7.2	7.2
Mirex	0/1	nd	nd	nd	7.2	7.2
Toxaphene	0/1	nd	nd	nd	360	360
Dungeness crab-edible meat						
2,4'-DDD	1/7	4.0 JN	4.0 JN	4.0	1.5	7.2
2,4'-DDE	0/7	nd	nd	nd	1.5	7.2
2,4'-DDT	7/7	8.0 JN	13 JN	10	na	na
4,4'-DDD	0/7	nd	nd	nd	1.5	7.2
4,4'-DDE	7/7	2.0 JN	2.8 JN	2.3	na	na
4,4'-DDT	7/7	6.5 JN	11 JN	8.2	na	na
DDTs (total-calc'd)[c]	7/7	16.9 JN	27 JN	21	na	na
Aldrin	0/7	nd	nd	nd	1.5	7.2
Dieldrin	0/7	nd	nd	nd	4.1	7.2
alpha-BHC	0/7	nd	nd	nd	1.5	7.2
beta-BHC	0/7	nd	nd	nd	1.5	7.2
delta-BHC	0/7	nd	nd	nd	1.5	7.2
gamma-BHC	1/7	4.0 JN	4.0 JN	4.0	7.2	7.2
alpha-Chlordane	0/7	nd	nd	nd	1.5	7.2
gamma-Chlordane	7/7	3.0 JN	5.4 JN	3.9	na	na
alpha-Endosulfan	0/7	nd	nd	nd	1.5	7.2
beta-Endosulfan	0/7	nd	nd	nd	1.5	7.2
Endosulfan sulfate	0/7	nd	nd	nd	1.5	7.2
Endrin	0/7	nd	nd	nd	1.5	7.2
Endrin aldehyde	0/7	nd	nd	nd	1.5	7.2
Endrin ketone	0/7	nd	nd	nd	1.5	7.2
Heptachlor	0/7	nd	nd	nd	1.5	7.2
Heptachlor epoxide	6/7	1.2 JN	2.3 JN	1.8	7.2	7.2
Methoxychlor	0/7	nd	nd	nd	1.5	7.2
Mirex	0/7	nd	nd	nd	1.5	7.2
Toxaphene	0/7	nd	nd	nd	120	360
Dungeness crab-hepatopancreas						
2,4'-DDD	0/3	nd	nd	nd	22	28
2,4'-DDE	0/3	nd	nd	nd	15	32
2,4'-DDT	3/3	150 JN	210 JN	180	na	na
4,4'-DDD	2/3	6.1 JN	6.6 JN	6.4	15	15
4,4'-DDE	3/3	15 JN	46 JN	34	na	na
4,4'-DDT	3/3	120 JN	180 JN	150	na	na
DDTs (total-calc'd)[c]	3/3	290 JN	440 JN	370	na	na
Aldrin	0/3	nd	nd	nd	7.2	15
Dieldrin	0/3	nd	nd	nd	7.2	34
alpha-BHC	0/3	nd	nd	nd	7.2	15
beta-BHC	0/3	nd	nd	nd	7.2	15
delta-BHC	0/3	nd	nd	nd	7.2	15

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
gamma-BHC	0/3	nd	nd	nd	7.2	15
alpha-Chlordane	0/3	nd	nd	nd	7.2	15
gamma-Chlordane	3/3	49 JN	73 JN	62	na	na
alpha-Endosulfan	0/3	nd	nd	nd	7.2	15
beta-Endosulfan	0/3	nd	nd	nd	8.7	15
Endosulfan sulfate	0/3	nd	nd	nd	7.2	15
Endrin	0/3	nd	nd	nd	9.4	15
Endrin aldehyde	0/3	nd	nd	nd	7.2	15
Endrin ketone	0/3	nd	nd	nd	13	15
Heptachlor	0/3	nd	nd	nd	7.2	15
Heptachlor epoxide	1/3	12 JN	12 JN	12	11	15
Methoxychlor	0/3	nd	nd	nd	7.2	15
Mirex	0/3	nd	nd	nd	7.2	15
Toxaphene	0/3	nd	nd	nd	1,900	2,200
Slender crab-edible meat						
2,4'-DDD	9/12	1.6 JN	5.2 JN	2.7	1.5	1.5
2,4'-DDE	0/12	nd	nd	nd	1.5	2.4
2,4'-DDT	12/12	3.7 JN	14 JN	8.6	na	na
4,4'-DDD	0/12	nd	nd	nd	1.5	2.2
4,4'-DDE	12/12	1.2 JN	4.7 JN	2.6	na	na
4,4'-DDT	12/12	3.7 JN	12 JN	7.3	na	na
DDTs (total-calc'd)[c]	12/12	10.5 JN	32 JN	21	na	na
Aldrin	0/12	nd	nd	nd	1.5	1.5
Dieldrin	1/12	1.3 JN	1.3 JN	1.3	1.5	3.3
alpha-BHC	0/12	nd	nd	nd	1.5	1.5
beta-BHC	0/12	nd	nd	nd	1.5	8.2
delta-BHC	0/12	nd	nd	nd	1.5	1.5
gamma-BHC	0/12	nd	nd	nd	1.5	1.5
alpha-Chlordane	2/12	1.5 JN	1.8 JN	1.7	1.5	1.5
gamma-Chlordane	12/12	2.0 JN	6.3 JN	3.8	na	na
alpha-Endosulfan	1/12	0.34 JN	0.34 JN	0.34	1.5	1.5
beta-Endosulfan	0/12	nd	nd	nd	1.5	1.5
Endosulfan sulfate	0/12	nd	nd	nd	1.5	1.5
Endrin	0/12	nd	nd	nd	1.5	5.0
Endrin aldehyde	5/12	0.83 JN	2.8 JN	1.9	1.5	1.5
Endrin ketone	0/12	nd	nd	nd	1.5	1.5
Heptachlor	0/12	nd	nd	nd	1.5	1.5
Heptachlor epoxide	9/12	0.93 JN	3.0 JN	2.1	1.5	1.5
Methoxychlor	3/12	7.7 JN	130 JN	55	1.5	1.5
Mirex	0/12	nd	nd	nd	1.5	1.5
Toxaphene	0/12	nd	nd	nd	72	160
Slender crab-hepatopancreas						
2,4'-DDD	1/4	15 JN	15 JN	15	4.6	8.9

