



BAYWIDE WATER QUALITY MONITORING PROGRAM

PROGRESS REPORT No. 15 (MARCH 2009)

APRIL 2009

INTRODUCTION TO THE PROGRAM

This report summarises water quality data obtained for the Channel Deepening Project (CDP) Baywide Water Quality Monitoring Program at 11 sampling sites in Port Phillip Bay. Data is for March 2009. Monthly Progress Reports will be prepared throughout the dredging program and for two years thereafter.

Where extensive local water quality data is available, control charts (Shewhart and EWMA) have been developed (see Appendix 1). These charts provide a guide against which data can be compared. Where data is recorded beyond natural or expected variation, further investigation will be undertaken.

The information contained in this report is correct as available to EPA Victoria at the time of publication.

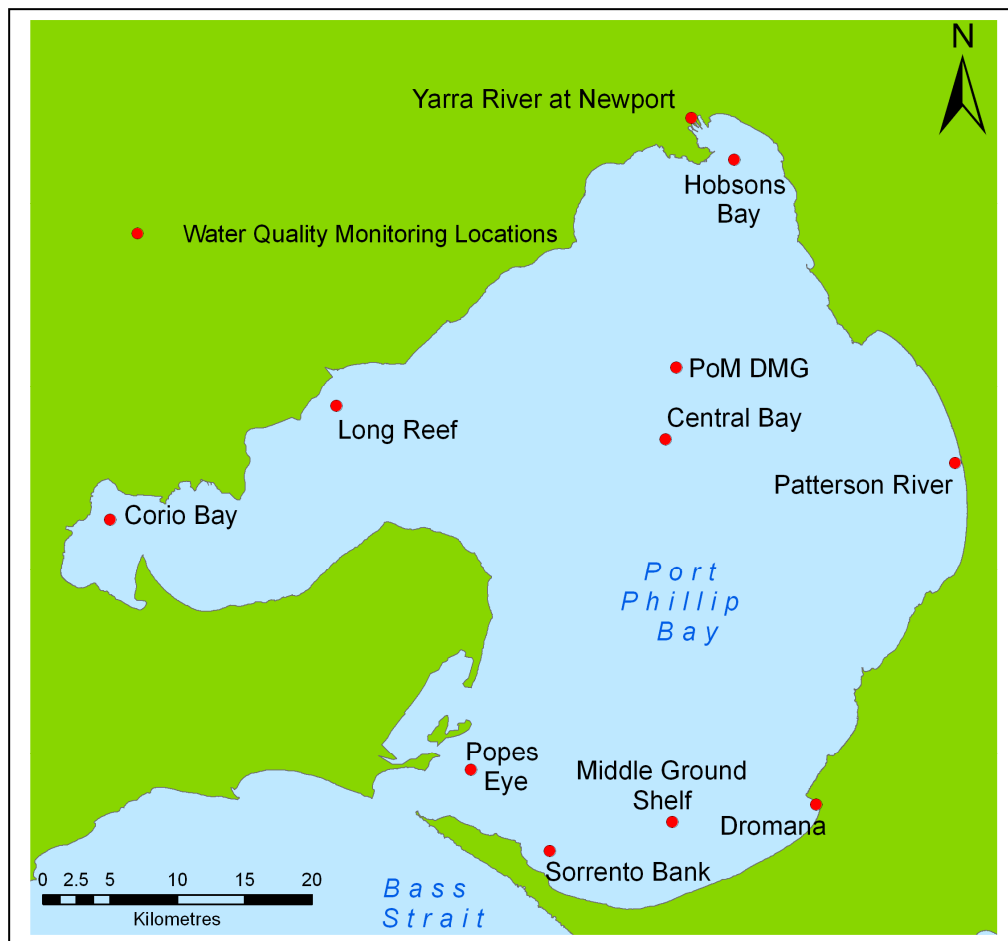


FIGURE 1 MAP OF SAMPLING SITES IN PORT PHILLIP BAY

MATERIALS AND METHODS

The materials and methods for this program are described in the CDP Water Quality Detailed Design document CDP_ENV_MD_023 Rev 1.1 (PoMC 2008).

EXCEPTIONS

There were two new exceptions to the Detailed Design (PoMC 2008) during this reporting period. These are detailed in exception reports ER090301 and ER090302, and outlined as follows:

- ER090301: EWMA values for chlorophyll-a were incorrectly reported in Progress Reports No. 7-12 covering the period July – December 2008 inclusive. The amended values are presented in Appendix 3 (Table 9) of this report.
- ER090302: Laboratory results for zinc did not meet internal QAQC requirements and have not been reported.

The following, previously issued exception report still applies:

- ER080901: A variation to the LOR for various parameters.

RESULTS AND DISCUSSION

All results presented in Tables 1 - 4 were assessed against the control limits listed in Tables 5 and 6 and where appropriate, compared to the SEPP objectives and ANZECC trigger levels of Table 7 (Appendix 1). Phytoplankton data is presented in Table 8 (Appendix 2).

Within this reporting period the EWMA control limits were exceeded six times. There were no exceedences of the Shewhart control limits (see Tables 1 - 4).

