

Table ESI-1 Sediment PAHs concentrations ($\mu\text{g}/\text{kg}$, except THC mg/kg) in Milford Haven, 18 – 22 October 1993 (MHWESG survey; Levell³⁰)

Site	Location	Latitude, Longitude	% < 63 μm	Naphthalene	C1-N	C2-N	C3-N	Phenanthrene	Anthracene	C1-P	Fluoranthene	Pyrene
1	Black Hill	N51.778°, W4.9443°	38.81	< 70	58.3	199	303	457	107	246	< 400	288
2	Hook Bight	N51.768°, W4.9349°	28.21	< 86	25	31	< 48	643	312	211	880	654
3	Underwood Quay	N51.7722°, W4.9146°	3.47	< 57	16.9	< 24	< 7	38.4	< 23	11.8	46.5	39.7
5	Picton Point	N51.7649°, W4.8945°	18.85	< 26	12.2	< 5	< 5	67.2	< 34	32.1	88.2	74.6
7	off Rigan Pill	N51.7733°, W4.8736°	50.41	< 26	< 21	16	< 18	116	< 42	34.4	164	132
9	Crafty Wood Fort	N51.7825°, W4.8655°	34.92	< 10	8.65	< 5	< 5	41.8	11.6	13.1	66.8	51.9
11	off Landshipping Quay	N51.7616°, W4.8918°	53.77	< 18	< 13	11.4	< 15	56.3	< 51	27.5	106	91.6
12	Knap Wood	N51.753°, W4.8983°	26.41	< 56	43.1	< 17	< 19	276	97.9	85.1	343	252
14	off Llangwm Pill	N51.7447°, W4.8975°	59.15	40.2	16.8	< 5	< 5	30.7	< 11	11	35.6	32.6
17	Garron Pill	N51.7338°, W4.8832°	27.7	< 180	87.3	< 26	< 18	314	< 165	126	290	210
19	Jenkins Point	N51.7183°, W4.8849°	45.65	171	164	45.7	< 45	< 165	< 56	94.7	81.8	70.7
30	downstream Lawrenny	N51.7165°, W4.8923°	22.97	< 19	31.1	< 11	< 8	67.8	< 41	28	99.5	85.6
35	Cosheston Point	N51.7014°, W4.9182°	44.33	< 720	366	< 48	< 37	464	146	149	206	161
38	Cosheston Pill	N51.6973°, W4.9191°	82.42	< 180	< 150	63.4	< 40	487	185	176	427	340
44	Neyland Bridge	N51.7086°, W4.9357°	50.62	< 1400	953	< 150	< 105	839	< 280	352	314	253
47	off Hobbs Point	N51.7003°, W4.9455°	1.83	78.7	55.3	21.7	< 17	138	< 39	32.3	106	97.8
48	off Llanstadwell	N51.7011°, W4.9614°	0.83	142	41.8	< 15	< 12	159	< 60	43.7	167	161
50	off Hazelbeach	N51.6982°, W4.9661°	36.99	< 90	66.3	< 19	< 27	231	< 68	84	138	124
52	off Llanreath	N51.6959°, W4.9707°	36.68	90.9	< 75	29.9	< 21	170	48	55.6	178	153
56	Pembroke River	N51.6846°, W4.9748°	64.51	417	121	< 52	< 44	310	102	125	196	160
61	off Pennar	N51.6791°, W4.9531°	61.7	194	< 160	48.5	< 28	270	< 90	112	306	252
64	Mid-channel off Gulf	N51.6953°, W4.9964°	95.48	< 63	47.9	36.7	< 41	370	109	80	< 221	172
67	off Mine Depot jetty	N51.7006°, W5.0142°	54.85	< 80	52.7	32.4	< 42	282	81.7	100	< 191	169
69	off Texaco jetty	N51.7009°, W5.027°	58.42	< 60	< 60	< 26	31.1	174	75.6	60.6	183	150
72	off Hakin Point	N51.7051°, W5.0377°	41.86	< 51	< 51	< 31	42.8	128	34.5	56	< 98	81.5
74	Texaco to Elf jetties	N51.6988°, W5.0515°	57.66	219	219	< 54	60.7	517	110	121	387	299

Site	Location	Latitude, Longitude	% < 63 µm	Naphth- alene	C1-N	C2-N	C3-N	Phenan- threne	Anthra- cene	C1-P	Fluoran- thene	Pyrene
78	off Angle point	N51.6943°, W5.0694°	20.09	< 40	< 40	15.9	< 26	68.3	29.8	17.7	32	26.6
80	Angle Bay	N51.6994°, W5.0612°	27.17	< 32	< 32	12.1	< 9	73.6	18.2	25.2	52.6	40.8
85	Mid-channel Angle Pen.	N51.6967°, W.0865°	18.32	< 48	< 48	< 20	< 23	149	58	57	177	205
87	off West Pill	N51.6971°, W5.1009°	10.82	< 25	< 25	< 15	< 13	108	24.8	25.4	79	67.4
93	Dale Roads	N51.7082°, W5.1549°	35.42	< 22	< 22	< 14	< 13	66.9	16.2	23.3	60.5	46.3
95	Dale Pt. to Thorn Pt.	N51.6973°, W5.1384°	25.81	< 28	< 28	< 21	< 17	64.6	< 17	26.2	< 51	39.7
96	Castlebeach Bay	N51.6996°, W5.1528°	29.4	59.7	59.7	17.1	< 20	75.9	18.4	29.2	< 56	44.5
103	off St. Ann's Head	N51.6776°, W5.1636°	25.19	< 6	< 6	< 5	< 5	6.44	6.01	< 5	< 7	< 6