Analyte	Detection Frequency	Detected Concentration (µg/kg ww)			Reporting Limit[a] (µg/kg ww)	
		Minimum	Maximum	Mean[b]	Minimum	Maximum
2,4'-DDE	0/4	nd	nd	nd	1.5	7.2
2,4'-DDT	4/4	53 JN	89 JN	71	na	na
4,4'-DDD	1/4	1.6 JN	1.6 JN	1.6	1.5	3.3
4,4'-DDE	4/4	16 JN	24 JN	21	na	na
4,4'-DDT	4/4	45 JN	68 JN	58	na	na
DDTs (total-calc'd)[c]	4/4	119 JN	181 JN	150	na	na
Aldrin	0/4	nd	nd	nd	1.5	1.5
Dieldrin	0/4	nd	nd	nd	7.2	9.1
alpha-BHC	1/4	0.41 JN	0.41 JN	0.41	1.5	1.5
beta-BHC	0/4	nd	nd	nd	1.5	2.1
delta-BHC	0/4	nd	nd	nd	1.5	1.8
gamma-BHC	0/4	nd	nd	nd	1.5	1.5
alpha-Chlordane	0/4	nd	nd	nd	1.5	1.5
gamma-Chlordane	4/4	23 JN	36 JN	30	na	na
alpha-Endosulfan	1/4	3.4 JN	3.4 JN	3.4	1.5	1.5
beta-Endosulfan	0/4	nd	nd	nd	2.0	3.6
Endosulfan sulfate	0/4	nd	nd	nd	1.5	7.2
Endrin	0/4	nd	nd	nd	1.5	7.2
Endrin aldehyde	0/4	nd	nd	nd	1.9	8.4
Endrin ketone	0/4	nd	nd	nd	2.5	2.8
Heptachlor	0/4	nd	nd	nd	1.5	1.5
Heptachlor epoxide	0/4	nd	nd	nd	3.1	6.1
Methoxychlor	0/4	nd	nd	nd	1.5	2.1
Mirex	0/4	nd	nd	nd	1.5	1.5
Toxaphene	0/4	nd	nd	nd	290	360

a Reporting limit range for nondetect samples

b Reported mean concentrations are the average of the detected concentrations only; RLs were not included in calculation of the mean concentration.

c Methods for calculating total DDTs are presented in Appendix C.

na – not applicable

nd – not detected

J – estimated concentration

JN – analysis indicates that the result is likely affected by the presence of interfering compounds; value is an estimate

At least one DDT isomer was detected in every fish and crab tissue sample, with 2,4′-DDT and 4,4′-DDT the most frequently detected isomers. Total DDT concentrations in whole-body fish composite samples ranged from 33 to 1,020 µg/kg ww. The highest concentration was detected in a shiner surfperch whole-body sample. The next two highest concentrations (570 and 450 µg/kg ww) were also detected in shiner surfperch whole-body samples. Total DDT concentrations in fish fillet composite samples ranged from 10.2 to 103 µg/kg ww. In crab composite samples, total DDT concentrations were higher in hepatopancreas (ranging from 119 to 440 µg/kg ww) than in edible meat (ranging from 10.5 to 32 µg/kg ww).

Gamma-chlordane was detected in all fish and crab composite samples at concentrations ranging from 2 to 330 µg/kg ww. The highest concentration was detected in a shiner surfperch whole-body composite sample from Area T2.

Four organochlorine pesticides were not detected in any fish or crab composite samples: toxaphene, mirex, endosulfan sulfate, and delta-BHC. An additional five organochlorine pesticides (aldrin, dieldrin, endrin ketone, heptachlor, and methoxychlor) were detected in five or fewer of the 108 fish and crab composite samples, at concentrations ranging from 0.6 to 130 µg/kg ww. The remaining organochlorine pesticides were detected in 7 to 41 of the 108 fish and crab composite samples, at concentrations ranging from 0.2 to 78 µg/kg ww.

4.1.8 Lipids and total solids

Table 4-9 presents the range of concentrations of lipids and total solids in each tissue type. Data tables for lipids and total solids for each composite sample of each tissue type are presented in Appendix A. The highest lipid content (8.7%) was measured in an English sole whole-body composite sample and the lowest lipid content (0.23%) was measured in Dungeness crab and slender crab edible meat composite samples. The highest total solids content (27.6%) was measured in a shiner surfperch whole-body composite sample and the lowest total solids content (11.4%) was measured in a slender crab hepatopancreas composite sample.

