APPENDIX D

Sediment Quality Conditions Boston Harbor

Data Excerpt: Durell *et al*. 2008 with comparisons to guidelines in CCME 2002.

Data summaries that follow are for sediment sampling stations that fell within the segments areas being reported on by the Massachusetts Department of Environmental Protection as part of the Boston Harbor 2004-2008 Water Quality Assessment Report. For each sampling station sediment concentration data (excerpted from Appendix B of Durell *et al*. 2008) are provided in tables including: % fines and total organic carbon (TOC) content, a sewage tracer bacterium *(Clostridium perfringens),* selected metals (Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, and Zn), and organic contaminants (PAHs, PCBs, and chlorinated pesticides). We then compared the metals and organic concentrations in these sediments to both the Interim Sediment Quality Guidelines (ISQGs) and the Probable Effect Levels (PELs) available in the *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life --Summary Tables Updated 2002* (CCME 2002). We used the methods outlined below to characterize the overall level of pollutant contamination in each sediment sample:

1. divided the concentration of each individual analyte (metals and organics) by its corresponding ISQG; [it should be noted that guidelines are not available for every analyte so only some comparisons could be made;]
2. called this ratio the number of "Toxic Units" (TU) for the particular analyte being assessed;
3. summed the ISQG TUs for all ratios that exceeded a value of 1.0 to arrive at the Sum of TUs for all analytes in the sample;
4. repeated this process using the PELs to calculate TUs.

As noted above the relative pollutant strength of each sediment sample is calculated by summing those TUs for individual analytes that exceed a value of 1.0. An underlying assumption of this method is that organisms simultaneously exposed to a variety of metals and/or organics will not suffer ill effects as long as the TU of each of these does not exceed a value of 1.0.

Brief summary of sampling information (excerpted from Durell *et al.* 2008):

"In August 2006, sediment samples were collected from 17 stations (Figure 2-1, Table 2-1) in Boston Harbor, most of which are located in Dorchester Bay. The field and laboratory procedures used in 2006 are the same as those used to conduct the 1990, 1994, 1998, and 2002 CSO sediment surveys (Durell et al., 1991; Durell, 1995; Lefkovitz et al., 2000, 2006). The technical procedures are briefly summarized in this report; detailed technical descriptions regarding sample collection, transport, and storage can be found in the survey report (Williams, 2006) and the combined work/quality assurance project plan (CW/QAPP) for benthic monitoring (Williams et al., 2006). Samples were analyzed according to the Quality Assurance Project Plan for Sediment Chemistry Analyses for Harbor and Outfall Monitoring (Prasse et al., 2007), and referenced standard operating procedures (SOPs)."

Reporting Polychlorinated Biphenyls (PCBs): *"PCB data are presented and analyzed as the sum of the 20 PCB congener analytes (Table 2-2). There are 209 possible PCB congeners, with approximately 100 of those PCB congeners comprising more than 95% of the total PCB in most Aroclor formulations and environmental samples. The 20 PCB congeners that have been measured in the CSO sediment investigations were originally selected for the NOAA National Status and Trends monitoring project because they cover a wide range of PCB characteristics (congeners with from two to ten chlorine substitutions on the biphenyl molecule), and are among the most abundant; these 20 congeners together comprise about 50% of the total PCB in most US coastal sediments. Therefore, it is possible to estimate the total PCB concentration in most coastal sediments by multiplying the sum of the 20 PCB congener concentrations by two."*

"At each station, three replicate samples were collected with a Kynar-coated 0.1-m2 Ted Young-modified van Veen grab sampler. The top two centimeters of the grab were removed and processed for sedimentological, chemical, and microbiological parameters….Sediment samples were analyzed for organic contaminants (PAHs, PCBs, and chlorinated pesticides), selected metals (Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, and Zn), grain size, TOC, and a sewage tracer bacterium (Clostridium perfringens). Analytical methods for organic contaminants used in the 2006 study are comparable to those used in the historical CSO studies (Durell et al., 1991; Durell, 1995; Lefkovitz et al., 2000, 2006), with the exception that the PCB and pesticide analyses are now being conducted using GC/MS (rather than GC/ECD); GC/MS typically provides higher quality data, as it is generally less susceptible to sample matrix interference issues.

