Comhairle Contae Chorcaí
Cork County Council

Halla an Chontae,
Corcaigh, Éire.
Fón: (021) 4276891 • Faics: (021) 4276321
Suíomh Gréasáin: www.corkcoco.ie
County Hall,
Cork, Ireland.
Tel: (021) 4276891 • Fax: (021) 4276321
Web: www.corkcoco.ie

Administration,
Office of Environmental Enforcement.
EPA Headquarters,
PO Box 3000,
Johnstown Castle Estate,
Co. Wexford.

Direct Tel. No. (021) 4285304
Direct Fax No. (021) 4343255
e-mail: patricia.power@corkcoco.ie

23rd February, 2011.

Re: Licence Register Number: D0129-01
Passage West-Monkstown Agglomeration
Annual Environmental Report 2010.

Dear Sir/Madam,

Please find enclosed Annual Environmental Report 2010 and attachments for Passage West-Monkstown, in accordance with Condition 6.11 of the Waste Water Discharge Licence D0129-01.

Attachments enclosed:

1. 1 no. original hard Copy.
2. 2 no. copies of original document.
3. 1 no. CD with the AER and all attachments in PDF format.

The content of the electronic files is a true copy of the signed original hard copy.

Yours faithfully,

MAIREAD LUCEY,
S/DIRECTOR OF SERVICES,
AREA OPERATIONS SOUTH,
FLOOR 5.

Recycled

PASSAGE WEST / MONKSTOWN AGGLOMERATION ANNUAL ENVIRONMENTAL REPORT

20th July 2010 – 31st DECEMBER 2010

CORK COUNTY COUNCIL – SOUTHERN DIVISION

ORIGINAL

Environmental Protection Agency
P.O. Box. 3000, Johnstown Castle Estate, County Wexford
Telephone : 053- 60600 Fax : 053 – 60699

Licence Reg. No.	**D0129-01**

Table of Contents

List of Attachments

Revision Control Table

Rev. Nr:	Description of Changes:	Prepared by:	Checked by:	Approved by:	Date:
0	Issue to EPA	BQ	RO'F	PP	25/02/11

1.0 Introduction

Cork County Council (Southern Division) holds a Waste Water Discharge Licence (Register No. D0129-01) in respect of the agglomeration named Passage West / Monkstown. This licence was granted on 20th July 2010. The aim of this Annual Environmental Report (AER) is to provide a review of activities relevant to the discharge from the 20th July to the 31st December 2010.

The required scope of the report is outlined in Schedule D (Annual Environmental Report Content) of the Waste Water Discharge Licence.

2.0 Summary of Monitoring Reports

2.1 Discharges from the Agglomeration.

Condition 4.1 states that;

"The licensee shall carry out such sampling, analyses, measurement, examinations, maintenance and calibrations as set out below and in accordance with Schedule B: Monitoring of this licence".

2.1.1 Monitoring of Primary Waste Water Discharge.

No Primary Waste Water Discharge monitoring is required in this licence.

2.1.2 Monitoring of Secondary Waste Water Discharge.

No Secondary Waste Water Discharge monitoring is required in this licence.

2.1.3 Interpretation of Discharge Monitoring Results.

This schedule does not apply.

2.1.4 Ambient Monitoring

Condition 4.8 states that;

"The licensee shall report annually in the AER on the chemical and ecological status of the receiving waters…….".

This report is attached in **Attachment 1.** An assessment has been carried out and is included in the attachment.

Condition 4.8 states that;

"The license shall within twelve months of the date of grant of this licence, investigate the sources of metals detected during monitoring of discharges from the wastewater works and take such measures as are necessary to reduce these substances in the discharge. A report on the investigation and measures identified, including timeframe for implementation, shall be included in the AER".

This condition will not apply until the completion of the waste water works.

3.0 Data collection and reporting requirements under the Urban Waste Water Treatment Directive

No data was collected under the UWWT Directive.

4.0 Complaints and Incident Reports

4.1 Complaints Summary

Condition 6.5 states that:

"The licensee shall record all complaints of an environmental nature related to the discharge(s) to waters from the waste water works in accordance with the national environmental complaints procedure. Each such record shall give details of the date and time of the complaint, the name of the complainant (if provided), and the nature of the complaint. A record shall also be kept of the response made in the case of each complaint".

No complaints were received in 2010 relating to the discharge(s) to water from wastewater works.

4.2 Reported Incidents Summary

Condition 6.1 states that;

"The licensee, shall notify the Agency by both telephone and facsimile, to the Agency's headquarters in Wexford, or to such other Agency office as may be specified by the Agency, as soon as is practicable after the occurrence of any incident (as defined in this licence). The licensee shall include as part of the notification, date and time of the incident, summary details of the occurrence, and where available, the steps taken to minimise any discharges".

Condition 6.4 states that;

"The licensee shall make a record of any incident. This record shall include details of the nature, extent, and impact of, and circumstances giving rise to the incident. The record shall include all corrective actions taken to manage the incident, to minimise the effect on the environment, and to avoid recurrence. The licensee shall as soon as practicable following incident notification, submit to the Agency the incident record including clean up and recurrence prevention measures".

No know reportable incidents in 2010 relating to the discharge(s) to water from wastewater works.

5.0 Project Plan and Status report for the Cork Lower Harbour Sewerage Scheme.

The Passage West – Monkstown agglomeration is made up of the towns/villages of Passage West, Glenbrook and Monkstown. These adjacent coastal population centres stretch for approximately 4km along the western side of Cork Harbour and are mainly residential with little significant industrial development.

At present wastewater produced in the towns and villages in the Lower Harbour area is discharged in an untreated condition into Cork Harbour at numerous dispersed locations.

There are plans in place to provide a wastewater treatment plant (WWTP) for the Lower Harbour area as part of the proposed Cork Lower Harbour Sewerage Scheme.

An Bord Pleanála granted approval for the proposed Cork Lower Harbour Sewerage Scheme on 24th June 2009 and the Preliminary Report ***Cork Harbour Main Drainage Scheme Preliminary Report March 2008*** was submitted to the Department of Environment, Heritage and Local Government (DOEHLG) for approval.

Cork County Council issued an addendum report to the Preliminary Report to the DOEHLG on 27th January 2011, and is currently awaiting a decision. The Council has advertised to pre-qualify Consultants for the Design, Tender, Construction and Handover Stages on Friday 11th February 2011.

The requirement for the addendum report has had a knock on effect on the project programme that was submitted as part of the response to Condition 5.1. A revised project programme is attached in **Attachment 2**. The timeframe for completion is now June 2016; this is subject to available finance both locally and from the DOEHLG.

For further information see the letter and associated attachments of the 7th of December 2010. This is included in **Attachment 3**.

6.0 Environmental Liability and Financial Provisions

6.1 Annual statement on prevention of environmental damage

Condition 7.2.1 states that;

"The licensee shall a part of the AER provide an annual statement as to the measures taken or adopted in relation to the prevention of environmental damage and the financial provisions in place in relation to the underwriting of costs for remedial actions following anticipated events or accidents/incidents, as may be associated with discharges or overflows from the waste water works".

This condition will not apply until the completion of the waste water works.

Attachment 1 Annual Reports on the Chemical and Ecological Status of the Receiving waters.

Attachment 2 Revised Project Programme.

Attachment 3 Letter and Report to the EPA of the 7th of December 2010

Copy of Marine Insitute Monitoring Data -Cork Harbour Shellfish Water Monitoring Programme compliance with SI 268 of 2006

Year	Sample	Date	Time	Station	Latitude	Longitude	Temp	pH	Salinity	DO (mg/L)	DO (% sat)	Colour	Suspended Solids (mg/l)
10	1050	21/01/10	14:35	Cork Harbour - North Channel	51.8837	-8.2670	7.6		19	10.6	100		
10	1118	21/02/10	17:28	Cork Harbour - North Channel	51.8840	-8.2690	6.2	8.5	28	10.1	100	5.6	20
10	1185	31/03/10	14:54	Cork Harbour - North Channel	51.8837	-8.2677	10.3		25	9.2	96		
10	1252	21/04/10	19:15	Cork Harbour - North Channel	51.8843	-8.2683	12.5	8.4	28	9.8	109		
10	1319	14/05/10	14:58	Cork Harbour - North Channel	51.8842	-8.2688	13.2	8.2	32	9.5	110	5.4	16
10	1355	30/06/10	15:23	Cork Harbour - North Channel	51.8842	-8.2685	21.1	8.2	33	8	109		
10	1448	13/07/10	14:15	Cork Harbour - North Channel	51.8842	-8.2670	17.9	7.7	30	8.8	112		
10	1521	24/08/10	13:02	Cork Harbour - North Channel	51.8843	-8.2682	17.9	8.1	32	7.3	94	9.3	39
10	1589	24/09/10	16:25	Cork Harbour - North Channel	51.8840	-8.2683	15.2	7.9	33	9	111		
10	1659	29/10/10	09:05	Cork Harbour - North Channel	51.8837	-8.2690	11.5	7.7	32	8.1	90		
10	1049	21/01/10	13:22	Cork Harbour - Rostellan North	51.8577	-8.1963	7.7		17	10.7	101		
10	1117	21/02/10	16:27	Cork Harbour - Rostellan North	51.8578	-8.1963	6.3	8.8	28	11	110	<4	9
10	1184	31/03/10	14:11	Cork Harbour - Rostellan North	51.8577	-8.1967	11.3		28	9.8	105		
10	1251	21/04/10	18:11	Cork Harbour - Rostellan North	51.8577	-8.1967	12.0	8.4	30	8.8	101		
10	1318	14/05/10	14:11	Cork Harbour - Rostellan North	51.8577	-8.1963	16.0	8.4	32	12.7	155	4.7	17
10	1354	30/06/10	14:31	Cork Harbour - Rostellan North	51.8577	-8.1963	21.4	8.5	33	11	152		
10	1447	13/07/10	15:31	Cork Harbour - Rostellan North	51.8577	-8.1963	17.8	8.3	32	11.9	150		
10	1519	24/08/10	14:21	Cork Harbour - Rostellan North	51.8577	-8.1963	18.3	8.1	33	7.8	101	5.3	53
10	1587	24/09/10	15:21	Cork Harbour - Rostellan North	51.8575	-8.1963	15.8	7.9	34	10.5	131		
10	1657	29/10/10	10:15	Cork Harbour - Rostellan North	51.8583	-8.1963	12.2	7.7	32	8.2	92		
10	1048	21/01/10	12:59	Cork Harbour - Rostellan South	51.8492	-8.1953	7.2		25	10.1	99		
10	1116	21/02/10	15:56	Cork Harbour - Rostellan South	51.8492	-8.1950	7.2	8.7	30	10.5	105	<4	4
10	1183	31/03/10	13:46	Cork Harbour - Rostellan South	51.8492	-8.1957	10.2		21	10	102		
10	1250	21/04/10	17:31	Cork Harbour - Rostellan South	51.8492	-8.1953	12.5	8.5	32	10.4	119		
10	1317	14/05/10	13:45	Cork Harbour - Rostellan South	51.8492	-8.1938	15.4	8.3	31	12.7	153	<4	16
10	1353	30/06/10	14:09	Cork Harbour - Rostellan South	51.8492	-8.1950	18.9	8.3	33	10.4	137		
10	1446	13/07/10	15:15	Cork Harbour - Rostellan South	51.8492	-8.1953	18.2	8.3	32	11	142		
10	1518	24/08/10	13:41	Cork Harbour - Rostellan South	51.8492	-8.1947	19.1	8.5	32	11.1	146	6	18
10	1586	24/09/10	15:11	Cork Harbour - Rostellan South	51.8492	-8.1958	15.7	8.1	33	10.5	130		
10	1656	29/10/10	10:41	Cork Harbour - Rostellan South	51.8492	-8.1938	11.9	7.7	32	8.1	92		
10	1520	31/08/10	12:36	Cork Harbour - Rostellan West	51.8493	-8.2050	15.8	8.2	34	9.1	112	8.7	<2
10	1588	24/09/10	15:02	Cork Harbour - Rostellan West	51.8493	-8.2050	15.4	8.0	34	9.2	113		
10	1658	29/10/10	11:43	Cork Harbour - Rostellan West	51.8493	-8.2050	12.5	7.8	33	8.4	96		

Shellfish Water Regulations S.I. 268 of 2006

Shellfish Waters Mandatory Limits	7.0 to 9.0	<40		≥70	eviation not >10						
Shellfish Waters Guide Limits	n/a	12 to 38		≥80		n/a					
Compliance with Shellfish Waters Mandatory L	**yes**	**yes**	n/a	**yes**	n/a	**yes**					
Compliance with Shellfish Waters Guide Limit	**yes**	**yes**	n/a	**yes**	n/a	n/a					

Copy of Marine Insitute Monitoring Data -Cork Harbour Shellfish Water Monitoring Programme compliance with SI 268 of 2006														
Year	Sample	Date	Time	Station	Probe_Temp	Probe_pH	Probe_Salinity	Probe_DO_mgL	Probe_DO_%_Sat	Suspended_Solids_mgL	True_Colour			
09	1027	091201	1800	Cork Harbour - Rostellan North	8.03	7.11	25.3	9.23	92	58.7	<4			
09	1080	091229	1125	Cork Harbour - Rostellan South	6.60		30.7	9.80	98	36.3	<4			
09	1081	091215	1330	Cork Harbour - Rostellan North	5.60		25.0	10.30	100	344	<4			
10	1116	100221	1556	Cork Harbour - Rostellan South	7.20		30.0	10.50	105	4.00	<4			
10	1117	100221	1627	Cork Harbour - Rostellan North	6.30		28.0	11.00	110	9.00	<4			
10	1317	100514	1345	Cork Harbour - Rostellan South	15.40	8.30	31.0	12.70	153	16	<4			
10	1318	100514	1411	Cork Harbour - Rostellan North	16.00	8.40	32.0	12.70	155	17	4.7			
10	1516	100824	1341	Cork Harbour - Rostellan South	19.10	8.50	32.0	11.10	146	5	17			
10	1517	100824	1421	Cork Harbour - Rostellan North	18.30	8.10	33.0	7.80	101	10	4.2			
10	1518	100831	1236	Cork Harbour - Rostellan South	15.80	8.20	34.0	9.10	112	18	6			
09	1026	091201	1720	Cork Harbour - North Channel	7.57	8.16	23.8	9.58	94	35.9	<4.1			
10	1118	100221	1728	Cork Harbour - North Channel	6.20		28.0	10.10	100	20.0	5.6			
10	1319	100514	1458	Cork Harbour - North Channel	13.20	8.20	32.0	9.50	110	16	5.4			
10	1519	100824	1302	Cork Harbour - North Channel	17.90	8.10	32.0	7.30	94	53	5.3			
09	1028			Cork Harbour - Rostellan South						58.4	<4			
				Shellfish Water Regulations S.I. 268 of 2006										
				Shellfish Waters Mandatory Limits		7.0 to 9.0	<40		≥70		deviation not >10			
				Shellfish Waters Guide Limits		n/a	12 to 38		≥80		n/a			
				Compliance with Shellfish Waters Mandatory Limits		**yes**	**yes**	n/a	**yes**	n/a	**yes**			
				Compliance with Shellfish Waters Guide Limits		**yes**	**yes**	n/a	**yes**	n/a	n/a			

Copy of Marine Insitute Monitoring Data -Cork Harbour Shellfish Water Monitoring Programme compliance with SI 268 of 2006

Year	Sample	Date	Time	Station	Designated Shellfish Water Area (with 1Km buffer)	Water Framework Directive Area (with 1Km buffer)	Probe temp	Probe pH	Probe salinity	Probe DO (mg/L)	Probe DO (% Sat)	Suspend Solids (mg/L)
09	1027	01/12/09	18:00	Cork Harbour - Rostellan North	Rostellan North	Cork Harbour	8.03	7.11	25.30	9.23	92.00	58.7
09	1028			Cork Harbour - Rostellan South	Rostellan North	Cork Harbour						58.4
09	1080	29/12/09	11:25	Cork Harbour - Rostellan South	Rostellan South	Cork Harbour	6.60		30.70	9.80	98.00	36.3
09	1026	01/12/09	17:20	Cork Harbour - North Channel	Cork Great Island North Channel	North Channel Great Island	7.57	8.16	23.79	9.58	93.50	35.9