Table 4-9. Concentrations of lipids and total solids in LDW fish and crab samples

Analyte	Detection Frequency	Detected Concentration (% ww)		
		Minimum	Maximum	Mean
Lipid				
English sole-whole body	21/21	2.6	8.7	5.8
English sole-fillet	7/7	1.6	4.3	2.9
starry flounder-whole body	3/3	2.1	2.5	2.2
starry flounder-fillet	1/1	2.6	2.6	2.6
Pacific staghorn sculpin-whole body	24/24	1.3	2.7	2.1
shiner surfperch-whole body	24/24	2.3	5.6	3.9
pile perch-fillet	1/1	1.1	1.1	1.1
striped perch-fillet	1/1	1.4	1.4	1.4
Dungeness crab-edible meat	7/7	0.23	0.72	0.40
Dungeness crab-hepatopancreas	3/3	4.6	8	6.3
slender crab-edible meat	12/12	0.23	0.74	0.44
slender crab-hepatopancreas	4/4	1.9	3.6	2.6
Total solids				
English sole-whole body	21/21	21.5	27.1	25.0

Analyte	Detection Frequency	Detected Concentration (% ww)		
		Minimum	Maximum	Mean
English sole-fillet	7/7	20.8	24.3	22.6
starry flounder-whole body	3/3	22.2	22.9	22.6
starry flounder-fillet	1/1	21.8	21.8	21.8
Pacific staghorn sculpin-whole body	24/24	19.5	22.0	21.1
shiner surfperch-whole body	24/24	22.8	27.6	24.7
pile perch-fillet	1/1	23.3	23.3	23.3
striped perch-fillet	1/1	22.9	22.9	22.9
Dungeness crab-edible meat	7/7	15.1	21.1	18.2
Dungeness crab-hepatopancreas	3/3	15.9	24.4	20.1
slender crab-edible meat	12/12	13.5	19.7	17.7
slender crab-hepatopancreas	4/4	11.40	13.3	12.6

4.1.9 Comparison of non-detect results to analytical concentration goals

Appendix D of the fish and crab QAPP (Windward 2004b) documented the derivation of fish and crab ACGs and included a comparison of ACGs to MDLs. As stated in Section 3.3.2, the laboratory reported non-detect results to the RL rather than the MDL. The sample-specific RL is based on the lowest point of the calibration curve associated with each analytical batch of samples, whereas the MDL is statistically derived following EPA methods. Both the RL and MDL will be elevated in cases where the sample extract is diluted. Detected concentrations between the MDL and RL were reported by the laboratory and flagged with a J qualifier to indicate that the reported concentration was an estimate because it falls below the lowest known point on the calibration curve.

In this section, ACGs are compared to both RLs and MDLs for non-detect results. ACGs were derived for five different tissue types (sculpin whole body, English sole whole body, shiner surfperch whole body, English sole fillet, and crab edible meat) according to methods described in Appendix D of the fish and crab QAPP (Windward 2004b). ACGs for fish and crab whole bodies were derived using ecological toxicity reference values. ACGs for English sole fillets, shiner surfperch, and crabs were also derived using human health risk equations for seafood consumption because data from these sample types will be used in the human health risk assessment. Ecological ACGs were derived for 40 chemicals, and human health ACGs were derived for 97 chemicals.

The reported RLs for non-detect results in the whole-body sampleswere below the applicable ecological ACGs described in Appendix D of the QAPP (Windward 2004b), with the exception of bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and endrin. All of the RLs for bis(2-ethylhexyl)phthalate (490 – 7,200 µg/kg ww) in the 67 whole-body fish samples were higher than the fish residue ACG of 390 µg/kg ww. Most (59 of 67) of the MDLs (53 – 760 µg/kg ww) for bis(2-ethylhexyl)phthalate also exceeded this ACG. The RLs for di-n-butyl phthalate (400-1,200 µg/kg ww) were higher than the crab ACG of 500 µg/kg ww in 14 of 24 samples; none of the MDLs were higher than the ACG. The RLs and MDLs for endrin (1.0–72 and 0.15–44 µg/kg ww**,** respectively) in whole-body fish were higher than the fish residue ACG in two samples. The uncertainty associated with risk estimates for these chemicals will be discussed in the baseline ecological risk assessment. For other chemicals , there will be relatively low uncertainty for risk estimates associated with the non-detect results.

Many of the RLs for the non-detect results in the 53 human health samples (10 English sole, perch, or starry flounder fillet, 24 shiner surfperch whole body, and 19 crab edible meat) were higher than the lowest human health ACGs reported in Appendix D of the QAPP (Windward 2004b) (Table 4-10). Of the 97 chemicals with human health ACGs, 46 had RLs higher than the applicable ACGs. Most were SVOCs, but 12 organochlorine pesticides, five PCB Aroclors, and inorganic arsenic were also above their respective ACGs. Thirty-nine of these chemicals also had MDLs higher than the applicable ACGs (Table 4-10). The magnitude of the exceedance was most pronounced for carcinogenic chemicals with low ACGs that are very difficult to quantitate analytically, such as benzidine and 3,3′-dichlorobenzidine. The uncertainty associated with non-detect results will be discussed in the uncertainty assessment of the baseline human health risk assessment.

