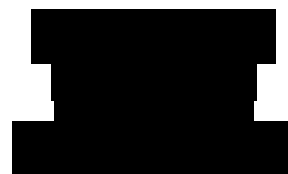**CREH**

CENTRE FOR
RESEARCH INTO
ENVIRONMENT AND
HEALTH

Ressessment of
the trophic status of
St Aubin's Bay, Jersey
2009-2010

A Report to
Transport and Technical Services, States of Jersey
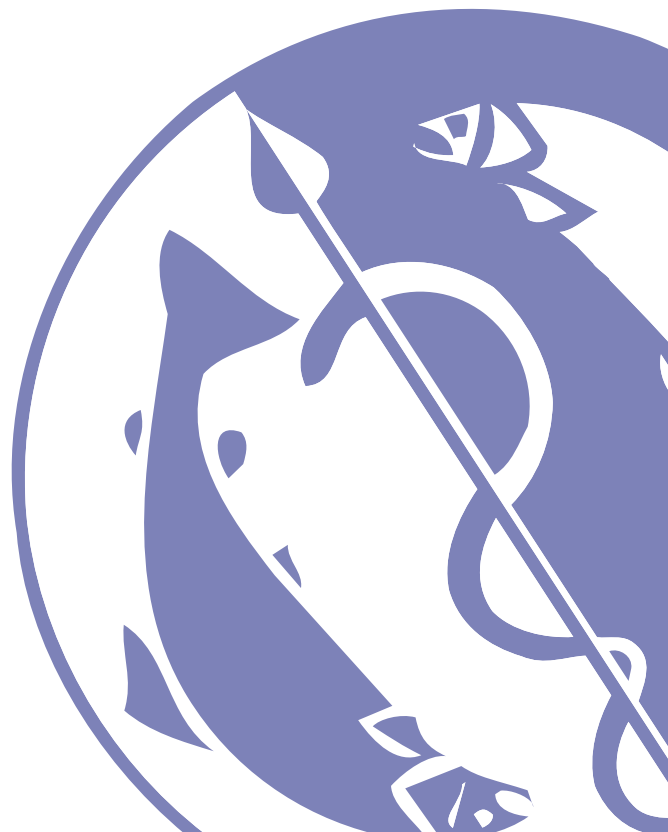
November 2010

Tables

Table 2.1   Beach and offshore survey details, 2009-2010.

Survey	Date	Predicted High Water (m)	High Water Time (GMT)	Time of survey (GMT)
Beach surveys				
Beach 1	01/06/09	8.77	13:12	14:30 – 16:55
Beach 2	15/06/09	8.65	11:12	07:20 – 15:20
Beach 3	29/06/09	9.37	11:29	08:35 – 14:15
Beach 4	13/07/09	9.52	09:53	07:15 – 13:00
Beach 5	27/07/09	10.34	10:03	07:45 – 12:45
Beach 6	10/08/09	10.33	08.47	06:45 – 14:15
Beach 7	24/08/09	11.18	08:49	09:15 – 14:55
Beach 8	02/09/09	9.25	17:30	07:15 – 10:40
Beach 9	14/09/09	8.22	14:14	07:00 – 09:30
Beach 10	29/09/09	7.66	15.26	07:10 – 11:00
Beach 11	15/10/09	9.68	16:19	07:15 – 11:10
Beach 12	27/10/09	7.43	12:55	08:15 – 11:45
Beach 13	08/02/10	7.54	14:00	08:40 – 13:30
Beach 14	02/03/10	12.32	07:28	07:45 – 12:10
Beach 15	15/03/10	10.34	06:23	08:15 – 12:10
Beach 16	30/03/10	11.81	06:26	07:40 – 11:00
Beach 17	12/04/10	9.54	05:17	06:45 – 10:40
Beach 18	26/04/10	10.18	04:34	11:35 – 14:10
Beach 19	20/05/10	9.27	11:03	08:00 – 10:50
Beach 20	08/06/10	8.56	15:18	06:20 – 10:05
Beach 21	16/06/10	10.57	09:05	08:00 – 12:15
Beach 22	01/07/10	9.58	09:18	06:30 – 10:00
Offshore surveys*				
Offshore 1	02/06/09	8.75	14:21	09:00 – 14:37
Offshore 2	30/06/09	8.85	12:27	08:10 – 12:26
Offshore 3	11/08/09	10.12	09:20	08:10 – 12:25
Offshore 4[a]	14/08/09	8.80	11:33	08:10 – 09:54
Offshore 5	01/03/10	12.04	06:48	09:50 – 13:30
Offshore 6	29/03/10	11.24	05:45	09:05 – 12:35
Offshore 7	26/04/10	10.18	04:34	06:06 – 09:45
Offshore 8[b]	07/06/10	8.22	14:19	06:21 – 12:53
Offshore 9[b]	28/06/10	9.91	07:31	03:35 – 10:07

*   NB an attempted offshore survey on 28/7/09 was abandoned due to inclement weather after only three samples were collected from zone C.

a   Depth profile water quality samples only

b   Depth profile water quality samples and sonde measurements also taken in addition to routine surface samples.

Table 2.2 **Sampling and discharge gauging site details (see Figure 2.1 also)**

Site	Name	Easting (m)[a]	Northing (m)[a]
Water quality monitoring sites:			
101	St Brelade's stream at St Aubin's Harbour	560575	5448825
102	La Haule A at coastal outfall	560850	5449375
103	La Haule B at coastal outfall	561300	5449675
104	St Peter's Valley at coastal outfall	561650	5449825
105	Waterworks Valley at coastal outfall	562950	5449775
106	Bellozanne Valley at sewage treatment works	563950	5450550
107	Weighbridge outfall at manhole 9	565100	5448225
301	Bellozanne Outfall	563375	5449275
301a	First Tower pumping station manhole	563600	5449625
Discharge gauging sites:			
101a	St Brelade's stream upstream of culvert	560175	5448900
104a	St Peter's Valley at Sandybrook	561600	5450475
107a	Vallée desVaux at supermarket	565575	5449750
107b	Grands Vaux below reservoir dam	566450	5450675

a Jersey Grid

Table 2.3 **Minimum reaction values for the nutrient and chlorophyll *a* tests carried out by the Environment Agency National Laboratory Service.**

Parameter	Minimum reactive value	
Ammoniacal Nitrogen Filtered as N (NH_4-N)	0.0070 mg l^{-1}	0.500 mmol m^{-3}
Nitrite Filtered as N (NO_2-N)	0.0007 mg l^{-1}	0.050 mmol m^{-3}
TON, Filtered as N (NO_2-N + NO_3-N)	0.0070 mg l^{-1}	0.500 mmol m^{-3}
DAIN	0.0140 mg l^{-1}	0.999 mmol m^{-3}
Orthophosphate Filtered as P (PO_4-P, DAIP)	0.0020 mg l^{-1}	0.065 mmol m^{-3}
Silicate Filtered (SiO_2, DRS)	0.0200 mg l^{-1}	0.712 mmol m^{-3}
Chlorophyll *a*, Acetone Extract	0.5000 μg l^{-1}	0.500 mg m^{-3}

Table 3.1   Summary of hydrological monitoring results, 2009-2010

Site	n^a	Mean	S. D.[b]	Minimum	Maximum
Stage (m)					
St Brelade's stream	5	0.116	0.029	0.070	0.140
St Peter's Valley	5	0.222	0.070	0.120	0.280
Vallée desVaux	7	0.104	0.039	0.060	0.160
Grands Vaux	4	0.053	0.038	0.001	0.085
Discharge (m³/s)					
St Brelade's stream	5	0.0311	0.0287	0.0026	0.0720
St Peter's Valley	5	0.0696	0.0627	0.0011	0.1563
Vallée desVaux	7	0.0308	0.0220	0.0083	0.0621
Grands Vaux	4	0.0954	0.0694	0.0028	0.1531

a n = number of observations
b   Standard deviation

Table 3.2   Summary of all hydrological monitoring results from the 2007 and 2009-2010 study periods used to define discharge ratings