All data recorded in this report have been subject to internal quality assurance. Zinc results could not be validated and have been withheld from this report (see also ER090302). All other metals results have been verified and are considered valid.

No significant events were observed during the field sampling that would affect these results.

As described in section 4.1.3 of the Detailed Design (PoMC 2008), samples were not taken at depth at the Yarra River site, as the salinity difference between the near surface and depth was less than 10 ppt.

REFERENCES

PoMC 2008. Water Quality Detailed Design CDP_ENV_MD_023 Rev1.1, Port of Melbourne Corporation, September 2008.

TABLE 1 PHYSICO-CHEMICAL PARAMETERS (NST – No Sample Taken)

Date	Sampling Site	Depth m	Dissolved Oxygen		Salinity g/L	Secchi disc depth m	Temperature °C	Turbidity NTU	Total Suspended Solids ¹ mg/L	PAR micro Einsteins/m ² /sec
			mg/L	% saturation						
11/03/09	Yarra River at Newport	0.5	6.9	95	35.0	1.25	21.1	6.0	9.3	1231.3
11/03/09	Yarra River at Newport	7.6	NST	NST	NST		NST	3.8	NST	1.6
11/03/09	Hobsons Bay	0.5	7.3	100	37.5	4.25	20.2	1.8	1.9	1246.6
10/03/09	Central Bay	0.5	7.0	95	37.6	6.25	19.1	0.7	<1.5	400.4
10/03/09	PoM DMG	0.5	7.0	94	37.7	4.50	18.8	0.9	1.6	127.8
11/03/09	Corio Bay	0.5	7.0	95	38.7	4.25	18.8	1.5	1.9	133.0
11/03/09	Long Reef	0.5	7.2	97	36.4	1.75	19.3	2.6	4.3	443.3
10/03/09	Patterson River	0.5	7.2	97	37.4	6.50	19.2	0.6	<1.5	788.8
10/03/09	Dromana	0.5	7.1	97	37.2	>7.00 ²	19.3	<0.5	<1.5	1526.1
10/03/09	Middle Ground Shelf	0.5	7.2	97	37.3	7.50	19.5	<0.5	<1.5	1626.8
10/03/09	Sorrento Bank	0.5	7.3	99	36.4	>3.00 ²	19.3	<0.5	<1.5	1393.1
10/03/09	Popes Eye	0.5	7.2	96	35.8	9.50	18.7	<0.5	<1.5	1177.5

NOTES:

In situ data for temperature, turbidity and PAR are recorded across the depth profile. The result presented is for the specific depth noted. All other physico-chemical samples are taken at 0.5 m from surface, except Yarra River at Newport and Hobsons Bay where, if required, bottom samples are also collected.

Blue coloured cells indicate a result outside SEPP objectives (see Appendix 1, Table 7 for details).

1. Limit of Reporting (LOR) has been amended where previously reported at Limit of Detection (see Exception Report ER080901).
2. Secchi disc visible on bottom.

TABLE 2A NUTRIENTS

Date	Sampling Site	Depth m	Ammonium µg/L		Nitrate ¹ µg/L	Nitrite ¹ µg/L	Nitrate plus Nitrite µg/L		Dissolved Organic Nitrogen µg/L	Total Nitrogen µg/L	
			Measured Value	EWMA			Measured Value ¹	EWMA		Measured Value	EWMA
11/03/09	Yarra River at Newport	0.5	27.9	22.7	25.0	1.5	26.5	26.4	146	268	251
11/03/09	Hobsons Bay	0.5	8.6	8.1	2.7	<1.2	2.7	6.0	130	177	190
10/03/09	Central Bay	0.5	6.7	6.2	1.9	<1.2	<2.4	2.1	115	149	149
10/03/09	PoM DMG	0.5	7.3	6.4	2.2	<1.2	<2.4	3.3	119	159	150
11/03/09	Corio Bay	0.5	7.7	6.5	2.3	<1.2	<2.4	2.4	197	238	204
11/03/09	Long Reef	0.5	39.9	17.5	65.1	4.5	69.7	29.4	238	435	261
10/03/09	Patterson River	0.5	7.0	6.7	1.7	<1.2	<2.4	4.8	113	145	161
10/03/09	Dromana	0.5	6.3	6.8	<1.2	<1.2	<2.4	3.7	111	135	142
10/03/09	Middle Ground Shelf	0.5	7.0	6.1	1.8	<1.2	<2.4	2.1	119	143	138
10/03/09	Sorrento Bank	0.5	6.8	5.8	2.1	<1.2	<2.4	3.1	99	124	116
10/03/09	Popes Eye	0.5	8.3	6.7	4.9	<1.2	4.9	5.2	96	120	107

NOTES:

Orange coloured cells indicate EWMA calculated results above EWMA control limits (see Appendix 1, Table 6 for details).

Green coloured cells indicate results above ANZECC trigger value only (see Appendix 1, Table 7 for details). These results are within natural variation for Port Phillip Bay (see control limits, Appendix 1, Tables 5 and 6).

1. Limit of Reporting (LOR) has been amended where previously reported at Limit of Detection (see Exception Report ER080901).

