



BAYWIDE WATER QUALITY MONITORING PROGRAM

PROGRESS REPORT No. 19 (JULY 2009)

AUGUST 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 July 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.

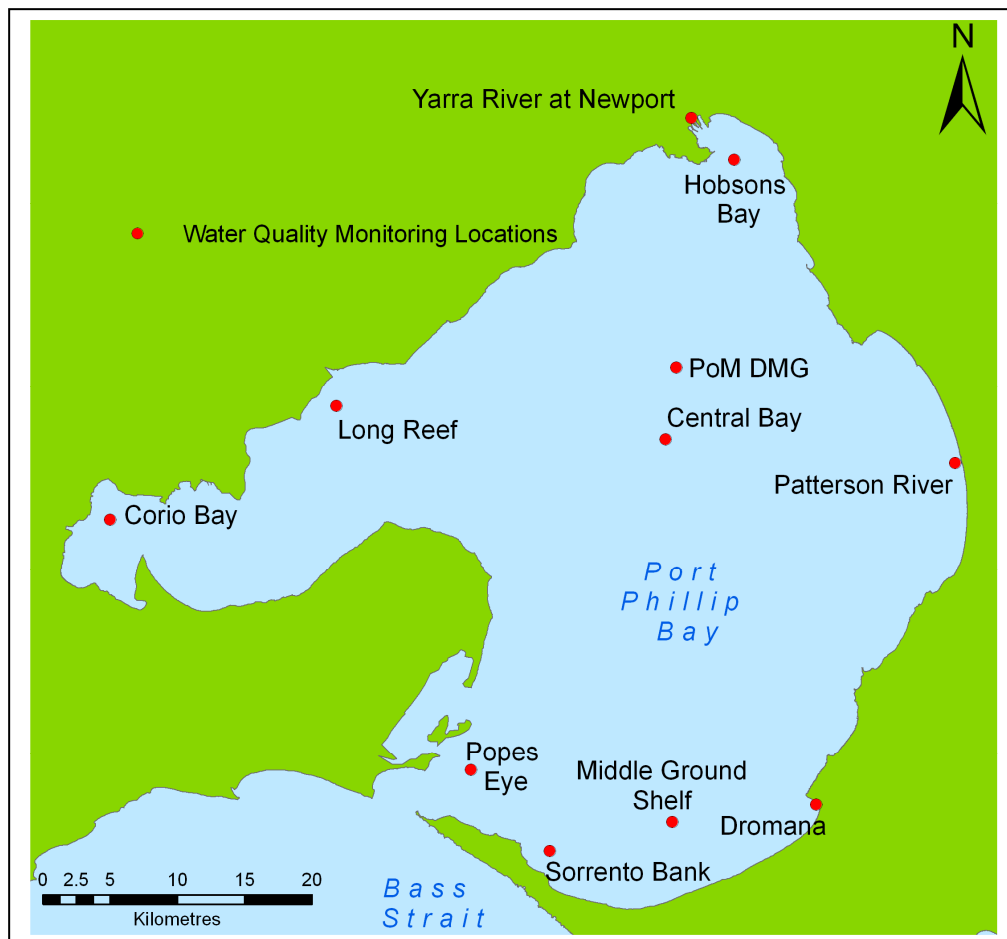


FIGURE 1 MAP OF SAMPLING SITES IN PORT PHILLIP BAY

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 2.0 (PoMC 2009).

The format of EPA progress reports has been updated to improve clarity around reported results and exceedences of control limits in line with the Detailed Design. The progress reports now:

- Report both dissolved and total metal values (rather than reporting dissolved values only when total values exceed SEPP water quality objectives).
- Highlight exceedences of SEPP water quality objectives only in cases where a site specific control limit is not defined
- Highlight the total fraction of metals only when it exceeds SEPP objectives or dissolved fraction values for ANZECC trigger levels.

EXCEPTIONS

There was one new exception to the Detailed Design (PoMC 2009) during this reporting period, outlined as follows:

- ER090701: The July 2009 sampling event was undertaken one week prior to the scheduled date.

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 Shewhart control limits were exceeded twice and the EWMA control limits were exceeded 8 times (see Tables 1 - 4).

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

As detailed in section 4.1.3 in the Water Quality detailed design document CDP_ENV_MD_023 Rev 2.0, 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 2009, Water Quality Detailed Design CDP_ENV_MD_023 Rev 2.0, Port of Melbourne Corporation, May 2009.