Site	n^a	Mean	S. D.[b]	Minimum	Maximum
Stage (m)					
St Brelade's stream	24	0.128	0.048	0.070	0.245
St Peter's Valley	26	0.208	0.068	0.120	0.330
Vallée desVaux	30	0.126	0.068	0.038	0.310
Grands Vaux	12	0.119	0.083	0.001	0.270
Discharge (m³/s)					
St Brelade's stream	24	0.0527	0.0481	0.0026	0.1745
St Peter's Valley	26	0.1157	0.1189	0.0011	0.4097
Vallée desVaux	30	0.0532	0.0377	0.0083	0.1389
Grands Vaux	12	0.2177	0.1497	0.0028	0.4876

a n = number of observations
b   Standard deviation

Table 3.3   Drainage basin analysis results (see Figure 2.1 also)

Catchment	Outlet	Area from geographical information system analysis (km^2)
St Brelade's stream	101 at coast	4.37
St Brelade's stream	101a gauging site	4.25
La Haule A	102 at coast	0.38
La Haule B	103 at coast	1.23
St Peter's Valley	104 at coast	12.21
St Peter's Valley	104a gauging site	11.64
St Peter's Valley	Reservoir	5.30
Waterworks Valley	105 at coast	6.37
Waterworks Valley	Millbrook Reservoir	5.83
Bellozanne Valley	106 at STW	3.09
Bellozanne Valley	At coast	3.94
Grands Vaux/Vallée des Vaux	107 at coast	17.75
Vallée des Vaux	107a gauging site	3.40
Grands Vaux	107b gauging site	9.47

Table 3.4   **Summary of DAIN[a] concentrations (mg/l) in stream inputs and the results of normality tests**

Site Code	Site	n[b]	Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
101	St Brelade's Stream	21	8.55	2.18	2.52	11.73	-0.7085	0.2000*	0.0842*
102	La Haule A	14	8.59	2.34	5.10	12.01	-0.2993	0.2000*	0.1859*
103	La Haule B	22	12.67	2.48	7.00	17.53	0.0588	0.2000*	0.5801*
104	St Peter's Valley	20	7.38	3.68	1.22	12.67	-0.1939	0.0231	0.0760*
105	Waterworks Valley	21	6.59	2.61	1.81	10.51	-0.1423	0.2000*	0.2685*
106	Bellozanne Valley	18	13.91	2.59	5.91	16.75	-1.7168	0.2000*	0.0077
107	Weighbridge Outfall	19	7.74	2.98	1.94	11.88	-0.7286	0.2000*	0.0706*

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N

b n = number of observations

c   Standard deviation

d   significance, p, of Kolmogorov-Smirnov normality test

e   significance, p, Shapiro-Wilk normality test

*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.5   Summary of DAIP[a] concentrations (mg/l) in stream inputs and the results of normality tests

Site Code	Site	n[b]	Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
101	St Brelade's Stream	21	0.0834	0.0289	0.0321	0.1350	-0.0052	0.2000*	0.5383*
102	La Haule A	14	0.1955	0.2671	0.0060	1.0900	3.2851	0.0000	0.0000
103	La Haule B	22	0.1315	0.0899	0.0685	0.5120	3.9233	0.0000	0.0000
104	St Peter's Valley	20	0.1368	0.0829	0.0304	0.3410	0.9651	0.2000*	0.0871*
105	Waterworks Valley	21	0.0977	0.1734	0.0102	0.8310	4.1639	0.0000	0.0000
106	Bellozanne Valley	18	0.0595	0.0210	0.0196	0.1250	1.4523	0.0254	0.0038
107	Weighbridge Outfall	19	0.1011	0.0351	0.0306	0.1860	0.3197	0.2000*	0.8604*

a   DAIP = dissolved available inorganic phosphorus – PO_4-P

b n = number of observations

c   Standard deviation

d   significance, p, of Kolmogorov-Smirnov normality test

e   significance, p, Shapiro-Wilk normality test

*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.6   Summary of $\log_{10}$ transformed DAIP[a] concentrations (mg/l) in stream inputs and the results of normality tests

Site Code	Site	n[b]	Geometric Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
101	St Brelade's Stream	21	0.0781	0.1700	0.0321	0.1350	-0.7543	0.0242	0.1261*
102	La Haule A	14	0.1124	0.5073	0.0060	1.0900	-0.8167	0.1204*	0.1272*
103	La Haule B	22	0.1177	0.1803	0.0685	0.5120	2.1280	0.0283	0.0009
104	St Peter's Valley	20	0.1141	0.2772	0.0304	0.3410	-0.2221	0.2000*	0.8122*
105	Waterworks Valley	21	0.0559	0.4064	0.0102	0.8310	0.8346	0.0796*	0.0683*
106	Bellozanne Valley	18	0.0560	0.1607	0.0196	0.1250	-0.9748	0.0192	0.0088
107	Weighbridge Outfall	19	0.0946	0.1727	0.0306	0.1860	-1.1282	0.200*0	0.1419*

a   DAIP = dissolved available inorganic phosphorus – PO_4-P

b n = number of observations

c   Standard deviation of $\log_{10}$ transformed values

d   significance, p, of Kolmogorov-Smirnov normality test

e   significance, p, Shapiro-Wilk normality test

*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.7   **Summary of DAIN[a] and DAIP[a] concentrations (mg/l) in final effluent (FE) from Bellozanne sewage treatment works (STW) and the results of normality tests**

Parameter	Site	n[b]	Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
DAIN	STW FE	159	29.33	8.94	12.03	56.94	0.3225	0.0580*	0.0309
DAIP	STW FE	157	3.57	1.28	0.7	7.00	0.1859	0.2000*	0.4013

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N , DAIP = dissolved available inorganic phosphorus – PO_4-P
b n = number of observations
c   Standard deviation
d   significance, p, of Kolmogorov-Smirnov normality test
e   significance, p, Shapiro-Wilk normality test
*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.8   **Comparison of DAIN[a] and DAIP[a] concentrations (mg/l) in final effluent from Bellozanne sewage treatment works sampled at three locations**

Parameter	Site	n[b]	Mean	S. D.[c]	Minimum	Maximum	Lower 95% CI[d]	Upper 95% CI[d]
DAIN	STW	137	29.28	9.24	12.03	56.94	27.72	30.84
DAIN	Outfall	10	27.20	7.69	16.91	39.80	21.69	32.70
DAIN	First Tower	12	31.63	5.94	23.41	41.65	27.85	35.40
DAIP	STW	135	3.63	1.25	0.70	7.00	3.4205	3.8445
DAIP	Outfall	10	3.42	1.80	1.36	6.45	2.1344	4.7036
DAIP	First Tower	12	2.98	1.19	1.71	5.95	2.2237	3.7313

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N , DAIP = dissolved available inorganic phosphorus – PO_4-P
b n = number of observations
c   Standard deviation
d   CI = confidence interval for the mean

Table 3.9   Comparison of DAIN[a] concentrations (mg/l) in stream and final effluent inputs to St Aubin's Bay in 2007 and 2009-2010

Input	Study	n[b]	Mean	S. D.[c]	Levene - p[d]	t-value	$t - p$[e]
St Brelade's Stream	2007	21	8.5627	3.4020	0.0256*	0.0130	0.9897
	2009-2010	21	8.5512	2.1751			
La Haule A	2007	18	8.6411	3.1430	0.1740	0.0550	0.9565
	2009-2010	14	8.5857	2.3409			
La Haule B	2007	20	12.4832	4.8248	0.0203*	-0.1561	0.8771
	2009-2010	22	12.6707	2.4755			
St Peter's Valley	2007	20	10.6341	2.8588	0.0438*	3.1226	0.0035*
	2009-2010	20	7.3803	3.6802			
Waterworks Valley	2007	20	7.1836	2.7705	0.7093	0.7008	0.4876
	2009-2010	21	6.5949	2.6088			
Bellozanne Valley	2007	20	13.2867	4.9702	0.0034*	-0.4890	0.6285
	2009-2010	18	13.9068	2.5928			
Weighbridge	2007	20	9.0125	3.0841	0.9829	1.3046	0.2001
	2009-2010	19	7.7449	2.9778			
Final effluent	2007	112	28.1549	10.9385	0.0262*	-0.9360	0.3504
	2009-2010	159	29.3282	8.9419			