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TABLE 2B NUTRIENTS (CONT'D) – PHOSPHORUS AND SILICATE

Date	Sampling Site	Depth m	Phosphate µg/L		Organic Phosphorus ¹ µg/L	Total Phosphorus µg/L		Silicate µg/L
			Measured Value ¹	EWMA		Measured Value ¹	EWMA	
11/03/09	Yarra River at Newport	0.5	58.7	62.6	25	84	88	472
11/03/09	Hobsons Bay	0.5	51.7	61.5	<18	68	80	119
10/03/09	Central Bay	0.5	48.4	49.7	<18	64	63	107
10/03/09	PoM DMG	0.5	52.6	50.0	<18	68	65	128
11/03/09	Corio Bay	0.5	64.1	64.2	20	84	82	160
11/03/09	Long Reef	0.5	412.7	156.8	47	459	184	288
10/03/09	Patterson River	0.5	42.3	52.3	<18	58	67	61
10/03/09	Dromana	0.5	34.2	38.0	<18	45	51	74
10/03/09	Middle Ground Shelf	0.5	38.9	41.0	<18	51	51	60
10/03/09	Sorrento Bank	0.5	17.2	21.1	<18	27	31	52
10/03/09	Popes Eye	0.5	<7.5	11.4	<18	<18	21	49

NOTES:

Green coloured cells indicate results above ANZECC trigger value (see Appendix 1, Table 7 for details). These results are within natural variation for Port Phillip Bay (see control limits, Appendix 1, Tables 5 and 6).

1. Limit of Reporting (LOR) has been amended where previously reported at Limit of Detection (see Exception Report ER080901).

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TABLE 3 METALS, METALLOIDS AND ORGANOMETALLICS (NST – No Sample Taken, NVR - No Valid Result)

Date	Sampling Site	Depth m	Arsenic µg/L		Tri-butyl Tin ¹ (TBT) µg/Lx10 ⁻³	Cadmium µg/L	Chromium µg/L	Copper µg/L	Mercury µg/L	Nickel µg/L	Lead µg/L	Zinc ² µg/L
			Measured Value	EWMA								
11/03/09	Yarra River at Newport - total	0.5	2.7	2.6	<2	<0.2	<0.5	<1	<0.1	<0.5	<0.2	NVR
11/03/09	Hobsons Bay - total	0.5	2.9	2.8	<2	<0.2	<0.5	<1	<0.1	0.7	<0.2	NVR
10/03/09	Central Bay - total	0.5	2.8	2.8	NST	<0.2	<0.5	<1	<0.1	0.7	<0.2	NVR
10/03/09	PoM DMG - total	0.5	2.9	2.7	NST	<0.2	<0.5	<1	<0.1	0.8	<0.2	NVR
11/03/09	Corio Bay - total	0.5	3.8	3.0	NST	<0.2	<0.5	<1	<0.1	1.3	<0.2	NVR
11/03/09	Corio Bay - dissolved	0.5	3.8	-	NST	<0.2	<0.5	<1	<0.1	1.0	<0.2	NVR
11/03/09	Long Reef - total	0.5	2.9	2.8	NST	<0.2	<0.5	<1	<0.1	2.0	<0.2	NVR
10/03/09	Patterson River - total	0.5	2.8	2.7	NST	<0.2	<0.5	<1	<0.1	0.7	0.2	NVR
10/03/09	Dromana - total	0.5	2.7	2.7	NST	<0.2	<0.5	<1	<0.1	0.7	<0.2	NVR
10/03/09	Middle Ground Shelf - total	0.5	2.8	2.7	NST	<0.2	<0.5	<1	<0.1	1.0	<0.2	NVR
10/03/09	Sorrento Bank - total	0.5	2.4	2.3	NST	<0.2	<0.5	<1	<0.1	<0.5	<0.2	NVR
10/03/09	Popes Eye - total	0.5	2.2	2.1	NST	<0.2	<0.5	<1	<0.1	<0.5	<0.2	NVR

NOTES:

Orange coloured cells indicate EWMA calculated results above EWMA control limits (see Appendix 1, Table 6 for details).

Blue coloured cells indicate results above SEPP objectives (for metals, ANZECC triggers are the default objective when no SEPP value is specified; see Appendix 1, Table 7 for details). These results are within natural variation for Port Phillip Bay (see control limits, Appendix 1, Tables 5 and 6), unless **bolded** to indicate that no Shewhart control limit exists for metals at these sites.

1. TBT is only sampled from sub-surface levels at Yarra River at Newport and Hobsons Bay.
2. No Valid Result (see Exception Report ER090302).