The analytical laboratory performed the appropriate sample cleanups in an attempt to achieve the lowest possible RLs. When sample extracts were diluted because the concentrations for one or more target analytes exceeded the upper end of the calibration curve, RLs from the original undiluted extract were reported for compounds other than the target analytes that required dilution.

Table 4-10. Detected and non-detected results (in µg/kg ww, except where noted), RLs, and MDLs for human health samples compared to human health ACGs

Chemical	Number of Detected Results	Range of Detected Results	Number of Non-detect Results	Range of RLs	Number of RLs > ACG	Range of MDLs	Number of MDLs > ACG	Human Health ACG
1,4-Dichlorobenzene	0	na	53	57 - 580	53	16 - 160	39	42
2,4,6-Trichlorophenol	0	na	53	120 - 2,900	53	13 - 130	30	97
2,4-Dichlorophenol	0	na	53	120 - 1,200	39	18 - 180	0	250
2,4-Dinitrophenol	0	na	53	1,200 - 12,000	53	33 - 330	3	160
2,4-Dinitrotoluene	0	na	53	290 - 15,000	53	13 - 610	1	160
2,6-Dinitrotoluene	0	na	53	57 - 2,900	50	10 - 100	30	78
2-Chlorophenol	0	na	53	120 - 1,200	39	16 - 160	0	410
3,3'-Dichlorobenzidine	0	na	53	2,900 - 29,000	53	1,200 - 12,000	53	2.3
4,4'-DDD	30	1.3 - 8.5	23	1.5 - 7.2	9	0.93 - 4.7	1	4.2
4,4'-DDE	43	1.0 - 15	10	3.7 - 8.1	10	3.7 - 8.1	10	3.0
4-Chloroaniline	0	na	53	290 - 2,900	39	8.4 - 85	0	330
4-Methylphenol	0	na	53	120 - 5,700	39	22 - 1,100	1	410
4-Nitrophenol	2	530 - 530	51	570 - 15,000	40	11 - 380	0	640
Aldrin	1	1.4 - 1.4	52	1.0 - 7.2	52	0.20 - 3.7	52	0.059
alpha-BHC	3	0.38 - 0.46	50	1.5 - 7.2	50	0.23 - 1.5	50	0.16
alpha-Chlordane	19	0.60 - 3.6	34	1.5 - 7.2	16	0.52 - 3.3	1	2.9
Aniline	0	na	53	1,200 - 12,000	53	330 - 3,300	53	180
Aroclor 1016	0	na	53	10 - 150	5	2.0 - 29	5	15
Aroclor 1221	0	na	53	20 - 290	53	3.1 - 45	53	0.51
Aroclor 1232	0	na	53	10 - 150	53	2.0 - 29	53	0.51
Aroclor 1242	0	na	53	10 - 150	53	3.5 - 50	53	0.51
Aroclor 1248	41	40 - 4,400	12	15 - 15	12	1.1 - 1.1	12	0.51
Arsenic (inorg) (mg/kg ww)	20	0.003 - 0.16	4	0.01 - 0.01	4	0.003 - 0.003	4	0.00069
Benzidine	0	na	53	7,200 - 72,000	53	7,200 - 72,000	53	0.0046

Chemical	Number of Detected Results	Range of Detected Results	Number of Non-detect Results	Range of RLs	Number of RLs > ACG	Range of MDLs	Number of MDLs > ACG	Human Health ACG
Benzo(a)pyrene	24	0.13 - 1.5	29	0.50 - 0.72	29	0.076 - 0.11	0	0.14
beta-BHC	18	1.6 - 15	35	1.5 - 8.2	35	0.30 - 8.2	34	0.59
Bis(2-chloroethyl)ether	0	na	53	57 - 1,200	53	13 - 130	53	0.97
Bis(2-ethylhexyl)phthalate	7	280 - 2,100	46	720 - 7,200	46	76 - 760	46	74
Bis-chloroisopropyl ether	0	na	53	57 - 580	53	16 - 160	53	15
Carbazole	0	na	53	290 - 15,000	53	47 - 2,400	39	51
Dibenzo(a,h)anthracene	4	0.13 - 0.24	49	0.50 - 0.72	49	0.079 - 0.12	0	0.14
Dieldrin	1	1.3 - 1.3	52	1.0 - 7.2	52	0.16 - 7.2	52	0.064
Di-n-octyl phthalate	0	na	53	290 - 2,900	27	19 - 190	0	1,600
Endrin	11	0.89 - 40	42	1.0 - 44	1	0.15 - 44	1	25
gamma-BHC	8	0.59 - 5.1	45	1.0 - 7.2	45	0.28 - 2.8	25	0.78
Heptachlor	1	9.7 - 9.7	52	1.0 - 7.2	52	0.65 - 6.8	52	0.23
Heptachlor epoxide	20	0.93 - 10	33	1.5 - 7.2	33	0.83 - 7.0	33	0.11
Hexachlorobenzene	3	0.93 - 4.1	50	1.5 - 7.2	50	0.49 - 4.3	38	0.64
Hexachlorobutadiene	0	na	53	57 - 580	53	13 - 130	39	13
Hexachloroethane	0	na	53	57 - 580	39	13 - 130	39	74
Nitrobenzene	0	na	53	57 - 580	53	15 - 150	39	43
N-Nitrosodimethylamine	0	na	53	120 - 12,000	53	15 - 150	53	0.021
N-Nitrosodi-N-propylamine	0	na	53	57 - 580	53	12 - 120	53	0.15
N-Nitrosodiphenylamine	0	na	53	57 - 2,900	39	14 - 680	2	210
Pentachlorophenol	3	2,200 - 2,400	50	570 - 5,800	50	45 - 450	50	8.7
Toxaphene	0	na	53	72 - 3,600	53	51 - 3,600	53	0.97