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b n = number of observations
c   Standard deviation
d   significance, p, of Levene homogeneity of variances test, unequal variances assumed when $p < 0.05$ (indicated by *)
e   significance, p, of Student's t-test, means are significantly different when $p < 0.05$ (indicated by *)

Table 3.10   Comparison of DAIP[a] concentrations (mg/l) in stream and final effluent inputs to St Aubin's Bay in 2007 and 2009-2010

Input	Study	n[b]	Mean[c]	S. D.[d]	Levene $-p$[e]	t-value	$t-p$[f]
St Brelade's Stream	2007	21	0.1108	0.2905	0.6493	2.0704	0.0449*
	2009-2010	21	0.0781	0.1700			
La Haule A	2007	18	0.1326	0.1639	0.0217*	0.5096	0.6177
	2009-2010	14	0.1124	0.5073			
La Haule B	2007	20	0.1486	0.2048	0.1724	1.7041	0.0961
	2009-2010	22	0.1177	0.1803			
St Peter's Valley	2007	20	0.1772	0.2985	0.5322	2.1016	0.0423*
	2009-2010	20	0.1141	0.2772			
Waterworks Valley	2007	20	0.0942	0.3398	0.3826	1.9348	0.0603
	2009-2010	21	0.0559	0.4064			
Bellozanne Valley	2007	20	0.1055	0.4733	0.1027	2.3431	0.0248*
	2009-2010	18	0.0560	0.1607			
Weighbridge	2007	20	0.1413	0.1391	0.7737	3.4754	0.0013*
	2009-2010	19	0.0946	0.1727			
Final effluent	2007	112	3.2355	1.4757	0.0723	-1.9711	0.0497*
	2009-2010	157	3.5689	1.2844			

a   DAIP = dissolved available inorganic phosphorus – PO_4-P
b n = number of observations
c   Geometric for stream inputs, arithmetic for final effluent
d   Standard deviation (of $\log_{10}$ values in the case of stream inputs)
e   significance, p, of Levene homogeneity of variances test, unequal variances assumed when $p < 0.05$ (indicated by *)
f   significance, p, of Student's t-test, means are significantly different when $p < 0.05$ (indicated by *)

Table 3.11 **Summary of total discharge (m^3) and dissolved available inorganic nitrogen (DAIN) and phorphorus (DAIP) load (kg) estimates during three studies of inputs to St Aubin's Bay**

| | Study Period | | | | | |
| | 1997 | | 2007 | | 2009-2010 | |
Source	Loading	%*	Loading	%*	Loading	%*
Discharge (m^3):						
Brooks	9.15×10^6	62.21	$1.17E+0^7$	56.36	9.26×10^6	53.75
STW effluent	5.56×10^6	37.79	9.03×10^6	43.64	7.97×10^6	46.25
Total	1.47×10^7		2.07×10^7		1.72×10^7	
DAIN (kg):						
Brooks	1.25×10^5	46.44	1.36×10^5	35.08	9.13×10^4	28.35
STW effluent	1.44×10^5	53.56	2.52×10^5	64.92	2.31×10^5	71.65
Total	2.68×10^5		3.89×10^5		3.22×10^5	
DAIP (kg):						
Brooks	1.26×10^3	2.58	1.52×10^3	4.90	7.67×10^2	2.68
STW effluent	4.78×10^4	97.42	2.94×10^4	95.10	2.79×10^4	97.32
Total	4.91×10^4		3.09×10^4		2.87×10^4	

* % of total

Table 3.12   Summary of DAIN[a] concentrations in offshore zones B and C and the results of normality tests

Date	Zone	n[b]	Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
02/06/09	B	20	0.9995	†	0.9995	0.9995	†	†	†
	C	15	1.0085	0.0281	0.9995	1.1065	3.4918	0.0000	0.0000
30/06/09	B	20	1.1606	0.2328	0.9995	1.7848	1.7422	0.0028	0.0001
	C	15	1.0477	0.0619	0.9995	1.1351	0.5981	0.0000	0.0002
11/08/09	B	20	1.4346	0.6216	0.9995	3.1697	1.6135	0.0007	0.0002
	C	15	1.0225	0.0146	0.9995	1.0423	-0.4694	0.0153	0.0421
01/03/10	B	20	15.3035	4.2410	11.2796	28.1991	1.6809	0.0567*	0.0024
	C	15	10.9170	0.3136	10.4943	11.4938	0.5034	0.2000*	0.3579*
29/03/10	B	20	7.5464	0.5839	6.7535	9.2593	1.3814	0.0385	0.0375
	C	15	7.0233	0.1822	6.7178	7.3603	0.2486	0.2000*	0.6467*
26/04/10	B	20	3.8740	0.8975	2.8913	5.9896	0.9441	0.2000*	0.0380
	C	15	3.0816	0.1827	2.8056	3.3839	0.0921	0.1871*	0.3253*
07/06/10	B	20	1.2804	0.6363	0.9995	3.8479	3.7966	0.0000	0.0000
	C	15	1.9454	1.0832	1.0423	5.3614	2.4160	0.0494	0.0006
28/06/10	B	20	1.1506	0.3159	0.9995	2.2202	2.5178	0.0000	0.0000
	C	13	2.3129	4.1078	0.9995	15.9200	3.5483	0.0000	0.0000

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b n = number of observations
c   Standard deviation
d   significance, p, of Kolmogorov-Smirnov normality test
e   significance, p, Shapiro-Wilk normality test
*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)
†   all values equal

Table 3.13   **Summary of DAIP[a] concentrations in offshore zones B and C and the results of normality tests**

Date	Zone	n[b]	Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
02/06/09	B	20	0.1006	0.0153	0.0646	0.1227	-0.4635	0.2000*	0.4736*
	C	15	0.0906	0.0103	0.0678	0.1033	-1.2628	0.0023	0.0147
30/06/09	B	20	0.0756	0.0055	0.0662	0.0840	0.0105	0.2000*	0.2548*
	C	15	0.0739	0.0080	0.0646	0.0936	1.0647	0.2000*	0.1575*
11/08/09	B	20	0.1361	0.0296	0.0710	0.1960	-0.0771	0.2000*	0.9893*
	C	15	0.1592	0.0285	0.1314	0.2357	1.6776	0.0140	0.0054
01/03/10	B	20	0.6497	0.1244	0.5360	1.0946	2.6082	0.0578	0.0001
	C	15	0.5793	0.0351	0.5392	0.6361	0.4033	0.1579*	0.0551*
29/03/10	B	20	0.3282	0.0167	0.3035	0.3584	0.3839	0.2000*	0.3594*
	C	15	0.3167	0.0109	0.2919	0.3326	-0.5843	0.2000*	0.5432*
26/04/10	B	20	0.1734	0.0578	0.1292	0.3810	2.6772	0.0110	0.0000
	C	15	0.1675	0.0179	0.1421	0.2034	0.4287	0.2000*	0.4243*
07/06/10	B	20	0.1355	0.0703	0.0904	0.4262	4.0857	0.0000	0.0000
	C	15	0.1088	0.0157	0.0807	0.1295	-0.4543	0.2000*	0.2750*
28/06/10	B	20	0.0783	0.0235	0.0646	0.1453	2.4302	0.0002	0.0000
	C	13	1.3417	4.5256	0.0646	16.4033	3.6051	0.0000	0.0000

a   DAIP = dissolved available inorganic phosphorus – PO_4-P
b n = number of observations
c   Standard deviation
d   significance, p, of Kolmogorov-Smirnov normality test
e   significance, p, Shapiro-Wilk normality test
*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.14   Summary of DRS[a] concentrations in offshore zones B and C and the results of normality tests