TABLE 4 PHYTOPLANKTON AND ALGAL PIGMENTS (NST – No Sample Taken)

Date	Sampling Site	Depth m	Chlorophyll-a		Phaeophytin-a µg/L	Fluorescence (as <i>in situ</i> chlorophyll-a) mg/m ³	Total Phytoplankton cells/L	Diatoms cells/L	Dinoflagellates cells/L	Other Flagellates cells/L
			Measured Value µg/L	EWMA						
11/03/09	Yarra River at Newport	0.5	2.72	2.19	<0.18	0.74	9.3E+05	5.3E+05	8.0E+04	3.2E+05
11/03/09	Yarra River at Newport	7.6	NST ¹	-	NST ¹	0.64				
11/03/09	Hobsons Bay	0.5	1.23	1.30	<0.18	0.51	6.6E+05	2.8E+05	6.0E+04	3.2E+05
10/03/09	Central Bay	0.5	0.83	0.69	<0.18	0.15	6.6E+05	3.3E+05	3.0E+04	3.1E+05
10/03/09	PoM DMG	0.5	0.96	0.68	<0.18	0.56	6.4E+05	1.7E+05	5.5E+04	4.2E+05
11/03/09	Corio Bay	0.5	1.31	1.04	<0.18	0.59	1.3E+06	9.7E+05	5.5E+04	2.8E+05
11/03/09	Long Reef	0.5	2.57	1.42	<0.18	0.61	1.3E+06	1.0E+06	4.5E+04	2.5E+05
10/03/09	Patterson River	0.5	0.44	0.72	<0.18	0.26	7.7E+05	5.2E+05	3.5E+04	2.2E+05
10/03/09	Dromana	0.5	0.44	0.57	<0.18	<0.01	5.6E+05	2.7E+05	2.5E+04	2.7E+05
10/03/09	Middle Ground Shelf	0.5	0.42	0.51	<0.18	0.36	5.4E+05	2.5E+05	3.5E+04	2.6E+05
10/03/09	Sorrento Bank	0.5	0.64	0.63	<0.18	0.34	5.4E+05	2.6E+05	3.0E+04	2.5E+05
10/03/09	Popes Eye	0.5	0.48	0.58	<0.18	0.18	5.3E+05	2.4E+05	1.5E+04	2.8E+05

NOTES

Sedgewick count method for phytoplankton, diatoms, dinoflagellates, and other flagellates undertaken by using a vertical profile grab sample. For detailed cell counts based on individual species see Appendix 2.

The chlorophyll-a values are assessed against the 90th percentile objective in SEPP (WoV) Schedule F6.

Orange coloured cells indicate EWMA calculated results above EWMA control limits (see Appendix 1, Table 6 for details).

- 1. No algal pigment sample taken at Yarra River at Newport bottom waters.

APPENDIX 1

DERIVATION OF CONTROL LIMITS AND GUIDANCE VALUES

To define changes outside expected natural variability ('control limit'), control charts have been generated for all parameters where an extensive body of locally relevant water quality data exists (see Tables 5 and 6). The data used in developing control charts is validated data from 1994 onwards.

For other parameters where sufficient background data is not available, comparison is made to water quality objectives in State Environment Protection Policy (SEPP) Schedules F6 (Waters of Port Phillip Bay) and Schedule F7 (Waters of the Yarra Catchment).

Where no specific objective is listed in SEPP, the Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters (2001) are identified (see Table 7).

The derivation and application of the control limits and comparison values is set out in more detail in the Water Quality detailed design document CDP_ENV_MD_023 Rev 1.1 (available on the Channel Deepening Project website www.channelproject.com).

Specifically, two control charting techniques have been developed and employed in the analysis of water quality results:

- An Exponentially Weighted Moving Average (EWMA) control chart is used for assessment of longer-term changes in baseline results.
The EWMA is a statistic that averages the data in a way that gives less weight to data as they are further removed in time. To do this EWMA applies weighting factors which decrease exponentially over time. This gives relatively greater importance to recent observations while still not discarding older observations entirely.
EWMA is being used in this context to detect persistent changes from a baseline 'target' concentration, usually the historical mean of the data, which may reflect long term changes in water quality. An upper control limit for the EWMA has been calculated to assist in deciding whether a persistent change from the target value may have occurred
- A Shewhart control chart is used to compare short-term events, by comparing the measured result directly against the respective limit.

In the case of metals, EWMA and Shewhart control limits apply to the 'total' fraction, since the historical data they are derived from are 'total' metals. Conversely SEPP objectives and ANZECC guidelines apply to the 'dissolved' metal fraction. For transparency, this report highlights all metals exceedences whether total or dissolved.



APPENDIX 1 (CONT'D)

TABLE 5. SHEWHART CONTROL LIMITS FOR LISTED WATER QUALITY PARAMETERS

Sampling site	Total Nitrogen µg/L	Ammonium µg/L	Nitrate plus Nitrite µg/L	Total Phosphorus µg/L	Phosphate µg/L	Arsenic µg/L	Cadmium µg/L	Chromium µg/L	Copper µg/L	Lead µg/L	Mercury µg/L	Nickel µg/L	Zinc µg/L	TBT µg/L
Yarra River at Newport	383.31	88.78	182.90	138.91	107.54	4.75	0.20	0.58	3.08	2.79	0.10	4.29	12.77	0.02
Hobsons Bay	382.82	50.61	257.50	135.51	129.08	4.43	0.25	1.17	1.70	0.95	0.13	2.28	9.13	0.01
Central Bay	206.91	21.50	7.43	106.48	112.50	4.66	*	*	*	*	*	1.95	*	*
PoM DMG	217.07	7.81	28.33	107.98	76.61	4.73	*	*	*	*	*	2.82	*	0.02
Corio Bay	275.74	25.37	5.00	140.27	127.68	5.57	*	NA	*	*	*	1.90	*	NA
Long Reef	1035.88	999.28	512.03	536.16	445.31	4.56	*	NA	*	*	*	2.17	*	NA
Patterson River	367.57	30.57	366.52	111.81	87.58	3.56	*	NA	*	*	*	1.14	*	NA
Dromana	222.84	11.03	5.71	89.64	75.42	3.58	*	NA	*	*	*	1.06	*	NA
Middle Ground Shelf	185.93	10.66	2.71	96.82	65.33	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sorrento Bank	168.74	11.54	9.50	63.20	48.44	NA	NA	NA	NA	NA	NA	NA	NA	NA
Popes Eye	209.84	14.74	42.71	471.38	148.04	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTES

NA - No limit, as no historical data is available.