Shellfish Water Regulations S.I. 268 of 2006			
Shellfish Waters Mandatory Limits	7.0 to 9.0	<40	≥70
Shellfish Waters Guide Limits	n/a	12 to 38	≥80
Compliance with Shellfish Waters Mandatory Limits	**yes**	**yes**	**yes**
Compliance with Shellfish Waters Guide Limits	**yes**	**yes**	**yes**

2009 harbour data (Data Source Harbour Monitoring by EPA) Transitional waters Loch Mahon

Sample_ID	Station_No	Sample_Label	Date_Surveyed	Time	Depth_Bed	Depth_sample	Salinity	Temp	pH	Secchi	DO_Saturation	DO_mgL	BOD	TON	NH3	PO4	chl_a	Si_est	DIN	Free_NH3	WB_Name
92253	LE310	LE310B	01/07/2009	10:52:00	9.4	9	31.47	17.72	8.13	1.5	94.9	7.5	3.9	0.264	0.143	16	11.6	55	0.407	0.00752	Lough Mahon
92542	LE310	LE310BR	01/07/2009	14:58:00	10	9.8	31.42	17.72	8.13	1.2	91	7.2		0.189	0.167	21	9	112	0.356	0.00879	Lough Mahon
101223	LE310	LE310B	15/09/2009	10:48:00	7.8	7.3	30.5	14.08	7.65	1.4	81.2	6.9	1.1	0.396	0.314	37	2.7	823	0.71	0.0043	Lough Mahon
101389	LE310	LE310CR	15/09/2009	15:38:00	10.1	9.7	30.4	14.57	7.62	1.4	81.7	6.9	1.5	0.619	0.226	31	2.6	1370	0.845	0.003	Lough Mahon
92433	LE310	LE310S	01/07/2009	10:52:00	9.4	0	18.84	18.61	8.11	1.5	128.3	10.7	4.6	0.2	0.009999	8	40.4	466	0.209999	0.00054	Lough Mahon
92538	LE310	LE310SR	01/07/2009	14:58:00	10	0	15.14	18.69	8.57	1.2	125.6	10.7		0.796	0.009999	5	8.7	614	0.805999	0.00144	Lough Mahon
101389	LE310	LE310CR	15/09/2009	15:38:00	10.1	0	14.62	15.48	7.62	1.4	95	8.7	1.5	0.619	0.226	31	2.6	1370	0.845	0.00321	Lough Mahon
101222	LE310	LE310S	15/09/2009	10:48:00	7.8	0	14.12	14.02	7.78	1.4	86.7	8.2	1.3	2	0.231	33	2.5	2600	2.231	0.00423	Lough Mahon
92515	LE330	LE330B	01/07/2009	11:09:00	8.8	8.3	31.38	17.78	8.18	1.5	98.3	7.7		0.184	0.122	14	7.8	68	0.306	0.0072	Lough Mahon
101396	LE330	LE330BR	15/09/2009	15:53:00	11.2	10.8	31.29	14.84	7.88	1.6	89.3	7.4	0.49999	1.51	0.167	20	1.5	718	1.677	0.00408	Lough Mahon
101230	LE330	LE330B	15/09/2009	11:03:00	7.9	7.6	30.52	14.56	7.82	1.3	81.8	6.9	1.1	0.386	0.305	36	2.9	859	0.691	0.00637	Lough Mahon
92280	LE330	LE330S	01/07/2009	11:09:00	8.8	0	29.89	18.06	8.31	1.5	107.2	8.5		0.263	0.044	2.49999	15.3	14.9999	0.307	0.00351	Lough Mahon
101397	LE330	LE330SR	15/09/2009	15:53:00	11.2	0	17.19	15.08	7.74	1.6	94.4	8.5	1.2	0.805	0.214	30	4.4	1720	1.019	0.00388	Lough Mahon
101229	LE330	LE330S	15/09/2009	11:03:00	7.9	0	14.01	14.21	7.72	1.3	88.4	8.3	1.5	1.43	0.257	34	5.6	1820	1.687	0.00417	Lough Mahon
933	LE330	LE330B	22/01/2009	11:17:00					7.93					0.273	0.067	28	0.249999	611	0.34		Lough Mahon
926	LE330	LE330BR	22/01/2009	14:42:00					7.89					0.268	0.047	30		612	0.315		Lough Mahon
972	LE330	LE330S	22/01/2009	11:17:00					7.82					1.79	0.147	39	0.7	2310	1.937		Lough Mahon
912	LE330	LE330SR	22/01/2009	14:42:00					7.83					1.5	0.027	40		1940	1.527		Lough Mahon
92267	LE330	LE330CR	01/07/2009	14:42:00					8.24				3.7	0.236	0.062	7	13.3	67	0.298		Lough Mahon
92503	LE340	LE340BR	01/07/2009	14:28:00	13	12.5	33.35	17.36	8.14	2	97.3	7.6		0.089	0.075	11	7.3	132	0.164	0.00393	Lough Mahon
92421	LE340	LE340B	01/07/2009	11:22:00	12	11	32.62	17.54	8.14	1.6	96.1	7.5		0.124	0.084	12	4.6	95	0.208	0.00446	Lough Mahon
101398	LE340	LE340CR	15/09/2009	16:07:00	12.5	12.3	32.16	14.92	7.95	1.1	93.2	7.7		0.673	0.181	21	3.1	1270	0.854	0.00521	Lough Mahon
101244	LE340	LE340B	15/09/2009	11:19:00	12.1	11.8	31.35	14.8	7.95	1.75	87.3	7.3		0.33	0.255	24	1.4	699	0.585	0.00727	Lough Mahon
92279	LE340	LE340SR	01/07/2009	14:28:00	13	0	29.15	18.45	8.32	2	127.9	10.1		0.239	0.043	2.49999	15.1	54	0.282	0.0036	Lough Mahon
92255	LE340	LE340S	01/07/2009	11:22:00	12	0	28.73	18.3	8.32	1.6	115.5	9.1		0.297	0.051	2.49999	12	53	0.348	0.00423	Lough Mahon
101398	LE340	LE340CR	15/09/2009	16:07:00	12.5	0	16.46	15.16	7.95	1.1	95.8	8.7		0.673	0.181	21	3.1	1270	0.854	0.0053	Lough Mahon
101243	LE340	LE340S	15/09/2009	11:19:00	12.1	0	13.69	14.33	7.74	1.75	90.8	8.5		1.38	0.227	31	4	1880	1.607	0.00389	Lough Mahon
921	LE340	LE340B	22/01/2009	11:40:00					7.96					0.239	0.042	25	0.249999	525	0.281		Lough Mahon
916	LE340	LE340BR	22/01/2009	15:04:00					7.93					0.251	0.034	25		541	0.285		Lough Mahon
965	LE340	LE340S	22/01/2009	11:40:00					7.85					1.6	0.132	35	1.2	2170	1.732		Lough Mahon
960	LE340	LE340SR	22/01/2009	15:04:00					7.88					1.31	0.11	35		1900	1.42		Lough Mahon
92259	LE360	LE360S	02/07/2009	10:15:00	0.7	0		18.11	7.69		65.6		2.7	1.26	0.254	46	12.3	1140	1.514	0.00513	Lough Mahon
92290	LE360	LE360CR	02/07/2009	16:26:00	2.5	0		18.94	8.17		106.5		2.9	0.588	0.094	13	18.1	119	0.682	0.00588	Lough Mahon
92290	LE360	LE360CR	02/07/2009	16:26:00	2.5	2		18.94	8.17		107.7		2.9	0.588	0.094	13	18.1	119	0.682	0.00588	Lough Mahon
				Mean Value			25.3773	16.49	7.97		97.1		2.17143	0.687	0.136559	22.92646971	7.7466666	885.7941	0.823882	0.0046808	
				95% percentile							127.44		4.145								
				Median												0.0245	4.5				
				90% percentile													15.58				

EQS Standard		>70% or >80%* <120%or<130%*	≤4.0	≤0.04/≤0.06*	10.0(Med)& 20(90%)
Compliance		Yes at DO lower limit No at DO upper Limit	**No**	Yes	Yes meets Good/Mod status

Note*-value dependent on Salinity

indicates parameters for compliance purposes

Copy of Marine Insitute Monitoring Data -Cork Harbour Shellfish Water Monitoring Programme compliance with SI 268 of 2006

myear	Sample	Sub Sample	Cruise	Date (yymmdd)	Station	Shellfish Area	WFD WB (with 1Km buffer)	Fixed Lat	Fixed Long	Actual Lat	Actual Long	Species (Latin)	# in Sample	Purpose	Temp	p H	Salinity	DO (mg/L)	DO (%sat)	TSS	Weather
2008	83	1	SW08	081029	Cork Harbour - North Channel	Cork Great Island North Channel	North Channel Great Island	51.8837	-8.2670	51.8810	-8.2593	Mytilus edulis	47	SH	8.53	7.74	27	9.72	99.0		
2008	84	1	SW08	081029	Cork Harbour - Main		Cork Harbour	51.8513	-8.2803	51.8513	-8.2803	Mytilus edulis	49	SH	10.5	7.74	26.6	13.4	142		
2008	85	1	SW08	081029	Cork Harbour - Ringaskiddy		Cork Harbour	51.8312	-8.3000	51.8307	-8.2973	Mytilus edulis	90	T	10.9	7.83	28.4	12.0	129	78.6	F
2008	85	2	SW08	081029	Cork Harbour - Ringaskiddy		Cork Harbour	51.8312	-8.3000	51.8307	-8.2973	Mytilus edulis	90	T	10.9	7.83	28.4	12.0	129	78.6	F
2008	85	3	SW08	081029	Cork Harbour - Ringaskiddy		Cork Harbour	51.8312	-8.3000	51.8307	-8.2973	Mytilus edulis	90	T	10.9	7.83	28.4	12.0	129	78.6	F
2008	146	1	SW08	081210	Cork Harbour - North Channel		North Channel Great Island	51.8837	-8.2670	51.8830	-8.2440	Crassostrea gigas	25	SH							
2008	147	1	SW08	081210	Cork Harbour - Rostellan North		Cork Harbour	51.8577	-8.1963	51.8575	-8.1957	Mytilus edulis	50	SH							
2008	148	1	SW08	081210	Cork Harbour - Rostellan South	Rostellan South	Cork Harbour	51.8492	-8.1953	51.8492	-8.1947	Crassostrea gigas	11	SH							
2009	54	1	SW09	090804	Cork Harbour - North Channel		North Channel Great Island	51.8837	-8.2670	51.8762	-8.2583	Mytilus edulis	50	SH							W
2009	55	1	SW09	090804	Cork Harbour - Rostellan South		Cork Harbour	51.8492	-8.1953	51.8500	-8.1920	Crassostrea gigas	19	SH							W
2009	68	1	SW09	090811	Cork Harbour - Rostellan North		Cork Harbour	51.8577	-8.1963			Crassostrea gigas	9	SH							F
2009	69	1	SW09	090811	Cork Harbour - North Channel	Cork Great Island North Channel	North Channel Great Island	51.8837	-8.2670	51.8848	-8.2422	Mytilus edulis	50	SH							F
2009	105	1	SW09		Cork Harbour - Ringaskiddy		Cork Harbour	51.8312	-8.3000	51.8308	-8.3005	Mytilus edulis	60	T	14.2	7.85	28.7		105	278	
2009	105	2	SW09		Cork Harbour - Ringaskiddy		Cork Harbour	51.8312	-8.3000	51.8308	-8.3005	Mytilus edulis	60	T	14.2	7.85	28.7		105	278	
2009	105	3	SW09		Cork Harbour - Ringaskiddy		Cork Harbour	51.8312	-8.3000	51.8308	-8.3005	Mytilus edulis	60	T	14.2	7.85	28.7		105	278	
2009	4023	1	SW09	091118	Cork Harbour - North Channel	Cork Great Island North Channel	North Channel Great Island	51.8837	-8.2670			Crassostrea gigas	25	SH							WR
2009	4024	1	SW09	091118	Cork Harbour - North Channel	Cork Great Island North Channel	North Channel Great Island	51.8837	-8.2670			Mytilus edulis	50	SH							WR
2009	4025	1	SW09	091118	Cork Harbour - Rostellan North		Cork Harbour	51.8577	-8.1963			Crassostrea gigas	13	SH							WR
Shellfish Water Regulations S.I. 268 of 2006										**Shellfish Water Regulations S.I. 268 of 2006**											
Shellfish Waters Mandatory Limits										**Shellfish Waters Mandatory Limits**			n/a	7.0 to 9.0	<40		≥70	n/a	n/a
Shellfish Waters Guide Limits										**Shellfish Waters Guide Limits**			n/a	n/a	12 to 38		≥80	n/a	n/a
Compliance with Shellfish Waters Mandatory Limits										**Compliance with Shellfish Waters Mandatory Limits**			n/a	**yes**	**yes**	n/a	**yes**	n/a	n/a
Compliance with Shellfish Waters Guide Limits										**Compliance with Shellfish Waters Guide Limits**			n/a	**yes**	**yes**	n/a	**yes**	n/a	n/a

Copy of Marine Insitu													Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls
myear	Sample	Culture Type	Time High Tide	Programme	# in pool	Length (min)	Length (mean)	Length (max)	Length (stdev)	% Lipids	% Moisture	Tissue	CB101 (ug kg-1 WW)	CB105 (ug kg-1 WW)	CB114 (ug kg-1 WW)	CB118 (ug kg-1 WW)	CB123 (ug kg-1 WW)	CB126 (ug kg-1 WW)	CB138 (ug kg-1 WW)	CB149 (ug kg-1 WW)	CB153 (ug kg-1 WW)	CB156 (ug kg-1 WW)	CB157 (ug kg-1 WW)	CB167 (ug kg-1 WW)	CB169 (ug kg-1 WW)
2008	83	B		Spatial Shellfish	47	42.0	50.8	58.0	3.35		72.5	SB													
2008	84	B		Spatial Shellfish	49	42.0	51.8	60.0	3.80		76.3	SB													
2008	85	WB		Trend Shellfish	30	40.0	44.6	49.5	3.00	1.21	76.8	SB													
2008	85	WB		Trend Shellfish	30	40.5	45.4	49.5	2.51	1.21	76.4	SB													
2008	85	WB		Trend Shellfish	30	41.0	45.0	49.5	2.58	1.21	77.0	SB													
2008	146	T		SWD	25	79.0	113	147	18.5	1.45	81.2	SB	1.3	nd (<0.02)		0.61			1.03		1.03	<0.11			
2008	147	T		SWD	50	43.5	50.0	56.0	3.31	0.87	75.6	SB	0.37	0.11		0.29			0.54		0.78	<0.02			
2008	148	T		SWD	11	101	127	148	14.8	1.50	77.9	SB		0.12		0.42			0.53		1.33	0.02			
2009	54	I	0515	SWD	50	41.5	51.6	58.0	4.40	1.10	73.4	SB	0.13	<0.12		0.22			0.29		0.25	0.04			
2009	55	T	0515	SWD	19	70.0	124	222	40.2	2.00	77.5	SB	<0.5	<0.61		<1.28			0.84		1.44	<0.12			
2009	68	T	0951	SWD	9	87.0	137	210	38.3	3.12	81.7	SB	0.29	<0.54		0.95			0.44		1.57	<0.02			
2009	69		0951	SWD	50	41.0	50.2	60.0	6.00	1.38	74.5	SB	0.2	nd (<0.04)		nd (<0.17)			0.3		0.51	0.05			
2009	105	B		Trend Shellfish	22	40.0	46.1	50.0	3.51	1.52	84.3	SB													
2009	105	B		Trend Shellfish	22	40.0	45.3	50.0	3.46	1.52	85.3	SB	0.16	0.02	0.0008	0.07	0.001	0.0006	0.11		0.2	0.004	0.001	0.003	<0.001
2009	105	B		Trend Shellfish	16	50.5	51.3	52.0	0.58	1.52	84.8	SB													
2009	4023	T	1800	SWD	25	75.5	107	148	20.8	2.24	82.6	SB	0.24	0.16		0.31			0.37		0.85	0.02			
2009	4024	I	1800	SWD	50	41.0	48.6	59.5	4.50	2.45	80.8	SB	<0.42	0.04		0.5			0.43		0.88	0.04			
2009	4025	T	1800	SWD	13	82.0	138	200	32.3	3.72	82.3	SB	<0.56	<0.01		0.8			0.4		1.6	0.04			
Shellfish Water Regulations																									
Shellfish Waters Mandatory L		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	total of 300 ug/Kg @1 percent li			total of 0.30ug/ litre(seawater)									
Shellfish Waters Guide Limit		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	total of 100 ug/Kg @1 percent lipid (shellfish flesh)												
Compliance with Shellfish W		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Yes												
Compliance with Shellfish W		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Yes												