Date	Zone	n[b]	Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
02/06/09	B	20	4.0637	0.2373	3.4532	4.4856	-0.4379	0.2000*	0.5065*
	C	15	3.7567	0.1885	3.3286	4.0584	-0.4674	0.2000*	0.8400*
30/06/09	B	20	4.4500	0.1424	4.1296	4.6280	-0.4550	0.2000*	0.2585*
	C	15	4.5378	0.1893	4.3432	5.1264	2.3151	0.0779*	0.0013
11/08/09	B	20	5.8651	0.1465	5.6604	6.1232	0.0324	0.2000*	0.1751*
	C	15	5.5251	0.1227	5.3400	5.7672	0.5532	0.2000*	0.5512*
01/03/10	B	20	10.5198	2.1811	8.2236	17.0524	1.5789	0.1359*	0.0055
	C	15	8.0954	0.3220	7.5116	8.6152	-0.1024	0.2000*	0.9378*
29/03/10	B	20	3.0639	0.1426	2.8195	3.3856	0.6668	0.1481*	0.4385*
	C	15	2.9325	0.1067	2.7554	3.1328	0.4529	0.2000*	0.5868*
26/04/10	B	20	2.3699	0.1819	2.1111	2.7768	0.6319	0.2000*	0.2332*
	C	15	2.1355	0.0653	2.0328	2.2820	0.9844	0.0041	0.0549*
07/06/10	B	20	4.6369	0.2110	4.2364	5.0908	0.5916	0.1463*	0.3530*
	C	15	4.2554	0.1642	3.9872	4.5568	0.3558	0.2000*	0.7207*
28/06/10	B	20	5.5750	0.1753	5.2688	5.9096	0.0794	0.2000*	0.7347*
	C	13	6.1588	2.3247	5.3756	13.8840	3.5864	0.0000	0.0000

a   DRS = Dissolved reactive silicon
b n = number of observations
c   Standard deviation
d   significance, p, of Kolmogorov-Smirnov normality test
e   significance, p, Shapiro-Wilk normality test
*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.15   **Summary of chlorophyll *a* concentrations (mg m^{-3}) in offshore zones B and C and the results of normality tests**

Date	Zone	N^a	Mean	S. D.^{b}	Minimum	Maximum	Skewness	K-S p^c	S-W p^d
02/06/09	B	20	1.9750	0.2552	1.6000	2.8000	1.8088	0.0200	0.0050
	C	15	1.7280	0.3907	0.9200	2.3000	-0.3074	0.2000*	0.8341*
30/06/09	B	20	1.5700	0.2849	1.1000	2.3000	0.5345	0.1948*	0.1022*
	C	15	1.2667	0.1291	1.1000	1.5000	0.7235	0.0009	0.0245
11/08/09	B	20	1.2880	0.2736	0.9600	1.9000	0.9274	0.0059	0.0238
	C	15	1.3333	0.2093	1.1000	1.9000	1.4301	0.0185	0.0229
01/03/10	B	20	1.1805	0.1946	0.8200	1.6000	0.3757	0.1895*	0.6464*
	C	15	1.2333	0.1047	1.1000	1.4000	0.5113	0.0013	0.0168
29/03/10	B	20	4.5350	0.3774	3.9000	5.1000	-0.2111	0.2000*	0.2401*
	C	15	4.6333	0.4012	3.9000	5.3000	-0.2666	0.2000*	0.6363*
26/04/10	B	20	2.3700	0.1895	2.0000	2.6000	-0.9122	0.0008	0.0054
	C	15	1.7733	0.3863	1.3000	2.7000	1.4688	0.0183	0.0091
07/06/10	B	20	0.8930	0.1283	0.6600	1.2000	0.0730	0.2000*	0.2374*
	C	15	1.1020	0.4892	0.5000	1.8000	0.0050	0.2000*	0.0688*
28/06/10	B	20	0.5915	0.0811	0.5000	0.7800	0.6006	0.2000*	0.0642*
	C	13	0.6346	0.1298	0.5000	0.9900	1.7777	0.2000*	0.0209

a   *n* = number of observations
b   Standard deviation
c   significance, *p*, of Kolmogorov-Smirnov normality test
d   significance, *p*, Shapiro-Wilk normality test
*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.16   Summary of log$_{10}$ transformed DAIN[a] concentrations in offshore zones B and C and the results of normality tests

Date	Zone	n[b]	Geometric Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
02/06/09	B	20	0.9995	0.0000	-0.0002	-0.0002	†	†	†
	C	15	1.0082	0.0116	3.4673	-0.0002	0.0440	0.0000	0.0000
30/06/09	B	20	1.1417	0.0775	-0.0002	0.2516	1.4573	0.0052	0.0003
	C	15	1.0460	0.0253	0.5888	-0.0002	0.0550	0.0000	0.0002
11/08/09	B	20	1.3365	0.1585	-0.0002	0.5010	1.1381	0.0007	0.0008
	C	15	1.0224	0.0062	-0.4808	-0.0002	0.0180	0.0141	0.0405
01/03/10	B	20	14.8405	0.1063	1.0523	1.4502	1.0759	0.2000*	0.0426
	C	15	10.9128	0.0124	0.4629	1.0210	1.0605	0.2000*	0.3905*
29/03/10	B	20	7.5260	0.0323	0.8295	0.9666	1.1222	0.0839*	0.1248*
	C	15	7.0211	0.0112	0.1863	0.8272	0.8669	0.2000*	0.6761*
26/04/10	B	20	3.7835	0.0952	0.4611	0.7774	0.5771	0.2000*	0.1428*
	C	15	3.0766	0.0257	0.0266	0.4480	0.5294	0.2000*	0.3356*
07/06/10	B	20	1.2009	0.1383	-0.0002	0.5852	2.8159	0.0002	0.0000
	C	15	1.7535	0.1924	0.9979	0.0180	0.7293	0.2000*	0.1125*
28/06/10	B	20	1.1201	0.0962	-0.0002	0.3464	2.1150	0.0000	0.0000
	C	13	1.3902	0.3363	3.0505	-0.0002	1.2019	0.0001	0.0000
	C[f]	12	1.1346	0.1138	-0.0002	0.3889	2.7253	0.0001	0.0001

a	DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b	n = number of observations
c	Standard deviation
d	significance, p, of Kolmogorov-Smirnov normality test
e	significance, p, Shapiro-Wilk normality test
f	zone C excluding anomalous result from site C7 (see text)
*	significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)
†	all values equal

Table 3.17   **Summary of $\log_{10}$ transformed DAIP[a] concentrations in offshore zones B and C and the results of normality tests**

Date	Zone	n[b]	Geometric Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
02/06/09	B	20	0.0994	0.0699	-1.1899	-0.9111	-0.9078	0.2000*	0.1432*
	C	15	0.0900	0.0533	-1.4340	-1.1687	-0.9858	0.0012	0.0057
30/06/09	B	20	0.0754	0.0318	-1.1792	-1.0760	-0.1042	0.2000*	0.2656*
	C	15	0.0735	0.0451	0.8095	-1.1899	-1.0285	0.2000*	0.3330*
11/08/09	B	20	0.1328	0.1011	-1.1485	-0.7077	-0.8101	0.2000*	0.4218*
	C	15	0.1572	0.0705	1.3595	-0.8813	-0.6276	0.0243	0.0243
01/03/10	B	20	0.6406	0.0711	-0.2708	0.0393	1.9476	0.2000*	0.0023
	C	15	0.5783	0.0261	0.3605	-0.2682	-0.1965	0.1808*	0.0598*
29/03/10	B	20	0.3278	0.0219	-0.5178	-0.4456	0.3102	0.2000*	0.4258*
	C	15	0.3166	0.0151	-0.6807	-0.5348	-0.4781	0.2000*	0.4587*
26/04/10	B	20	0.1669	0.1149	-0.8889	-0.4190	1.7488	0.1495*	0.0030
	C	15	0.1666	0.0460	0.2207	-0.8475	-0.6916	0.2000*	0.5173*
07/06/10	B	20	0.1269	0.1381	-1.0438	-0.3704	3.0150	0.0001	0.0000
	C	15	0.1076	0.0656	-0.6461	-1.0930	-0.8878	0.2000*	0.1643*
28/06/10	B	20	0.0758	0.1039	-1.1899	-0.8377	2.1085	0.0018	0.0000
	C	13	0.1221	0.6543	3.3444	-1.1899	1.2149	0.0000	0.0000
	C[f]	12	0.0812	0.1451	-1.1899	-0.6780	2.3577	0.0422	0.0009

a	DAIP = dissolved available inorganic phosphorus – PO_4-P
b	n = number of observations
c	Standard deviation
d	significance, p, of Kolmogorov-Smirnov normality test
e	significance, p, Shapiro-Wilk normality test
f	zone C excluding anomalous result from site C7 (see text)
*	significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.18   Summary of log$_{10}$ transformed DRS[a] concentrations in offshore zones B and C and the results of normality tests