All concentrations, RLs, MDLs, and ACGs are in µg/kg ww, unless otherwise noted

na - not applicable

4.2 BACKGROUND RESULTS

4.2.1 Fish and crab tissue results

Table 4-11 presents a summary of total and inorganic arsenic concentrations in each tissue type for each background area, including the number of detections, the range of detected concentrations, and the range of RLs for nondetected results. A summary of total and inorganic arsenic results for LDW samples of the same tissue type is also included in Table 4-11 for comparative purposes. Data tables containing total and inorganic arsenic results for each background composite sample of each tissue type are presented in Appendix A.

Table 4-11. Concentrations of total and inorganic arsenic in background area and LDW fish and crab composite samples

Tissue Type	West of Blake Island				East Passage				LDW			
	Detection frequency	Concentration (mg/kg ww)			Detection frequency	Concentration (mg/kg ww)			Detection frequency	Concentration (mg/kg ww)		
		Min	Max	Mean		Min	Max	Mean		Min	Max	Mean
Total arsenic												
English sole – whole body	6/6	2.4	5.9	4.1	6/6	2.7	5.2	3.5	21/21	2.230	4.430	3.274
English sole – fillet	6/6	3.98	6.63	5.77	6/6	2.14	5.43	4.02	7/7	3.97	6.89	5.26
Shiner surfperch – whole body	6/6	1.32	1.58	1.41	3/3	1.00	1.30	1.15	24/24	0.715	1.290	0.955
Dungeness crab – edible meat	3/3	6.95	8.80	7.78	3/3	7.31	10.9	8.99	7/7	2.540	6.780	4.210
Dungeness crab – hepatopancreas	1/1	7.66	7.66	7.66	1/1	13.1	13.1	13.1	3/3	3.080	4.140	3.750
Slender crab – edible meat	3/3	10.4	11.3	10.8	3/3	5.4	7.0	6.0	12/12	1.670	3.570	2.612
Slender crab – hepatopancreas	1/1	8.2	8.2	8.2	1/1	2.6	2.6	2.6	4/4	2.230	3.310	2.645
Inorganic arsenic												
English sole – whole body	6/6	0.010	0.030	0.020	6/6	0.007 J	0.020	0.011	7/7	0.020	0.090	0.051
English sole – fillet	2/6	0.002	0.010 U	0.004	1/6	0.003 U	0.004 J	0.003	6/7	0.003	0.006 J	0.004
Shiner surfperch – whole body	6/6	0.010	0.030	0.020	2/3	0.009 J	0.010 J	0.010	8/8	0.020	0.160	0.070
Dungeness crab – edible meat	3/3	0.020	0.030	0.023	3/3	0.010 J	0.010	0.010	2/2	0.010	0.010	0.010
Dungeness crab – hepatopancreas	1/1	0.340	0.340	0.340	1/1	0.080	0.080	0.080	2/2	0.050	0.090	0.070
Slender crab – edible meat	3/3	0.020	0.030	0.023	3/3	0.020	0.040	0.027	4/4	0.030	0.030	0.030
Slender crab – hepatopancreas	1/1	0.270	0.270	0.270	1/1	0.080	0.080	0.080	4/4	0.080	0.330	0.240

na – not applicable

The highest total arsenic concentration in background samples (13.1 mg/kg ww) was detected in a Dungeness crab hepatopancreas composite sample collected from East Passage. The highest inorganic arsenic concentration in background samples (0.340 mg/kg ww) was detected in a Dungeness crab hepatopancreas composite sample collected west of Blake Island.

Table 4-12 presents the range of concentrations of lipids and total solids in each tissue type. Data tables for lipids and total solids for each composite sample of each tissue type are presented in Appendix A. The highest lipid content (14%) was measured in a Dungeness crab hepatopancreas composite sample and the lowest lipid content (0.27%) was measured in a Dungeness crab edible meat composite sample. The highest total solids content (32.8%) was measured in a Dungeness crab hepatopancreas composite sample and the lowest total solids content (7.91%) was measured in a slender crab hepatopancreas composite sample.

Table 4-12. Concentrations of lipids and total solids in background area fish and crab composite samples

Analyte	Number of samples	Minimum Detected Concentration (% ww)	Maximum Detected Concentration (% ww)
Lipids			
English sole – whole body	12	2.9	5.9
English sole – fillet	12	1.6	3.1
shiner surfperch – whole body	9	5.0	9.9
Dungeness crab – edible meat	6	0.27	0.47
Dungeness crab – hepatopancreas	2	6.3	14
slender crab – edible meat	6	0.54	0.79
slender crab – hepatopancreas	2	1.9	2.0
Total solids			
English sole – whole body	12	21.9	25.6
English sole – fillet	12	20.0	22.6
shiner surfperch – whole body	9	26.9	31.5
Dungeness crab – edible meat	6	17.8	21.0
Dungeness crab – hepatopancreas	2	22.2	32.8
slender crab – edible meat	6	18.3	21.3
slender crab – hepatopancreas	2	7.91	13.3

4.2.2 Sediment results

Table 4-13 presents results for arsenic and total solids in composite sediment samples collected from each of the background locations.