* - No limit, as greater than half historical data is below limits of reporting.

Source: Table 5 CDP_ENV_MD_023 Rev 1.1 (available on the Channel Deepening Project website www.channelproject.com).

TABLE 6. EWMA CONTROL LIMITS FOR LISTED WATER QUALITY PARAMETERS (Exponentially Weighted Moving Average)

Sampling site	Ammonium µg/L	Nitrate plus Nitrite µg/L	Total Nitrogen µg/L	Phosphate µg/L	Total Phosphorus µg/L	Chlorophyll- <i>a</i> µg/L	Arsenic µg/L
Yarra River at Newport	32.42	39.52	278.39	86.19	108.01	2.0	3.23
Hobsons Bay	19.45	39.53	266.22	85.72	105.32	3.9	2.98
Central Bay	9.90	3.61	168.10	72.32	84.08	1.1	2.86
PoM DMG	6.16	9.92	176.47	66.31	83.99	1.0	3.10
Corio Bay	10.70	2.31	224.48	100.12	115.66	1.4	3.66
Long Reef	219.05	83.74	629.12	238.83	305.50	6.8	3.20
Patterson River	13.65	42.75	243.10	69.75	89.34	2.2	2.59
Dromana	5.00	4.29	170.20	56.93	70.12	1.6	2.52
Middle Ground Shelf	7.02	2.29	156.09	50.94	63.85	0.8	N/A
Sorrento Bank	8.16	4.93	143.10	36.40	45.74	0.8	N/A
Popes Eye	8.20	12.73	145.12	36.75	120.94	0.8	N/A

NOTES

NA - No limit, as no historical data is available.

Source: Table 4 CDP_ENV_MD_023 Rev 1.1 (available on the Channel Deepening Project website www.channelproject.com).

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TABLE 7. SEPP OBJECTIVES AND ANZECC TRIGGER VALUES (N = NATURAL)

		Channel Deepening PARAMETER																													
Sampling Site	SEPP (WoV) schedule & segment	ANZECC Level of Protection	Dissolved Oxygen (% saturation)				Salinity variation	Temperature (°C)	Secchi disc depth (m)	Attenuation of PAR Annual 90th percentile	Turbidity NTU	Suspended Solids (mg/L)				Chlorophyll-a (µg/L)															
			Min for 1m below surface	Min 1m above bottom	Lower limit for 90th percentile	Min percentage concentration						Annual 50th percentile	Annual 90th percentile	Annual 50th percentile	Annual 90th percentile	Annual Median	Annual 90th percentile	Ammonium (µg/L)	Nitrate plus nitrite (µg/L)	Total nitrogen (µg/L)	Phosphate (µg/L)	Total Phosphorus (µg/L)	Arsenic (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Nickel (µg/L)	Zinc (µg/L)	TBT (µg/L)
Yarra River at Newport	F6 Hobsons	95%	>90%	>90%			N ± 5%	N ± 1	>2	0.5	0.5 - 10					2.5	4.0	15	5	120	10	25	<3	5.5	<5	1.3	4.4	0.4	70	<10	0.006
	F7 Yarra Port					>60%		N ± 2					<20	<50	<25	<60			15	5	120	10	25	50	0.2	10	3	1	0.05	15	5
Hobsons Bay	F6 Hobsons		>90%	>90%			N ± 5%	N ± 1	>2	0.5	0.5 - 10					2.5	4.0	15	5	120	10	25	<3	5.5	<5	1.3	4.4	0.4	70	<10	0.006
Corio Bay	F6 Corio		>90%	>90%			N ± 5%	N ± 1	>3	0.45	0.5 - 10					1.5	2.5	15	5	120	10	25	<3	5.5	<5	1.3	4.4	0.4	70	<5	0.006
Long Reef	F6 Werribee		>90%	>90%			N ± 5%	N ± 1	>3	0.45	0.5 - 10					2.5	4.0	15	5	120	10	25	<3	5.5	<5	1.3	4.4	0.4	70	<5	0.006
Central Bay	F6 General		>90%		>90%		N ± 5%	N ± 1	>4	0.35	0.5 - 10					1.0	2.0	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004
PoM DMG	F6 General		>90%		>90%		N ± 5%	N ± 1	>4	0.35	0.5 - 10					1.0	2.0	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004
Patterson River	F6 Inshore		>90%	>90%			N ± 5%	N ± 1	>3	0.45	0.5 - 10					1.5	2.5	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004
Dromana	F6 Inshore	>90%	>90%			N ± 5%	N ± 1	>3	0.45	0.5 - 10					1.5	2.5	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004	
Middle Ground Shelf	F6 General	>90%		>90%		N ± 5%	N ± 1	>4	0.35	0.5 - 10					1.0	2.0	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004	
Sorrento Bank	F6 General	>90%		>90%		N ± 5%	N ± 1	>4	0.35	0.5 - 10					1.0	2.0	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004	
Popes Eye	F6 General	>90%		>90%		N ± 5%	N ± 1	>4	0.35	0.5 - 10					1.0	2.0	15	5	120	10	25	<3	<0.15	<5	0.3	2.2	0.1	7	<5	0.0004	