Date	Zone	n[b]	Geometric Mean	S. D.[c]	Minimum	Maximum	Skewness	K-S p[d]	S-W p[e]
02/06/09	B	20	4.0570	0.0258	0.5382	0.6518	-0.6828	0.2000*	0.3207*
	C	15	3.7523	0.0221	-0.6297	0.5223	0.6084	0.2000*	0.7081*
30/06/09	B	20	4.4478	0.0140	0.6159	0.6654	-0.5192	0.2000*	0.2338*
	C	15	4.5343	0.0174	2.1806	0.6378	0.7098	0.0862*	0.0024*
11/08/09	B	20	5.8634	0.0108	0.7528	0.7870	0.0015	0.2000*	0.1706*
	C	15	5.5239	0.0096	0.5094	0.7275	0.7610	0.2000*	0.6028*
01/03/10	B	20	10.3335	0.0817	0.9151	1.2318	1.0914	0.2000*	0.0608*
	C	15	8.0894	0.0173	-0.1878	0.8757	0.9353	0.2000*	0.9252*
29/03/10	B	20	3.0608	0.0200	0.4502	0.5296	0.5519	0.2000*	0.6001*
	C	15	2.9307	0.0157	0.3865	0.4402	0.4959	0.2000*	0.6576*
26/04/10	B	20	2.3634	0.0328	0.3245	0.4435	0.5141	0.2000*	0.3423*
	C	15	2.1346	0.0131	0.9193	0.3081	0.3583	0.0050	0.0682*
07/06/10	B	20	4.6324	0.0196	0.6270	0.7068	0.4626	0.2000*	0.4742*
	C	15	4.2525	0.0167	0.2825	0.6007	0.6587	0.2000*	0.7780*
28/06/10	B	20	5.5723	0.0137	0.7217	0.7716	0.0034	0.2000*	0.7385*
	C	13	5.9195	0.1117	3.5555	0.7304	1.1425	0.0000	0.0000
	C[f]	12	5.5136	0.0104	0.7304	0.7636	1.0174	0.2000*	0.1671*

a   DRS = Dissolved reactive silicon
b n = number of observations
c   Standard deviation
d   significance, p, of Kolmogorov-Smirnov normality test
e   significance, p, Shapiro-Wilk normality test
f   zone C excluding anomalous result from site C7 (see text)
*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.19 Summary of log_{10} transformed chlorophyll *a* concentrations (mg m^{-3}) in offshore zones B and C and the results of normality tests

Date	Zone	n^{b}	Geometric Mean	S. D.^{c}	Minimum	Maximum	Skewness	K-S p^{d}	S-W p^{e}
02/06/09	B	20	1.9609	0.0520	0.2041	0.4472	1.2744	0.0725*	0.0513*
	C	15	1.6826	0.1073	-0.9334	-0.0362	0.3617	0.2000*	0.3045*
30/06/09	B	20	1.5459	0.0785	0.0414	0.3617	-0.0416	0.2000*	0.1824*
	C	15	1.2607	0.0432	0.5809	0.0414	0.1761	0.0014	0.0366
11/08/09	B	20	1.2626	0.0874	-0.0177	0.2788	0.6151	0.0508*	0.1013*
	C	15	1.3194	0.0638	0.9539	0.0414	0.2788	0.0740*	0.0980*
01/03/10	B	20	1.1654	0.0716	-0.0862	0.2041	-0.0723	0.1706*	0.7995*
	C	15	1.2293	0.0364	0.3844	0.0414	0.1461	0.0025	0.0217
29/03/10	B	20	4.5199	0.0366	0.5911	0.7076	-0.3116	0.2000*	0.1973*
	C	15	4.6168	0.0382	-0.4374	0.5911	0.7243	0.2000*	0.5095*
26/04/10	B	20	2.3624	0.0361	0.3010	0.4150	-1.0047	0.0003	0.0031
	C	15	1.7392	0.0860	1.0997	0.1139	0.4314	0.0670*	0.0592*
07/06/10	B	20	0.8841	0.0638	-0.1805	0.0792	-0.4327	0.2000*	0.1566*
	C	15	0.9898	0.2166	-0.3594	-0.3010	0.2553	0.2000*	0.0274
28/06/10	B	20	0.5864	0.0582	-0.3010	-0.1079	0.3820	0.2000*	0.0877*
	C	13	0.6240	0.0803	1.1888	-0.3010	-0.0044	0.2000*	0.1777*

a   DAIP = Dissolved reactive silicon

b   *n* = number of observations

c   Standard deviation

d   significance, *p*, of Kolmogorov-Smirnov normality test

e   significance, *p*, Shapiro-Wilk normality test

*   significance ≥ 0.05 indicates no significant departure from normality (values < 0.05 indicate significant departure from normality)

Table 3.20 Comparison of DAIN[a] concentrations (mmol m^{-3}) in offshore zones B and C.

Date Offshore survey no. and date	Zone	n[b]	Geometric Mean	S. D.[c]	Levene - p[d]	t-value	$t - p$[e]
1 – 02/06/09	B	20	0.9995	0.0000	0.0040*	-1.2538	0.2305
	C	15	1.0082	0.0116			
2 – 30/06/09	B	20	1.1417	0.0775	0.0052*	2.0536	0.0510
	C	15	1.0460	0.0253			
3 – 11/08/09	B	20	1.3365	0.1585	0.0000*	3.2783	0.0039*
	C	15	1.0224	0.0062			
5 – 01/03/10	B	20	14.8405	0.1063	0.0001*	5.5683	0.0000*
	C	15	10.9128	0.0124			
6 – 29/03/10	B	20	7.5260	0.0323	0.0116*	3.8734	0.0007*
	C	15	7.0211	0.0112			
7 – 26/04/10	B	20	3.7835	0.0952	0.0006*	4.0280	0.0005*
	C	15	3.0766	0.0257			
8 – 07/06/10	B	20	1.2009	0.1383	0.1255	-2.9442	0.0059*
	C	15	1.7535	0.1924			
9 – 28/06/10	B	20	1.1201	0.0962	0.0392*	-0.9800	0.3446
	C	13	1.3902	0.3363			

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b n = number of observations
c   Standard deviation
d   significance, p, of Levene homogeneity of variances test, unequal variances assumed when $p < 0.05$ (indicated by *)
e   significance, p, of Student's t-test (two-tailed), means are significantly different when $p < 0.05$ (indicated by *)

Table 3.21   Comparison of DAIP[a] concentrations (mmol m^{-3}) in offshore zones B and C.

Date Offshore survey no. and date	Zone	n[b]	Geometric Mean	S. D.[c]	Levene - p[d]	t-value	$t - p$[e]
1 – 02/06/09	B	20	0.0994	0.0699	0.3207	1.9914	0.0548
	C	15	0.0900	0.0533			
2 – 30/06/09	B	20	0.0754	0.0318	0.2578	0.8548	0.3988
	C	15	0.0735	0.0451			
3 – 11/08/09	B	20	0.1328	0.1011	0.1916	-2.3914	0.0226*
	C	15	0.1572	0.0705			
5 – 01/03/10	B	20	0.6406	0.0711	0.0679	2.3003	0.0279*
	C	15	0.5783	0.0261			
6 – 29/03/10	B	20	0.3278	0.0219	0.0624	2.3031	0.0277*
	C	15	0.3166	0.0151			
7 – 26/04/10	B	20	0.1669	0.1149	0.0291*	0.0299	0.9764
	C	15	0.1666	0.0460			
8 – 07/06/10	B	20	0.1269	0.1381	0.5546	1.8473	0.0737
	C	15	0.1076	0.0656			
9 – 28/06/10	B	20	0.0758	0.1039	0.0206*	-1.1317	0.2792
	C	13	0.1221	0.6543			

a   DAIP = dissolved available inorganic phosphorus – PO_4-P
b n = number of observations
c   Standard deviation
d   significance, p, of Levene homogeneity of variances test, unequal variances assumed when $p < 0.05$ (indicated by *)
e   significance, p, of Student's t-test (two-tailed), means are significantly different when $p < 0.05$ (indicated by *)

Table 3.22   Comparison of DRS[a] concentrations (mmol m^{-3}) in offshore zones B and C.