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 mg/L	PAR micro Einsteins/m ² /sec
			mg/L	% saturation						
08/07/09	Yarra River at Newport	0.5	8.3	90	27.8	0.6	11.3	6.93	10.6	424.8
08/07/09	Yarra River at Newport	5.5	NST ²	NST ²	NST ²		NST ²	18.08	NST ²	0.1
08/07/09	Hobsons Bay	0.5	8.5	98	36.8	3.8	11.1	1.56	3.2	493.5
07/07/09	Central Bay	0.5	8.2	96	37.3	8.5	11.8	0.37	<1.5	233.1
07/07/09	PoM DMG	0.5	8.2	95	37.4	8.5	11.5	0.30	<1.5	66.6
08/07/09	Corio Bay	0.5	8.4	95	37.8	>5.6 ¹	10.1	0.69	<1.5	72.5
08/07/09	Long Reef	0.5	8.6	96	37.2	>5.1 ¹	9.8	0.56	<1.5	406.7
07/07/09	Patterson River	0.5	8.2	95	37.0	6.8	11.5	0.57	<1.5	305.0
07/07/09	Dromana	0.5	8.2	96	36.9	>6.8 ¹	11.9	0.30	<1.5	371.1
07/07/09	Middle Ground Shelf	0.5	8.2	96	37.0	9.3	11.9	0.52	<1.5	116.4
07/07/09	Sorrento Bank	0.5	8.2	96	36.6	>3.3 ¹	12.3	0.38	<1.5	395.4
07/07/09	Popes Eye	0.5	8.0	96	35.6	>10.3 ¹	13.6	0.18	<1.5	243.9

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 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. Secchi disc visible on bottom.
2. No sample taken at depth as the salinity difference between the near surface and depth was less than 10 ppt.

TABLE 2A NUTRIENTS

Date	Sampling Site	Depth m	Ammonium µg/L		Nitrate µg/L	Nitrite µg/L	Nitrate plus Nitrite µg/L		Dissolved Organic Nitrogen µg/L	Total Nitrogen µg/L	
			Measured Value	EWMA			Measured Value	EWMA		Measured Value	EWMA
08/07/09	Yarra River at Newport	0.5	54.4	30.4	150.6	3.7	154.3	51.7	140	381	276
07/07/09	Hobsons Bay	0.5	7.4	8.8	38.4	< 1.2	38.4	12.6	115	194	183
07/07/09	Central Bay	0.5	4.5	5.5	2.5	< 1.2	2.5	2.3	101	124	140
07/07/09	PoM DMG	0.5	4.5	5.7	1.5	< 1.2	1.5	2.5	112	134	142
08/07/09	Corio Bay	0.5	5.3	6.0	1.4	< 1.2	1.4	2.5	128	146	185
08/07/09	Long Reef	0.5	103.1	30.1	132.1	2.9	135.0	40.1	166	422	254
07/07/09	Patterson River	0.5	4.6	6.0	1.9	< 1.2	1.9	3.4	106	131	151
07/07/09	Dromana	0.5	5.1	5.7	2.3	< 1.2	2.3	3.8	87	105	131
07/07/09	Middle Ground Shelf	0.5	4.9	5.7	1.7	< 1.2	1.7	2.4	92	115	134
07/07/09	Sorrento Bank	0.5	5.0	5.6	4.3	< 1.2	4.3	5.5	78	101	109
07/07/09	Popes Eye	0.5	5.7	6.3	8.4	4.4	12.8	8.4	58	87	101

NOTES:

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

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

Date	Sampling Site	Depth m	Phosphate µg/L		Organic Phosphorus µg/L	Total Phosphorus µg/L		Silicate µg/L
			Measured Value	EWMA		Measured Value	EWMA	
08/07/09	Yarra River at Newport	0.5	47.6	57.4	< 18	62	81	816
07/07/09	Hobsons Bay	0.5	74.7	63.4	< 18	90	83	123
07/07/09	Central Bay	0.5	41.9	45.2	< 18	53	58	65
07/07/09	PoM DMG	0.5	44.4	46.6	< 18	57	60	57
08/07/09	Corio Bay	0.5	54.5	61.2	< 18	67	78	97
08/07/09	Long Reef	0.5	170.2	120.9	< 18	184	141	102
07/07/09	Patterson River	0.5	45.6	50.1	< 18	58	64	91
07/07/09	Dromana	0.5	31.9	35.2	< 18	38	47	53
07/07/09	Middle Ground Shelf	0.5	35.4	38.6	< 18	42	49	52
07/07/09	Sorrento Bank	0.5	24.9	18.9	< 18	34	29	44
07/07/09	Popes Eye	0.5	< 7.5	10.6	< 18	< 18	19	27