"The total petrogenic PAH (LMW PAH) is the sum of petroleum-related PAHs, whereas the total pyrogenic PAH (HMW PAH) represent the sum of pyrogenic (combustion and creosote, coal-tar related) PAHs. The HWM PAHs are primarily principal components of creosote and coal-tar mixtures or are derived from the combustion of fossil fuels, and are generally the heavier molecular- weight PAHs."

"Data presentation and most data analyses were performed on station mean data (i.e., the mean of three replicates from each station per year)."

Segment MA70-02

Station C019 mouth of Fort Point Channel (CSO impact from discharges in Fort Point Channel) with mean water depth of 7.9m. This station was added to the monitoring program in 2004 to allow evaluation of effectiveness of improvements to the CSO system. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
C019	-	-	95.93	2.83	-	-	96.67	2.87	97.00	3.03	97.61	3.20

[a] Percent fines is the sum of %silt and %clay, - No data available

	1994		*1998*		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
C019	12,643.33	3.99	15,133.33	4.16	17,766.67	4.25	17,293.68	4.24

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
C019	**1994**	19,450.11	4,900.30	14,549.81	74.80	186.46	4.34	34.88
C019	**1998**	17,283.31	4,126.80	13,156.51	76.11	204.72	5.54	21.94
C019	**2002**	11,226.15	3,139.35	8,086.80	72.07	93.11	1.98	8.64
C019	**2006**	16,031.91	3,341.07	12,690.85	79.18	209.65	3.45	25.97

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
C019	**1994**	4.76	7.00	1.14	214.67	146.00	4.34	0.81	37.33	137.13	218.00
C019	**1998**	4.03	7.40	1.09	204.67	148.33	4.78	0.79	44.80	150.30	234.33
C019	**2002**	3.19	7.54	0.59	207.67	128.18	4.73	0.76	39.30	130.08	220.83
C019	**2006**	2.78	7.99	0.60	182.67	109.00	4.55	0.65	39.57	125.67	200.00

Sediment Station C019 TU Calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS ISQG
C019	**1994**	1.6	4.1	36.0	6.2	4.5	1.8	54.3
C019	**1998**	1.6	3.9	36.6	6.1	5.0	1.9	55.0
C019	**2002**		4.0	31.6	5.8	4.3	1.8	47.5
C019	**2006**		3.5	26.9	5.0	4.2	1.6	41.1

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
C019	**1994**		1.3	1.4	1.2	1.2		5.1
C019	**1998**		1.3	1.4	1.1	1.3		5.1
C019	**2002**		1.3	1.2	1.1	1.2		4.7
C019	**2006**		1.1	1.0		1.1		3.3

	TU ISQG	**TU PEL**
ANALYTE	**C019**	**C019**
NAPHTHALENE	4.6	
ACENAPHTHYLENE	16.9	
ACENAPHTHENE	6.2	
FLUORENE	3.2	
ANTHRACENE	4.3	
PHENANTHRENE	7.4	1.2
2-METHYLNAPHTHALENE	1.7	
FLUORANTHENE	14.9	1.1
PYRENE	10.6	1.2
BENZ(A)ANTHRACENE	9.6	1.0
CHRYSENE	8.0	1.0
BENZO(A)PYRENE	10.4	1.2
DIBENZO(A,H)ANTHRACENE	22.1	1.0
Total DDE	4.5	
Total DDD	13.6	2.1
PCB total estimate =sum20_PCB*2	19.5	2.2
TOTAL TU CALC	157.4	12.1