Table ESI-1 Continued

Site	Location	B[a]A	Chrysene	"2,3BA"	B[b]F	B[jk]F	B[e]P	B[a]P	Perylene	I[123-cd]P	B[ghi]P	ΣPAH	THC
1	Black Hill	258	194	< 535	839	361	< 556	530	214	< 421	482	4536	503
2	Hook Bight	335	393	< 800	748	305	446	611	192	< 340	354	6140	283
3	Underwood Quay	22	16.9	< 25	< 24	< 8	14.4	11	< 7	< 10	< 11	218	42
5	Picton Point	53.7	49.4	< 120	373	121	222	238	< 92	511	695	2537	72
7	off Rigan Pill	94	108	< 260	1624	< 410	896	997	375	1608	2428	8592	178
9	Crafty Wood Fort	36.2	< 36	< 65	< 190	37.4	100	93.4	< 43	< 290	< 410	461	60
11	off Landshipping Quay	59.6	58.3	< 140	59.8	18.7	< 33	38.8	< 14	< 110	101	629	46
12	Knap Wood	174	173	< 370	188	56	107	131	< 48	< 510	690	2616	129
14	off Llangwm Pill	24.1	17.5	< 46	31.5	< 11	19.6	< 17	< 10	< 44	< 38	260	46
17	Garron Pill	197	184	< 490	643	< 395	364	< 415	< 140	191	< 370	2606	178
19	Jenkins Point	50.9	47.6	< 105	< 315	83.7	183	191	74.7	< 630	918	2177	181
30	downstream of Lawrenny	61.1	57.7	< 160	204	66.9	112	122	< 54	< 460	617	1553	121
35	Cosheston Point	113	120	< 305	330	113	200	226	< 93	< 720	1035	3629	1228
38	Cosheston Pill	242	237	< 550	782	215	435	489	185	< 1470	2234	6497	449
44	Neyland Bridge	187	160	< 320	< 590	227	392	380	170	< 1400	2202	6429	360
47	off Hobbs Point	63.1	57.5	< 150	79.5	25.2	47.6	45.3	< 16	121	128	1097	107

Site	Location	B[a]A	Chrysene	"2,3BA"	B[b]F	B[j/k]F	B[e]P	B[a]P	Perylene	I[123-cd]P	B[ghi]P	∑PAH	THC
48	off Llanstadwell	94.8	88.6	< 270	177	62.4	109	128	< 46	< 340	412	1786	121
50	off Hazelbeach	82.1	80.7	< 225	125	37.2	74.3	77.2	29.7	< 380	484	1634	177
52	off Llanreath	121	91.6	< 300	-	-	-	-	-	-	-	938	266
56	Pembroke River	122	110	< 200	629	166	398	366	< 170	< 1350	2020	5242	374
61	off Pennar	199	175	< 420	704	171	< 390	414	152	< 1130	1694	4692	
64	Mid-channel to Pwllcrochan	132	110	< 340	< 310	108	218	211	74.2	< 160	< 180	1669	205
67	off Mine Depot jetty	120	84.5	< 305	215	75.3	133	127	< 46	< 117	134	1607	314
69	off Texaco jetty	130	99.3	< 270	641	199	408	368	< 140	< 310	348	2868	245
72	off Hakin Point	67.6	47.2	< 108	< 310	< 107	< 202	144	< 163	< 160	187	789	159
74	Texaco to Elf jetties	218	175	< 218	1911	864	1287	1224	< 427	< 960	1072	8684	306
78	off Angle point	19.8	14.4	< 34	< 25	< 12	< 17	11.6	< 7.1	< 10.6	< 15.2	236	81
80	Angle Bay	31.6	23.8	< 59	< 43	< 20	< 31	24.2	< 10	< 22	27.4	330	63
85	Mid-channel Angle Pen.	94.2	75.5	< 200	< 115	39.7	72.3	70.5	< 26	< 55	< 62	998	141
87	off West Pill	46.5	33.4	< 105	< 53	21.8	35.7	32.5	< 12	< 25	27	502	65
93	Dale Roads	39.5	25.8	< 54	< 47	< 21	32.6	24.9	9.44	< 24	28.3	374	63
95	Dale Pt. to Thorn Pt.	33.4	24.9	< 69	< 49	< 23	33.5	28.2	10	< 24	27.1	288	64
96	Castlebeach Bay	37.8	30.4	< 80	< 55	< 26	37.5	33.1	< 12	< 30	35.6	479	171
103	off St. Ann's Head	< 5	< 5	< 8	< 5	< 5	< 5	< 5	< 5	< 5	< 5	12	4

[Source: Milford Haven Waterway Environmental Surveillance Group (MHWESG) 1993 survey; Level³⁰]

Table ESI-2 Sediment PAHs concentrations ($\mu\text{g}/\text{kg}$, except THC mg/kg) in Milford Haven, 14 October - 8 November 1996 (SEEEC survey; Levell³⁰)

Site	Location	% < 63 μm	Naphthalene	C1-N	C2-N	C3-N	Phenanthrene	Anthracene	C1-P	Fluoranthene	Pyrene	B[a]A
1	Black Hill	23.44	109	39.9	25.7	39.2	311	171	145	940	611	870
2	Hook Bight	70.14	40.5	24.6	66.8	121	1049	663	416	1990	1412	1027
3	Underwood Quay	32.1	19	11.3	9.5	15.7	285	86.4	56.3	511	< 262	431
5	Picton Point	5.51	< 8	5.42	< 5	5.59	46	20.4	15	80.2	69.8	46.4
7	off Rigan Pill	64.76	9.75	7.13	< 5	6.23	134	32.3	23.6	198	148	99
9	Crafty Wood Fort	22.3	< 10	9.2	5.16	5.12	76.1	24	19.3	120	96	70
11	off Landshipping Quay	7.42	19.1	10.1	7.44	13.4	171	97.9	57.6	334	261	319
12	Knap Wood	38.03	7.11	8.27	< 5	< 5	30.4	< 5	5.41	18.1	18.1	7.12
14	off Llangwm Pill	31.59	< 5	< 5	< 5	< 5	14.9	< 5	< 5	24.2	22.3	14.2
16	Beggars Reach	21.55	10.8	8.93	< 5	< 5	23.6	8.23	8.23	54.4	53.2	37.3
17	Garron Pill	53.58	17	11.8	< 5	5.52	49.4	13.4	15.3	92.9	77.4	67.8
19	Jenkins Point	39.19	48.4	75.2	50.6	113	535	98.4	156	445	364	272
23	Black Mixen Pool	48.07	-	-	-	-	-	-	-	420	341	369
30	downstream of Lawrenny	14.84	< 8.5	< 5	< 5	< 5	22.2	< 5	< 5	< 7	6.01	< 5
35	Cosheston Point	32.59	28.1	24.3	18.6	25	< 495	149	96.2	434	< 360	223
38	Cosheston Pill	74.93	83	79.3	43.6	39.2	305	54.3	73.3	327	263	229
44	Neyland Bridge	46.89	< 71	469	806	1001	< 9217	1716	2548	106	88.3	77.4
47	off Hobbs Point	24.79	< 37	28.5	26.9	30.2	382	173	81.6	656	544	267
48	off Llanstadwell	40.32	< 49	44	20.2	23.2	264	91.3	85.3	283	326	183
50	off Hazel Beach	67.52	42.9	49.2	24.3	14.3	110	< 28	34.7	94.6	119	114
52	off Llanreath	48.54	< 30	28.5	18.9	13.2	205	48.9	48.7	224	182	157
56	Pembroke River	88.77	< 9	8.58	6.34	< 5	15.3	< 5	6.73	7.14	6.54	8.95
61	off Pennar	62.52	< 38	43.7	21.4	14.9	189	< 37	48.6	286	247	195
64	Mid-channel to Pwllcrochan	6.72	< 27	27.3	13.5	8.5	79.7	21.8	24.9	87.7	111	90.3
67	off mine depot jetty	39.9	< 24	30.7	12.8	10.8	139	< 44	50.8	138	188	80.6
69	off Texaco jetty	73.11	< 43	53.2	21	20.6	375	93.2	127	540	< 425	320