N=natural background

ANZECC trigger values not highlighted

SEPP Waters of Victoria

SEPP Schedule F6 - Waters of Port Phillip Bay, and
SEPP Schedule F7 - Waters of the Yarra Catchment objectives

Limit of reporting above objective

NOTES

Schedule F7 (Waters of the Yarra Catchment) is included for comparison of water quality objectives at the Yarra River at Newport site, as this site has been determined to be in a crossover area between schedules F6 and F7. Both schedule segments can be applicable to the site dependent on tide cycle and flow conditions in the Yarra mouth.



APPENDIX 2

TABLE 8. PHYTOPLANKTON DATA

	Yarra River at Newport	Hobsons Bay	Central Bay	PoM DMG	Corio Bay	Long Reef	Patterson River	Dromana	Middle Ground Shelf	Sorrento Bank	Popes Eye
Collection Date	11/03/2009	11/03/2009	10/03/2009	10/03/2009	11/03/2009	11/03/2009	10/03/2009	10/03/2009	10/03/2009	10/03/2009	10/03/2009
Count Method	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick
Genus	Species										
	Estimate Cells/L										
Total Phytoplankton	9.3E+05	6.6E+05	6.6E+05	6.4E+05	1.3E+06	1.3E+06	7.7E+05	5.6E+05	5.4E+05	5.4E+05	5.3E+05
Diatoms	5.3E+05	2.8E+05	3.3E+05	1.7E+05	9.7E+05	1.0E+06	5.2E+05	2.7E+05	2.5E+05	2.6E+05	2.4E+05
Dinoflagellates	8.0E+04	6.0E+04	3.0E+04	5.5E+04	5.5E+04	4.5E+04	3.5E+04	2.5E+04	3.5E+04	3.0E+04	1.5E+04
Other flagellates	3.2E+05	3.2E+05	3.1E+05	4.2E+05	2.8E+05	2.5E+05	2.2E+05	2.7E+05	2.6E+05	2.5E+05	2.8E+05
Diatoms											
<i>Amphora</i>	<i>sp.</i>					1.5E+04	1.0E+04	1.0E+04			x
<i>Asteromphalus</i>	<i>sarcophagus</i>		x	x							
<i>Bacillaria</i>	<i>paxillifera</i>										5.0E+03
<i>Bacteriastrium</i>	<i>elegans</i>	x	2.0E+04	x			2.0E+04	x			
<i>Cerataulina</i>	<i>pelagica</i>		x								
<i>Chaetoceros</i>	<i>spp.</i>	1.5E+04	2.0E+04	1.1E+05	5.0E+03	2.5E+05	9.0E+04	2.7E+05	9.5E+04	1.5E+04	3.0E+04
<i>Cocconeis</i>	<i>spp.</i>	5.0E+03	5.0E+03	5.0E+03	x	1.0E+04	7.0E+04		1.0E+04	1.5E+04	3.0E+04
<i>Coscinodiscus</i>	<i>spp.</i>	x	x	x	x		x	x	x	x	x
<i>Cylindrotheca</i>	<i>closterium</i>	4.0E+04	4.0E+04	6.0E+04	3.5E+04	2.2E+05	5.2E+05	2.0E+04	4.0E+04	8.0E+04	1.1E+05
<i>Dactylosolen</i>	<i>blavyanus</i>	x	x		x	1.5E+04	5.0E+03	x		x	x
<i>Dactylosolen</i>	<i>fragilissimus</i>			x	x			1.0E+04		x	x
<i>Dietylum</i>	<i>brightwellii</i>	x	5.0E+03								
<i>Entomoneis</i>	<i>sp.</i>	1.5E+04		x	x	x	x	5.0E+03	2.0E+04	x	x
<i>Eucampia</i>	<i>zodiacus</i>	x						x			
<i>Fragilaria</i>	<i>sp.</i>	x			1.0E+04	2.0E+04	2.0E+04	x			x
<i>Fragiliopsis</i>	<i>sp.</i>	1.0E+04	1.0E+04								
<i>Grammotophora</i>	<i>marina</i>				x	5.0E+03					
<i>Guinardia</i>	<i>flaccida</i>	x		x	x		x	5.0E+03	x		x
<i>Hemiaulus</i>	<i>hauckii</i>	5.0E+03	5.0E+03	1.5E+04	x		x	1.0E+04	x	x	x
<i>Leptocylindrus</i>	<i>danicus</i>	1.5E+04	1.5E+04	x	1.5E+04		x	x	x	x	
<i>Licmophora</i>	<i>sp.</i>					2.0E+04	1.0E+04	5.0E+03	x		x
<i>Naviculoid</i>	<i>spp.</i>	5.0E+03	1.0E+04			1.0E+04	3.5E+04	x	5.0E+03	5.0E+03	1.5E+04
<i>Nitzschia</i>	<i>spp.</i>	2.0E+04	1.0E+04		1.0E+04	1.0E+04	4.5E+04				1.0E+04
<i>Pleurosigma</i>	<i>sp.</i>	x	x	x	x	5.0E+03	5.0E+03	1.0E+04		x	x
<i>Proboscia</i>	<i>alata</i>	x	2.0E+04	1.5E+04	5.0E+03		x	4.0E+04	3.5E+04	5.0E+04	4.0E+04
<i>Pseudo-nitzschia</i>	<i>delicatissima</i> group	8.0E+02	3.0E+03		6.0E+02	8.4E+03	4.0E+02	8.0E+02		4.0E+02	1.0E+03
<i>Pseudo-nitzschia</i>	<i>fraudulenta/australis</i>	2.1E+04	5.2E+03		x						x
<i>Pseudo-nitzschia</i>	<i>pungens/multiseriis</i>	4.2E+03	4.2E+03	1.1E+04	4.0E+03			1.4E+03			x
<i>Rhizosolenia</i>	<i>spp.</i>	x		x	x	x		5.0E+03			x
<i>Skeletonema</i>	<i>japonica/pseudocostatum</i>	2.6E+05	5.5E+04	1.5E+04	x	1.7E+05	1.5E+04	3.0E+04	1.5E+04	1.5E+04	x
<i>Thalassionema</i>	<i>sp.</i>						x				
<i>Thalassiosira</i>	<i>sp.</i>	x	x	x				1.0E+04			
<i>Thalassiosira</i>	<i>cf. mala</i>	1.1E+05	7.5E+04	7.5E+04	8.5E+04	2.4E+05	1.9E+05	7.0E+04	4.0E+04	6.5E+04	5.5E+04