Segment MA70-01

Station T02 just outside of Inner Harbor southeast of Logan Airport (no CSO direct impact) with mean water depth of 6.8m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
T02	-	-	37.87	1.63	55.50	1.46	53.00	1.44	54.43	1.77	83.83	1.99

[a] Percent fines is the sum of %silt and %clay, - No data available

	1997		*1998*		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T02	18,333.33	4.26	6,253.33	3.78	6,733.33	3.82	4,831.00	3.68

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
T02	**1994**	7,561.84	2,160.69	5,401.15	71.28	55.75	2.22	12.61
T02	**1997**	6,999.80	2,246.47	4,753.33	67.91	82.29	2.97	11.83
T02	**1998**	6,727.88	1,836.12	4,891.76	72.72	45.33	2.26	6.28
T02	**2002**	7,152.98	1,982.78	5,170.20	72.28	39.47	1.08	3.53
T02	**2006**	7,256.73	1,638.58	5,618.15	77.44	53.72	1.09	7.56

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T02	**1994**	2.50	5.67	0.48	125.67	59.33	2.63	0.37	23.33	63.07	101.00
T02	**1997**	2.28	6.94	0.46	107.52	64.51	2.80	0.61	32.24	62.54	112.57
T02	**1998**	1.80	5.91	0.42	104.70	52.93	3.05	0.31	24.58	62.90	108.17
T02	**2002**	1.49	6.43	0.26	124.43	55.47	3.23	0.31	25.87	63.23	111.70
T02	**2006**	1.25	7.73	0.34	126.67	47.67	3.49	0.41	29.90	67.33	122.00

Sediment Station T02 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T02	**1994**		2.4	14.6	2.8	2.1		22.0
T02	**1997**		2.1	15.9	4.7	2.1		24.7
T02	**1998**		2.0	13.1	2.4	2.1		19.5
T02	**2002**		2.4	13.7	2.4	2.1		20.5
T02	**2006**		2.4	11.8	3.2	2.2		19.6

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T02	**1994**							0.0
T02	**1997**							0.0
T02	**1998**							0.0
T02	**2002**							0.0
T02	**2006**							0.0

	TU ISQG	**TU PEL**
ANALYTE	**T02**	**T02**
NAPHTHALENE	1.8	
ACENAPHTHYLENE	7.0	
ACENAPHTHENE	2.9	
FLUORENE	1.7	
ANTHRACENE	2.1	
PHENANTHRENE	3.7	
2-METHYLNAPHTHALENE		
FLUORANTHENE	7.1	
PYRENE	4.7	
BENZ(A)ANTHRACENE	4.6	
CHRYSENE	3.6	
BENZO(A)PYRENE	4.6	
DIBENZO(A,H)ANTHRACENE	9.6	
Total DDE	1.5	
Total DDD	3.7	
PCB total estimate =sum20_PCB*2	5.0	
TOTAL TU CALC	63.6	0.0

Station T01 off of the western side of Deer Island (no direct CSO impact) with mean water depth of 4m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
T01	36.40	1.83	20.73	1.83	25.03	1.80	31.83	0.97	41.43	1.02

[a] Percent fines is the sum of %silt and %clay

	1997		*1998*		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T01	7,716.67	3.88	4,373.33	3.64	2,160.00	3.32	1,100.81	2.99

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
T01	**1994**	7,566.66	3,076.48	4,490.19	59.32	28.83	1.48	9.20
T01	**1997**	6,844.00	3,210.67	3,633.33	54.74	51.00	1.78	9.66
T01	**1998**	4,792.42	1,927.93	2,864.49	60.70	24.53	1.21	1.95
T01	**2002**	3,370.87	1,268.28	2,102.59	62.62	13.55	0.32	1.42
T01	**2006**	5,710.01	1,699.02	4,010.99	69.95	13.72	0.23	1.55