Site	Location	% < 63 µm	Naphth- alene	C1-N	C2-N	C3-N	Phenan- threne	Anthra- cene	C1-P	Fluoran- thene	Pyrene	B[a]A
72	off Hakin Point	66.3	< 47	58	28.8	26.5	224	41.9	57.7	258	200	144
74	between Texaco & Elf jetties	83.14	< 39	47.6	16.9	12.9	171	39.2	46.8	112	160	81
78	off Angle point	85.67	< 19	23.5	7.12	6.72	50	< 11	19.4	34.8	30.7	26.9
80	Angle Bay	69.96	< 67	93.4	34.8	34	288	73.4	72.8	290	< 240	173
85	Mid-channel Angle Peninsula	54.1	< 37	52.4	18	18.5	162	41.8	55	153	< 87	85.6
87	off West Pill	20.81	< 23	27.3	9.8	8	108	15	32.4	67.9	111	65.3
93	Dale Roads	45.39	< 22	29.4	11.2	12	72.2	17.9	27.2	38	< 33	33.4
95	between Dale Point & Thorn Pt.	29.62	< 20	28.7	10.5	10.8	< 51	8.5	16.8	37.3	34.4	37.1
96	Castle Beach Bay	21.07	< 10	12	< 5	< 5	41.1	12.4	12.3	33.4	26.4	22.6
103	off St. Ann's Head	0.48	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Table ESI-2 Continued

Site	Location	Chrysene	"2,3BA"	B[b]F	B[jk]F	B[e]P	B[a]P	Perylene	I[123-cd]P	B[ghi]P	ΣPAH	THC
1	Black Hill	647	< 675	< 301	352	< 650	< 262	288	372	342	5263	641
2	Hook Bight	1122	< 6185	229	116	141	190	57.4	101	97.2	8864	753
3	Underwood Quay	393	< 330	1544	650	< 1020	976	457	584	571	6600	190
5	Picton Point	40.8	< 50	45.4	12.4	< 30	21.6	10.4	12.2	11.4	443	21
7	off Rigan Pill	89.1	< 130	1803	696	< 1225	979	525	611	609	5970	155
9	Crafty Wood Fort	65.3	< 92	< 2020	777	< 1410	1060	591	637	664	4219	78
11	off Landshipping Quay	251	< 235	323	99.5	< 200	< 222	< 73	106	92.4	2162	86
12	Knap Wood	< 5	< 25	< 9	< 5	< 6	< 5	< 5	< 5	< 5	95	12
14	off Llangwm Pill	11	< 25	< 30	8.57	< 21	13.2	7.77	10	10.4	137	24
16	Beggars Reach	29.5	< 42	< 170	41.7	113	85.9	43.6	70.2	63.8	652	76
17	Garron Pill	54.3	< 73	1135	340	781	568	285	474	457	4445	237
19	Jenkins Point	239	-	369	118	< 260	254	95	171	146	3550	1340
23	Black Mixen Pool	281	-	1192	435	893	664	< 380	543	608	5746	713
30	downstream of Lawrenny	< 5	-	< 12	< 5	< 11	7.59	< 8	< 5	< 5	36	13.2

Site	Location	Chrysene	"2,3BA"	B[b]F	B[jk]F	B[e]P	B[a]P	Perylene	I[123-cd]P	B[ghi]P	ΣPAH	THC
35	Cosheston Point	218	-	292	104	194	228	< 82	134	108	2276	388
38	Cosheston Pill	183	-	462	132	< 321	279	120	232	199	3104	900
44	Neyland Bridge	60.9	-	171	58.1	< 130	118	< 56	99.2	84.5	7403	330
47	off Hobbs Point	291	-	426	141	< 285	343	139	208	185	3922	215
48	off Llanstadwell	174	-	292	87.5	< 195	203	75.4	126	109	2387	292
50	off Hazel Beach	64.5	< 671	614	148	460	315	197	< 59	319	2721	531
52	off Llanreath	142	< 1030	63.8	21.7	43.6	47.1	257	40.3	417	1959	352
56	Pembroke River	< 5	< 25	59.2	8.9	< 62	22.3	58	33.3	34.3	276	41
61	off Pennar	179	< 1200	108	399	827	70.4	404	73.2	64.2	3170	365
64	Mid-channel to Pwllcrochan	59.8	< 651	716	236	533	420	253	313	287	3283	215
67	off mine depot jetty	80.5	< 820	62.2	300	633	504	297	414	496	3437	174
69	off Texaco jetty	297	< 1920	167	624	1226	120	616	93	881	5574	347
72	off Hakin Point	124	< 810	752	269	566	418	269	36.4	36.5	3510	289
74	between Texaco & Elf jetties	68.5	< 840	77.9	380	926	682	496	47.4	37.9	3403	282
78	off Angle point	23.1	< 240	557	191	439	305	195	16.7	334	2260	168
80	Angle Bay	127	459	< 125	311	679	498	280	< 93	83.3	3497	1150
85	Mid-channel Angle Peninsula	64.4	< 810	61.9	263	40.8	< 38	13.3	< 42	34.4	1064	358
87	off West Pill	41.3	< 292	216	66.7	170	146	59.4	126	128	1398	58
93	Dale Roads	24.2	< 250	24.8	153	20.6	< 17	< 6.5	< 17	< 13	464	225
95	between Dale Point & Thorn Pt.	25.4	< 78	181	45.7	136	90.9	47.4	< 16	< 15	711	342
96	Castle Beach Bay	19.1	< 185	151	31.6	99.3	80.5	39.3	97.7	87.4	766	53
103	off St. Ann's Head	< 5	< 25	< 5	< 5	< 5	< 5	< 5	< 5	< 5	0	3.4