TABLE 3A TOTAL METALS, METALLOIDS AND ORGANOMETALLICS (NST – No Sample Taken)

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 µg/L
			Measured Value	EWMA								
08/07/09	Yarra River at Newport	0.5	2.1	2.5	<2	<0.2	0.7	1	<0.1	1	0.6	14
07/07/09	Hobsons Bay	0.5	2.2	2.6	<2	<0.2	<0.5	<1	<0.1	0.7	<0.2	<5
07/07/09	Central Bay	0.5	2.5	2.6	NST	<0.2	<0.5	<1	<0.1	0.6	<0.2	<5
07/07/09	PoM DMG	0.5	2.6	2.6	NST	<0.2	<0.5	<1	<0.1	0.7	0.3	<5
08/07/09	Corio Bay	0.5	2.4	2.8	NST	0.2	<0.5	<1	<0.1	0.9	0.3	<5
08/07/09	Long Reef	0.5	2.5	2.6	NST	<0.2	<0.5	<1	<0.1	0.8	0.2	<5
07/07/09	Patterson River	0.5	2.4	2.6	NST	<0.2	<0.5	<1	<0.1	0.7	<0.2	<5
07/07/09	Dromana	0.5	2.4	2.5	NST	<0.2	<0.5	<1	<0.1	0.6	<0.2	<5
07/07/09	Middle Ground Shelf	0.5	2.4	2.5	NST	<0.2	0.7	<1	<0.1	0.6	<0.2	<5
07/07/09	Sorrento Bank	0.5	2.3	2.2	NST	<0.2	<0.5	<1	<0.1	<0.5	<0.2	<5
07/07/09	Popes Eye	0.5	1.8	2.0	NST	<0.2	<0.5	<1	<0.1	<0.5	<0.2	<5

Notes:

Yellow coloured cells indicate measured results above the Shewhart control limit (for 'total' fraction) (see Appendix 1, Table 5 for details).

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

1. TBT is only sampled from sub-surface levels at Yarra River at Newport and Hobsons Bay.

TABLE 3B DISSOLVED METALS, METALLOIDS AND ORGANOMETALLICS

Date	Sampling Site	Depth m	Arsenic µg/L	Cadmium µg/L	Chromium µg/L	Copper µg/L	Mercury µg/L	Nickel µg/L	Lead µg/L	Zinc µg/L
08/07/09	Yarra River at Newport	0.5	1.8	<0.2	<0.5	<1	<0.1	1	<0.2	10
07/07/09	Hobsons Bay	0.5	2.2	<0.2	<0.5	<1	<0.1	0.7	<0.2	<5
07/07/09	Central Bay	0.5	2.4	<0.2	<0.5	<1	<0.1	0.6	<0.2	<5
07/07/09	PoM DMG	0.5	2.5	<0.2	<0.5	<1	<0.1	0.6	<0.2	<5
08/07/09	Corio Bay	0.5	2.3	<0.2	<0.5	<1	<0.1	0.8	<0.2	<5
08/07/09	Long Reef	0.5	2.2	<0.2	<0.5	<1	<0.1	0.8	<0.2	<5
07/07/09	Patterson River	0.5	2.3	<0.2	<0.5	<1	<0.1	0.7	<0.2	<5
07/07/09	Dromana	0.5	2.3	<0.2	<0.5	<1	<0.1	0.5	<0.2	<5
07/07/09	Middle Ground Shelf	0.5	2.3	<0.2	<0.5	<1	<0.1	0.6	<0.2	<5
07/07/09	Sorrento Bank	0.5	2.1	<0.2	<0.5	<1	<0.1	<0.5	<0.2	<5
07/07/09	Popes Eye	0.5	1.7	<0.2	<0.5	<1	<0.1	<0.5	<0.2	<5

NOTES:

Green coloured cells indicate results above ANZECC trigger values (for metals, ANZECC triggers are the default objective when no SEPP value is specified; see Appendix 1, Table 7 for details).