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T01	**1994**	0.89	6.50	0.31	78.33	26.67	2.60	0.26	20.50	32.80	67.67
T01	**1997**	0.65	5.62	0.18	50.62	36.44	1.93	0.26	20.31	37.70	77.21
T01	**1998**	0.71	5.19	0.32	58.87	33.60	2.30	0.17	19.68	50.83	71.77
T01	**2002**	0.60	6.31	0.09	62.50	27.37	2.30	0.18	17.27	37.70	63.07
T01	**2006**	0.60	6.47	0.17	73.13	51.97	2.37	0.12	16.30	40.23	69.43

Sediment Station T01 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T01	**1994**		1.5	6.6	2.0	1.1		11.2
T01	**1997**			9.0	2.0	1.2		12.2
T01	**1998**		1.1	8.3	1.3	1.7		12.4
T01	**2002**		1.2	6.7	1.4	1.2		10.6
T01	**2006**		1.4	12.8		1.3		15.5

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T01	**1994**							0.0
T01	**1997**							0.0
T01	**1998**							0.0
T01	**2002**							0.0
T01	**2006**							0.0

	TU ISQG	TU PEL
ANALYTE	**T01**	**T01**
NAPHTHALENE		
ACENAPHTHYLENE	4.8	
ACENAPHTHENE	3.7	
FLUORENE	2.7	
ANTHRACENE	4.1	
PHENANTHRENE	5.1	
2-METHYLNAPHTHALENE		
FLUORANTHENE	5.7	
PYRENE	3.4	
BENZ(A)ANTHRACENE	4.3	
CHRYSENE	2.5	
BENZO(A)PYRENE	3.2	
DIBENZO(A,H)ANTHRACENE	7.0	
Total DDE		
Total DDD		
PCB total estimate =sum20_PCB*2	1.3	
TOTAL TU CALC	47.8	0.0

Station T03 off of the northwestern side of Long Island (no CSO direct impact) with mean water depth of 8.7m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
T03	-	-	-	-	82.57	3.57	-	-	59.73	2.80	57.31	2.14

[a] Percent fines is the sum of %silt and %clay, - No data available

	1997		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T03	18,666.67	4.26	9,106.67	3.93	2,031.70	3.30

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
T03	**1997**	8,179.67	2,674.67	5,505.00	67.37	102.03	4.97	17.30
T03	**2002**	8,837.28	3,363.08	5,474.20	61.95	104.42	2.86	8.27
T03	**2006**	5,478.76	1,595.75	3,883.01	71.68	102.49	1.99	12.26

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T03	**1997**	3.23	7.54	0.22	173.05	100.98	3.98	0.97	41.48	121.75	160.85
T03	**2002**	2.87	6.97	0.27	187.00	88.03	3.90	1.09	36.03	106.00	159.67
T03	**2006**	2.58	7.54	0.41	137.00	64.70	3.40	1.26	29.13	94.67	139.00

Sediment Station T03 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T03	**1997**		3.3	24.9	7.5	4.0	1.3	41.0
T03	**2002**		3.6	21.7	8.4	3.5	1.3	38.5
T03	**2006**		2.6	16.0	9.7	3.1	1.1	32.5

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T03	**1997**		1.1		1.4	1.1		3.6
T03	**2002**		1.2		1.6			2.7
T03	**2006**				1.8			1.8

	TU ISQG	TU PEL
ANALYTE	**T03**	**T03**
NAPHTHALENE	2.0	
ACENAPHTHYLENE	4.1	
ACENAPHTHENE	2.3	
FLUORENE	1.3	
ANTHRACENE	1.5	
PHENANTHRENE	3.1	
2-METHYLNAPHTHALENE	2.0	
FLUORANTHENE	4.9	
PYRENE	3.1	
BENZ(A)ANTHRACENE	3.4	
CHRYSENE	2.4	
BENZO(A)PYRENE	3.2	
DIBENZO(A,H)ANTHRACENE	7.0	
Total DDE	1.2	
Total DDD	5.8	
PCB total estimate =sum20_PCB*2	9.5	1.1
TOTAL TU CALC	56.8	1.1