[Note: Station positions as given in Table ESI-1; Source: *Sea Empress* Environmental Evaluation Committee (SEEEC) 1996 survey; Level³⁰]

Table ESI-3 Sediment contaminants at 15 intertidal stations (EU Habitats Directive) in Milford Haven, October 2007 (See Table 1 for stations and positions)

Analyte, dry mass	Units	ISQG -TEL	PEL	1 SHU	2 SHL	3 AH	4 AB	5 PRU	6 PRL	7 CPU	8 CPL	9 CARL	11 CRRU	12 CRRL	13 WCL	14 WCU	15 ECL	16 ECU
Organic Carbon	%			<0.4	<0.40	1.40	<0.40	1.26	1.00	1.04	1.03	1.11	1.90	2.16	2.22	2.28	1.10	2.04
Mercury	mg/kg	0.13	0.7	0.006	0.008	0.192	0.02	0.14	0.126	0.144	0.102	0.243	0.152	0.124	0.114	0.172	0.083	0.18
Cadmium	mg/kg	0.7	4.2	0.025	<0.01	0.200	0.080	0.171	0.172	0.200	0.173	0.404	0.358	0.313	0.341	0.529	0.206	0.454
Chromium	mg/kg	52.3	160	9.91	8.93	50.2	21.4	48.3	42.5	35.4	39.2	66.7	47.6	50.7	47.5	75.8	32.6	63.0
Copper	mg/kg	18.7	108	4.93	8.15	28.3	5.54	23.3	22.3	19.9	19.5	38.1	59.6	26.4	25.1	49.8	15.8	32.2
Lead	mg/kg	30.2	112	4.13	5.11	48.9	10.3	36.1	36.6	37.4	34.5	66.7	38.0	39.9	33.7	50.4	24.4	41.4
Zinc	mg/kg	124	271	23.0	26.1	149	46.5	116	118	119	126	220	151	150	143	209	114	189
Acenaphthene	µg/kg	6.71	88.9	<10	<10.0	105	21.9	38.9	69.4	61.4	93.1	72.3	123	125	26.3	80.4	74.0	100
Acenaphthylene	µg/kg	5.87	128	<10	52.6	381	202	221	217	330	398	226	353	378	90.5	439	310	292
Anthracene	µg/kg	46.9	245	<10	10.6	138	65.6	69.8	122	143	193	132	177	214	39.4	151	137	145
B[a]anthracene	µg/kg	74.8	693	9.11	81.0	575	211	281	455	498	626	430	804	890	196	663	642	620
B[a]pyrene	µg/kg	88.8	763	8.44	56.8	620	192	298	479	573	624	472	878	938	211	699	616	615
B[b]anthracene	µg/kg			<10	<10.0	<22.6	<10.0	27.3	<20.0	<10.0	<40.6	<14.1	<16.4	<15.7	<10	<11.5	<10	620
B[b]fluoranthene	µg/kg			12.6	99.3	763	208	386	582	682	726	614	1090	1050	267	921	700	793
B[e]pyrene	µg/kg			<10	91.0	636	155	318	494	538	575	458	860	851	202	715	524	608
B[ghi]perylene	µg/kg			<10	75.6	531	111	269	410	464	485	400	719	718	171	620	405	498
B[j]fluoranthene	µg/kg			<10	47.9	283	82.0	171	268	306	316	241	388	323	93.6	322	254	280
B[k]fluoranthene	µg/kg			<10	52.2	397	104	190	309	287	368	282	510	494	123	426	324	367
Chrysene	µg/kg	108	846	11.0	103	733	224	341	545	584	701	497	999	1050	236	790	671	709
Dibenzo[ah]anthracene	µg/kg	6.22	135	<10	17.0	143	36.0	71.4	112	130	142	114	210	209	53.6	184	131	155
Dibenzothiophene C1	µg/kg			<10	<18.4	224	65.6	110	150	181	212	144	200	206	46.5	178	96.3	135
Dibenzothiophene C2	µg/kg			14.6	43.9	343	92.0	210	254	299	328	248	345	356	86.5	323	173	232
Dibenzothiophene	µg/kg			<10	<10.0	107	36.3	43.4	65.7	74.6	96.6	74.5	106	106	24.0	89.7	57.2	76.8
Dibenzothiophene C3	µg/kg			12.0	47.3	265	61.5	215	246	255	302	216	310	294	69.2	284	145	206
Fluoranthene	µg/kg	113	1494	17.6	111	1020	514	431	750	828	1090	789	1470	1740	342	1180	1070	1120
Fluorene	µg/kg	21.2	144	<10	15.0	352	76.5	128	176	187	304	195	304	279	62.1	257	154	235
Indeno[123-cd]Pyrene	µg/kg			<10	88.6	705	160	348	534	628	660	541	963	959	232	817	561	677
Naphthalene	µg/kg	34.6	391	52.3	86.0	556	124	239	333	411	502	334	517	428	116	523	235	401
Naphthalenes C1	µg/kg			17.7	29.6	585	91.0	231	349	390	623	286	390	354	96.8	339	151	252
Naphthalenes C3	µg/kg			<10	<10.0	851	177	344	<10.0	529	663	449	722	659	168	771	265	573
Perylene	µg/kg			<10	23.3	198	46.7	107	157	172	215	172	307	326	84.6	308	205	234