Date Offshore survey no. and date	Zone	n[b]	Geometric Mean	S. D.[c]	Levene - p[d]	t-value	$t - p$[e]
1 – 02/06/09	B	20	4.0570	0.0258	0.7570	4.0881	0.0003*
	C	15	3.7523	0.0221			
2 – 30/06/09	B	20	4.4478	0.0140	0.8911	-1.5751	0.1248
	C	15	4.5343	0.0174			
3 – 11/08/09	B	20	5.8634	0.0108	0.4661	7.3366	0.0000*
	C	15	5.5239	0.0096			
5 – 01/03/10	B	20	10.3335	0.0817	0.0005*	5.6526	0.0000*
	C	15	8.0894	0.0173			
6 – 29/03/10	B	20	3.0608	0.0200	0.5048	3.0204	0.0048*
	C	15	2.9307	0.0157			
7 – 26/04/10	B	20	2.3634	0.0328	0.0006*	5.4783	0.0000*
	C	15	2.1346	0.0131			
8 – 07/06/10	B	20	4.6324	0.0196	0.8124	5.9135	0.0000*
	C	15	4.2525	0.0167			
9 – 28/06/10	B	20	5.5723	0.0137	0.0355*	-0.8433	0.4153
	C	13	5.9195	0.1117			

a   DRS = Dissolved reactive silicon
b n = number of observations
c   Standard deviation
d   significance, p, of Levene homogeneity of variances test, unequal variances assumed when $p < 0.05$ (indicated by *)
e   significance, p, of Student's t-test (two-tailed), means are significantly different when $p < 0.05$ (indicated by *)

Table 3.23   Comparison of chlorophyll *a* concentrations (mgl m^{-3}) in offshore zones B and C.

Offshore survey no. and date	Zone	N[a]	Geometric Mean	S. D.[b]	Levene – p[c]	t-value	t – p[d]
1 – 02/06/09	B	20	1.9609	0.0520	0.0166*	2.2132	0.0394*
	C	15	1.6826	0.1073			
2 – 30/06/09	B	20	1.5459	0.0785	0.0433*	4.2587	0.0002*
	C	15	1.2607	0.0432			
3 – 11/08/09	B	20	1.2626	0.0874	0.1662	-0.7148	0.4798
	C	15	1.3194	0.0638			
5 – 01/03/10	B	20	1.1654	0.0716	0.0399*	-1.2481	0.2218
	C	15	1.2293	0.0364			
6 – 29/03/10	B	20	4.5199	0.0366	0.9732	-0.7234	0.4745
	C	15	4.6168	0.0382			
7 – 26/04/10	B	20	2.3624	0.0361	0.0108*	5.6309	0.0000*
	C	15	1.7392	0.0860			
8 – 07/06/10	B	20	0.8841	0.0638	0.0000*	-0.8503	0.4078
	C	15	0.9898	0.2166			
9 – 28/06/10	B	20	0.5864	0.0582	0.5461	-1.1218	0.2706
	C	13	0.6240	0.0803			

a   *n* = number of observations
b   Standard deviation
c   significance, *p*, of Levene homogeneity of variances test, unequal variances assumed when $p < 0.05$ (indicated by *)
d   significance, *p*, of Student's t-test (two-tailed), means are significantly different when $p < 0.05$ (indicated by *)

Table 3.24   Geometric mean DAIN[a], DAIP[b], DRS[c], and chlorophyll *a* concentrations (mmol m^{-3}) in samples collected from the surface, on-third depth, two-thirds depth and seabed during the first depth profile survey undertaken on 14/8/10.

Parameter	*n*	Surface	1/3 depth	2/3 depth	Seabed
Zone B					
DAIN	4	1.725	2.935	2.468	2.673
DAIP	4	0.084	0.099	0.091	0.100
DRS	4	6.127	6.204	6.115	6.119
Chlorophyll *a*	4	0.500	0.500	0.500	0.545
Zone C					
DAIN	4	1.986	4.111	3.556	3.979
DAIP	4	0.131	0.070	0.079	0.080
DRS	4	6.193	6.167	6.158	6.122
Chlorophyll *a*	4	0.519	0.500	0.500	0.500

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b   DAIP = dissolved available inorganic phosphorus – PO_4-P
c   DRS = dissolved reactive silicon
d   *n* = number of samples

Table 3.25   Geometric mean DAIN[a], DAIP[b], DRS[c], and chlorophyll *a* concentrations (mmol m^{-3}) in samples collected from the surface, on-third depth, two-thirds depth and seabed during the first depth profile survey undertaken on 7/6/10.

Parameter	*n*	Surface	1/3 depth	2/3 depth	Seabed
Zone B					
DAIN	6/5[e]	1.154	2.432	1.914	1.799
DAIP	6/5[e]	0.117	0.151	0.096	0.105
DRS	6/5[e]	4.579	4.661	4.660	4.584
Chlorophyll *a*	6/5[e]	0.915	0.906	0.759	0.868
Zone C					
DAIN	4	2.451	6.148	3.162	2.867
DAIP	4	0.113	0.136	0.131	0.108
DRS	4	4.387	4.453	4.321	4.358
Chlorophyll *a*	4	0.733	0.630	0.668	0.647

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b   DAIP = dissolved available inorganic phosphorus – PO_4-P
c   DRS = dissolved reactive silicon
d   *n* = number of samples
e   *n* = 6 for surface and seabed; *n* = 5 for 1/3 depth and 2/3 depth.

Table 3.26 Geometric mean DAIN[a], DAIP[b], DRS[c], and chlorophyll *a* concentrations (mmol m^{-3}) in samples collected from the surface, on-third depth, two-thirds depth and seabed during the first depth profile survey undertaken on 28/6/10.

Parameter	*n*	Surface	1/3 depth	2/3 depth	Seabed
Zone B					
DAIN	4	1.296	2.482	1.627	1.713
DAIP	4	0.065	0.065	0.067	0.065
DRS	4	5.436	5.436	5.490	5.561
Chlorophyll *a*	4	0.519	0.559	0.621	0.609
Zone C					
DAIN	4	1.420	3.192	2.683	2.431
DAIP	4	0.072	0.094	0.069	0.071
DRS	4	5.508	3.228	5.616	5.544
Chlorophyll *a*	4	0.667	0.660	0.622	0.662

a   DAIN = dissolved available inorganic nitrogen – NH_3-N + NO_2-N + NO_3-N
b   DAIP = dissolved available inorganic phosphorus – PO_4-P
c   DRS = dissolved reactive silicon
d   *n* = number of samples

Table 3.27 Vertical depth profile minimum and maximum values recorded in zone B and zone C during survey carried out on 2/6/10 and 26/6/10.

Date	Zone		Temp (°C)	Dissolved Oxygen % Sat	O2mg/l	Conductivity µS/cm	Salinity ppt	Turbidity NTU
2/6/10	B	Min	13.24	105.30	9.22	43520	28.05	—
	C	Max	13.89	110.50	9.60	44104	28.45	—
	B	Min	13.00	104.40	9.15	43621	28.10	—
	C	Max	13.89	110.50	9.60	44104	28.45	—
26/6/10	B	Min	14.87	105.70	8.99	43258	26.39	-3.30
	C	Max	15.26	108.70	9.21	44046	28.44	19.40
	B	Min	14.79	105.40	8.90	43015	27.90	-3.40
	C	Max	15.11	108.70	9.21	44056	28.90	-2.20

Table 3.28   Observed DAIN[a] concentrations (mmol m^{-3}) at the five nearshore sample points in St. Aubin's Bay and geometric mean of all five nearshore samples.