Station T05A off of the southern tip of Deer Island in President Roads (no CSO direct impact) with mean water depth of 17.5m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
T05A	-	-	-	-	32.13	1.42	-	-	12.37	0.87	28.55	0.49

[a] Percent fines is the sum of %silt and %clay, - No data available

	1997		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T05A	4,300.00	3.63	453.33	2.56	240.29	2.33

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
T05A	**1997**	12,410.57	4,515.90	7,894.67	65.11	42.17	2.00	5.82
T05A	**2002**	45,222.23	17,658.27	27,563.96	60.93	106.08	1.27	7.87
T05A	**2006**	8,526.52	2,529.46	5,997.06	70.45	12.82	0.27	3.63

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T05A	**1997**	1.13	6.44	0.29	69.24	36.25	2.46	0.22	19.77	40.02	84.30
T05A	**2002**	0.42	5.49	0.35	58.70	30.57	1.91	0.18	14.07	45.77	76.57
T05A	**2006**	0.34	5.93	0.21	45.57	13.80	2.06	0.10	13.80	32.30	57.50

Sediment Station T05A Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T05A	**1997**		1.3	8.9	1.7	1.3		13.3
T05A	**2002**		1.1	7.5	1.4	1.5		11.6
T05A	**2006**			3.4		1.1		4.5

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T05A	**1997**							0.0
T05A	**2002**							0.0
T05A	**2006**							0.0

	TU ISQG	TU PEL
ANALYTE	**T05A**	**T05A**
NAPHTHALENE	2.0	
ACENAPHTHYLENE	6.7	
ACENAPHTHENE	9.0	
FLUORENE	4.0	
ANTHRACENE	3.9	
PHENANTHRENE	8.1	1.3
2-METHYLNAPHTHALENE	1.4	
FLUORANTHENE	8.5	
PYRENE	5.3	
BENZ(A)ANTHRACENE	6.2	
CHRYSENE	3.8	
BENZO(A)PYRENE	4.7	
DIBENZO(A,H)ANTHRACENE	10.1	
Total DDE		
Total DDD	1.5	
PCB total estimate =sum20_PCB*2	1.2	
TOTAL TU CALC	76.4	1.3

Station T06 western side of Peddocks Island (no CSO direct impact) with mean water depth of 6.6m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

Station	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)
T06	-	-	-	-	41.07	1.88	-	-	26.37	1.60	58.01	1.80

[a] Percent fines is the sum of %silt and %clay, - No data available

	1997		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T06	17,233.33	4.19	1,770.00	3.24	1,225.48	3.05

Station	Sample Year	Total PAH (ng/g, DW)	Sum of LMW PAH (ng/g, DW)	Sum of HMW PAH (ng/g, DW)	%Pyrogenic PAH	Sum20_PCB Congeners (ng/g, DW)	Sum4_ Chlordanes (ng/g, DW)	Sum5_DDTs (ng/g, DW)
T06	**1997**	4,068.53	1,279.53	2,789.00	68.55	47.81	2.11	9.85
T06	**2002**	4,065.82	1,251.95	2,813.87	69.09	30.11	0.57	2.38
T06	**2006**	4,408.84	1,054.16	3,354.68	75.98	31.02	0.45	2.86

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T06	**1997**	2.25	6.33	0.20	84.20	47.90	2.69	0.69	21.76	62.79	92.89
T06	**2002**	1.48	6.48	0.15	103.47	44.63	3.02	0.39	24.03	61.37	103.10
T06	**2006**	1.44	6.68	0.28	102.20	40.77	3.08	0.36	25.53	82.27	111.33

Sediment Station T06 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T06	**1997**		1.6	11.8	5.3	2.1		20.8
T06	**2002**		2.0	11.0	3.0	2.0		18.0
T06	**2006**		2.0	10.1	2.8	2.7		17.5

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T06	**1997**							0.0
T06	**2002**							0.0
T06	**2006**							0.0