Analyte, dry mass	Units	ISQG -TEL	PEL	1 SHU	2 SHL	3 AH	4 AB	5 PRU	6 PRL	7 CPU	8 CPL	9 CARL	11 CRRU	12 CRRL	13 WCL	14 WCU	15 ECL	16 ECU
Phenanthrene	µg/kg	86.7	544	20.5	57.5	765	406	294	511	552	784	584	869	956	199	673	529	619
Phenanthrenes C1	µg/kg			21.3	99.0	1440	465	716	873	952	<1450	796	1100	1270	240	1120	632	847
Phenanthrenes C2	µg/kg			37.5	194	1470	449	902	1090	1210	1310	945	1370	1480	308	1260	791	904
Phenanthrenes C3	µg/kg			22.2	204	863	277	807	754	738	861	639	901	890	201	853	621	559
Pyrene	µg/kg	153	1398	15.9	113	848	394	413	676	740	914	674	1190	1430	277	963	872	868
PCB 028	µg/kg			<0.1	<0.1	0.29	<0.1	<0.1	<0.1	0.37	<0.1	<0.1	0.12	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 052	µg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.47	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 101	µg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.38	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 118	µg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.19	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 138	µg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.28	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 153	µg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.66	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 180	µg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.37	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TBT: as cation	µg/kg			<3.0	<3.0	9.0	<3.0	<3.0	8.0	<3.0	20.0	8.0	<3.0	<3.0	<3.0	<3.0	<3.0	9.0
2-Methylnaphthalene	µg/kg	20.2	201	<50	<50	100	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50

[Note: ISQG-TEL is Interim sediment Quality Guidelines- Threshold Effects Level of Environment Canada, and PEL is Probable Effects Level of NOAA; Source: Contains Natural Resources Wales information © Natural Resources Wales and database right]

Table ESI-4 Sediment contaminants at 15 intertidal stations (EU Habitats Directive) in Milford Haven, 1 – 3 October 2012 (See Table 1 for stations and positions)

Analyte, dry mass	Units	MRV	1 SHU	2 SHL	3 AH	4 AB	5 PRU	6 PRL	7 CPU
Ammoniacal Nitrogen	mg/kg	2	3.2	9.55	39.1	4.53	7.63	15.1	52.3
Nitrate	mg/kg	3	<3	<3	<3	<3	<3	<3	<3
Nitrite	mg/kg	0.1	<0.1	<0.1	0.16	<0.1	<0.1	<0.1	<0.1
Nitrogen Total	mg/kg	3	<3	<3	<3	<3	<3	<3	<3
Orthophosphate	mg/kg	1	<7	<7	<10	<7	22	<10	56
Phosphorus	mg/kg	60	173	254	664	351	527	556	747
Organic Carbon	%	0.4	0.95	1.05	1.81	0.92	1.42	1.27	2
Nitrogen	%	0.02	0.237	0.124	0.245	0.177	0.162	0.186	0.166
Mercury	mg/kg	0.002	-	-	-	0.022	-	-	-
Cadmium	mg/kg	0.02	0.025	0.033	0.182	0.068	0.181	0.138	0.161
Chromium	mg/kg	0.7	10	27.2	40.3	15.1	27.4	31.7	28.5
Copper	mg/kg	1	1.59	2.61	23.4	5.62	15.8	19.4	16.8
Lead	mg/kg	0.2	4.05	6.3	44.6	11.6	32.6	36.6	35.7
Zinc	mg/kg	3	21.3	30.2	141	50	106	118	109
Benzo[b]anthracene	µg/kg	10	<10	<10	<10	<10	<10	<10	<10
Benzo[e]pyrene	µg/kg	10	<10	<10	216	31.3	362	156	174
Benzo[j]fluoranthene	µg/kg	10	<10	<10	112	11.8	158	80.2	74.3
C1 Chrysene	µg/kg	10	<10	<10	247	36.3	374	180	203
C1 Dibenzothiophene	µg/kg	10	<10	<10	57.3	<10	43.2	31.8	36.7
C1 Fluoranthene	µg/kg	10	<10	16.4	376	55.4	654	266	292
C1 Fluorene	µg/kg	10	<10	<10	106	14.4	90.6	60	55
C1 Naphthalene	µg/kg	10	<10	22	234	45.5	120	140	124
C1 Phenanthrene	µg/kg	10	<10	<10	364	59.5	352	198	206
C2 Chrysene	µg/kg	10	<10	<10	61.5	<10	80.4	53	60.7
C2 Dibenzothiophene	µg/kg	10	<10	<10	93.6	18.3	71.7	59.7	60.2
C2 Fluorene	µg/kg	10	<10	<10	142	19.3	72.4	82.7	67.1

Analyte, dry mass	Units	MRV	1 SHU	2 SHL	3 AH	4 AB	5 PRU	6 PRL	7 CPU
C2 Naphthalene	µg/kg	10	<10	30.3	268	47.9	177	159	143
C2 Phenanthrene	µg/kg	10	<10	22.5	349	62.4	287	244	216
C3 Chrysene	µg/kg	10	<10	<10	103	15.2	99.9	99.7	89.6
C3 Dibenzothiophene	µg/kg	10	<10	<10	60	<10	36.6	35.6	34.4
C3 Fluorene	µg/kg	10	<10	<10	152	21.2	123	92.1	73.8
C3 Naphthalene	µg/kg	10	<10	27.6	244	49.4	172	163	154
C3 Phenanthrene	µg/kg	10	<10	19.9	245	51.5	203	188	165
C4 Chrysene	µg/kg	10	<10	<10	17.6	<10	22.1	15.3	22.4
C4 Naphthalene	µg/kg	10	<10	16.1	112	16.5	71.9	68.3	66.9
C4 Phenanthrene	µg/kg	10	<10	12.7	146	34.2	120	118	115
Dibenzothiophene	µg/kg	10	<10	<10	27.7	<10	36.6	16.3	18.3
Perylene	µg/kg	10	<10	<10	64.1	10.6	110	51.9	48.3
Acenaphthene	µg/kg	2	<2	3.56	23.9	7.05	299	29	30.6
Acenaphthylene	µg/kg	2	<2	<2	24.2	2.53	34	11.9	29.6
Anthracene	µg/kg	2	<2	2.38	51.8	9.73	196	35.2	81.5
Benz[<i>a</i>]anthracene	µg/kg	2	2.5	8.05	203	26	868	136	291
Benzo[<i>a</i>]pyrene	µg/kg	2	2.15	8.12	221	28	808	153	359
Benzo[<i>b</i>]fluoranthene	µg/kg	10	<10	12.5	286	42.4	982	205	450
Benzo[<i>ghi</i>]perylene	µg/kg	10	<10	<10	173	25.5	520	124	281
Benzo[<i>k</i>]fluoranthene	µg/kg	10	<10	<10	128	16.4	354	86.6	227
Chrysene	µg/kg	3	<3	11.4	255	36.7	1020	171	366
Dibenzo[<i>ah</i>]anthracene	µg/kg	5	<5	<5	49.8	6.91	182	36	77.8
Fluoranthene	µg/kg	2	2.15	15.2	351	44.6	1400	229	484
Fluorene	µg/kg	10	<10	<10	64.6	11.6	279	44.5	77.4
Indeno[1,2,3- <i>cd</i>]pyrene	µg/kg	10	<10	<10	197	29.9	590	143	320
Naphthalene	µg/kg	30	<30	<30	150	32.6	126	98.3	161
Phenanthrene	µg/kg	10	<10	14.3	241	38.9	972	156	289
Pyrene	µg/kg	3	3.76	13.1	281	38.1	1060	193	449