Copy of Marine Insitu		Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls	Chlorobiphenyls
myear	Sample	CB170 (ug kg-1 WW)	CB18 (ug kg-1 WW)	CB180 (ug kg-1 WW)	CB189 (ug kg-1 WW)	CB194 (ug kg-1 WW)	CB209 (ug kg-1 WW)	CB28 (ug kg-1 WW)	CB31 (ug kg-1 WW)	CB44 (ug kg-1 WW)	CB52 (ug kg-1 WW)	CB77 (ug kg-1 WW)	CB81 (ug kg-1 WW)	SCB6 (ug kg-1 WW)	SCB6E (ug kg-1 WW)	SCB7 (ug kg-1 WW)	SCB7E (ug kg-1 WW)	SCBI (ug kg-1 WW)	SCBIE (ug kg-1 WW)	TESCBW05E (ug kg-1 WW)	TESCBW05I (ug kg-1 WW)	TESCBW98E (ug kg-1 WW)	TESCBW98I (ug kg-1 WW)
2008	83																						
2008	84																						
2008	85																						
2008	85																						
2008	85																						
2008	146			0.05				0.19	0.63		0.25			3.85	3.85	4.46	4.46	4.46	4.46				
2008	147			0.05				<0.03	0.03		<0.17			1.94	1.74	2.23	2.03	2.23	2.03				
2008	148			0.07				<0.67	0.2		<0.15							3.17	2.35				
2009	54	nd (<0.001)		0.04		nd (<0.001)	nd (<0.13)	0.04			<0.33			1.08	0.75	1.3	0.97	1.3	0.97				
2009	55	nd (<0.001)		0.07		nd (<0.001)	nd (<0.13)	0.19			<0.82			3.86	2.54	5.14	2.54	5.14	2.54				
2009	68	nd (<0.24)		0.08		nd (<0.001)	nd (<0.001)	0.15			0.42			2.95	2.95	3.9	3.9	3.9	3.9				
2009	69			0.04				<0.08			<0.87			2	1.05	2.17	1.05	2.17	1.05				
2009	105																						
2009	105			<0.02	<0.0007			0.04			0.06	0.004	0.0003	0.59	0.57	0.66	0.64	0.66	0.64	6E-05	9E-05	7E-05	8E-05
2009	105																						
2009	4023	<0.006		<0.06		nd (<0.003)		0.07	nd (<0.01)		0.16			1.75	1.69	2.06	2	2.06	2				
2009	4024	0.01	0.02	<0.09		nd (<0.003)		0.11	0.23	nd (<0.008)	0.36			2.29	1.78	2.79	2.28	2.79	2.28				
2009	4025	<0.01		<0.07		nd (<0.003)		nd (<0.01)	nd (<0.01)									3.44	2.8				
Shellfish Water Regulations S																							
Shellfish Waters Mandatory L																							
Shellfish Waters Guide Limits																							
Compliance with Shellfish W																							
Compliance with Shellfish W																							

Copy of Marine Insitu		Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Cyclodienes	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)
myear	Sample	ALD (ug kg-1 WW)	CCDAN (ug kg-1 WW)	DIELD (ug kg-1 WW)	EDAN (WW)	END (ug kg-1 WW)	OCDAN (ug kg-1 WW)	SDRINM (ug kg-1 WW)	SDRINME (ug kg-1 WW)	TCDAN (ug kg-1 WW)	TNONC (ug kg-1 WW)	DDEOP (ug kg-1 WW)	DDEPP (ug kg-1 WW)	DDTOP (ug kg-1 WW)	DDTPP (ug kg-1 WW)	SDDT (ug kg-1 WW)	SDDTE (ug kg-1 WW)	SDDTM (ug kg-1 WW)
2008	83																	
2008	84																	
2008	85																	
2008	85																	
2008	85																	
2008	146	0.07	0.06	0.24	0.3		0.02	0.31	0.31	nd (<0.09)	0.13		0.92	0.05	0.23			1.74
2008	147	nd (<0.001)	0.07	0.58	0.32	0.01	0.08	0.59	0.59	0.09	0.08		0.64	0.06				1.03
2008	148	nd (<0.001)	0.12	0.59		0.03		0.62	0.62	0.11	0.13		0.99	0.07				1.52
2009	54	<0.006	0.02	0.32		nd (<0.006)	0.01	0.33	0.32	0.08	0.01	0.01	0.43	nd (<0.001)	<0.12			0.56
2009	55	<0.006	0.03	0.34		nd (<0.006)	0.002	0.35	0.34	<0.63	0.002	0.02	1.37	nd (<0.001)	0.43			1.85
2009	68	0.03	nd (<0.02)	0.4		0.02		0.45	0.45	<0.02	<0.02	nd (<0.001)	1.12	0.04	nd (<0.001)			1.42
2009	69	nd (<0.008)	0.03			nd (<0.008)	0.02	0.02	0		0.02		0.5	0.03	0.08			0.81
2009	105																	
2009	105																	
2009	105																	
2009	4023	nd (<0.003)	0.11	0.25		0.04	nd (<0.003)	0.29	0.29	0.11	0.04		0.65	nd (<0.01)	<0.19			1.1
2009	4024	nd (<0.003)	0.15	0.78		nd (<0.003)	nd (<0.003)	0.79	0.78	0.13	0.03	nd (<0.003)	0.74	<0.12	nd (<0.003)	1.12	0.99	1.12
2009	4025	nd (<0.003)	0.24	0.74		nd (<0.003)	nd (<0.003)	0.75	0.74	0.17	0.07		1.44	<0.15	nd (<0.003)			1.99
Shellfish Water Regulations S																		
Shellfish Waters Mandatory L																		
Shellfish Waters Guide Limit																		
Compliance with Shellfish W																		
Compliance with Shellfish W																		

Copy of Marine Insitu		Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dichloro-diphenyl-trichloroethane (DDTs)	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins
myear	Sample	SDDTME (ug kg-1 WW)	TDEOP (ug kg-1 WW)	TDEPP (ug kg-1 WW)	CDD1N (pg kg-1 WW)	CDD4X (pg kg-1 WW)	CDD6P (pg kg-1 WW)	CDD6X (pg kg-1 WW)	CDD9X (pg kg-1 WW)	CDDO (pg kg-1 WW)	CDF2N (pg kg-1 WW)	CDF2T (pg kg-1 WW)	CDF4X (pg kg-1 WW)	CDF6P (pg kg-1 WW)	CDF6X (pg kg-1 WW)	CDF9P (pg kg-1 WW)	CDF9X (pg kg-1 WW)	CDFDX (pg kg-1 WW)	CDFO (pg kg-1 WW)	CDFP2 (pg kg-1 WW)	TCDD (pg kg-1 WW)	TESCBCDCFW05E (ng kg-1 WW)	TESCBCDCFW05I (ng kg-1 WW)
2008	83																						
2008	84																						
2008	85																						
2008	85																						
2008	85																						
2008	146	1.74		0.54																			
2008	147	1.03		0.33																			
2008	148	1.52		0.46																			
2009	54	0.44	nd (<0.001)																				
2009	55	1.85	0.03																				
2009	68	1.42	0.26																				
2009	69	0.8	nd (<0.008)	0.19																			
2009	105																						
2009	105				40	60	860	80	60	6410	70	190	<30	<50	<30	<40	<30	<30	<220	<30	<20	0.17	0.24
2009	105																						
2009	4023	0.9	nd (<0.003)	0.25																			
2009	4024	0.99	nd (<0.003)	0.25																			
2009	4025	1.83	nd (<0.003)	0.39																			
Shellfish Water Regulations S																							
Shellfish Waters Mandatory L																							
Shellfish Waters Guide Limit																							
Compliance with Shellfish W																							
Compliance with Shellfish W																							

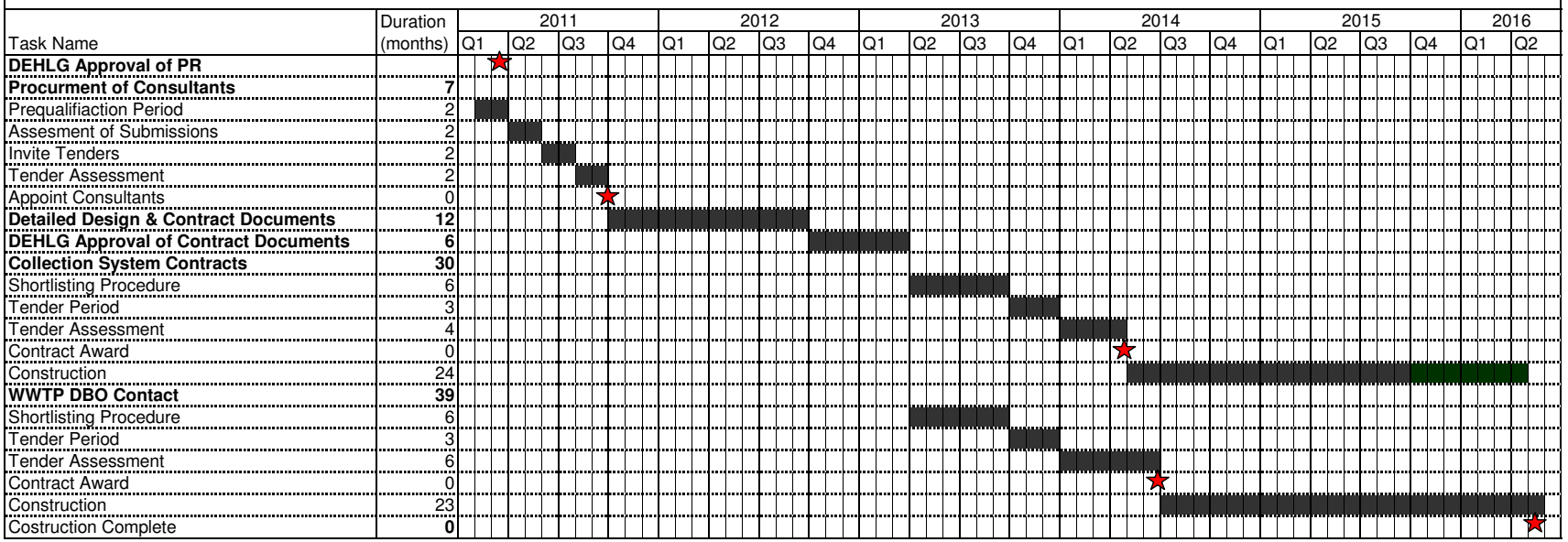
Copy of Marine Insitu		Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Dioxins	Hexachlorocyclohexanes	Hexachlorocyclohexanes	Hexachlorocyclohexanes	Metals and metalloids	Metals and metalloids	Metals and metalloids	Metals and metalloids	Metals and metalloids	Metals and metalloids	Metals and metalloids	Metals and metalloids	Metals and metalloids	Organobromines
myear	Sample	TESCBCDCFW98E (ng kg-1 WW)	TESCBCDCFW98I (ng kg-1 WW)	TESCDCFW05E (pg kg-1 WW)	TESCDCFW05I (pg kg-1 WW)	TESCDCFW98E (pg kg-1 WW)	TESCDCFW98I (pg kg-1 WW)	HCHA (ug kg-1 WW)	HCHB (ug kg-1 WW)	HCHG (ug kg-1 WW)	AG (mg kg-1 WW)	AS (mg kg-1 WW)	CD (mg kg-1 WW)	CR (mg kg-1 WW)	CU (mg kg-1 WW)	HG (mg kg-1 WW)	NI (mg kg-1 WW)	PB (mg kg-1 WW)	ZN (mg kg-1 WW)	BD100 (ug kg-1 WW)
2008	83										<0.01	2.09	0.1	0.09	1.9	0.03	<0.13	0.39	16	
2008	84										nd (<0.003)	2.13	0.07	0.09	2.4	0.02	<0.13	0.55	21.1	
2008	85										0.01	2.13	0.1	0.23	3.09	0.02	0.15	0.38	22	0.19
2008	85										0.01	2.5	0.1	0.13	3.02	0.02	<0.13	0.37	21.9	
2008	85										0.02	2.25	0.1	0.14	3.12	0.02	0.14	0.39	22.4	
2008	146							nd (<0.0008)	nd (<0.004)	0.07	0.59	2.03	0.19	0.1	19.8	0.03	<0.13	0.27	291	
2008	147							<0.09	nd (<0.006)	0.02	<0.01	2.05	0.15	0.2	1.85	0.03	0.13	0.53	17.9	
2008	148							<0.15	0.05	0.02	1.53	2.14	0.29	0.2	44.4	0.06	<0.13	0.38	638	
2009	54							0.05	0.02	0.03	0.04	2.4	0.13	0.17	2	0.03	<0.13		13.7	
2009	55							0.11	0.02	0.01	0.87	2.44	0.15	0.13	19.5	0.03	<0.13	0.27	455	
2009	68							nd (<0.001)	nd (<0.001)	0.005	0.67	1.54	0.13	0.09	17.5	0.03	<0.13	0.26	349	
2009	69							0.04	nd (<0.008)	0.09	0.02	1.55	0.05	0.15	1.37	0.02	<0.13	0.46	11.4	
2009	105										0.05	2.4	0.08	0.27	2.12		0.19	0.17	20.7	0.01
2009	105	0.2	0.24	113	147	126	160				0.06	2.74	0.08	0.26	1.77		0.23	0.16	20.5	
2009	105										0.03	2.61	0.07	0.31	1.24		0.22	0.16	20.3	
2009	4023							0.01	nd (<0.003)	0.06	0.22	2	0.09	0.07	5.59	0.02	<0.13	0.23	138	
2009	4024							0.03	<0.004	<0.008	<0.01	1.6	0.07	0.18	1.31	0.02	<0.13	0.34	12.9	
2009	4025							0.02	nd (<0.003)	0.05	0.58	1.51	0.13	0.06	15.6	0.02	<0.13	0.19	288	
Shellfish Water Regulations S																				
Shellfish Waters Mandatory L											10.0ug/L (seaw	40.0ug/L (seaw	5.0ug/L (seawa	30.0ug/L (seaw	10.0ug/L (seaw	0.4ug/L (seawa	50.0ug/L (seaw	20.0ug/L (seaw	200.0ug/L (seawater)	
Shellfish Waters Guide Limit											15.0mg/Kg dry	30.0mg/Kg dry	5.0mg/Kg dry v	6.0mg/Kg dry v	400.0mg/Kg dr	1.0mg/Kg dry v	5.0mg/Kg dry v	7.50mg/Kg dry	4000.0mg/Kg dry weight	
Compliance with Shellfish W											n/a*	n/a*	n/a*	n/a*	n/a*	n/a*	n/a*	n/a*	n/a*	
Compliance with Shellfish W											yes	yes	yes	yes	yes	yes	yes	yes	yes	

Copy of Marine Insitu		Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines
myear	Sample	BD119 (ug kg-1 WW)	BD126 (ug kg-1 WW)	BD138 (ug kg-1 WW)	BD153 (ug kg-1 WW)	BD154 (ug kg-1 WW)	BD156 (ug kg-1 WW)	BD183 (ug kg-1 WW)	BD184 (ug kg-1 WW)	BD191 (ug kg-1 WW)	BD196 (ug kg-1 WW)	BD197 (ug kg-1 WW)	BD206 (ug kg-1 WW)	BD207 (ug kg-1 WW)	BD209 (ug kg-1 WW)	BDE17 (ug kg-1 WW)	BDE28 (ug kg-1 WW)	BDE47 (ug kg-1 WW)	BDE49 (ug kg-1 WW)	BDE66 (ug kg-1 WW)	BDE71 (ug kg-1 WW)	BDE77 (ug kg-1 WW)	BDE85 (ug kg-1 WW)	BDE99 (ug kg-1 WW)
2008	83																							
2008	84																							
2008	85	<0.008	<0.008	<0.01	0.02	0.02	<0.01	<0.02	<0.02	<0.02	<0.04	<0.04	<0.08	<0.08	0.64	0.02	0.01	0.76	0.08	0.03	<0.008	<0.008	0.03	0.52
2008	85																							
2008	85																							
2008	146																							
2008	147																							
2008	148																							
2009	54																							
2009	55																							
2009	68																							
2009	69																							
2009	105	<0.01	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.1	<0.1	<0.41	<0.004	<0.004	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
2009	105																							
2009	105																							
2009	4023																							
2009	4024																							
2009	4025																							
Shellfish Water Regulations S																								
Shellfish Waters Mandatory L																								
Shellfish Waters Guide Limit																								
Compliance with Shellfish W																								
Compliance with Shellfish W																								