	TU ISQG	TU PEL
ANALYTE	**T06**	**T06**
NAPHTHALENE		
ACENAPHTHYLENE	3.1	
ACENAPHTHENE	2.5	
FLUORENE	1.2	
ANTHRACENE	1.4	
PHENANTHRENE	3.0	
2-METHYLNAPHTHALENE		
FLUORANTHENE	4.9	
PYRENE	3.0	
BENZ(A)ANTHRACENE	2.9	
CHRYSENE	2.1	
BENZO(A)PYRENE	2.8	
DIBENZO(A,H)ANTHRACENE	5.9	
Total DDE		
Total DDD	1.3	
PCB total estimate =sum20_PCB*2	2.9	
TOTAL TU CALC	37.0	0.0

Segment MA70-03

Station T04 off of Fox Point in Dorchester Bay (BOS-089 CSO impact area) with mean water depth of 3.2. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
T04	77.70	3.82	85.73	3.23	97.40	3.88	78.27	7.14	90.77	3.64	95.60	3.84

[a] Percent fines is the sum of %silt and %clay

	1997		*1998*		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T04(/DB13)	17,000.00	4.23	9,033.33	3.84	3,220.00	3.44	3,337.91	3.52

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
T04/DB13	**1990**	12,430.64	1,832.93	7,174.78	57.73	-	-	-
T04/DB13	**1994**	22,468.79	6,025.63	16,443.16	73.33	417.12	5.88	68.78
T04/DB13	**1997**	12,750.33	3,443.67	9,306.67	72.99	213.57	7.57	33.53
T04/DB13	**1998**	76,686.82	28,211.77	48,475.06	63.65	472.12	21.39	55.88
T04/DB13	**2002**	18,439.05	4,774.29	13,664.76	74.13	131.93	3.42	11.58
T04/DB13	**2006**	35,327.82	8,799.13	26,528.69	75.61	221.70	6.41	25.84

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T04	**1990**	-	7.41	2.01	212.07	181.73	4.01	-	44.31	191.63	342.29
T04	**1994**	5.59	6.83	2.12	254.00	157.50	3.79	1.24	37.33	198.73	266.00
T04	**1997**	4.16	7.38	1.10	170.30	125.10	3.95	1.12	41.19	152.25	217.29
T04	**1998**	3.48	5.85	2.10	163.65	193.48	3.97	2.29	38.68	388.50	435.00
T04	**2002**	2.64	6.33	0.71	170.67	127.33	3.96	0.75	34.97	145.37	216.33

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T04(/DB13)	**2006**	2.96	8.70	1.07	170.33	124.67	4.43	0.67	35.70	215.33	290.00

Sediment Station T04/DB13 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T04	**1990**	2.9	4.1	44.8	Not analyzed	6.3	2.8	
T04	**1994**	3.0	4.9	38.8	9.5	6.6	2.1	65.0
T04	**1997**	1.6	3.3	30.9	8.6	5.0	1.8	51.1
T04	**1998**	3.0	3.1	47.7	17.6	12.9	3.5	87.8
T04	**2002**	1.0	3.3	31.4	5.8	4.8	1.7	48.0
T04(/DB13)	**2006**	1.5	3.3	30.7	5.2	7.1	2.3	50.2

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T04	**1990**		1.3	1.7	Not analyzed	1.7	1.3	
T04	**1994**		1.6	1.5	1.8	1.8		6.6
T04	**1997**		1.1	1.2	1.6	1.4		5.2
T04	**1998**		1.0	1.8	3.3	3.5	1.6	11.2
T04	**2002**		1.1	1.2	1.1	1.3		4.6
T04(/DB13)	**2006**		1.1	1.2		1.9	1.1	5.2

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T04(/DB13)	**2006**	1.5	3.3	30.7	5.2	7.1	2.3	50.2

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T04(/DB13)	**2006**		1.1	1.2		1.9	1.1	5.2