Analyte, dry mass	Units	MRV	1 SHU	2 SHL	3 AH	4 AB	5 PRU	6 PRL	7 CPU
PCB - 028	µg/kg	0.1	<0.1	<0.1	1	0.16	0.4	0.72	0.32
PCB - 052	µg/kg	0.1	<0.1	<0.1	<0.2	<0.1	<0.2	<0.1	<0.1
PCB - 101	µg/kg	0.1	<0.1	<0.1	0.48	<0.1	0.24	<0.3	<0.1
PCB - 118	µg/kg	0.1	<0.1	<0.1	0.52	<0.1	0.2	0.32	<0.1
PCB - 138	µg/kg	0.1	<0.1	<0.1	0.56	<0.1	0.2	<0.2	<0.1
PCB - 153	µg/kg	0.1	<0.1	<0.1	0.72	<0.1	0.28	0.44	0.16
PCB - 180	µg/kg	0.1	<0.1	<0.1	0.36	<0.1	<0.1	0.16	<0.1
Tributyl Tin as Cation	µg/kg	3	<3	<3	<5	<3	<4	<4	<4
Dry Solids at 30°C	%	0.5	75.2	71.9	37.7	69.4	55.4	48.4	48.6

[Note: MRV is Measurement Reporting Verification; Source: CCW 2012 survey; contains Natural Resources Wales information © Natural Resources Wales and database right]

Table ESI-4 Continued

Analyte, dry mass	Units	MRV	8 CPL	9 CARL	11 CRRU	12 CRRL	13 WCL	14 WCU	15 ECL	16 ECU
Ammoniacal Nitrogen	mg/kg	2	24.1	28.4	20	17.9	13.2	27.4	11.9	17.9
Nitrate	mg/kg	3	<3	<3	11.5	<3	<3	<3	<3	<3
Nitrite	mg/kg	0.1	<0.1	0.11	0.13	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen Total	mg/kg	3	<3	<3	11.7	<3	<3	<3	<3	<3
Orthophosphate	mg/kg	1	<10	70	62.9	70.2	61.8	127	61.2	78.9
Phosphorus	mg/kg	60	556	911	981	832	1030	1600	851	1050
Organic Carbon	%	0.4	1.08	1.61	1.82	1.51	1.21	2.48	1.59	2.41
Nitrogen	%	0.02	0.166	0.201	0.205	0.198	0.316	0.251	0.187	0.223
Mercury	mg/kg	0.002	-	-	-	-	-	-	-	-
Cadmium	mg/kg	0.02	0.136	0.208	0.288	0.248	0.325	0.424	0.185	0.35
Chromium	mg/kg	0.7	26.1	32	32.9	30	31.6	39.5	23.8	36.7
Copper	mg/kg	1	14.3	20.3	24.5	21.7	22.2	31.1	14.4	25.2

Analyte, dry mass	Units	MRV	8 CPL	9 CARL	11 CRRU	12 CRRL	13 WCL	14 WCU	15 ECL	16 ECU
Lead	mg/kg	0.2	28.3	37.1	39.2	37.1	35.2	44.3	23.8	36.3
Zinc	mg/kg	3	102	127	143	131	148	186	110	157
Benzo[<i>b</i>]anthracene	µg/kg	10	<10	<10	<10	<10	<10	<10	<10	19.2
Benzo[<i>e</i>]pyrene	µg/kg	10	120	255	222	226	189	240	152	346
Benzo[<i>j</i>]fluoranthene	µg/kg	10	61.3	108	114	92.5	97.6	145	98.5	232
C1 Chrysene	µg/kg	10	153	266	230	238	217	248	155	361
C1 Dibenzothiophene	µg/kg	10	33.7	32.5	31.4	35.5	27.9	31.9	22.1	33.3
C1 Fluoranthene	µg/kg	10	230	430	343	356	337	355	247	606
C1 Fluorene	µg/kg	10	64	86.5	51.2	69.6	46.8	63.1	27.7	70.1
C1 Naphthalene	µg/kg	10	135	118	84.1	104	72	122	57.3	102
C1 Phenanthrene	µg/kg	10	208	311	204	235	183	222	146	300
C2 Chrysene	µg/kg	10	49.4	70.3	58.4	53.3	38.8	96.6	38.6	104
C2 Dibenzothiophene	µg/kg	10	74.5	76.4	59.9	67.5	61.1	63.1	36.9	62.4
C2 Fluorene	µg/kg	10	99	91.8	62	85	67.9	92.4	33.7	91.5
C2 Naphthalene	µg/kg	10	204	153	107	131	99.6	150	67.7	125
C2 Phenanthrene	µg/kg	10	232	372	204	231	220	240	139	306
C3 Chrysene	µg/kg	10	72.5	79.8	71.7	73.5	71.7	80.6	48.2	100
C3 Dibenzothiophene	µg/kg	10	46.2	35.7	37.6	43.4	43.1	34	23.1	43.8
C3 Fluorene	µg/kg	10	98.9	127	65.7	101	269	79.8	40.8	101
C3 Naphthalene	µg/kg	10	242	201	137	172	113	185	69.9	167
C3 Phenanthrene	µg/kg	10	204	324	178	200	174	197	94.6	242
C4 Chrysene	µg/kg	10	16	25.4	18.9	27.3	20.3	31.7	11.9	26.7
C4 Naphthalene	µg/kg	10	112	92.7	71.8	79.8	65.8	95.9	29.9	95.8
C4 Phenanthrene	µg/kg	10	181	406	126	149	111	132	63.3	161
Dibenzothiophene	µg/kg	10	16.2	25.8	17	20.8	16.2	16.7	15.3	18
Perylene	µg/kg	10	42.2	83.9	74.9	79.5	97.9	101	56.8	134
Acenaphthene	µg/kg	2	19.2	73.4	35.4	37.6	17.2	30.9	24.6	32.6