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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						
08/07/09	Yarra River at Newport	0.5	0.70	2.11	< 0.18	0.28	1.2E+06	9.9E+04	7.8E+05	2.7E+05
08/07/09	Yarra River at Newport	5.5	NST ¹	NST ¹	NST ¹	0.33				
07/07/09	Hobsons Bay	0.5	2.31	1.71	0.25	0.45	2.0E+06	4.2E+05	1.1E+06	4.4E+05
07/07/09	Central Bay	0.5	0.72	0.76	< 0.18	0.15	6.2E+05	1.4E+05	3.5E+05	1.3E+05
07/07/09	PoM DMG	0.5	0.68	0.79	< 0.18	0.22	7.8E+05	2.2E+05	4.2E+05	1.5E+05
08/07/09	Corio Bay	0.5	0.64	1.17	< 0.18	0.21	4.7E+05	6.1E+04	2.9E+05	1.2E+05
08/07/09	Long Reef	0.5	0.67	1.17	0.25	0.15	1.5E+06	3.7E+05	8.1E+05	3.1E+05
07/07/09	Patterson River	0.5	0.91	0.8	< 0.18	0.15	1.0E+06	3.1E+05	5.4E+05	1.8E+05
07/07/09	Dromana	0.5	0.52	0.78	< 0.18	0.05	3.5E+05	9.7E+04	2.0E+05	5.8E+04
07/07/09	Middle Ground Shelf	0.5	0.87	0.78	< 0.18	0.17	6.6E+05	1.7E+05	3.5E+05	1.3E+05
07/07/09	Sorrento Bank	0.5	0.78	0.81	< 0.18	0.15	5.6E+05	1.0E+05	3.3E+05	1.3E+05
07/07/09	Popes Eye	0.5	0.46	0.59	< 0.18	<0.01	4.2E+05	5.5E+04	2.7E+05	9.7E+04

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.

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 2.0 (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, specified SEPP objectives, EWMA and Shewhart control limits apply to the 'total' fraction, since the historical data they are derived from are 'total' metals. Conversely ANZECC guidelines apply to the 'dissolved' metal fraction.



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 2.0 (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 2.0 (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)				Attenuation of PAR			Turbidity		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	Salinity variation	Temperature (°C)	Secchi disc depth (m)	Annual 90th percentile	NTU	Annual 50th percentile	Annual 90th percentile	Annual 50th percentile	Annual 90th percentile	Chlorophyll-a (µg/L)	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	