NOTES

“X” denotes genus identified, but species not determined in sample.

Blank cells denotes neither genus nor species were detected.

For table on VSQAP Phytoplankton action levels refer to Algal Blooms – Detailed Design, CDP_ENV_MD_012 Rev 1.1.

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TABLE 8. PHYTOPLANKTON DATA (CONT'D)

	Yarra River at Newport	Hobsons Bay	Central Bay	PoM DMG	Corio Bay	Long Reef	Patterson River	Dromana	Middle Ground Shelf	Sorrento Bank	Popes Eye
Collection Date	11/03/2009	11/03/2009	10/03/2009	10/03/2009	11/03/2009	11/03/2009	10/03/2009	10/03/2009	10/03/2009	10/03/2009	10/03/2009
Count Method	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick
Genus	Estimate Cells/L										
Total Phytoplankton	9.3E+05	6.6E+05	6.6E+05	6.4E+05	1.3E+06	1.3E+06	7.7E+05	5.6E+05	5.4E+05	5.4E+05	5.3E+05
Diatoms	5.3E+05	2.8E+05	3.3E+05	1.7E+05	9.7E+05	1.0E+06	5.2E+05	2.7E+05	2.5E+05	2.6E+05	2.4E+05
Dinoflagellates	8.0E+04	6.0E+04	3.0E+04	5.5E+04	5.5E+04	4.5E+04	3.5E+04	2.5E+04	3.5E+04	3.0E+04	1.5E+04
Other flagellates	3.2E+05	3.2E+05	3.1E+05	4.2E+05	2.8E+05	2.5E+05	2.2E+05	2.7E+05	2.6E+05	2.5E+05	2.8E+05
Dinoflagellates											
<i>Alexandrium margalefi</i>		x									
<i>Alexandrium pseudogonyaulax</i>	x			x							
<i>Amphidinium spp.</i>				x							
<i>Ceratium fusus</i>		x		x							
<i>Ceratium tenue</i>	x	x	x	x				x	x		
<i>Ceratium tripos</i>		x	x								
<i>Dinophysis acuminata</i>				d							
<i>Gonyaulax spp.</i>	x										x
<i>Gymnodinium spp.</i>	6.0E+04	3.0E+04	2.0E+04	3.5E+04	3.0E+04	2.5E+04	3.0E+04	2.0E+04	2.0E+04	2.0E+04	5.0E+03
<i>Gyrodinium spp.</i>	x	x		5.0E+03	x			x			x
<i>Heterocapsa rotundata</i>	1.0E+04	2.0E+04	1.0E+04	1.5E+04	2.0E+04	2.0E+04	5.0E+03	5.0E+03	1.5E+04	1.0E+04	1.0E+04
<i>Noctiluca scintillans</i>		x		x	x	x			x	x	
<i>Peridinium sp.</i>	x	x	x		x					x	
<i>Polykrykos schwartzii</i>		x		x							
<i>Prorocentrum cordatum</i>											x
<i>Prorocentrum gracile</i>	x	x	x	x		x					
<i>Prorocentrum triestinum</i>	1.0E+04	5.0E+03			5.0E+03					x	
<i>Protoperidinium spp.</i>				x			x		x	x	
<i>Scrippsiella spp.</i>		5.0E+03					x				
<i>Takayama pulchella</i>					2.0E+02				2.0E+02		
Chrysophytes											
<i>Calycomonas sp.</i>		1.5E+04			1.0E+04		5.0E+03	5.0E+03	1.0E+04	1.5E+04	
Prymnesiophytes											
<i>Calcioappus caudatus</i>								5.0E+03			
<i>Chrysochromulina spp.</i>	1.5E+04	3.5E+04	7.0E+04	6.5E+04	5.0E+04	2.5E+04	4.5E+04	3.0E+04	4.5E+04	4.5E+04	5.0E+04
<i>Emiliana huxleyi</i>	5.0E+03	3.5E+04	6.0E+04	5.0E+04	1.5E+04	5.0E+03	1.5E+04	3.0E+04	3.0E+04	4.0E+04	5.0E+04
<i>Gephyrocapsa oceanica</i>									5.0E+03		5.0E+03
Cryptophytes											
<i>Hemiselmis sp.</i>	7.5E+04	7.5E+04	6.0E+04	7.5E+04	8.5E+04	2.5E+04	5.0E+04	7.0E+04	4.5E+04	6.5E+04	4.5E+04