Analyte, dry mass	Units	MRV	8 CPL	9 CARL	11 CRRU	12 CRRL	13 WCL	14 WCU	15 ECL	16 ECU
Acenaphthylene	µg/kg	2	13.8	23.9	16.8	18	22.1	18.3	11.1	35.4
Anthracene	µg/kg	2	37.4	62.4	42.4	46.4	40.7	40.5	42.3	78.8
Benz[<i>a</i>]anthracene	µg/kg	2	111	266	216	229	202	220	178	404
Benzo[<i>a</i>]pyrene	µg/kg	2	116	274	239	242	199	246	174	420
Benzo[<i>b</i>]fluoranthene	µg/kg	10	160	327	286	293	245	311	204	446
Benzo[<i>ghi</i>]perylene	µg/kg	10	95.4	189	174	175	146	197	117	264
Benzo[<i>k</i>]fluoranthene	µg/kg	10	65.4	139	121	126	99.6	127	82.5	187
Chrysene	µg/kg	3	147	323	255	268	227	265	205	437
Dibenzo[<i>ah</i>]anthracene	µg/kg	5	29.1	63.1	54.4	53.7	47.2	56.8	37.7	79.7
Fluoranthene	µg/kg	2	188	432	347	375	303	366	281	611
Fluorene	µg/kg	10	40.7	80.6	39.5	49.4	34.2	43	30.3	47.8
Indeno[1,2,3- <i>cd</i>]pyrene	µg/kg	10	108	218	198	196	158	217	133	296
Naphthalene	µg/kg	30	84.9	78.1	55.1	69.8	54.5	105	46.9	86.5
Phenanthrene	µg/kg	10	142	322	172	211	128	184	147	225
Pyrene	µg/kg	3	165	337	280	289	246	302	217	507
PCB - 028	µg/kg	0.1	0.64	0.44	0.56	0.52	0.32	0.52	0.2	0.4
PCB - 052	µg/kg	0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 101	µg/kg	0.1	<0.3	0.32	<0.3	<0.2	<0.2	0.28	<0.1	0.32
PCB - 118	µg/kg	0.1	0.2	0.24	0.32	0.28	<0.1	0.28	<0.1	<0.2
PCB - 138	µg/kg	0.1	0.28	0.2	<0.3	0.32	0.2	0.28	<0.1	0.28
PCB - 153	µg/kg	0.1	0.32	0.36	0.48	0.4	0.28	0.48	0.2	0.48
PCB - 180	µg/kg	0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Tributyl Tin as Cation	µg/kg	3	<4	<4	<5	<4	<5	<6	<4	<5
Dry Solids at 30°C	%	0.5	48.8	46.8	41.6	44.2	37.9	32.3	53.8	36.7

[Note: MRV is Measurement Reporting Verification; Source: CCW 2012 survey; contains Natural Resources Wales information © Natural Resources Wales and database right]

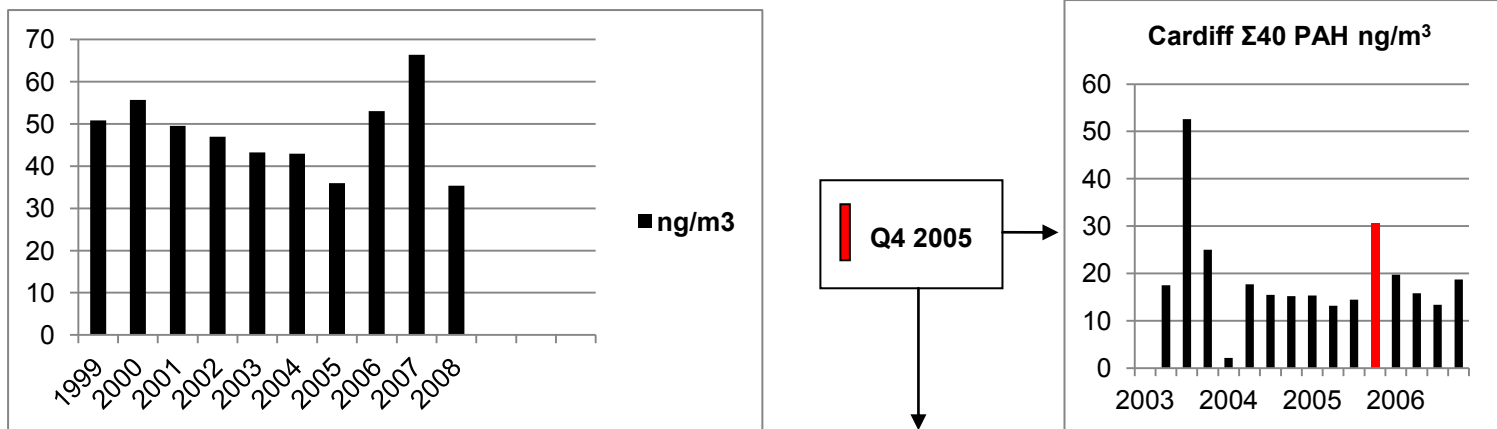


Figure ES1-1 Annual mean $\Sigma 40$ PAH concentrations in air samples (left) at up to 25 monitoring stations in UK from 1999 – 2008, and (right) quarterly mean at Cardiff monitoring station from 2003 – 2006; Q4 2005 (Buncefield incident 11 December 2005) indicated in red (Defra⁴⁰)