SEPP Waters of Victoria N=natural background

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

Limit of reporting above objective

ANZECC trigger values not highlighted

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	8/07/2009	8/07/2009	7/07/2009	7/07/2009	8/07/2009	8/07/2009	7/07/2009	7/07/2009	7/07/2009	7/07/2009	7/07/2009
Count Method	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick
Genus	Species										
Total Phytoplankton	1.2E+06	2.0E+06	6.2E+05	7.8E+05	4.7E+05	1.5E+06	1.0E+06	3.5E+05	6.6E+05	5.6E+05	4.2E+05
Diatoms	9.9E+04	4.2E+05	1.4E+05	2.2E+05	6.1E+04	3.7E+05	3.1E+05	9.7E+04	1.7E+05	1.0E+05	5.5E+04
Dinoflagellates	7.8E+05	1.1E+06	3.5E+05	4.2E+05	2.9E+05	8.1E+05	5.4E+05	2.0E+05	3.5E+05	3.3E+05	2.7E+05
Other flagellates	2.7E+05	4.4E+05	1.3E+05	1.5E+05	1.2E+05	3.1E+05	1.8E+05	5.8E+04	1.3E+05	1.3E+05	9.7E+04
Estimate Cells/L											
Diatoms											
<i>Amphora</i>	<i>sp.</i>			2.0E+03		X	5.0E+03	2.5E+03	1.0E+03		6.0E+03
<i>Asterionomphalus</i>	<i>sarcophagus</i>				2.0E+03					2.0E+03	
<i>Attheya</i>	<i>sp.</i>						5.0E+03				
<i>Bacillaria</i>	<i>paxillifera</i>					X					
<i>Bacteriastrium</i>	<i>elegans</i>									2.0E+03	
<i>Campylodiscus</i>	<i>sp.</i>	X									
<i>Chaetoceros</i>	<i>ssp.</i>	4.3E+04	3.0E+05	7.8E+04	1.1E+05	3.1E+04	8.5E+04	2.2E+05	7.1E+04	1.1E+05	4.0E+04
<i>Cocconeis</i>	<i>ssp.</i>	3.3E+03	1.0E+04	2.0E+03		2.0E+03	4.5E+04			2.0E+03	2.0E+03
<i>Coscinodiscus</i>	<i>ssp.</i>	X	X								1.2E+04
<i>Cylindrotheca</i>	<i>closterium</i>		5.0E+03	2.0E+03	3.0E+04	3.0E+03	9.0E+04	1.0E+04	2.0E+03	4.0E+03	4.0E+03
<i>Cymbella</i>	<i>sp.</i>						5.0E+03				
<i>Dactylosolen</i>	<i>sp.</i>		X	X			X	X	1.0E+03		
<i>Dactylosolen</i>	<i>fragilissimus</i>				4.0E+03					4.0E+03	
<i>Dactylosolen</i>	<i>phukutensis</i>								X	2.0E+03	X
<i>Diploneis</i>	<i>sp.</i>			2.0E+03							
<i>Ditylum</i>	<i>brightwellii</i>				X				X	X	X
<i>Encyonema</i>	<i>sp.</i>						5.0E+03				3.0E+03
<i>Entomoneis</i>	<i>sp.</i>	X	X	X	2.0E+03	X	X	X	X	X	X
<i>Eucampia</i>	<i>zodiacus</i>	X		X	X		X	7.5E+03	X	X	1.0E+04
<i>Fallica</i>	<i>sp.</i>			X							
<i>Fragilaria</i>	<i>sp.</i>		5.0E+03			X	1.0E+04				
<i>Guinardia</i>	<i>flaccida</i>			X	X			X	X	2.0E+03	X
<i>Guinardia</i>	<i>striata</i>			X					X	X	
<i>Helicotheca</i>	<i>tamesis</i>										X
<i>Hemiaulus</i>	<i>hauckii</i>			1.6E+04	2.2E+04			X	1.0E+04	1.6E+04	2.0E+03
<i>Leptocylindrus</i>	<i>danicus</i>			2.0E+03	8.0E+03	X	X	2.5E+03	1.0E+03	X	8.0E+03
<i>Leptocylindrus</i>	<i>mediterraneus</i>										
<i>Leptocylindrus</i>	<i>minimus</i>										4.0E+03
<i>Licmophora</i>	<i>sp.</i>					1.0E+04	5.0E+03	2.5E+03	1.0E+03		
<i>Lioloma</i>	<i>sp.</i>					X					
<i>Minidiscus</i>	<i>tricolatus</i>		1.0E+04		4.0E+03	2.0E+03		1.0E+04	1.0E+03	4.0E+03	1.0E+04
<i>Minutocellus</i>	<i>sp.</i>	3.3E+03	5.0E+03							2.0E+03	2.0E+03
<i>Navicloid</i>	<i>ssp.</i>	3.3E+03		X	2.0E+03	2.0E+03	5.0E+03	2.5E+03			2.0E+03
<i>Nitzschia</i>	<i>sp.</i>	2.3E+04	1.0E+03	4.0E+03	1.2E+04	3.0E+03	5.5E+04	1.3E+04	1.0E+03	1.0E+04	6.0E+03
<i>Nitzschia</i>	<i>sigmoidea</i>						5.0E+03				
<i>Pleurosigma</i>	<i>sp.</i>	X	X	2.0E+03	X	X	5.0E+03		1.0E+03	X	X
<i>Proboxia</i>	<i>alata</i>	X		4.0E+03	X				X	X	X
<i>Pseudo-nitzschia</i>	<i>sp.</i>										
<i>Pseudo-nitzschia</i>	<i>delicatissima</i> group	X		3.5E+03	3.5E+03	X	1.0E+03	2.0E+03	1.5E+03	1.0E+03	X
<i>Pseudo-nitzschia</i>	<i>heimii</i>						1.0E+03				5.0E+02
<i>Pseudo-nitzschia</i>	<i>pungens/multiseriis</i>	1.7E+02	2.5E+03	2.0E+03	1.5E+03	X	X	2.5E+03	2.0E+03	2.0E+03	4.0E+02
<i>Rhizosolenia</i>	<i>ssp.</i>	X	X	X	X		X	X	X	2.0E+03	X
<i>Rhizosolenia</i>	<i>setigera</i>				X			X			
<i>Skeletonema</i>	<i>japonicum/pseudocostatum</i>		X					X			
<i>Stauroneis</i>	<i>sp.</i>	X									
<i>Striatella</i>	<i>unipunctata</i>										X
<i>Thalassionema</i>	<i>sp.</i>					X			X		
<i>Thalassiosira</i>	<i>sp.</i>	1.0E+04	3.5E+04	2.0E+03	2.0E+03	1.0E+03		2.5E+03		2.0E+03	1.0E+03
<i>Thalassiosira</i>	<i>cf. mala</i>	1.3E+04	4.5E+04	1.6E+04	1.2E+04	7.0E+03	4.5E+04	3.5E+04	4.0E+03	1.2E+04	2.2E+04
											8.0E+03