<i>Leucocryptos marina</i>			5.0E+03								
<i>Plagioselmis prolunga</i>	1.0E+05	6.0E+04	4.5E+04	1.1E+05	4.5E+04	8.0E+04	5.5E+04	9.0E+04	8.0E+04	5.5E+04	8.5E+04
<i>Teleaulax acuta</i>	3.0E+04	2.0E+04	5.0E+03	2.5E+04	2.5E+04	1.5E+04	5.0E+03		5.0E+03	x	1.5E+04
Chlorophytes											
<i>Cosmarium sp.</i>						x					
<i>Closteriopsis sp.</i>						x					
<i>Oocystis sp.</i>						x					
<i>Pediastrum sp.</i>						x					
<i>Scenedesmus sp.</i>						x					
Prasinophytes											
<i>Pyramimonas spp.</i>	8.0E+04	6.0E+04	5.5E+04	6.5E+04	4.5E+04	4.5E+04	4.0E+04	4.0E+04	3.0E+04	2.5E+04	3.0E+04
<i>Tetraselmis spp.</i>	1.0E+04	5.0E+03	5.0E+03	1.5E+04		5.0E+04			5.0E+03		5.0E+03
Euglenophyta											
<i>Eutreptiella spp.</i>	5.0E+03	5.0E+03		5.0E+03			x				5.0E+03
Other											
<i>Apedinella spinifera</i>				5.0E+03							
<i>Dicyocha fibula</i>		x	x	5.0E+03				x	x	x	
<i>Mesodinium rubrum</i>		5.0E+03									

VSQAP Phytoplankton action levels in cells per litre (DPI, 2008)		Comparative data in the report										
		Yarra River at Newport	Hobsons Bay	Central Bay	PoM DMG	Corio Bay	Long Reef	Patterson River	Dromana	Middle Ground Shelf	Sorrento Bank	Popes Eye
Taxa	Warning to growers											
<i>Pseudo-nitzschia spp.</i>	50 000	25800	12400	10800	4600	8400	400	2200		400	1000	
<i>Rhizosolenia cf chunii</i>	10 000	x		x	x	x		x			x	
<i>Alexandrium catenella</i>	100											
<i>Alexandrium minutum</i>	100											
<i>Alexandrium tamarense</i>	100											
<i>Dinophysis acuminata</i>	1 000				150							
<i>Dinophysis caudata</i>	1 000											
<i>Dinophysis fortii</i>	1 000											
<i>Gymnodinium catenatum</i>	100											
<i>Karenia mikimotoi</i>	1 000											
<i>Karenia brevis</i>	1 000											
<i>Prorocentrum lima</i>	1 000											

NOTES

“X” denotes genus identified, but species not determined in sample.

Blank cells denotes neither genus nor species were detected.

For table on VSQAP Phytoplankton action levels refer to Algal Blooms – Detailed Design, CDP_ENV_MD_012 Rev 1.1.

APPENDIX 3

TABLE 9. SUMMARY OF CHANGES TO CHLOROPHYLL-A EWMA VALUES* REPORTED IN PROGRESS REPORTS #7 - 12 (JULY – DECEMBER 2008).

Date	Sampling Site	Depth m	Chlorophyll-a µg/L		
			Measured Value	Reported EWMA	Revised EWMA
16/07/2009	Sorrento Bank	0.5	0.78	0.63	0.66
17/08/2008	Middle Ground Shelf	0.5	1.21	0.74	0.79
17/09/2008	Middle Ground Shelf	0.5	0.70	0.78	0.77
16/10/2008	PoM DMG	0.5	0.47	0.70	0.72
12/11/2008	Yarra River at Newport	0.5	1.87	1.64	1.67
8/12/2008	Yarra River at Newport	0.5	4.01	2.10	2.14

*NOTES

Incorrect EWMA data was originally published in Progress Reports No.7-12 due to an error in the calculation of the EWMA values (see also Exception Report ER090301 for details).