Copy of Marine Insitu		Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organobromines	Organochlorines (general)	Organochlorines (general)	Organochlorines (general)	Organochlorines (general)	Organochlorines (general)	Organochlorines (general)	Organofluorines	Organofluorines	Organofluorines	Organofluorines	Organofluorines	Organofluorines
myear	Sample	HBCD (ug kg-1 WW)	HPBDE (ug kg-1 WW)	HXBDE (ug kg-1 WW)	NBDE (ug kg-1 WW)	OBDE (ug kg-1 WW)	PEBDE (ug kg-1 WW)	SBDE (ug kg-1 WW)	SBDEE (ug kg-1 WW)	TEBDE (ug kg-1 WW)	TRBDE (ug kg-1 WW)	ENDA (ug kg-1 WW)	ENDB (ug kg-1 WW)	HCB (ug kg-1 WW)	HCEPT (ug kg-1 WW)	HCEPX (ug kg-1 WW)	HEPC (ug kg-1 WW)	PFDOA (ug kg-1 WW)	PFDS (ug kg-1 WW)	PFOA (ug kg-1 WW)	PFOS (ug kg-1 WW)	SPFCE (ug kg-1 WW)	SPFCI (ug kg-1 WW)
2008	83																						
2008	84																						
2008	85	13.3	nd (<)	0.05	nd (<)	nd (<)	0.74	1.52	1.52	0.86	0.03												
2008	85																	<0.2	<0.2	<0.2	<0.2	nd (<)	2.2
2008	85																						
2008	146											nd (<0.0008)		<0.11		0.02	0.03						
2008	147											<0.03	<0.14	0.3		0.02	<0.006						
2008	148											<0.02	<0.12	0.31		0.06	0.06						
2009	54											nd (<0.001)	nd (<0.001)	0.1	0.02		<0.006						
2009	55											0.01	nd (<0.001)	0.1	nd (<0.006)		0.02						
2009	68											0.005	nd (<0.02)	<0.02			nd (<0.001)						
2009	69											nd (<0.008)	nd (<0.008)	0.02	nd (<0.008)		nd (<0.008)						
2009	105	0.73	nd (<)	nd (<)	nd (<)	nd (<)	0.03	0.11	0.07	0.04	nd (<)												
2009	105																						
2009	105																						
2009	4023												nd (<0.003)	<0.01	0.03		0.03						
2009	4024												nd (<0.003)	0.05	<0.04		0.04						
2009	4025												nd (<0.003)	0.01	nd (<0.003)		0.06						
Shellfish Water Regulations S																							
Shellfish Waters Mandatory L																							
Shellfish Waters Guide Limits																							
Compliance with Shellfish W																							
Compliance with Shellfish W																							

Copy of Marine Insitu		Organofluorines	Organofluorines	Pesticides (general)
myear	Sample	SPFOSOAE (ug kg-1 WW)	SPFOSOAI (ug kg-1 WW)	ENDS (ug kg-1 WW)
2008	83			
2008	84			
2008	85			
2008	85	nd (<)	0.4	
2008	85			
2008	146			nd (<0.09)
2008	147			nd (<0.006)
2008	148			<0.02
2009	54			
2009	55			
2009	68			0.004
2009	69			nd (<0.008)
2009	105			
2009	105			
2009	105			
2009	4023			<0.008
2009	4024			nd (<0.003)
2009	4025			nd (<0.003)
Shellfish Water Regulations S				
Shellfish Waters Mandatory L				
Shellfish Waters Guide Limit				
Compliance with Shellfish W				
Compliance with Shellfish W				

CORK LOWER HARBOUR SEWERAGE SCHEME - PROJECT PROGRAMME



Comhairle Contae Chorcaí
Cork County Council

Halla an Chontae,
Corcaigh, Éire.
Fón: (021) 4276891 • Faics: (021) 4276321
Suíomh Gréasáin: www.corkcoco.ie
County Hall,
Cork, Ireland.
Tel: (021) 4276891 • Fax: (021) 4276321
Web: www.corkcoco.ie

Environmental Protection Agency,
P.O.Box 3000,
Johnstown Castle Estate,
County Wexford.

7th December 2010

Re: Waste Water Discharge Licence Reg. No. D0129-01
Agglomeration of Passage West / Monkstown, County Cork.

Dear Sir/Madam,

I refer to the above Licence. Cork County Council's Response to Condition 5.1 of this licence is detailed in the table below and the associated attachments.

Ref	Condition:	Response:
5.1	The licensee shall, within three months, prepare and submit to the Agency for its agreement a Project Plan for the Cork Lower Harbour Sewerage Scheme that will achieve the following objectives:	
5.1(a)	Achieve improvements in the quality of all discharges from the works;	Refer to Chapters 3, 4 & 5 of Volume 1 of the Cork Harbour Main Drainage Scheme Preliminary Report at **Attachment 1**, of which Section 5.6 "Proposed Wastewater Treatment Plant" is particularly relevant.
5.1(b)	Cease discharges listed under Schedule A.3: Discharges to be Discontinued, of this licence;	Refer to the Cork Lower Harbour Scheme Project Program at **Attachment 2**. Also refer to letter dated 2nd November 2010 which states the current position at **Attachment 3**.
5.1(c)	Give effect to Regulation 2 of the Waste Water Discharge (Authorisation) Regulations 2007 (S.I. No. 684 of 2007).	Refer to the Cork Lower Harbour Sewage Scheme EIS previously submitted as part of the licence application. Refer to Regulation 18-3b response dated 20th February 2009 at **Attachment 4** and An Bord Pleanála Inspector's Report at **Attachment 5**, of which Section 5.0 "Assessment" is particularly relevant.

I trust that the above meets with your satisfaction.

Yours faithfully,

PATRICIA POWER
DIRECTOR OF SERVICES

ATTACHMENT 1

3. Future Infrastructure

3.1 Introduction

The proposed drainage infrastructure within the Lower Harbour Catchment Area is designed to convey the design loads to the proposed Waste Water Treatment Plant. Section 4 of this report presents the analysis of the various conceptual options examined with regard to the conveyance of effluent, the treatment plant site selection and the disposal of the treated effluent. The criteria used for this analysis included cost and all environmental impacts. The flows used for this analysis were based on full development of all areas zoned at the time the analysis was carried out, with an allowance for additional development in line with the Cork Area Strategic Plan.

This section deals with the more detailed design of the proposed conveyance system for the full development of the catchment area. The four population centres, Cobh, Carrigaline (including Crosshaven), Passage West/Monkstown, and Ringaskiddy (including Shanbally and Coolmore), are defined and analysed in this section of the report.

Firstly, the design loading is presented within each population centre with due regard to the infiltration/leakage target. Flows have been allowed based on full development of all areas zoned at the time of this report (2009), with an allowance for additional development in line with the Cork Area Strategic Plan.

Secondly, a description of the conceptual design is then discussed in relation to each town. Then, more detailed options within each population centre and between population centres presented and the preferred scheme selected.

Section 6 contains the cost estimates for the proposed scheme discussed in this section.

3.2 Overall Harbour Analysis

3.2.1 General

Existing and proposed development within the Cork Lower Harbour Catchment Area is shown on drawing A5670-N002. Full development of these areas has been allowed for in the collection system design.

3.2.2 Future Population

In order to assess the future loading within the collection system the following development plans were examined:

- 2009 Cork County Development Plan
- Carrigaline Electoral Area Local Area Plan 2005
- Midleton Electoral Area Local Area Plan 2005
- Adopted Amendment of the Carrigaline Electoral Area Local Area Plan 2005 (Amendment 2)
- Cobh Town Development Plan 2005 – 2011
- Cork Area Strategic Plan 2001 – 2020 (2008 Update)
- Crosshaven Design Loads

The residential areas zoned within each plan were identified and allowances made for the full development of each. In addition to these areas, development was allowed for in areas unzoned within the development boundaries.

Typical housing densities were applied to each area and a housing occupancy of 3 persons / house was applied.

The Cork Area Strategic Plan identified proposed directions of future development for Cobh and Carrigaline. For the purposes of this report, these directions were assigned general areas within the catchment and allowances made for their development.

3.2.3 Future Discharges

The development plans listed in the previous section were also examined to identify future commercial and industrial development as well as residential development. In addition to allowances made for zoned land, future commercial/institutional loadings were quantified using 24 l/head/day (i.e. 16% of the domestic loading).

Loading rates for zoned residential, commercial and industrial development are discussed within each section.

Flow surveys were carried out in order to assess the extent of infiltration within the existing sewers as discussed in Section 2.

The recommendations in this section are deemed sufficient to reduce infiltration to meet the specific infiltration/leakage target of 50 l/head/day. This allowance for infiltration has been accepted as the norm for the design of the collection system.

3.2.4 Future Collection System

The analysis of the various options for Waste Water collection, treatment and disposal are presented in Section 4.

The preferred scheme identified the proposed Wastewater Treatment Plant site at Carrigaline East and the overall conveyance route.

The significance of the preferred scheme and the internal options it presented are discussed within each population centre.

The hydraulic modelling is then discussed and issues within each area are presented.

From this, recommendations are outlined with reference to the relevant drawings within each population centre.

3.2.4.1 Separation of Flows in Combined Sewers

Where considered economically viable, partially separate foul and storm sewers have been incorporated in the proposal. This separation has the following main advantages:
- Provides spare capacity in existing combined sewers
- Reduces pumping costs and storage tank requirements
- Smaller and more consistent flows to the proposed Waste Water Treatment Plant.

The level of separation provided was based on economic and practical considerations within each housing group. Where fully combined systems exist at present it was considered feasible to provide only partial separation.

3.2.4.2 Foul Sewer Design

For the design of new, fully separate, foul sewers the following criteria was adopted:
- No surcharging for 6 times DWF.

Generally, for the design of new partially separate foul sewers the following criteria were adopted:
- No surcharging for a 1 in 2 yr. Storm of critical duration with 2.5 DWF.
- No flooding for a 1 in 5 yr. Storm of critical duration with 2.5 DWF
- No excessive/damaging flooding for a 1 in 20 yr. Storm of critical duration with 2.5 DWF.

For the upgrading of existing partially separate foul sewers the following criteria were adopted:
- No flooding for a 1 in 5 yr. Storm of critical duration with 2.5 DWF.
- No excessive flooding for a 1 in 20 yr. Storm of critical duration with 2.5 DWF.
- No operational problems/flooding at present on fully utilised routes.

3.2.4.3 Storm Sewer Design

New Storm Sewers were designed adopting the following criteria:
- No surcharging for a 1 in 2 yr. Storm of critical duration
- No flooding for a 1 in 5 yr. Storm of critical duration
- No excessive flooding for a 1 in 20 yr. Storm of critical duration

Existing Storm Sewers were upgraded unless the following criteria applied:
- No flooding for a 1 in 5 yr. Storm of critical duration
- No excessive flooding for a 1 in 20 yr. Storm of critical duration
- No operational problems/flooding at present on fully utilised routes.

3.2.4.4 Pumping Station Design

The proposed pumping stations within the Lower Harbour Catchment have been designed to pump forward "Formula A" flow in line with DEHLG recommendations.

During prolonged dry periods it is likely that some solids in the dry weather flow (DWF) will settle in the sewers. These deposits will be flushed out of the system during a rain event, with the result that the first flows during a rain event will be considerably less dilute than the subsequent flows. This period is called the "First Foul Flush". The "First Foul Flush" volume was calculated based on the size of catchment and design storm used.

For many of the smaller catchment, this "First Foul Flush" period in relatively short and there is sufficient capacity within the pumping station to store or pump forward the required volume.

For larger catchments, separate storage tanks were incorporated to store the "First Foul Flush" volume. This volume will be then returned to the foul system once the storm has abated.

In some cases the pumping stations have been designed to pump forward at a rate in excess of "Formula A". This has been necessary in order to limit the overflows to Sensitive designated waters.

Where smaller pumping stations are required it is proposed to install package pumping stations.

3.2.4.5 Design of Overflows

The pumping stations are designed to pump "Formula A" flow to the Proposed Waste Water Treatment Plant.

Storm overflows, with screens, are provided at each pumping station to discharge to the Harbour when flows exceed Formula A.

In certain locations, flow limiting devices were incorporated upstream of the pumping stations where storage or overflows at the pumping stations was considered unfeasible. The overflows from these also receive screening.

The Urban Waste Water Treatment (Amendment) Regulations 2004 (SI No 440 of 2004) designates the Lee Estuary/Lough Mahon – from the salmon weir (downstream of waterworks intake) to Monkstown (excluding North Channel at Great Island) as sensitive waters. The DEHLG publication 'Procedure and Criteria in relation to Storm Water Overflows' suggests that overflows to sensitive waters should be limited to 20% of the rainfall run-off volume. This has impacted on the design of overflows not only at Passage West / Monkstown which discharge directly into the Sensitive Waters, but also Cobh and Ringaskiddy where incoming tides flush the overflows into the Sensitive Waters.

3.2.4.6 Design Tidal Levels

For the purpose of design a high tide level of 3.5 mOD Malin has been adopted. This effects the storm pumps provided in the proposed Old Waterpark Pumping Station. Also, all manholes with ground levels of less than 3.5 mOD are to be sealed.

This value includes an allowance for climate change and is based on the findings of the Lee Catchment Flood Risk Assessment and Management Study.

3.3 Cobh

3.3.1 General

The town of Cobh is located on the south western corner of Great Island overlooking the outer harbour. The island has one road link, via Fota Island, to the main land at Belvelly Bridge. It is approximately 24km by road to Cork City and is also accessible by rail and ferry. Cobh is a linear town stretching from Rushbrooke in the West to Cuskinny Bay in the East and is situated on a hill that rises steeply from the shore to 85 mOD.

Tourism plays an important part in the economy of Cobh. The Cobh Cathedral and Heritage Centre are significant tourist attractions throughout the year.

The Ballynoe area in the western environs of Cobh town has seen significant residential development in the last number of years. The Carrignafoy area, to the east of the town centre, has also seen new development but on a smaller scale. The North Cobh SLI has opened up significant areas of land for development to the north west of the town.

The existing (2001) hydraulic loading and drainage system for Cobh is outlined in Section 2.3. This section presents the recommendations with regard to future population and hydraulic loading for the design of the collection system. The design hydraulic and organic loadings for the Waste Water Treatment Plant are presented in Section 4.

The design population for Cobh is arrived at in Section 3.3.2 based on the development of the catchment.

The design loading for the collection system is presented in Section 3.3.3.

The proposed collection system is discussed in Section 3.3.4.

The estimated cost of the proposed scheme is presented in Section 6.

3.3.2 Future Population

3.3.2.1 Local Area Plan

The 2005 Midleton Local Area Plan covers the Cobh area. This was examined to identify the areas zoned for development outside the Cobh UDC boundary. Much of the lands zoned for residential development have either already been developed or are currently being developed.

The area of land yet to be developed is approximately 37 ha (areas shaded green in Figure 3.3.1). These lands are zoned for residential development which, when developed, will result in an additional 1,600 houses.

3.3.2.2 Cobh Development Plan 2005 - 2011

The Cobh development plan identified development zones within the UDC boundary. Much of this infill development has already taken place however one of the zones which has yet to be developed will result in an additional 63 houses when developed.

3.3.2.3 Cork Area Strategic Plan

The interim report on the Cork Area Strategic Plan sets out a proposed strategy for development in Cobh. The plan identifies the areas in Cobh targeted for development. One area has been identified for future residential development in addition to the areas represented in the development plans. The area is approximately 40 ha and provides for the development of approximately 2,032 houses (see Figure 3.3.1).

3.3.2.4 Infill Housing

Within the existing development boundary there are vacant lands on which infill development is likely to occur within the design horizon of this report. This is anticipated to provide for an additional 158 houses if fully developed.