NOTES

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

Blank cells denotes neither genus nor species were detected.

For table on VSOM Phytoplankton action levels refer to Algal Blooms – Detailed Design, CDP_ENV_MD_012 Rev 2.0.

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	8/07/2009	8/07/2009	7/07/2009	7/07/2009	8/07/2009	8/07/2009	7/07/2009	7/07/2009	7/07/2009	7/07/2009	7/07/2009
Count Method	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick	Sedgewick
Genus	Estimate Cells/L										
Total Phytoplankton	1.2E+06	2.0E+06	6.2E+05	7.8E+05	4.7E+05	1.5E+06	1.0E+06	3.5E+05	6.6E+05	5.6E+05	4.2E+05
Diatoms	9.9E+04	4.2E+05	1.4E+05	2.2E+05	6.1E+04	3.7E+05	3.1E+05	9.7E+04	1.7E+05	1.0E+05	5.5E+04
Dinoflagellates	7.8E+05	1.1E+06	3.5E+05	4.2E+05	2.9E+05	8.1E+05	5.4E+05	2.0E+05	3.5E+05	3.3E+05	2.7E+05
Other flagellates	2.7E+05	4.4E+05	1.3E+05	1.5E+05	1.2E+05	3.1E+05	1.8E+05	5.8E+04	1.3E+05	1.3E+05	9.7E+04
Dinoflagellates											
<i>Alexandrium catenella/fundvense</i>		X		X							X
<i>Alexandrium marsaleii</i>						X		X			
<i>Alexandrium pseudogonyaulax</i>								X			
<i>Alexandrium tamarense</i>		X	X		X						
<i>Alexandrium</i> sp.				5.0E+01					5.0E+01		
<i>Ceratium furca</i>			2.5E+03		X						
<i>Ceratium fusus</i>				X							X
<i>Ceratium lineatum</i>											X
<i>Ceratium macroceros</i>			X	5.0E+02							
<i>Ceratium tenue</i>		X	X		X	X	1.0E+03	5.0E+02	5.0E+01	X	X
<i>Dinophysis acuminata</i>		X			X	X	5.0E+01		5.0E+01	5.0E+01	
<i>Diplopelta bomba</i>		X							X		
<i>Gonyaulax</i> spp.		X		X	X				X		
<i>Gymnodinium</i> spp.	4.3E+04	1.5E+04	6.0E+03	1.0E+04	5.0E+03	2.0E+04	2.0E+04	7.0E+03	4.0E+03	2.0E+03	5.0E+03
<i>Gyrodinium</i> spp.	6.7E+03	1.5E+04	2.0E+03	4.0E+03	1.0E+03		2.5E+03			2.0E+03	2.0E+03
<i>Heterococcosa rotundata</i>	2.7E+04	5.5E+04	6.0E+03	8.0E+03	1.0E+04	2.5E+04	2.0E+04	4.0E+03	1.0E+04	2.0E+03	6.0E+03
<i>Noctiluca scintillans</i>		1.0E+02	1.0E+02		5.0E+01	X			1.5E+02		
<i>Polykrykos schwartzii</i>				X							
<i>Preperidinium meuneri</i>		X			X	X			X		X
<i>Prorocentrum spinifera</i>				X							
<i>Prorocentrum cordatum</i>						1.0E+03					
<i>Prorocentrum gracile</i>			X								
<i>Prorocentrum rhalthymum</i>								5.0E+01			
<i>Protoperidinium</i> spp.		5.0E+03	X	X	X	X	X	X	X	X	X
<i>Scrippsiella</i> spp.		X		X	X	X					1.0E+03
<i>Takayama pulchella</i>				1.0E+02							
Chrysophytes											
<i>Calycomonas</i> sp.	1.3E+04	1.5E+04	8.0E+03	2.0E+03	1.0E+03	4.0E+04	5.0E+03	1.0E+03	4.0E+03	2.0E+03	