Table 4-13. Arsenic and total solids data from the composite sediment sample from each background location

AREA	SAMPLE ID	ARSENIC (mg/kg dw)	TOTAL SOLIDS (% ww)
East Passage	LDW-EP-S1	2.51	77.1
West of Blake Island	LDW-BL-S1	4.38	64.7

4.3 DATA VALIDATION RESULTS

Independent data validation of all results was conducted by Laboratory Data Consultants Inc. The complete data validation report is provided in Appendix D. The following sections summarize the results of the validation, but do not list every sample affected by a qualification in this summary. Detailed information regarding every qualified sample is available in Appendix D.

Two reference area sediment samples were collected as part of the fish and crab study. These samples were analyzed for arsenic and the data validation was conducted in conjunction with the sediment samples collected for the benthic invertebrate study. A summary of the data validation results for these samples is presented in Section 4.3.5.

4.3.1 Overall data quality

The tissue composite samples were analyzed by Columbia in five sample delivery groups (SDGs). LDC conducted a full validation on subsets of three SDGs (K2409443, K2409445 and K2409451). Brooks Rand analyzed one SDG for inorganic arsenic. LDC conducted a full validation on a subset of the Brooks Rand SDG (05BR023). All sample results that were not selected for full validation underwent a summary validation. Table 4-14 provides a summary of the number of samples in each SDG, the analyses performed, and the level of data validation. The percent of samples submitted for full validation for each analysis ranged from 10-20% which is consistent with the QAPP requirement that at least 10% of the samples be submitted for full validation.

Table 4-14. Summary data validations performed for each SDG

SDG	Lab	Validation Level	SVOCs	Low Level PAHs	Pesticides	PCBs	Metals and Mercury	Inorganic Arsenic	Butyltins	Lipid
K2409443	Columbia	summary	na	na	na	na	15[a]	na	na	15
		full	na	na	na	na	5[a]	na	na	5
K2409813	Columbia	summary	na	na	na	na	29[a]	na	na	29
K2409445	Columbia	summary	13	na	17[b]	13	13	na	14	13
		full	11	na	15	11	11	na	11	11
K2409451	Columbia	summary	56	45	74[b]	53	53	na	53	53
		full	nr	9	nr	nr	nr	na	nr	nr
K2409809	Columbia	summary	31	na	32[b]	31	31	na	31	31
05BR0023	Brooks Rand	summary	na	na	na	na	na	78	na	na
		full	na	na	na	na	na	9	na	na
Percent data submitted for full validation			10%	20%	11%	11%	10%	10%	10%	10%

a Only arsenic was analyzed

b In addition to the summary validation, additional review of the target compound identifications was conducted in order to identify results that may have been affected by PCB interferences

na – not analyzed

nr – not reviewed

The majority of the data were either not qualified or had "J" (estimate) qualifiers added; however, a few non-detected results were rejected as a result of the validation review. Specifically, low recoveries in the laboratory control samples for benzidine resulted in the rejection of all the nondetected benzidine results (note that because benzidine was never detected, all of the benzidine results were rejected). In addition, zero percent recoveries in the laboratory control sample for 2,4-dinitrophenol in SDGs K2409445 and K2409451 resulted in the rejection of the non-detected results for those compounds in these SDGs. These compounds are known to have poor recoveries when analyzed by EPA method 8270C. In addition, low surrogate recoveries resulted in the rejection of non-detected results for butyltins in one sample (LDW-T2-M-ES-WB-comp 1).

Based on the information reviewed, the overall data quality was considered acceptable for use in the RI as qualified. The results of the validation are summarized below by analyte group.

4.3.2 Sample transport and holding times

All analyses of the tissue samples were conducted within the maximum holding times, with one exception. LDW-T3-SS-WB was analyzed for SVOCs 42 days after extraction, which exceeds the 40-day holding time. All of the SVOC results for this sample were J-qualifed as a result. The chain-of-custody documents were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria for the shipment of individual fish to Axys as well as the shipment of composited tissue samples from Axys to CAS and Brooks Rand.

4.3.3 SVOCs (including PAHs)

4.3.3.1 Calibration

The initial calibration was conducted correctly. All response factors and system performance check compounds were adequate. Continuing calibration was conducted at the required frequencies. The only compounds with percent differences higher than 25% in the continuing calibration results relative to the initial calibration results (National Functional Guidelines criteria) were pentachlorophenol, hexachlorocyclopentadiene, and benzidine. The results for these compounds for samples in SDG K2409445 were qualified as estimated (J qualifier).

4.3.3.2 Blanks

Six method blanks were found to contain SVOCs. All six of the blanks contained di-n-butylphthalate. Dimethylphthalate and bis(2-ethylhexyl)phthalate were each detected in two blanks. Diethylphthalate and 4-nitrophenol were detected in one blank. Sample concentrations were compared to the concentrations detected in the method blanks. Detected concentrations that were less than ten times the blank concentration were qualified as non-detected with elevated reporting limits as a result of blank contamination. The number of samples in each SDG qualified as a result of phthalate contamination in method blanks is summarized in Table 4-15.