3.3.2.5 Future Design Population

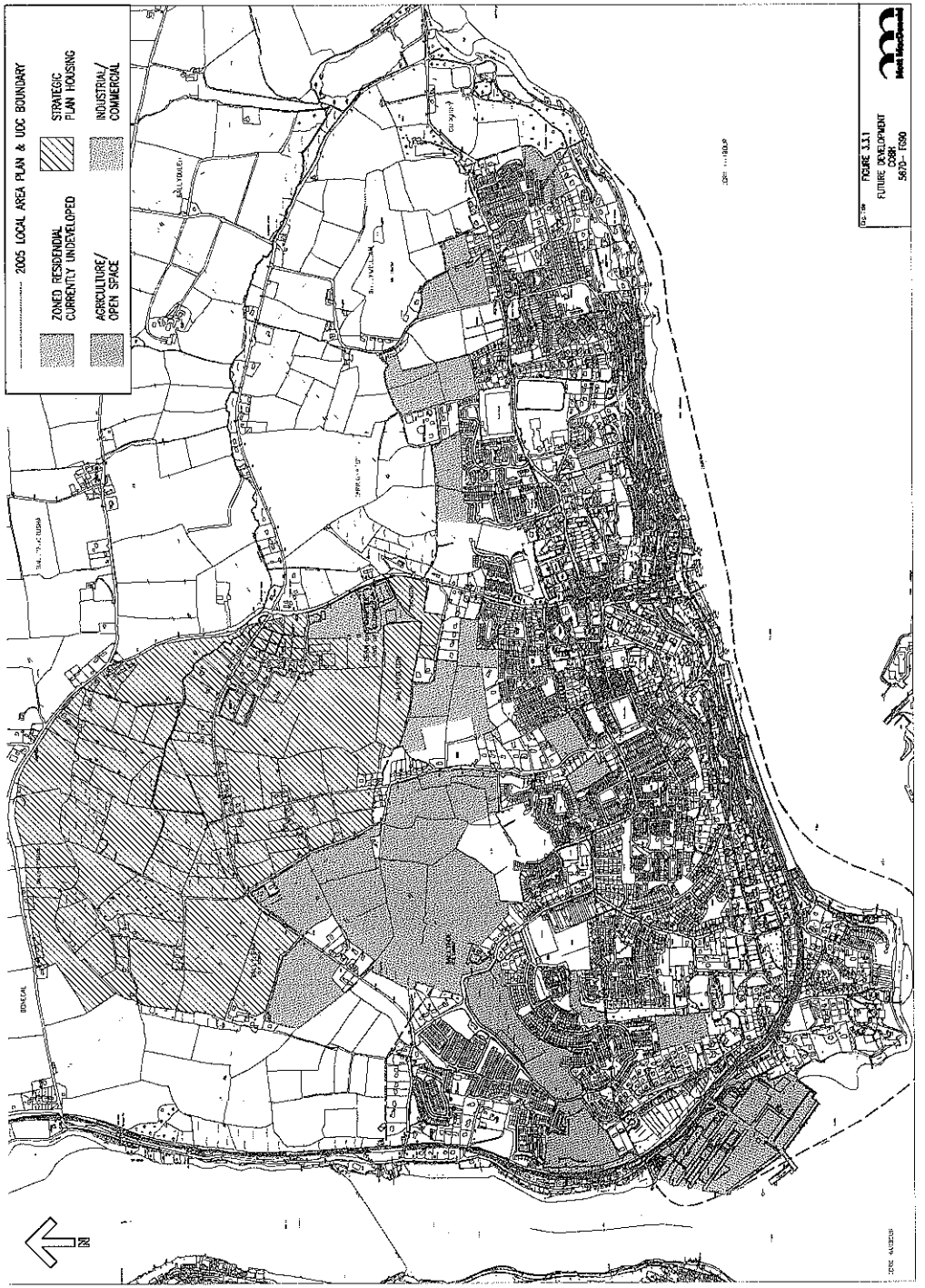
The estimated existing and future number of houses within the Cobh catchment is summarised as follows:

Existing Nr. of Houses:	5,412
Development Plans:	1,663
Strategic Plan Development:	2,032
Infill Housing:	158
Total	**9,265**

The housing occupancy, taken as 3 persons / house, is applied to the total number of houses to arrive at a design population.

Future Nr. of Houses:	9,265
House Occupancy:	3.0
Design Population:	27,795

A design population of 27,795 is taken for the Cobh Catchment.



3.3.3 Future Flows and Loads

3.3.3.1 Domestic Loading

A future design population of 27,795 has been established for Cobh. Table 3.3.1 below summarises the design loading for the collection system and the ultimate loading for the Waste Water treatment plant from the estimated domestic population.

Table 3.3.1			Cobh Design Domestic Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Population	27,795		
Domestic Loading	150 l/head/day	60 g/head/day	70 g/head/day
Design Domestic Loading	4,169 m^3/d	1,668 kg/d	1,946 kg/d

3.3.3.2 Non-Domestic Loading

Commercial Loading

The existing commercial loadings in the Cobh catchment are presented in Section 2.3.3.2.

A review of the existing records on water usage for Cobh has indicated that the commercial flow element (including institutional) represents approximately 16% of the domestic flow element. The design commercial loading is therefore taken as 16% of the future domestic loading.

Table 3.3.2 summarises the components of the design loadings from commercial activities.

Table 3.3.2			Cobh Design Commercial Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Commercial Loading	667	267	311

Industrial Loading

The development plans allow for industrial development at Rushbrooke Commercial Park (5 ha likely to develop) and north of Cobh (11.4 ha). Assuming an average industrial load of 21 m^3/ha/day, the design flow for future industrial development is 344 m^3. The characteristics of this flow are taken to be similar to domestic waste water.

Table 3.3.3			Cobh Design Industrial Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Industrial Loading	344	138	161

Institutional Loading

Institutional loading is taken to be equal to the current (2009) institutional loading, with any increase in institutional loading included for in the increase in commercial loading.

Table 3.3.4 summarises the components of the design loadings from institutional sources.

Table 3.3.4			Cobh Design Institutional Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Institutional Loading	128	51	60

3.3.3.3 Infiltration

The surveys carried out to estimate the extent of infiltration in Cobh indicate that infiltration is widespread throughout the entire catchment.

Recommendations are contained in Section 3.3.4 of this report concerning the reduction of infiltration to the existing sewer network. However, it is recognised that the complete elimination of infiltration is not possible nor would it be cost effective to reduce levels below recognised acceptable values. An allowance of 50 l/ head/ day will therefore be made within the Cobh catchment. Based on a design population of 27,795 this equates to an increase in the dry weather flow of 1,390 m^3/d.

3.3.3.4 Summary

The apportionment of the design loading throughout the catchment is based on development plan proposals. Drawing A5670-N100 shows the sub-catchments defined as part of this report and Appendix F contains the loadings from each. These flows were used for the design of the collection system. Table 3.3.5 below summarises the design loadings for Cobh.

Table 3.3.5			Cobh Design Load Summary
	Flow (m^3/d)	BOD (kg/d)	SS (kg/d)
Domestic	4,169	1,668	1,946
Infiltration	1,390	0	0
Institutional	128	51	60
Commercial	667	267	311
Industrial	344	138	161
Total	6,698	2,124	2,478

3.3.4 Future Collection System

3.3.4.1 Conceptual Design

The analysis of the various options for Waste Water collection and treatment are presented in Chapter 4. The preferred scheme is for a single Waste Water Treatment Plant located across the harbour in the Carrigaline/Ringakiddy area. The Cobh collection system will convey all effluent to a proposed harbour crossing Pumping Station at Carrigaloe.

The collection system within the centre of the town will drain to a new pumping station to be constructed at West Beach. This pumping station will pump to the gravity system to the west of the town which can gravitate to the location of the harbour crossing. Smaller pumping stations will be provided in the town and at Whitepoint to direct foul flows to the main collection system.

Two storm overflow chambers are to be incorporated into the collection system. Flows up to 605 l/s will be pumped at the harbour crossing.

The hydrodynamic model of the harbour (ref Appendix G) demonstrates that on the incoming tide >98% of the overflows at West Beach and White Point are carried into the designated Sensitive Waters at Monkstown. As such, in accordance with DEHLG guidance, overflow volumes must be limited to 20% of rainfall runoff.

Gravity and pumped flows will be directed to a new pumping station at Carrigaloe. Twin 500mm nominal size rising mains will cross the harbour between Carrigaloe and Glenbrook.

The majority of the existing network at Cobh is a combined system, and it is proposed to separate these flows where possible. Storm sewers are proposed on the main roads to separate flows where possible (from roads and front of houses) and to intercept any dedicated storm sewers from individual developments which currently discharge to the combined sewer. Storm sewers have not been proposed for future development of greenfield sites. It has been assumed that on site storm water management will be implemented to limit discharges to current discharge rates. In most cases the natural fall of the land is away from the existing catchment boundary. Furthermore, for some of the areas for future development, the optimum disposal route will depend on the phasing of the development of the particular area.

3.3.4.2 Options

Recommendations for the collection system in Cobh were made in the Cobh Sewerage System Review Report 1997. The recommendations in the 1997 Report were based on the construction of a Waste Water treatment plant within the catchment. The analysis presented in Section 4 of this report recommends a single Waste Water treatment plant to be located in Carrigaline/Ringaskiddy area. In addition, development has occurred on lands within Cobh which were previously available for parts of the infrastructure for the sewerage system.

The 1997 Review Report recommends a pumping station at West Beach and some of the recent upgrading of the collection system has been carried out with this intention. This proposal is considered to be the preferred location taking into consideration the nature of the catchment and the layout of the existing collection system.

Siphon at Spy Hill

The review report recommended a siphon at Spy Hill to reduce the volume of flow to the West Beach Pumping Station. This proposal together with the alternatives considered are discussed below.

a. The proposal presented in the Review Report included for a siphon at Spy Hill commencing at a point opposite the Palace. All flows from the upstream catchment would discharge to the siphon. The rising main from the proposed West Beach Pumping Station would also discharge to the siphon. The operation of the Pumping Station is intended to allow for cleansing velocities to occur in the pipeline on a daily basis.
b. This alternative allows for the installation of a combined storm overflow (CSO) upstream of the siphon. The CSO would be designed to overflow flows in excess of 6 DWF to the West Beach Pumping Station.
c. The third alternative is to eliminate the siphon and to allow all flows to enter the West Beach Pumping Station.

In option A, the siphon consists of twin parallel pipes of 450 mm dia. The gravity sewer at the end of the siphon would be a 750 mm dia. pipeline. This pipeline would extend from the end of the siphon in High Road to the site for the proposed harbour crossing pumping station, increasing to 900mm dia. in the vicinity of White Point.

The advantage of this arrangement is that flows are reduced to the West Beach Pumping Station leading to lower pumping costs. However, all flows, including storm flows from the upper catchment pass through the siphon to the downstream gravity sewer. This requires larger pipelines than would be required if storm flows were overflowed upstream of the siphon and will also result in increased overflows at Carrigaloe Pumping Station. There will also be additional maintenance requirements with the siphon as well as the potential for operational difficulties due to settlement of solids, entrapment or air etc.

In Option B, stormwater flow in excess of 6 DWF from the catchment upstream of the siphon will overflow at the CSO to a gravity sewer leading to the West Beach Pumping Station. This has the potential to allow the size of the siphon pipes and the downstream gravity pipelines to be reduced. In this arrangement the storm overflow will be directed to the West Beach Pumping Station which incorporates a storm holding tank and screening at the point of outfall. However due to the restriction on overflow volumes it will be necessary to provide extensive storage as well as pumping forward at 300 l/s.

The advantage of this arrangement is that the gravity sewer downstream of the siphon requires less capacity and therefore comprises of smaller pipes and shallower grades. This reduces the cost of the pipelines and decreases the depth of excavation along the roadway.

Option C involves directing all of the flow from Spy Hill to the proposed pumping station at West Beach. Excess flows will overflow at the pumping station after storage tanks become full. The amount of storage required would be the same as with Option A, however the pump rate would increase from 160 l/s to 300 l/s to limit overflows to 20% of rainfall runoff. The pumps would operate in a duty/assist/assist/standby mode to limit the pump rate during periods of dry weather.

This option will result in higher capital costs for the pumping station and increased operating and maintenance costs than those associated with Option A. The advantage of this system is that any potential operational problems concerning the siphon are removed. The size of the downstream pipeline will be the same as Option B.

The preferred option is option C for the following reasons:

- Pipe sizes for the gravity sewers are reduced.
- Excavation depths along the route of the gravity sewer are reduced.
- Screening will be provided to storm overflows at the West Beach Pumping Station.
- Overflows directly into the sensitive waters at Carrigaloe are limited.
- The potential for operational problems with the siphon is eliminated.

Storm Pumps at West Beach Pumping Station

The 1997 Review Report recommended the installation of storm sump and pumps at the proposed West Beach Pumping Station. Appendix 2 of that report indicates that the storm pumps are designed to prevent surcharging above the level of the lowest house connection.

Ground levels within the town are generally above 3.00 m OD. The highest astronomical tide is reported to be 2.84 mOD. Investigations have indicated that flooding is not a problem within the town. There are some basement properties which do experience problems in exceptionally high tides. However, these properties have facilities to deal with these occurrences when this occurs.

This report recommends that the storm pumps be eliminated. In such circumstances pipelines will be allowed to surcharge during high tide. However, flooding will not occur as ground levels are above the highest astronomical tide level. The elimination of the storm pumps will reduce capital and operation costs.

River Crossing Location

Alternatives were considered for the location of the pumping station for the Marine Crossing. A number of possible sites were identified including the following.

1. A site at Whitepoint.
2. A site at the Cork Dock Yard.
3. A site adjacent to the Rushbrooke Hotel.
4. A site between the Rushbrooke Hotel and the Carrigaloe Ferry Crossing.
5. A site at the Carrigaloe Ferry Crossing.

All of the above options were considered in the context of the preferred location for the marine crossing, difficulties associated with laying the rising main and the location of the pumping station with regard to servicing land in Ballynoe north of the town and lands designated under the Cork Area Strategic Plan.

Site Nr. 1 was not considered feasible due to the requirements of Iarnród Éireann. The railway company have indicated that they require a minimum height clearance of 4.85m above the existing railway track. Their requirements are more than the clearance indicated in proposals contained in the 1997 Review Report. It would not be possible to continue a gravity sewer above the railway track to a possible site at Whitepoint. In addition, the conceptual design anticipates that the Waste Water from Cobh will arrive upstream of Monkstown.

Site Nr. 2 was again identified in the 1997 Review Report as a possible point of crossing the harbour. There are a lot of unknowns associated with this site with respect to possible underground obstructions for gravity sewers and rising mains. A large proportion of the Dockyard is constructed on reclaimed land which is retained by a series of sheet piled walls. It is likely that these piled walls have ties which may conflict with any proposed route for a rising main leading to high costs. This site would not easily permit a gravity flow from the future development of the lands in Ballynoe.

Site Nr. 3 is a vacant portion of land adjacent to the Rushbrooke Hotel. This site was considered because the crossing can be taken to a point on the opposite bank of the harbour where a gravity flow can be achieved for the proposed new Monkstown Pumping Station. However, whilst the area of the site is sufficient to accommodate the pumping station access would have to be from the car park of the Rushbrooke Hotel. In addition a gravity flow cannot easily be achieved from the lands in the Ballynoe Area.

Site Nr. 4 was considered because a gravity flow can be achieved to this site from the Ballynoe lands and the site would allow for a marine crossing which would not interfere with the navigation of the ferry crossing. However, the site is part of a private garden of a house which would have to be purchased. A compulsory purchase order of this site could prove difficult to obtain as a vacant industrial site (site nr. 5) exists within a few hundred metres of this site.

Site Nr. 5 is an old abandoned warehouse adjacent to the existing Carrigaloe Ferry Crossing Terminal. The site is of adequate size and will provide for a gravity flow from Ballynoe. The only disadvantage of this site is that there could be some interference of the activities of the ferry during construction.

The preferred site is Site Nr. 5. The site is large enough to accommodate the proposed pumping station and a gravity flow can be achieved from the Cobh direction and from Ballynoe. It is envisaged that any possible interference with the operation of the ferry crossing can be managed to minimise possible disruption to this service.

3.3.4.3 Hydraulic Modelling

It was decided that, where possible, the collection system in Cobh should be separated. It was not considered feasible to totally separate the collection system, and it is proposed that the foul system will continue to take the storm runoff from the roofs of houses, with other areas draining to a dedicated storm sewer network.

A future model was set up which was based on the existing model, with additional sewers input for areas which are currently not connected or are yet to be developed, as well as the proposed interceptor sewers. The design loadings arrived at in Section 3.3.3 were input into the model, and the model run to identify areas where upgrading of sewers was required.

In some cases it was found that there is a greater storm runoff contribution to the foul sewers than to the proposed storm sewers. Where the existing network was found to have insufficient capacity for the design foul flows, but had capacity for the design storm flows, the existing sewer is converted to a dedicated storm sewer, with all foul connections diverted to a new foul sewer adjacent to the existing sewer.