	TU ISQG	TU PEL
ANALYTE	**T04(/DB13)**	**T04(/DB13)**
NAPHTHALENE	4.5	
ACENAPHTHYLENE	14.6	
ACENAPHTHENE	25.3	1.9
FLUORENE	9.4	1.4
ANTHRACENE	10.4	2.0
PHENANTHRENE	30.5	4.9
2-METHYLNAPHTHALENE	3.4	
FLUORANTHENE	46.0	3.5
PYRENE	26.1	2.9
BENZ(A)ANTHRACENE	21.3	2.3
CHRYSENE	15.3	1.9
BENZO(A)PYRENE	18.0	2.1
DIBENZO(A,H)ANTHRACENE	38.3	1.8
Total DDE	3.7	
Total DDD	14.9	2.3
PCB total estimate =sum20_PCB*2	20.6	2.3
TOTAL TU CALC	302.2	29.2

Segment MA70-05

Station T07 in Quincy Bay (no direct CSO impact) with mean water depth of 5.9m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
T07	-	-	-	-	55.10	3.09	57.37	2.16	54.51	2.73	80.61	2.42

[a] Percent fines is the sum of %silt and %clay, - No data available

	1997		*1998*		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T07	18,000.00	4.25	7,763.33	3.89	8,116.67	3.91	5,115.28	3.67

Station	**Sample Year**	**Total PAH (ng/g, DW)**	**Sum of LMW PAH (ng/g, DW)**	**Sum of HMW PAH (ng/g, DW)**	**%Pyrogenic PAH**	**Sum20_PCB Congeners (ng/g, DW)**	**Sum4_ Chlordanes (ng/g, DW)**	**Sum5_DDTs (ng/g, DW)**
T07	**1997**	4,398.43	1,348.43	3,050.00	69.28	108.29	4.62	27.40
T07	**1998**	5,204.78	1,364.41	3,840.37	73.81	83.16	3.89	11.33
T07	**2002**	5,439.47	1,674.95	3,764.52	69.22	79.68	1.62	10.17
T07	**2006**	5,535.90	1,285.56	4,250.34	76.75	86.41	1.13	7.96

Concentration (µg/g, dry weight)											
Station		**Ag**	**Al(%dw)**	**Cd**	**Cr**	**Cu**	**Fe(%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T07	**1997**	4.82	6.16	0.74	144.48	88.51	2.83	1.13	26.60	110.54	137.76
T07	**1998**	5.56	6.10	0.94	164.50	99.03	3.38	0.83	32.47	110.10	146.97
T07	**2002**	4.00	5.60	0.47	167.00	88.80	3.11	0.84	29.07	107.27	140.47
T07	**2006**	3.33	6.89	0.46	147.00	70.83	3.11	0.77	29.43	107.00	139.00

Sediment Station T07 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T07	**1997**	1.1	2.8	21.8	8.7	3.7	1.1	39.1
T07	**1998**	1.3	3.1	24.4	6.4	3.6	1.2	40.1
T07	**2002**		3.2	21.9	6.5	3.6	1.1	36.2
T07	**2006**		2.8	17.5	5.9	3.5	1.1	30.9

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T07	**1997**				1.6			1.6
T07	**1998**		1.0		1.2			2.2
T07	**2002**		1.0		1.2			2.2
T07	**2006**				1.1			1.1

	TU ISQG	TU PEL
ANALYTE	**T07**	**T07**
NAPHTHALENE	1.2	
ACENAPHTHYLENE	5.2	
ACENAPHTHENE	2.3	
FLUORENE	1.2	
ANTHRACENE	1.4	
PHENANTHRENE	3.2	
2-METHYLNAPHTHALENE		
FLUORANTHENE	5.5	
PYRENE	3.6	
BENZ(A)ANTHRACENE	3.3	
CHRYSENE	2.6	
BENZO(A)PYRENE	3.6	
DIBENZO(A,H)ANTHRACENE	7.8	
Total DDE	1.5	
Total DDD	3.9	
PCB total estimate =sum20_PCB*2	8.0	
TOTAL TU CALC	54.5	0.0