<i>Chromonas</i> spp.	3.3E+03	1.5E+04	8.0E+03	1.0E+04	2.0E+03	5.0E+03	7.5E+03		2.0E+03	2.0E+03	
Prymnesiophytes											
<i>Chrysochromulina</i> spp.		3.0E+04	8.0E+03	6.0E+03	1.3E+04		7.5E+03	3.0E+03	6.0E+03	1.0E+04	5.0E+03
<i>Emiliania huxleyi</i>		5.0E+03	1.6E+04	2.6E+04	1.5E+04		2.3E+04	4.0E+03	3.4E+04	1.2E+04	2.6E+04
<i>Gephyrocapsa oceanica</i>							2.5E+03	1.0E+03	2.0E+03	4.0E+03	1.4E+04
<i>Paraphysomonas</i> sp.											1.0E+03
<i>Syracosphaera</i> sp.											1.0E+03
Cryptophytes											
<i>Hemiselmis</i> sp.	6.7E+04	6.5E+04	3.0E+04	1.8E+04	2.3E+04	1.2E+05	5.3E+04	1.0E+04	2.6E+04	2.0E+04	2.1E+04
<i>Leucocryptos marina</i>	3.0E+04	6.5E+04	1.0E+04	1.6E+04	1.1E+04	3.0E+04	1.5E+04	1.0E+04	1.4E+04	1.4E+04	5.0E+03
<i>Plagioselmis prolonga</i>	1.2E+05	1.5E+05	2.6E+04	4.0E+04	2.4E+04	8.5E+04	4.0E+04	2.1E+04	3.6E+04	4.0E+04	1.0E+04
<i>Rhodomonas salina</i>	6.7E+03	5.0E+03	2.0E+03				5.0E+03				
<i>Teleaulax acuta</i>	6.7E+03	3.5E+04	8.0E+03	6.0E+03	3.0E+03	1.0E+04	2.5E+03	4.0E+03	4.0E+03	6.0E+03	3.0E+03
Chlorophytes											
<i>Closterium</i> sp.						X					
<i>Pediastrum</i> sp.						X					
Prasinophytes											
<i>Pyramimonas</i> spp.	1.3E+04	3.0E+04	1.0E+04	2.6E+04	8.0E+03	1.5E+04	1.8E+04	4.0E+03	4.0E+03	1.4E+04	5.0E+03
<i>Tetraselmis</i> spp.	1.3E+04	1.5E+04	2.0E+03	2.0E+03	5.0E+03	5.0E+03	5.0E+03			2.0E+03	5.0E+03
Euglenophyta											
<i>Eutreptiella</i> spp.		5.0E+03	2.0E+03	2.0E+03		5.0E+03	2.5E+03	1.0E+03		2.0E+03	X
Other											
<i>Apedinella spinifera</i>		1.0E+04			1.0E+03						
<i>Dicyocha fibula</i>						X					
<i>Unidentified bodonids</i>	3.3E+03			2.0E+03			2.5E+03	1.0E+03	2.0E+03	1.0E+04	1.0E+03
<i>Mesodinium rubrum</i>					1.0E+03	1.0E+04	2.5E+03		2.0E+03		

VSOM Phytoplankton action levels in cells per litre (DPI, 2009)	Warning to growers	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
<i>Pseudo-nitzschia</i> spp.	100 000	170	2500	5500	5000	X	2000	4500	3500	3000	400	1000
<i>Rhizosolenia cf chunii</i>	10 000				X							
<i>Alexandrium catenella</i>	200		X		X							
<i>Alexandrium minutum</i>	200											
<i>Alexandrium tamarense</i>	200		X	X		X						
<i>Dinophysis acuminata</i>	1 000		X			X	X	50		50	50	
<i>Dinophysis caudata</i>	1 000											
<i>Dinophysis fortii</i>	1 000											
<i>Gymnodinium catenatum</i>	1000											
<i>Karenia mikimotoi</i>	100 000											
<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 VSOM Phytoplankton action levels refer to Algal Blooms – Detailed Design, CDP_ENV_MD_012 Rev 2.0