Beach survey date	B1 Victoria Pool	B2 PSD outfall	B3 Beach Rock	B4 Second Tower	B5 St. Aubin	Geometric Mean
1/6/09	<0.999	<0.999	<0.999	3.412	1.342	1.355
15/6/09	1.099	1.085	1.221	<0.999	<0.999	1.078
29/6/09	<0.999	5.483	1.171	1.185	3.105	1.882
13/7/09	<0.999	5.211	9.930	<0.999	<0.999	2.201
27/7/09	1.428	1.185	1.314	1.342	2.499	1.494
10/8/09	2.963	<0.999	<0.999	2.192	1.449	1.565
24/8/09	3.277	4.505	2.470	3.027	2.806	3.149
2/9/09	<0.999	6.140	1.057	<0.999	1.271	1.524
14/9/09	<0.999	0.999	4.233	9.195	10.680	3.339
29/9/09	4.469	2.127	2.363	1.913	1.221	2.208
15/10/09	6.054	8.460	23.487	22.345	17.276	13.595
27/10/09	9.616	10.273	43.619	29.270	23.773	19.741
8/2/10	17.205	16.484	37.979	121.577	48.759	36.394
2/3/10	16.113	16.677	18.925	63.987	22.488	23.598
15/3/10	12.208	18.112	67.335	20.934	14.307	21.372
30/3/10	6.711	10.045	45.761	15.849	10.523	13.876
12/4/10	5.333	7.724	16.170	25.451	26.129	13.467
26/4/10	2.963	59.040	5.097	19.989	3.113	8.888
20/5/10	2.070	11.372	16.691	7.632	5.419	6.953
8/6/10	1.478	1.228	7.589	2.356	50.473	4.394
16/6/10	<0.999	1.442	1.770	6.018	4.183	2.299
1/7/10	1.835	11.144	1.028	<0.999	2.006	2.113

a   DAIN = dissolved available inorganic nitrogen – NH$_3$-N + NO$_2$-N + NO$_3$-N

Table 3.29   Observed DAIP[a] concentrations (mmol m^{-3}) at the five nearshore sample points in St. Aubin's Bay and geometric mean of all five nearshore samples.

Beach survey date	B1 Victoria Pool	B2 PSD outfall	B3 Beach Rock	B4 Second Tower	B5 St. Aubin	Geometric Mean
1/6/09	0.068	0.110	0.097	0.094	0.126	0.207
15/6/09	0.394	0.260	0.149	0.168	0.149	0.258
29/6/09	0.665	0.901	0.084	0.291	0.077	0.394
13/7/09	0.310	0.475	0.743	0.355	0.245	0.422
27/7/09	0.446	0.307	0.333	0.462	0.639	0.199
10/8/09	0.510	0.371	0.145	0.107	0.107	0.310
24/8/09	0.643	0.801	0.252	0.181	0.123	0.291
2/9/09	0.239	0.856	0.184	0.228	0.242	0.451
14/9/09	0.071	0.136	0.814	1.388	1.708	0.262
29/9/09	0.530	0.504	0.178	0.161	0.161	0.738
15/10/09	0.455	0.643	1.350	0.943	0.588	0.754
27/10/09	0.500	0.326	1.886	1.221	0.649	1.522
8/2/10	2.063	0.733	1.392	1.908	2.034	0.592
2/3/10	0.542	0.607	0.526	0.675	0.623	0.593
15/3/10	0.614	0.849	0.562	0.510	0.491	0.607
30/3/10	0.326	0.520	2.002	0.539	0.449	0.685
12/4/10	0.297	0.552	0.859	1.020	1.046	0.610
26/4/10	0.814	2.312	0.436	0.358	0.287	0.617
20/5/10	0.420	1.886	0.898	0.358	0.352	0.247
8/6/10	0.094	0.155	0.759	0.310	0.268	0.296
16/6/10	0.123	0.284	0.329	0.559	0.355	0.200
1/7/10	0.158	2.632	0.168	0.071	0.065	0.207

a   DAIP = dissolved available inorganic phosphorus – PO_4-P

Table 3.30   Observed DRS[a] concentrations (mmol m⁻³) at the five nearshore sample points in St. Aubin's Bay and geometric mean of all five nearshore samples.

Beach survey date	B1 Victoria Pool	B2 PSD outfall	B3 Beach Rock	B4 Second Tower	B5 St. Aubin	Geometric Mean
1/6/09	2.360	3.101	2.923	3.667	1.876	2.714
15/6/09	1.709	2.759	2.791	3.667	3.325	2.761
29/6/09	2.421	2.848	2.189	3.809	3.596	2.905
13/7/09	3.596	2.698	4.130	3.845	4.521	3.703
27/7/09	5.269	4.521	5.767	6.088	7.049	5.677
10/8/09	4.343	4.521	3.916	5.091	5.376	4.620
24/8/09	7.832	8.402	5.304	6.800	8.117	7.194
2/9/09	2.047	3.154	4.664	4.450	6.088	3.822
14/9/09	3.987	2.727	6.622	7.832	8.900	5.497
29/9/09	5.910	5.198	7.334	5.340	4.165	5.495
15/10/09	12.602	9.968	9.754	9.541	8.224	9.922
27/10/09	13.279	11.748	15.450	10.217	12.389	12.499
8/2/10	10.787	9.398	16.162	72.980	28.658	20.276
2/3/10	9.363	8.722	10.288	35.458	11.000	12.679
15/3/10	6.515	8.330	34.674	13.279	7.832	11.437
30/3/10	2.901	3.261	9.897	4.913	3.560	4.394
12/4/10	2.460	2.620	3.987	8.295	8.615	4.496
26/4/10	2.357	10.644	2.894	6.906	2.371	4.121
20/5/10	2.531	0.737	3.200	3.667	3.952	2.440
8/6/10	2.132	2.090	2.303	0.612	3.033	1.803
16/6/10	2.848	3.204	3.204	5.981	5.447	3.942
1/7/10	5.055	6.301	4.664	4.379	5.554	5.147

a   DRS = Dissolved reactive silicon

Table 3.31 Observed chlorophyll *a* concentrations (mmol m^{-3}) at the five nearshore sample points in St. Aubin's Bay and geometric mean of all five nearshore samples.

Beach survey date	B1 Victoria Pool	B2 PSD outfall	B3 Beach Rock	B4 Second Tower	B5 St. Aubin	Geometric Mean
1/6/09	4.30	5.20	6.10	7.40	5.80	5.67
15/6/09	6.60	2.40	5.20	3.40	5.10	4.28
29/6/09	10.50	11.00	11.50	7.60	7.70	9.51
13/7/09	11.40	30.90	14.30	4.50	5.80	10.56
27/7/09	19.90	9.30	12.20	18.30	12.80	13.95
10/8/09	5.00	8.10	6.20	8.20	9.50	7.22
24/8/09	13.40	13.70	10.60	6.30	12.10	10.82
2/9/09	33.60	44.20	12.30	23.30	14.60	22.84
14/9/09	9.80	12.10	7.40	8.10	10.00	9.34
29/9/09	18.90	22.50	11.70	13.00	10.90	14.78
15/10/09	4.80	7.90	10.40	12.20	13.40	9.16
27/10/09	11.00	34.80	28.20	19.20	31.80	23.11
8/2/10	9.60	10.60	8.90	19.40	16.40	12.36
2/3/10	1.10	4.80	5.20	7.90	9.00	4.55
15/3/10	5.30	5.20	2.50	3.60	3.40	3.85
30/3/10	6.90	6.70	10.30	12.30	9.40	8.87
12/4/10	1.40	3.00	3.90	4.90	5.10	3.33
26/4/10	15.60	12.50	12.70	12.20	10.60	12.62
20/5/10	6.60	8.80	6.20	10.20	8.90	8.00
8/6/10	2.50	3.60	8.00	4.10	2.10	3.62
16/6/10	7.10	15.40	23.50	3.30	4.60	8.28
1/7/10	2.40	3.50	0.71	<0.50	0.91	1.22

Table 4.1   Predicted steady state nutrient concentrations (*S*) for dissolved available inorganic nitrogen (DAIN) and dissolved available inorganic phosphorus (DAIP) for the offshore surveys undertaken during 2009/10 and for comparable surveys undertaken during 1997.