Segment MA70-07

Station T08 northwest of Bumkin Island in Hingham/Hull Bay (no direct CSO impact) with mean water depth of 11.3m. Data excerpted for this sampling station as follows (Appendix B of Durell *et al.* 2008):

Station	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)	% Fines[a]	TOC (%)
T08	-	-	6.13	1.17	5.97	0.45	5.43	0.43	10.43	0.50	6.34	0.36

[a] Percent fines is the sum of %silt and %clay, - No data available

	1997		*1998*		*2002*		*2006*	
Station	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/gDW)**	***C. perfringens* Log 10**
T08	1,900.00	3.25	1,893.33	3.25	386.67	2.50	413.90	2.56

Station	Sample Year	Total PAH (ng/g, DW)	Sum of LMW PAH (ng/g, DW)	Sum of HMW PAH (ng/g, DW)	%Pyrogenic PAH	Sum20_PCB Congeners (ng/g, DW)	Sum4_ Chlordanes (ng/g, DW)	Sum5_DDTs (ng/g, DW)
T08	**1994**	2,998.82	1,226.33	1,772.49	61.88	7.90	0.42	2.94
T08	**1997**	1,784.97	630.87	1,154.10	64.99	13.37	0.48	2.29
T08	**1998**	650.12	228.88	421.23	64.83	5.92	0.39	0.59
T08	**2002**	3,816.90	1,701.25	2,115.65	58.62	5.75	0.08	1.05
T08	**2006**	1,494.20	495.22	998.98	68.06	5.42	0.09	1.20

		Concentration (µg/g, dry weight)									
Station		**Ag**	**Al (%dw)**	**Cd**	**Cr**	**Cu**	**Fe (%dw)**	**Hg**	**Ni**	**Pb**	**Zn**
				0.7/4.2	**52.3/160**	**18.7/108**		**0.13/0.70**		**30.2/112**	**124/271**
T08	**1994**	0.53	3.00	0.10	49.00	16.00	2.03	0.10	13.67	25.87	47.33
T08	**1997**	0.47	4.43	0.09	26.72	10.07	1.52	0.13	9.63	26.91	38.81
T08	**1998**	0.41	3.89	0.12	28.97	16.93	1.71	0.08	12.23	27.47	44.13
T08	**2002**	0.37	4.98	0.07	37.48	16.60	1.72	0.08	11.88	25.77	47.92
T08	**2006**	0.26	4.41	0.11	38.57	9.80	1.66	0.07	11.23	29.67	46.63

Sediment Station T08 Toxic Unit (TU) calculations:

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER ISQG
T08	**1994**			3.9				3.9
T08	**1997**			2.5	1.0			3.5
T08	**1998**			4.2				4.2
T08	**2002**			4.1				4.1
T08	**2006**			2.4				2.4

Station		Cd	Cr	Cu	Hg	Pb	Zn	TOTAL SUM TU FOR METALS OVER PEL
T08	**1994**							0.0
T08	**1997**							0.0
T08	**1998**							0.0
T08	**2002**							0.0
T08	**2006**							0.0

	TU ISQG	TU PEL
ANALYTE	**T08**	**T08**
NAPHTHALENE		
ACENAPHTHYLENE	1.8	
ACENAPHTHENE	1.7	
FLUORENE		
ANTHRACENE		
PHENANTHRENE	1.4	
2-METHYLNAPHTHALENE		
FLUORANTHENE	1.4	
PYRENE		
BENZ(A)ANTHRACENE		
CHRYSENE		
BENZO(A)PYRENE		
DIBENZO(A,H)ANTHRACENE	2.2	
Total DDE		
Total DDD		
PCB total estimate =sum20_PCB*2		
TOTAL TU CALC	8.5	0.0

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