Table 4-15. Number of composite samples in each SDG qualified as a result of blank contamination

ANALYTE	SDG K2409445	SDG K2409451	SDG K2409809
Bis(2-ethylhexyl)phthalate	0	2	0
Diethylphthalate	4	0	0
Dimethylphthalate	0	3	0
Di-n-butylphthalate	1	5	12
Di-n-butylphthalate and diethylphthalate	15	0	0
Di-n-butylphthalate and bis(2-ethylhexyl)phthalate	0	3	0

Five method blanks associated with two SDGs (K2409451 and K2409809) contained PAHs. Two blanks contained three PAH compounds, one blank contained four PAH compounds, one blank contained eight PAH compounds, and one blank contained nine PAH compounds.

Sample concentrations of PAHs were compared to the concentrations detected in the method blanks. Detected concentrations that were less than five times the blank concentration for other contaminants were qualified as non-detected with elevated reporting limits as a result of blank contamination. The following composite samples from SDG K2409451 were qualified based on PAH blank contamination: 24 shiner surfperch whole body, 3 English sole whole body, 1 English sole fillet, 12 slender crab edible meat, 4 slender crab hepatopancreas, 1 Dungeness crab edible meat, and two Dungeness crab hepatopancreas composite samples. Naphthalene, 2-methyl naphthalene, phenanthrene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene were the most commonly qualified PAHs in this SDG. Composite samples from SDG K2409809 that were qualified as a result of PAH blank contamination included six English sole fillet, one pile perch fillet, one striped perch fillet, three starry flounder whole body and one fillet, six Dungeness crab edible meat, and one Dungeness crab hepatopancreas composite sample. Naphthalene, 2-methyl naphthalene, and phenanthrene were the most commonly qualified PAHs in this SDG. The detected phenanthrene concentration in one Pacific staghorn sculpin sample from SDG K2409445 was qualified based on blank contamination.

4.3.3.3 Surrogate recovery

Surrogates were added to all samples and blanks as required by the method. All surrogate recoveries were within QC limits.

4.3.3.4 Matrix spike

The laboratory mistakenly believed that insufficient material was available for matrix spike analyses in all SDGs. Therefore, MS/MSDs were not analyzed. MS/MSD samples are currently being analyzed, and the data will be provided in the fish and crab tissue data addendum.

4.3.3.5 Laboratory control samples and standard reference material

LCSs were run at the required frequency. The following recoveries and relative percent differences (RPDs) were outside of the specified QC limits of 20-130%. Percent recovery of benzoic acid exceeded the QC limits for SDG K2409445, resulting in J qualification of all detected values. Benzidine recoveries were below the QC limits for all the samples, with recoveries ranging from 0–3%, resulting in the rejection of all non-detected results for benzidine. All the benzidine results were non-detected; therefore, all the benzidine results were rejected. In addition, 2,4-dinitrophenol was reported to have 0% recovery for 21 samples associated with SDGs K2409445 and K2409451. The detected 2,4-dinitrophenol concentrations in these samples were J-qualified and the non-detected results were rejected. Laboratories commonly report difficulties analyzing these compounds by the SVOC method. PAH SRMs were run at the required frequency and the SRM results for PAHs were within QC limits.

4.3.3.6 Internal standards

All internal standard areas and retention times were within QC limits, with the following exceptions. Two samples (LDW-T3-D-SS-WP-comp1 and LDW-T3-E-SS-WB-comp1) had low internal standard areas associated with acenaphthene-d10. As a result, the detected results were J-qualified and the nondetected results for the SVOC analytes associated with the acenaphthene-d10 internal standard were rejected.

4.3.3.7 Compound quantification

One sample result for n-nitrosodiphenylamine was J-qualified because the sample result exceeded the calibration range (LDW-T3-D-SS-WB-comp 1).

4.3.4 PCBs and pesticides

4.3.4.1 Calibration

Initial and continuing calibrations were conducted as required by the methods. The percent relative standard deviations (RSDs) were less than or equal to 20% for all compounds, and retention times of all compounds were within QC limits. The percent differences (%D) calculated for the continuing calibrations were higher than 15% for four DDT isomers, dieldrin, and hexachlorobenzene standards associated with SDG K2409445. Thus six Pacific staghorn sculpin whole-body composite samples were J-qualified for 2,4′ DDE, 2,4′ DDD, and 4,4′ DDD concentrations; three Pacific staghorn sculpin whole-body composite samples were J-qualified for 2,4′ DDE, 2,4′ DDD, and dieldrin; and two Pacific staghorn sculpin whole-body composite samples were J-qualified for 4,4′ DDE and hexachlorobenzene.

4.3.4.2 Blanks

PCBs were not detected in the PCB method blanks. Four pesticide method blanks were found to contain methoxychlor at concentrations ranging from 0.84-5.3 µg/kg ww. The detected methoxychlor concentration in one sample (LDW-T4-D-SS-WB-comp 1) was U qualified as a result.

4.3.4.3 Surrogate recovery

Surrogates were added to all samples and blanks as required by the method. All surrogate recoveries were within QC limits.

4.3.4.4 Matrix spike

The laboratory mistakenly believed that insufficient material available for matrix spike analyses in all SDGs. Therefore, MS/MSDs were not analyzed. MS/MSD samples are currently being analyzed, and the data will be provided in the fish and crab tissue data addendum.

4.3.4.5 Laboratory control samples and standard reference materials

The laboratory control sample/laboratory control sample duplicate (LCS/LCSD) results for the PCB analyses were within QC limits. For pesticides, the LCS/LCSD results were within QC limits for all analyses except the relative percent difference reported for beta-BHC associated with SDG K2409451. The elevated RPD for these samples resulted in J qualification of all detected and non-detected results.