2009/10 Survey	*S* (mmol m^{-3}) 2009/10 data	1997 Survey	S (mmol m^{-3}) 1997 data
DAIN – Dissolved available inorganic nitrogen			
1. 02/06/09	3.03	4. 03/06/97	2.49
2. 30/06/09	3.07	5. 01/07/97	2.54
		6. 29/07/97	3.46
3. 11/08/09	2.47		
		7. 09/09/97	4.23
5. 01/03/10	14.35	1. 27/02/97	15.55
6. 29/03/10	10.46	2. 02/04/97	14.53
7. 26/04/10	5.07	3. 30/04/97	4.77
8. 07/06/10	3.28	4. 03/06/97	2.49
9. 28/06/10	2.92	5. 01/07/97	2.54
DAIP – Dissolved available inorganic phosphorus			
1. 02/6/09	0.18	4. 03/06/97	0.26
2. 30/6/09	0.17	5. 01/07/97	0.31
		6. 29/07/97	0.25
3. 11/8/09	0.24		
		7. 09/09/97	0.57
5. 01/03/10	0.67	1. 27/02/97	0.70
6. 29/03/10	0.40	2. 02/04/97	0.52
7. 26/04/10	0.26	3. 30/04/97	0.13
8. 07/06/10	0.18	4. 03/06/97	0.26
9. 28/06/10	0.19	5. 01/07/97	0.31

Table 4.2   **Estimated range of maximum biomass chlorophyll concentration (X_{max}) for dissolved available inorganic nitrogen (DAIN) and dissolved available inorganic phosphorus (DAIP) calculated using data from the offshore surveys undertaken during 2009/10 and for comparable surveys undertaken in 1997.**

2009 Survey	X_{max} (mg chl m^{-3}) 2009 data	1997 survey	X_{max} (mg chl m^{-3}) 1997 data
DAIN – Dissolved available inorganic nitrogen			
1. 02/06/09	5.0 – 10.2	4. 03/06/97	3.9 – 8.2
2. 30/06/09	4.6 – 9.9	5. 01/07/97	3.8 – 8.2
		6. 29/07/97	5.1 – 10.9
3. 11/08/09	4.0 – 8.2		
		7. 09/09/97	6.7 – 13.9
5. 01/03/10	17.0 – 41.4	1. 27/02/97	19.3 – 45.8
6. 29/03/10	16.1 – 33.9	2. 02/04/97	17.1 – 41.8
7. 26/04/10	7.3 – 15.9	3. 30/04/97	7.7 – 15.8
8. 07/06/10	4.6 – 10.2	4. 03/06/97	3.9 – 8.2
9. 28/06/10	3.8 – 8.8	5. 01/07/97	3.8 – 8.2
DAIP – Dissolved available inorganic phosphorus			
1. 02/06/09	10.9 – 20.2	4. 03/06/97	14.4 – 27.7
2. 30/06/09	9.7 – 18.1	5. 01/07/97	16.4 – 31.7
		6. 29/07/97	14.0 – 26.7
3. 11/08/09	13.5 – 25.7		
		7. 09/09/97	30.4 – 58.7
5. 01/03/10	34.6 – 67.9	1. 27/02/97	37.2 – 72.1
6. 29/03/10	24.9 – 45.1	2. 02/04/97	26.9 – 52.7
7. 26/04/10	14.6 – 27.5	3. 30/04/97	9.0 – 15.5
8. 07/06/10	10.0 – 18.9	4. 03/06/97	14.4 – 27.7
9. 28/06/10	10.3 – 20.0	5. 01/07/97	16.4 – 31.7

Table 4.3   **Results of calculations to estimate the potential for maximum phytoplankton biomass.**

	μ (d^{-1})[a]	(E + L)[b]	Result
March (average sun)			
Neap tides	0.65	0.6 + 0.0 = 0.6	$\mu > (E + L)$
Spring Tides		0.7 + 0.0 = 0.7	$\mu < (E + L)$
June (average sun)			
Neap tides	0.95	0.6 + 0.0 = 0.6	$\mu > (E + L)$
Spring Tides		0.7 + 0.0 = 0.7	$\mu > (E + L)$
June (full sun)			
Neap tides	1.40	0.6 + 0.0 = 0.6	$\mu > (E + L)$
Spring Tides		0.7 + 0.0 = 0.7	$\mu > (E + L)$

a μ = relative rate of light controlled growth
b   (E + L) = relative exchange rate + relative loss rate of phytoplankton by zooplankton and benthic filter feeders

Table 4.4   **Assessment of the effects of the Bellozanne discharge on zone B and the nearshore zone based on CSTT criteria. (refer to Section 4.4 for details)**

	Zone B	Nearshore zone
Observed winter DAIN>12 mmol^{-3} <u>and</u> DAIP>0.2 mmol^{-3}?	✓	✓
Predicted S_{DAIN}>12 mmol^{-3} <u>and</u> S_{DAIP}>0.2 mmol^{-3} ?	✓	✓
Observed summer chlorophyll a > 10 mg m^{-3}?	✗	✓
Predicted summer X_{max} > 10 mg m^{-3} ?	✗/✓[a]	n/a
Nutrient removal reduces summer X_{max} > 1 mg m^{-3}?	?[b]	n/a

a   threshold not exceeded if lower 'median' phytoplankton biomass used, but exceeded if higher '90 percentile' yield used.
b   nutrient removal technology is currently under review – see Section 4.4.3

Table 4.5   **Predicted zone B steady state DAIN (S) concentrations and range of maximum biomass chlorophyll concentration (X_{max}) calculated using data from the offshore surveys undertaken during 2009/10 and assuming a concentration of 10mg l^{-1} DAIN in the Bellozanne WwTW effluent.**

Survey	S (mmol m^{-3})	X_{max} (mg chl m^{-3})
1. 02/06/09	1.83	3.7 – 6.8
2. 30/06/09	1.87	3.3 – 6.5
3. 11/08/09	1.63	3.1 – 5.9
5. 01/03/10	13.53	16.1 – 39.1
6. 29/03/10	9.64	15.2 – 31.6
7. 26/04/10	4.24	6.4 – 13.6
8. 07/06/10	2.48	3.7 – 7.9
9. 28/06/10	2.12	3.0 – 6.6

Table 4.6 **Predicted maximum DAIN concentrations in the Bellozanne WwTW final effluent required to achieve a 1 mg m^{-3} decrease in chlorophyll *a* concentrations[a] in zone B.**

Survey	Effluent DAIN concentration (mg l^{-1})	Resultant X_{max}[a] (mg chl m^{-3})
1. 02/06/09	25.5	9.2
2. 30/06/09	26.0	8.9
3. 11/08/09	21.5	7.2
5. 01/03/10	17.5	40.4
6. 29/03/10	17.5	32.9
7. 26/04/10	20.0	14.9
8. 07/06/10	20.0	9.2
9. 28/06/10	19.5	7.8

a   based on the upper value for yield of chlorophyll for phytoplankton – 2.8 mg chl (mmol DAIN)$^{-1}$

Table 4.7 **Predicted DAIN concentration in the Bellozanne WwTW final effluent required for the predicted chlorophyll *a* concentrations[a] in zone B to equal the 10 mg m^{-3} CSTT eutrophication threshold.**

Survey	Effluent DAIN concentration (mg l^{-1})	Resultant X_{max}[a] (mg chl m^{-3})
1. 02/06/09	30.5	10.0
2. 30/06/09	33.0	10.0
3. 11/08/09	45.5	10.0
5. 01/03/10	0.0[b]	37.4
6. 29/03/10	0.0[b]	29.8
7. 26/04/10	0.0[b]	12.3
8. 07/06/10	26.0	10.0
9. 28/06/10	36.5	10.0

a   based on the upper value for yield of chlorophyll for phytoplankton – 2.8 mg chl (mmol DAIN)$^{-1}$

b   10 mg m^{-3} threshold would not be achieved even if DAIN concentration in the effluent was zero.