It was not considered necessary to model the less critical sewers, and it was decided to model all sewers which could feasibly require a sewer size greater than the minimum sizes considered for the project of 225mm diameter for foul sewers and 300mm diameter for storm sewers.

As high tides do not presently cause flooding within the Cobh catchment, and the ground levels are generally above the design high tide level of 3.5mOD, the tide was not included in the hydraulic models.

The proposed network was examined for storms of different durations for the various return periods considered. It was generally found that the 30 minute storm was the most critical. Resultant tables and plans from the InfoWorks simulations for the foul (2.5 DWF) and storm networks with storms of two year (surcharging), five year (flooding) and twenty year (excessive flooding) return periods and 30 minute

durations are included in Appendix F. Plans and results for the foul (6 DWF) network with the 5 year, 30 minute storm are also included.

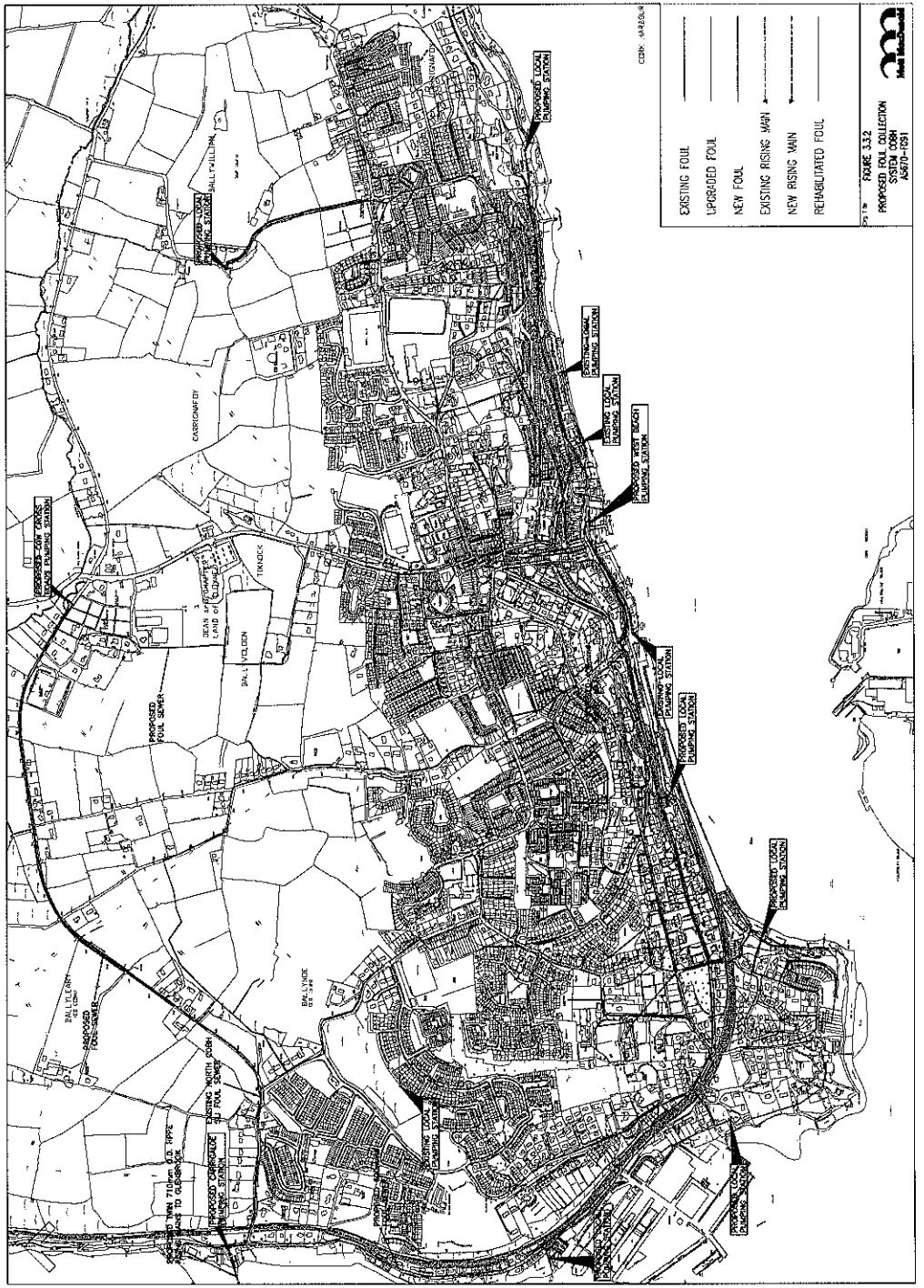
3.3.4.4 Recommendations

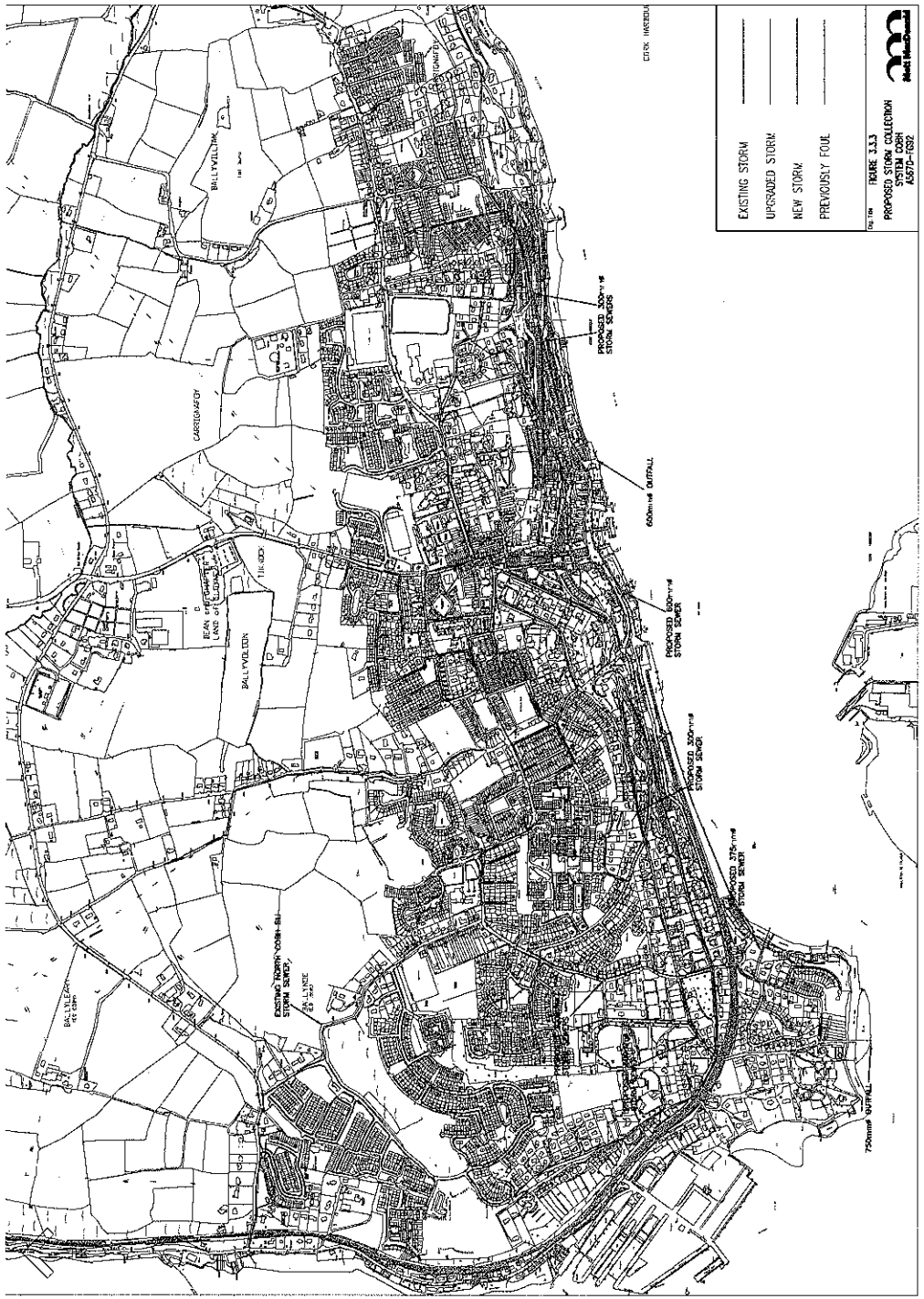
Fig. 3.3.2 shows a schematic of the proposals for upgrading the foul collection system in Cobh. Many of the existing sewers are unable to deal with the design flows. In order to achieve as much separation of flows as possible, it is proposed to lay new dedicated storm sewers on all major roads, with capacity to take the storm flows from the adjacent roads and catchments. In general these sewers will run parallel to the existing or proposed foul/ combined sewers, using existing foul/ combined outfalls to discharge to sea. Figure 3.3.3 contains a schematic of the proposals for the storm system in Cobh.

Overall layout plans of the proposed foul and storm sewers are shown on Drawings A5670-N120, N121 and N122. Detailed Plans and longitudinal sections of the proposed sewers are shown on Drawings A5670-N123 to N140.

A summary of 12 recommendations is as follows:-

- West Beach Pumping Station and Storm Storage Tanks
- New Interceptor Sewer East of West Beach Pumping Station
- New Interceptor Sewer on High Road to Carrigaloe
- Storm Water Overflows
- Upgrading of Under Capacity Sewers
- New Foul Sewers to Unconnected/ New Developments.
- Carrigaloe Pumping Station.
- New Twin 500mm diameter Rising Mains from Carrigaloe to Glenbrook
- Rehabilitation of sewers identified by the CCTV Survey
- New Storm Sewers
- Existing Combined Sewers converted to dedicated storm sewers.
- North West of Cobh





West Beach Pumping Station and Storm Storage Tanks (Ref. Drg. Nr. A5670-N141)

It is proposed to construct a new pumping station at the town centre at West Beach. This pumping station will serve the town centre and the catchments to the East of the town centre.

The pumping station will include for foul pumps in a wet well/dry well arrangement.

The foul pumps will have a combined capacity to pump 300 l/s. This is greater than the "Formula A" flow for the catchment due to the requirement to limit flows to 20% of rainfall runoff. It is proposed that the pump station will comprise of four pumps operating on a Duty/Assist/Assist/Standby basis. Flows in excess of 300 l/s will overflow into a storm holding tank. The storm holding tank is sized to hold the 'first foul flush' from the catchment. The storm holding tank can hold approximately 1,120m^3 to a level of 1.8 m O.D. Malin. This is sufficient for the 'first foul flush' period of 20.5 minutes for a two year storm and together with a pup rate of 300 l/s is sufficient to limit overflows to 20% of rainfall runoff. Flows in excess of the capacity of the Pumping Station will discharge to the harbour via 6mm screens.

New Interceptor Sewer East of West Beach Pumping Station (Ref. Drg. Nrs. A5670-N123 & -N125)

The catchments to the East of the town centre fall towards the proposed West Beach pumping station. It is proposed to lay an interceptor sewer to collect the flows from these catchments near the existing outfalls and direct them to the proposed West Beach pumping station.

The following lengths of sewer are required:
- 59m of 450mm diameter sewer between Mhs. HFP812 and HFP813
- 245m of 600mm diameter sewer between Mhs. HFP813 and HFP807
- 297m of 750mm diameter sewer between Mhs. HFP807 and GFP802
- 177m of 900mm diameter sewer between Mhs. GFP802 and GFP785
- 274m of 750mm diameter sewer between Mhs. GFP785 and FFP790
- 18m of 900mm diameter sewer between Mh. FFP790 and proposed West Beach Pumping Station.

The pipe diameter reduces from 900mm to 750mm flowing down East Beach. Along this section the pipe is relatively steep, and the smaller diameter is sufficient to carry the required flows. As this is a busy, yet narrow street, it was considered prudent to install the smallest pipe size feasible.

New Interceptor Sewer on High Road to Carrigaloe (Ref. Drg. Nrs. A5670-N130 & A5670-N132)

It is proposed to lay an interceptor sewer from the header manhole on High Road to the proposed pumping station at Carrigaloe. This sewer will intercept flows from the western side of the town, which presently flow through the comminutor station at White Point, upstream of the railway crossing at Wharton's Corner. Flows from White Point are pumped to this interceptor sewer.

The following lengths of sewer are required:
- 701m of 525mm diameter sewer between Mhs. DFP716 and DFP706
- 57m of 600mm diameter sewer between Mhs. DFP706 and DFP705
- 1,115m of 750mm diameter sewer between Mhs. DFP705 and BFP633
- 1,021m of 900mm diameter sewer between Mh. BFP633 and Carrigaloe Pumping Station.

Restrictions concerning the minimum clearance above the railway track preclude crossing above the railway track. Iarnród Éireann have advised that a minimum clearance of 4.85m above the track, or 2.0m below the track, is required. A clearance of 4.85m above the track cannot be achieved at any point along the length of sewer due to the required gradient of the sewer. It is proposed to cross under the railway track at the railway station opposite the entrance to Cork Dockyard. At this point the required minimum cover below a railway track can be achieved. This route will involve tunnelling a section through the high ground from Manhole BF P641 to BF P638 and beneath the railway track between BF P638 to BF 637.

Storm Water Overflow (Ref. Drg. Nr. A5670-N131)

The purpose of the overflow is to limit the flows to be carried to Carrigaloe, and to limit the overflows into the Sensitive designated waters at Carrigaloe. The location of the overflow allows excess flows to use the existing combined sewer and discharge through the existing outfall at White Point.

The storm overflow chamber is located on the foul sewer on Lake Road, upstream of where the sewer joins the proposed Interceptor Sewer at Wharton's Corner. This sewer serves the areas surrounding Rushbrooke Park, Norwood Park, Elmwood Grove, Russell Heights, Springfield Park and Inishmore Park.

The hydrodynamic model demonstrates that on the incoming tide >98% of the overflows at White Point are carried to the designated Sensitive waters at Monkstown. In order to limit the overflows to 20% of rainfall runoff it is necessary to provide a stormwater holding tank at the overflow, and to limit the continuation flows to 200 l/s. This is significantly in excess of the 6 DWF flow from the catchment, however reducing the continuation flows would result in the stormwater holding tank becoming excessively large. The volume of the stormwater holding tank will be just over 200m^3. All overflows to the storm holding tank would be via 6mm screens, and a tipping bucket would be required in the holding tank to flush the tank after a storm event.

Upgrading of Under-Capacity Sewers

Approximately 4,051 metres of foul sewers are to be upsized to cater for design flows. Figure 3.3.2 shows the lengths of sewers requiring upgrade under design flow conditions. Many of the areas identified presently experience problems with surcharge and flooding. The InfoWorks models discussed in Section 3.3.4.3 identified the under capacity sewers.

The following lengths and diameters are proposed:
- 229m of 300mm diameter sewer between Mhs. GFE537 and HFP810 at Lower Cottrel's Row
- 275m of 375mm diameter sewer between Mhs. GFP460a and GFP806 at Harbour Terrace
- 70m of 300mm diameter sewer between Mhs. GFE462 and GFE461 at Willmount Avenue
- 237m of 300mm diameter sewer between Mhs. GFE458 and GFE455 at Harbour View
- 157m of 300mm diameter sewer between Mhs. EFE379 and EFE375 at Hilltop Park
- 426m of 375mm diameter sewer between Mhs. EFE406 and EFP374C at Bishop Street
- 235m of 300mm diameter sewer between Mhs. EFE379 and EFP374C at Hilltop Park
- 47m of 375mm diameter sewer between Mhs. EFP374C and EFP766 at Midleton Street
- 202m of 300mm diameter sewer between Mhs. EFE347and EFE236 at Kirkwood Villas
- 100m of 300mm diameter sewer between Mhs. EFE362 and EFP755 adjacent to Stark Terrace
- 34m of 225mm diameter sewer to be regraded between Mhs EFE301 and EFE299 at Kirkwood Villas
- 151m of 375mm diameter sewer between Mhs. EFP754 and EFE294 adjacent to St. Colman's Park
- 595m of 450mm diameter sewer between Mhs. EFE294 and EFP764 at Lake Road and Laundry Hill
- 189m of 300mm diameter sewer between Mhs EFE235 and EFE234 at Laundry Hill

- 222m of 300mm diameter sewer between Mhs CFE47 and CFE89 at Norwood Park
- 73m of 375mm diameter sewer between Mhs. CFE86 and CFE84 at Norwood Park
- 64m of 225mm diameter sewer to be regraded between Mhs. BFE76 and BFE74 at Newtown
- 503m of 375mm diameter sewer between Mhs. BFP73 and BFE32 at Norwood Park
- 146m of 600mm diameter sewer between Mhs. BFE32 and BFE30 at Lake Road
- 96m of 225mm diameter sewer between Mhs. BFE30 and BFP700 at Lake Road

New Foul Sewers to Unconnected/New Developments

(a) New foul sewer at Carrignafoy.