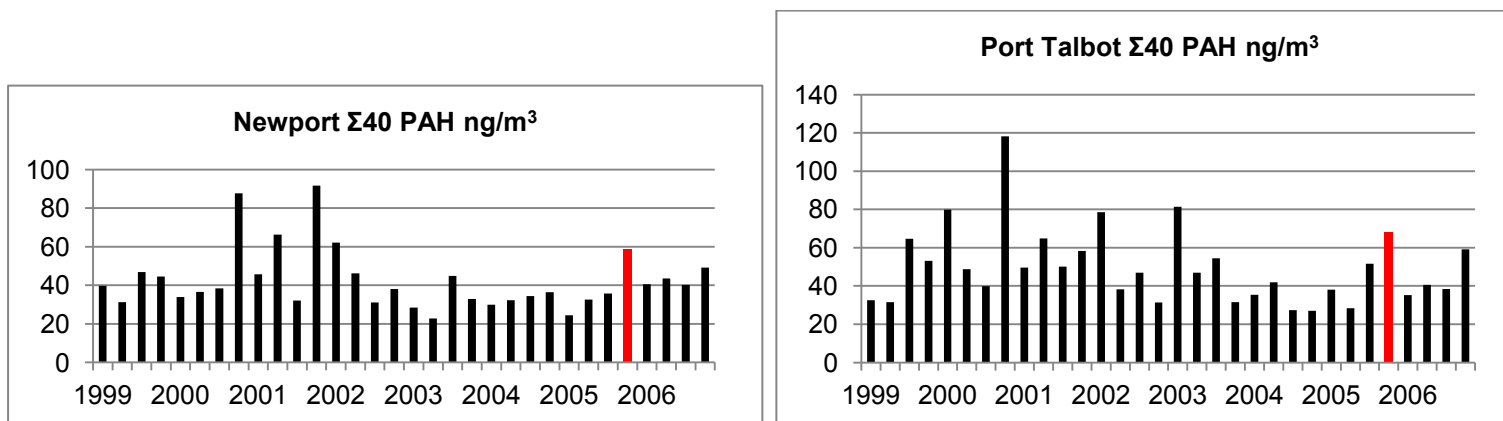


Figure ES1-2 Quarterly mean $\Sigma 40$ PAH concentrations in air samples at (left) Newport and (right) Port Talbot monitoring stations from 1999 – 2006; Q4 2005 (Buncefield incident 11 December 2005) indicated in red (Defra⁴⁰)

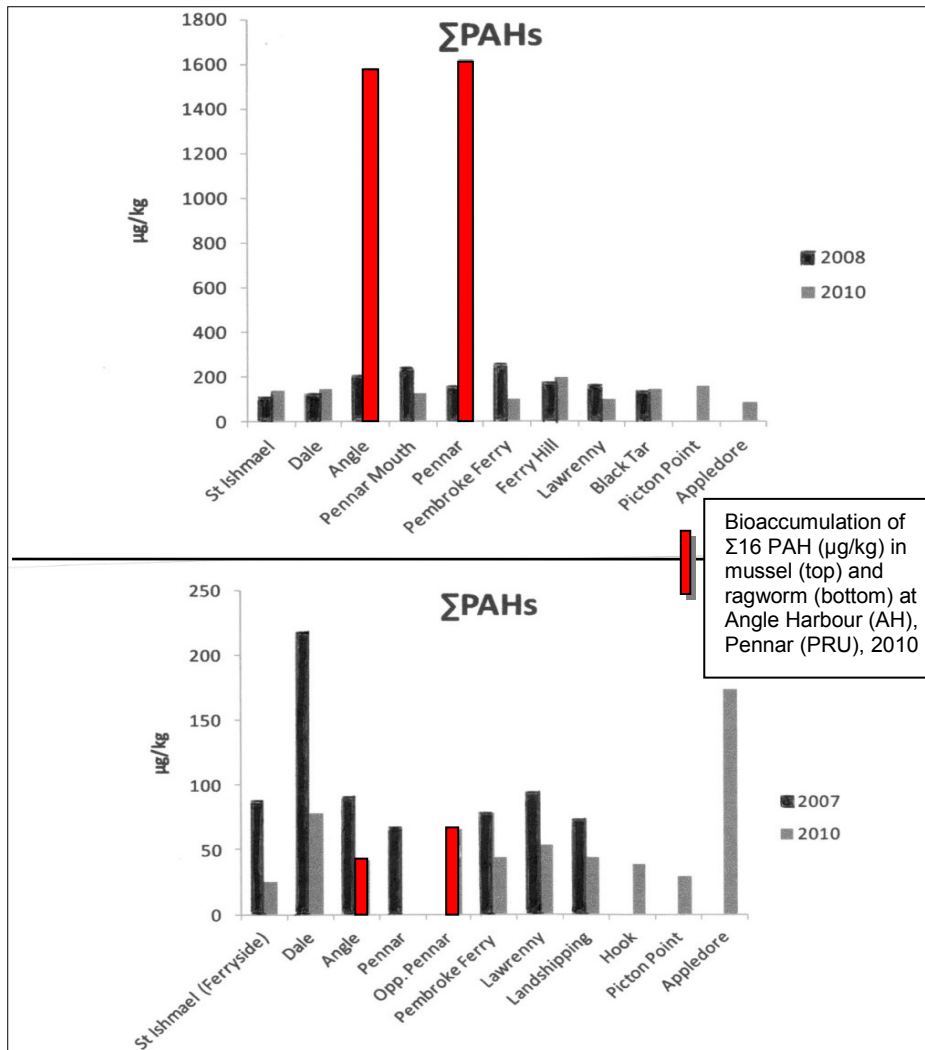


Figure ESI-3 Concentrations Σ16 PAH (µg/kg) at MHWESG bioaccumulation monitoring sites (top) in mussel *Mytilus edulis* from early 2008-2010 and (bottom) in ragworm *Hediste diversicolor* from late 2007 to 2010; Angle Harbour and Pennar (Pembroke River Upper) in 2010 shown in red (after Langston³⁸ their Figures 22 and 23 respectively)

Plate 1 Contemporary photograph showing the Admiralty Llanreath fuel depot fire after *Luftwaffe* bombing raid of 19 August 1940 (Source: www.memories.thepenpro.com/Memories8A.html)

Plate 2 West Williamston marsh-front at the Carew and Cresswell Rivers confluence, oiled by the *El Omar* incident, photograph 7 December 1988 (Source: Little⁴)



Plate ESI-1 Contemporary photograph showing the Admiralty Llanreath fuel depot fire after *Luftwaffe* bombing raid of 19 August 1940 (Source: www.memories.thepenvro.com/Memories8A.html)



Plate ESI-2 West Williamston marsh-front at the Carew and Cresswell Rivers confluence, oiled by the *El Omar* incident, photograph 7 December 1988 (Source: Little⁴)