The SRM results for pesticides were within QC limits except for SRM results associated with three SDGs. SDG K2409445 had two SRMs with beta-BHC concentrations below the certified value, which resulted in J qualifiers for both detected and non-detected results for this compound in this SDG. SDG K2409415 had 5 SRM samples associated with it. There were three SRMs in which mirex concentrations were below the certified value. Two SRMs had delta-BHC and beta-BHC results higher than the certified value. In addition, one SRM result for 2,4′-DDT was less than the certified value. All of these results resulted in J qualification for the analytes in the samples associated with the specific SRMs. SDG K2409809 had two SRMs associated with it. The delta-BHC concentrations exceeded the certified value and the beta-BHC concentrations were below the certified value in both SRMs. One SRM also had reported 2,4′-DDD, 2,4′-DDT and 4,4′-DDT concentrations that were higher than the certified values for these compounds. All of these results resulted in J qualification for the analytes in the samples associated with the specific SRMs.

4.3.4.6 Compound quantification

All PCB compound identification and quantification parameters were within validation criteria. The results for Aroclor 1248 in six samples were higher than 40%

RPD between the two analytical columns. The results for Aroclor 1254 in 12 samples were higher than 40% RPD between the two analytical columns. The result for Aroclor 1260 in one sample was higher than 40% RPD between the two analytical columns. The results associated with higher than 40% RPD were qualified as estimated (J-qualified).

Aroclor standards were run as interference check samples for the pesticide analysis, and based on this analysis, all detected pesticides were JN-qualified in SDG K2409445 because of potential interference from PCBs. The JN qualifier indicates that the result is likely affected by the presence of interfering compounds. Target compound identification data were reviewed for SDGs submitted for summary validation, and as a result all the detected pesticide results were JN-qualified because of interference likely associated with the presence of PCBs in the samples.One hundred thirty-five samples contained detected pesticides for which the results for the two analytical columns were higher than 40% RPD. Therefore, the results associated with RPDs higher then 40% were J-qualified.

4.3.5 Metals (including mercury and inorganic arsenic)

The summary presented here includes the results of the tissue analyses as well as the two sediment samples that were analyzed for total arsenic only.

4.3.5.1 Calibration

The initial calibration was performed and the frequency and analysis criteria of the initial calibration verification and continuing calibration verification were met.

4.3.5.2 Blanks

Method blanks were reviewed. Selenium and nickel were detected in two blanks. Arsenic was detected in one blank. One nickel concentration (LDW-T2-B-PS-WB-comp 1) was qualified as non-detected with an elevated reporting limit as a result of blank contamination. Selenium and arsenic detections in blanks did not result in any data qualifications.

4.3.5.3 Matrix spike

MS and MSD results were reviewed. Percent recoveries and relative percent differences were within QC limits except for the percent recovery reported for silver in a MS associated with K2409809, which was less than the QC limit. The silver concentrations in 11 samples were J-qualified as a result.

The MS results for the inorganic arsenic results associated with SDG BR0023 were below the QC limits for seven samples. Therefore, the sample results associated with these results were flagged as estimated and potentially biased low (J-). The MS recovery was 71.8% compared to the QC limits of 75-125%.

4.3.5.4 Laboratory control samples

The percent recoveries and RPDs for metals were within QC limits, except for nickel in two LCS samples associated with SDG K2409451, which was reported at concentrations above the QC limits. All detected nickel concentrations in samples associated with the LCS samples were qualified as J+ for a potential high bias.

4.3.5.5 Sample result verification

All sample result verifications met validation criteria.

4.3.6 Butyltins

4.3.6.1 Calibration

Initial calibration was performed as required by the method. Calibration verification was performed and all aspects of the calibration were within QC limits.

4.3.6.2 Blanks

No butyltin compounds were detected in the method blanks.

4.3.6.3 Surrogate Recovery

All surrogate recoveries were within QC limits except for three English sole whole body samples in SDG K24-9451. The recoveries of tri-n-propyltin in these samples were less than the QC limits (20-130%). As a result, all of the detected results for butyltins in these samples were J-qualified. The non-detected results in two samples with percent recoveries of 16% were J-qualified and the non-detected results in sample LDW-T2-M-ES-WB-comp-1 were rejected due to a percent recovery of 7%.

4.3.6.4 Matrix spike

The laboratory mistakenly believed that insufficient material was available for matrix spike analyses in all SDGs. Therefore, MS/MSDs were not analyzed. MS/MSD samples are currently being analyzed, and the data will be provided in the fish and crab tissue data addendum.

4.3.6.5 Standard reference materials and laboratory control samples

The SRM results were within QC limits. However, two LCS samples associated with SDG K2409451 and K2409809 reported recoveries of monobutyltin that were below the QC limits. The recoveries ranged from 15-19%, compared to the QC limit of 20-30%. All n-butyltin concentrations in these SDGs were J-qualified as a result.

4.3.6.6 Compound quantification

The results for di-n-butyltin in two samples, tri-n-butyltin in two samples, and both di-n-butyltin and tri-n-butyltin in one sample exceeded the 40% RPD allowed between the two analytical columns. All detected concentrations in these samples were qualified as estimated (J-qualified).

5.0 References

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