This sewer will be laid adjacent to the existing combined sewer, which will become a dedicated storm sewer. The following lengths and diameters are proposed:
- 182m of 225mm diameter sewer
- 120m of 300mm diameter sewer
- 864m of 450mm diameter sewer
- as well as 67m of 225mm diameter sewer adjacent to the main sewer

(b) New foul sewer at The Retreat, South of Carrignafoy.

This sewer will connect houses in the area which presently discharge to sea to the proposed local pumping station H5, which will pump flows through 132m of rising main to MH HFP812. This will consist of 756m of 225mm diameter sewer.

(c) New foul sewer at Velvethouse Crossroads.

This sewer will connect houses in the area, which are presently served by septic tanks, to the proposed local pumping station H6, which will pump flows through 563m of rising main to MH GFP882. This will consist of 573m of 225mm diameter sewer.

(d) New foul sewer at Ticknock.

This sewer will connect houses in the area, which are presently served by septic tanks, to the proposed local pumping station E7, which will pump flows through 292m of rising main to MH EFE416. This will consist of 469m of 225mm diameter sewer.

(e) New foul sewer from Willmount Park to Belmont House.

This sewer will be laid adjacent to the existing combined sewer, which will become a dedicated storm sewer. The following lengths and diameters are proposed:
- 160m of 225mm diameter sewer
- 418m of 300mm diameter sewer
- as well as 19m of 225mm diameter sewer adjacent to the main sewer

(f) New foul sewer at Willmount Terrace.

This sewer will connect houses which presently discharge to septic tanks to the upgraded foul sewer on Harbour Terrace. This will consist of 184m of 225mm diameter sewer.

(g) New foul sewers at Fr. Corbett's Terrace.

These sewers will connect the upgraded sewers at Harbour View and Harbour Terrace to the proposed interceptor sewer at MH GFP805. These will consist of 62m of 300mm diameter sewer and 19m of 375mm diameter sewer.

(h) New foul sewer from John O'Connell Street to Harbour Hill.

This sewer will be laid adjacent to the existing combined sewer, which will become a dedicated storm sewer. The following lengths and diameters are proposed:
- 169m of 225mm diameter sewer
- 469m of 300mm diameter sewer
- as well as 65m of 225mm diameter sewer adjacent to the main sewer

(i) New foul sewer at West View.

This sewer will be laid adjacent to the existing combined sewer, which will become a dedicated storm sewer. This will consist of 294m of 525mm diameter sewer

(j) New foul sewer at Westbourne Place.

This sewer will connect from the existing outfall at Westbourne Place to the proposed pumping station at West Beach. This will consist of 162m of 300mm diameter sewer

(k) New foul sewer adjacent to St. Colman's Park.

This sewer will connect three sections of upgraded sewer. This will consist of 28m of 300mm diameter sewer

(l) New foul sewer at Elmwood Grove.

This sewer will be laid adjacent to the existing combined sewer, which will become a dedicated storm sewer. The following lengths and diameters are proposed:
- 45m of 225mm diameter sewer
- 327m of 375mm diameter sewer

(m) New foul sewer at Lake Road.

This sewer will be laid adjacent to the existing combined sewer, which will become a dedicated storm sewer. The following lengths and diameters are proposed:
- 53m of 375mm diameter sewer
- 417m of 450mm diameter sewer
- as well as 26m of 225mm diameter sewer adjacent to the main sewer

(n) New foul sewer on Lower Road.

This sewer will connect from the existing outfall on Lower Road to the proposed local pumping station D4, which will pump flows to through 39m of rising main to MH DFP712 on High Road. This will consist of

332m of 225mm diameter sewer. As this area currently discharges near the bathing waters at White Point it is not considered appropriate to defer these works to a later phase of the scheme.

(o) New foul sewers at White Point.

The proposed sewers at White Point will divert foul flows which presently flow to the main sewer (to be converted to storm) to the proposed local pumping station A3, which will pump flows to through 265m of rising main to MH DFP704 on High Road. The existing submersible pumping station is to be made redundant and the flows diverted to the new pumping station. This will consist of 1094m of 225mm diameter sewer.

(p) New foul sewers at Black Point.

This sewer will connect houses in this area which presently discharge to sea to the proposed local pumping station A2, which will pump flows through 180m of rising main to MH BFP644. This will consist of 542m of 225mm diameter sewer.

(q) New foul sewers serving Riviera Terrace.

This sewer will run to the rear of the houses on Riviera Terrace. These houses presently discharge to septic tanks, as they are below the level of the existing sewer on Riviera Terrace. This will consist of 235m of 225mm diameter sewer, as well as 9m of 375mm diameter sewer connecting the sewer on Riviera Terrace to the proposed interceptor sewer at MH BFP643.

(r) New Pumping Station at Dock Cottages.

Dock Cottages is a group of houses between the road and the harbour adjacent to Verolme Dockyard, which presently outfall to the harbour. It is proposed to pump these flows from the proposed local pumping station B1 through 44m of rising main, to the interceptor sewer at MH BFP633.

Carrigaloe Pumping Station (Reference Drg. Nr. A5670-N142)

It is proposed that a new pumping station be constructed on Council property at a disused shipyard warehouse south of the Carrigaloe Ferry Slipway. The proposed pumping station will pump the Waste Water from Cobh across the harbour via twin 710mm OD HPPE rising mains to Glenbrook.

The design capacity of the Carrigaloe Pumping Station shall be 605 l/s. The pumping station will comprise of three pumps operating on a duty/assist/standby basis. The station will be a wet well/dry well arrangement with an above ground structure to house the control panels and electrical equipment.

It is proposed that the pumping station will include for screening and grit removal to prevent any grit build up in the marine crossing pipelines. The screenings will be macerated and returned to the flow. It is proposed that the grit be cleaned and removed off site.

It is not necessary at this pumping station to provide any additional storage to limit the overflows to 20% of rainfall runoff.

New Twin 710mm diameter Rising Mains from Carrigaloe to Glenbrook (Reference Drg. Nr. A5670-N433)

It is proposed that the Carrigaloe Pumping Station will pump Waste Water from Cobh across the harbour via twin 710 mm OD HPPE SDR22 rising mains to Glenbrook. As the mains will be inaccessible following construction, it is proposed that the rising mains be installed in a duty/standby arrangement with only one of the rising mains in operation at any one time. The twin rising mains will combine into a single 710mm diameter pipeline after the crossing and continue along the Coast road to header manhole FP500 near the railway tunnel. The proposed routes of the rising mains are shown on Drg. Nrs. A5670-N433 and N427.

Rehabilitation of Sewers Identified by the CCTV Survey

Ten sections of sewers were found to require rehabilitation. Appendix G identifies the sewers and highlights the method of rehabilitation required.

New storm sewers

The following new storm sewers are proposed for areas presently served by a combined system or unconnected areas.

- 516m of 300mm diameter sewer at Carrignafoy.
- 365m of 300mm diameter sewer at the Retreat, South of Carrignafoy.
- 110m of 300mm diameter sewer at Wilmount Park.
- 562m of 300mm diameter sewer at Belmont, Mount Alto.
- 274m of 300mm diameter sewer and 20m of 375mm diameter sewer at East Hill.
- 517m of 300mm diameter sewer at Seafield Avenue and Bellvue Terrace.
- 215m of 300mm diameter sewer at Wolfe Tone Street.
- 311m of 300mm diameter sewer at Harbour View.
- 261m of 300mm diameter sewer at Harbour Row.
- 56m of 300mm diameter sewer at Thomas Kent Street.
- 228m of 300mm diameter sewer at Church Street.
- 109m of 300mm diameter sewer at Lower Midleton Street.
- 36m of 300mm diameter sewer and 91m of 525mm diameter sewer at West Beach.
- 548m of 300mm diameter sewer at Bishop Street.
- 658mof 300mm diameter sewer at Hilltop Park.
- 111m of 375mm diameter sewer at Midleton Street.
- 955m of 300mm diameter sewer at Coolamber Crescent.
- 330m of 300mm diameter sewer at St. Colman's Square.
- 320m of 300mm diameter sewer at Barrymore Avenue.
- 622m of 300mm diameter sewer and 703m of 375mm diameter sewer at St. Colman's Park and Lake Road.
- 688m of 600mm diameter sewer at Spy Hill and Westbourne Place.
- 766m of 300mm diameter sewer at Elmwood Grove.
- 597m of 300mm diameter sewer at Norwood Park.
- 1107m of 300mm diameter sewer at High Road.
- 271m of 375mm diameter sewer from High Road to White Point.
- 1566m of 300mm diameter sewer at Norwood Park.
- 254m of 300mm diameter sewer, 148m of 375mm diameter sewer and 130m of 600mm diameter sewer at Lake Road.
- 260m of 300mm diameter sewer at Rushbrook Convent.
- 272m of 300mm diameter sewer at White Point.
- 1231m of 300mm diameter sewer at Ballynoe.

Existing combined sewers converted to dedicated storm sewers

In some cases, where it was proposed to lay a new storm sewer adjacent to an existing foul/combined sewer, it was found that the existing foul/combined sewer did not have sufficient capacity for future flows following separation. Where the existing sewer had sufficient capacity to take the proposed storm flows following separation, the existing sewer is converted to a future storm sewer. These locations are listed below:

- 478m of 600mm diameter and 750mm diameter from Wharton's Corner to the outfall at White Point. The existing comminutor station along this length of sewer is to be made redundant.
- 711m of 300mm and 375mm diameter along Norwood Park and Lake Road
- 152m of 225mm and 300mm diameter at Elmwood Grove
- 255m of 250mm to 375mm diameter at West View in the town centre
- 206m of 300mm diameter at West Beach
- 839m of 225mm to 375mm diameter sewer from John O'Connell Street, through Cathedral Place, to King's Quay.
- 70m of 375mm diameter outfall at Father Corbett's Terrace
- 551m of 225mm and 300mm diameter along Wilmount Park to Belmont House
- 1400m of 225mm to 450mm diameter through Carrignafoy.

North West of Cobh

The recently completed North Cobh Sewers SLI opens up significant areas for development to the north west of Cobh. However some of the recently zoned lands cannot flow by gravity into this network. Furthermore, it is envisaged that significant new areas will be developed to the north of Cobh. In order to service these areas it is proposed to construct a new pump station at Cow Cross Roads.

The ultimate capacity of the pump station will be in the order of 130 l/s based on the development of all lands identified for strategic development. Some of the lands that will be served by this pump station have been zoned in the current Local Area Plans, and these will require a pump station capacity of approximately 35 l/s.

3.4 Carrigaline

3.4.1 General

Carrigaline is one of the main satellite towns of Cork City. It is situated approximately 12 km south of Cork City and has experienced rapid growth over the last ten years. Improvement in road infrastructure has decreased travel times to/ from Cork City, which has added to the attraction of the town. Cork Airport and the Passenger Ferry at Ringaskiddy are both in close proximity to the town. The major expansion has been to the North and South of the central commercial area at Carrigaline Bridge.

Large-scale industrial development exists in Ringaskiddy which, along with Cork City, are the two main employment centres for the area. Industrial development in the town itself is located south of the Owenboy River on Crosshaven Road and is predominantly light industry.

Carrigaline frequently experiences flooding due to tidal influences in the Owenboy River. The centre of the town, which experiences the most flooding, is also the major traffic route through the town. There are plans to construct a bypass route to the west of the town, which will resolve traffic congestion and also make the town a more attractive place to live.

The existing (2001) hydraulic loading and drainage system is presented in Section 2.4. This section presents the recommendations with regard to future population and hydraulic loading for the design of the collection system. The design hydraulic and organic loading for the Waste Water Treatment Plant are presented in Section 4.

A design population for Carrigaline is set out at in Section 3.4.2.

The design loading for the collection system is presented in Section 3.4.3. Allowance has also been made for pumped effluent from the Crosshaven catchment.

The future collection system is discussed in Section 3.4.4.

The estimated cost of the proposed scheme is presented in Section 6.

3.4.2 Future Population

3.4.2.1 Local Area Plan

The 2005 Carrigaline Local Area Plan covers the Carrigaline area. This was examined to identify the areas zoned for development.

Approximately 115 ha within the Carrigaline catchment was identified for future development in the 2005 Carrigaline Local Area Plan. Much of this zoned land has already been developed and is taken into account in the assessment of the existing flows and loads in Section 2.4. Figure 3.4.1. identifies the land uses in the Carrigaline Area within the catchment boundary.

The area of land yet to be developed is approximately48 ha. These lands are zoned for residential development which when developed will result in an additional 1,327 houses.

3.4.2.2 Cork Area Strategic Plan

The interim report on the Cork Area Strategic Plan sets out a proposed strategy for development in Carrigaline. The plan identifies directions in which development should occur and the broad extent of same. This information has been interpreted to areas as shown in Figure 3.4.1.

One of the areas, to the South of the town, has been zoned for development in the Local Area Plan and is currently under development. The areas to the north of the town comprise 106 ha and provide for the development of approximately 3,762 houses.

3.4.2.3 Infill Housing

There are vacant lands within the existing developed areas on which infill development is likely to occur with the design horizon of this report. The area of vacant land is anticipated to accommodate an additional 357 houses when fully developed.

3.4.2.4 Future Design Population

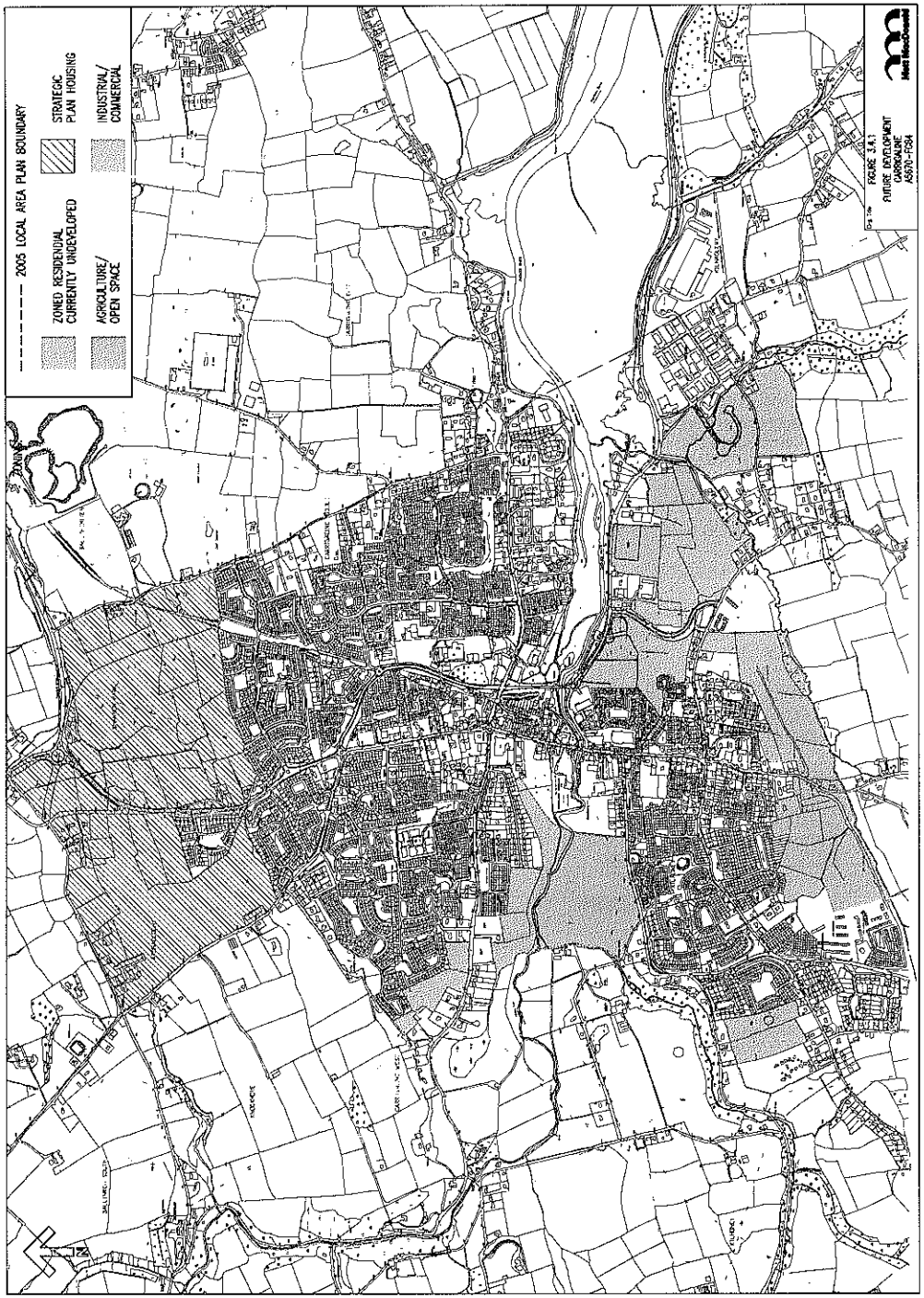
The estimated existing and future number of houses within the Carrigaline catchment is summarised as follows:

Existing Nr. of Houses:	5,447
Development Plans:	2,005
Strategic Plan Development:	3,762
Infill Housing:	357
Total	**11,571**

The housing occupancy, taken as 3 persons / house, is applied to the total number of houses to arrive at a design population.

Future Nr. of Houses:	11,571
House Occupancy:	3.0
Design Population:	34,713

A design population of 34,713 is taken for the Carrigaline Catchment.



3.4.3 Future Flows and Loads

3.4.3.1 Domestic Loading

A design population of 34,713 has been estimated for Carrigaline. Table 3.4.1 below summarises the design loading to the collection system and the ultimate loading to the Waste Water treatment plant resulting from the estimated domestic population.

Table 3.4.1			Carrigaline Design Domestic Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Population	34,713		
Domestic Loading	150 l/head/day	60 g/head/day	70 g/head/day
Design Domestic Loading	5,207 m^3/d	2,083 kg/d	2,430kg/d

3.4.3.2 Non- Domestic Loading

Commercial Loading

The existing commercial loadings in the Carrigaline catchment are presented in Section 2.4.

A review of the existing records on water usage has indicated that the commercial flow element (including institutional) represents approximately 16% of the domestic flow element. This is consistent with similar estimates carried out for other areas.

The design commercial loading is therefore taken as 16% of the future domestic loading.

Table 3.4.2 summarises the components of the design loadings from commercial activities.

Table 3.4.2			Carrigaline Design Commercial Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Commercial Loading	833	333	389

Industrial Loading

The discharge licence for Kerry Bio-Science (formerly Quest) allows a discharge of 1,200 m^3/day, with limits on BOD and Suspended Solids of 25 mg/l and 35 mg/l respectively. However flow records indicate that their actual discharge is in the region of 200 m^3/day. Although discussions ware ongoing with Kerry Bio-Science regarding their future discharges, an allowance of 600 m^3/day is considered appropriate for the purposes of this report.

The company operates an on-site Waste Water treatment plant designed to achieve the required discharge limits. As these discharge limits are consistent with the standards required for the treatment of urban Waste Water it would not make economic sense to include this flow for treatment at a future urban Waste

Water treatment plant. However, Kerry Bio-Science would have to make separate arrangements for a suitable outfall which may not represent their most economical solution. The options for the treatment of Waste Water from Kerry Bio-Science include:

i. Continue to discharge to sewer at 25/35 standard
ii. Revise the licence conditions to allow Kerry Bio-Science to discharge at domestic effluent strength.
iii. Abandon the on-site Waste Water treatment plant and discharge raw effluent to sewer.
iv. Discontinue the discharge to sewer and provide a separate outfall.

Option i) above would not provide any advantage to the company as contributions would be required from the company for processing the Waste Water through the future Waste Water treatment plant without any reduction in their on-site costs or improvement in the final effluent quality. Furthermore, the discharge of treated effluent would dilute the flow to the future Waste Water treatment plant making it less efficient to operate.

Option ii) would allow the company to reduce operating costs for the on-site Waste Water treatment plant and avoid having to provide a separate outfall. The contributions to be paid by the company may be offset by the savings in operating costs.

Option iii) would make any investment the company has made in the existing on-site Waste Water treatment plant valueless and the company would incur higher contribution costs for a future Waste Water treatment plant.

Option iv) would require the company to seek permission to discharge directly to the Owenboy River which would likely result in higher discharge standards and therefore further investment in on-site treatment facilities.

Ultimately Kerry Bio-Science will determine which of the above options is best suited to their needs. However, it would seem practical to allow in the future design loading for Option 2 as the initial assessment of the options suggest that this could represent the most economically viable option.

The 2005 Carrigaline Local Area Plan identifies lands for industrial development at Kilnagleary. Of these lands, area I-02 is currently in use by Pepsi. Pepsi have a licence to discharge at 200 m^3/day, with limits on BOD and Suspended Solids of 25 mg/l and 35 mg/l respectively. For the purposes of this report a flow of 200 m^3/day at domestic strength is allowed.

Areas I-01 and I-03 are currently undeveloped and amount to 15.9 ha. Assuming an average industrial load of 21 m^3/ha/day the design flow for this future industrial development is 334 m^3/day. The characteristics of this flow ate taken to be similar to domestic waste water.

Table 3.4.3			Carrigaline Design Industrial Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Kerry Bio-Science	600	240	96
Pepsi	200	80	93
Undeveloped Zoned Lands	334	134	156
Design Industrial Loading	1,134	454	345

Institutional Loading

Institutional loading is taken to be equal to the current (2009) institutional loading, with any increase in institutional loading included for in the increase in commercial loading.

Table 3.3.4 summarises the components of the design loadings from institutional sources.

Table 3.3.4			Carrigaline Design Institutional Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Institutional Loading	111	44	52

3.4.3.3 Infiltration

The surveys carried out to estimate the extent of infiltration in Carrigaline indicate that infiltration is influenced by tidal conditions. Investigations into the sources of infiltration focused on the older, low lying areas of the town and to areas where existing pipelines cross under the tidal portions of the river. Recommendations are contained in Section 3.4.4 of this report concerning the reduction of infiltration to the existing sewer network. However, it is recognised that the complete elimination of infiltration is not possible nor would it be cost effective to reduce levels of infiltration below recognised acceptable values. An allowance of 50 l/h/d will therefore be made for infiltration within the Carrigaline catchment. Based on a design population of 34,713 this equates to an allowance of 1,736m^3/d for infiltration.

3.4.3.4 Summary

The apportionment of the design loading throughout the catchment is based on development plan proposals. Drawing A5670-N200 shows the sub-catchments defined as part of this report. The design loadings allocated to each sub-catchment are shown in Appendix F. Table 3.4.5 below summarises the design loadings for Carrigaline.

Table 3.4.5			Carrigaline Design Load Summary
	Flow (m^3/d)	BOD (kg/d)	SS (kg/d)
Domestic	5,207	2,083	2,430
Infiltration	1,736	0	0
Institutional	111	44	52
Commercial	833	333	389
Industrial	1,134	454	345
Total	9,021	2,914	3,216

3.4.4 Future Collection System

3.4.4.1 Conceptual Design

The analysis of the various options for Waste Water collection and treatment are presented in Chapter 4. The preferred option was based on economic and environmental considerations. The preferred location of the Waste Water treatment plant is in Shanbally as shown on Drg. Nr. A5670-N003. The Carrigaline collection system will continue to convey all effluent to the Church Road Pumping Station. The rising mains at this pumping station are of sufficient capacity to deal with the design loads from Carrigaline and Crosshaven. The rising mains will ultimately be diverted to the new Waste Water treatment plant when this becomes available. There is space for two additional foul pumps within the structure and these will be required to deal with design flows.

The examination of the existing collection system has confirmed that there is significant infiltration in parts of the collection system. The reduction in the volumes of infiltration will reduce pumping costs at the Church Road pumping station and will also create capacity within the collection system. The possibilities for the reduction of infiltration have been assessed and recommendations are given below. Proposals include retaining some existing combined sewers as storm only sewers, laying new foul sewers, laying new storm sewers, and making repairs to existing manholes and pipelines.

The design tide level of 3.5m OD (Malin Head) has been adopted for the purposes of analysing the collection system. Separation of storm and foul flows is not considered feasible in the centre of the town. Ground levels in places are below the high tide level. When high rainfall events coincide with high tide levels, parts of the town are subject to flooding.

The majority of the existing network at Carrigaline is a combined system, and it is proposed to separate these flows where possible. Storm sewers are proposed on the main roads to separate flows where possible (from roads and front of houses) and to intercept any dedicated storm sewers from individual developments which currently discharge to the combined sewer. Storm sewers have not been proposed for future development of greenfield sites. It has been assumed that on site storm water management will be implemented to limit discharges to current discharge rates. In most cases the natural fall of the land is away from the existing catchment boundary. Furthermore, for some of the areas for future development, the optimum disposal route will depend on the phasing of the development of the particular area.

3.4.4.2 Options

Upgrading of the existing collection system is required to correct deficiencies in the existing network and to provide for discharges from future development. The following are the options that were considered for upgrading of the existing collection system.

Area South of the Owenboy River

The major deficiencies in this part of the catchment include infiltration in the Southern Interceptor Sewer, lack of capacity at the Crosshaven Road Pumping Station, flooding at Main Street, possible cross connections between storm and foul sewer in the Kilmoney Area, and general lack of capacity for future development.

Southern Interceptor Sewer

It is intended that future flows from new development in the south of the town would be directed to the Southern Interceptor Sewer. This sewer does not have capacity to cater for the increased flows. In addition, there is significant infiltration into this section of the sewer. The options identified for resolving these deficiencies include:

a. Carrying out remedial measures to the existing interceptor sewer to reduce infiltration and laying a new rider sewer adjacent to the existing sewer to provide additional capacity.
b. Abandon the existing foul sewer and replace with a new sewer to cater for future loading.
c. Utilise the existing foul sewer as a storm sewer and lay a new foul sewer to connect to the existing river crossing and carry out remedial works to the river crossing.

Option A will require detailed surveys to locate the source of infiltration along the entire length of the interceptor sewer. It will be difficult to undertake this task as the sewer will have to be kept in operation at all times. All sources of infiltration may not be identified by the surveys leading to higher pumping costs at the Church Road Pumping Station. A rider sewer would have to be provided to cater for the additional flows and a second storm sewer would also be required to increase the storm sewer capacity.

An assessment of Option A indicates that if remedial works are extensive a more cost effective option would be to increase the diameter of the rider sewer to cater for the future design flow (Option B). However, in Option B the existing foul sewer becomes redundant which results in the loss of the value of this asset and a new storm sewer is required to provide for the increased storm flow. Option C includes for the use of the foul sewer as a storm sewer. This is considered to be the preferred option for the following reasons:

A new foul sewer would result in minimum infiltration leading to lower pumping costs.

The existing foul sewer can be used to provide additional storm sewer capacity thus eliminating the need to construct a second storm sewer.

Storm flows from Kilmoney area

The collection system from the Kilmoney area is in part a combined system. Storm discharges to this combined system are taking up capacity in the downstream foul sewers and leading to higher pumping costs at the Church Road Pumping Station. The options considered for separating storm and foul sewer in the Kilmoney Area are as follows:

a. Lay a new storm sewer in Kilmoney Road Upper to drain northwards and then westwards into Kilmoney Road Lower, connecting to the existing storm sewer and outfall to the Owenboy River.
b. Lay a storm sewer in Kilmoney Road Upper draining northwards and then eastwards along Mount Rivers Close discharging to the existing storm sewer system.

Option A would involve constructing a new storm sewer along the main by-pass road and would also involve upgrading a section of the existing storm sewer to the outfall point at the Owenboy River.

Option B avoids construction works on the main by-pass road and the pipeline will tie to the existing storm sewer to the east of Mount Rivers Estate. There is little cost difference between Option A or Option B. However, Option B is considered to be the preferred option as the discharge point will be further downstream of the town.

Central Area of Carrigaline

Deficiencies in the collection system in the centre of the town result in regular localised flooding when high rainfall coincides with high tide levels. These deficiencies mainly relate to the arrangement and operation of the Crosshaven Road Pumping Station and the Old Waterpark Pumping Station. The options which were considered to reduce the frequency of flooding were:

a. Upgrade the Crosshaven Road Pumping Station and the Old Waterpark Pumping Station to cater for influent flows.
b. Divert some of the flow away from the Crosshaven Road Pumping Station to allow the pumping station to operate within its existing capacity and upgrade the Old Waterpark Pumping Station.
c. Decommission the Old Waterpark Pumping Station and divert all flows to an upgraded Crosshaven Road Pumping Station.

All of the above options will prevent flooding for the one in five year storm.

Option A would involve high capital and operating costs as both pumping stations would have to be replaced with new structures and pumps. Option B has lower capital cost than Option A. This is because very little work would be required to the existing Crosshaven Road Pumping Station. Option C requires a larger pumping station to be constructed on the site of the existing Crosshaven Road Pumping Station. The existing site is too small for a larger station and additional land purchase would be required.

The preferred option is a combination of A and B. Flows from north of the Owenboy River currently discharging to the Crosshaven Road Pumping Station will be diverted to the Old Waterpark Pumping Station. This will require the complete rebuilding of Old Waterpark Pumping Station thus eliminating the problems that currently exist at this Station. This will also eliminate the existing sewer which crosses the Owenboy River below the soffit level of the bridge.

The only works that will be required at the Crosshaven Road Pumping Station will be the construction of a new storm sump to allow storm flows to be pumped against high tides.

Area North of Owenboy River

Separation of Strom Flows

There are a number of new housing developments which have been carried out in this area in recent years. These new developments have separate collection systems discharging to existing combined sewers. The options considered to reduce the volume of stormwater entering the foul sewer system were as follows:-

a. The incorporation of storm overflows on the combined sewers.
b. Separation of storm and foul flows.

Option A would involve the construction of storm overflows at the upstream section of the northern interceptor sewer. These would discharge to the Owenboy River, thus providing additional capacity in the downstream section of the interceptor sewer. The Owenboy River is part of a National Heritage Area (NHA) at the location where the overflows would occur. Overflows would be activated on every storm event due to the volume of stormwater entering the collection system.

In Option B, new storm sewers would be constructed to direct storm flows from the newer housing estate to the existing storm outfalls. These housing estates have separate collection systems and this option provides a continuation of the separate system to the point of discharge.

Option B is considered the preferred option for the following reasons:-

- This option provides a continuation of existing separate systems
- The provision of separate storm sewers eliminates any possibility of foul effluent discharging to the NHA from the combined sewer overflows.
- Separating storm water from this section of the existing combined sewer creates greater capacity for foul flows in the existing sewers.

CASP Development

The Cork Area Strategic Plan envisages that the majority of future housing development in Carrigaline will occur north of the Owenboy River. Stormwater and foul flows from these future development lands will not drain by gravity to the existing collection system and therefore pumping will be required. The implications for the collection system, resulting from the development of the Strategic Plan depends on where the pump flows enter the collection system. The options which were considered are as follows:-

a. All foul flows to drain to new pumping stations to be pumped to the foul sewer in the Cork Road.
b. All foul flows to drain to a new pumping station in the Shannon Park area, to be pumped to a new gravity sewer in Fern Hill Road.
c. All foul flows to be pumped directly to the Waste Water treatment plant.
d. Foul flows from the Ardnacloghy Area, east of the Cork Road to enter the collection system at the Cork Road and foul flows from the Shannon Park Area to enter the collection system at Fern Hill Road.

The low point in the catchment is in the centre of the Shannon Park Area. The natural drainage route from the Ardnacloghy Area is towards the Shannon Park Area. In such circumstances Option B would appear to represent the most appropriate solution. However, the timing of development will influence decisions on drainage routes. If the Ardnacloghy Area develops first it is likely that flows will be directed to the existing collection system in the Cork Road. Alternatively, if the Shannon Park Area develops first, the Ardnacloghy Area could drain to the Shannon Area and thereafter to Fern Hill Road.

The option to pump Waste Water directly to the Waste Water treatment plant would eliminate double pumping. However, the timing of the future development, vis-à-vis availability of the Waste Water treatment plant, may not make this a practical solution.

The preferred solution is a combination of Option B and D, whereby a new sewer will be constructed in Fern Hill Road to service existing properties and the sewer will be oversized to cater for the foul flow from all the lands identified in the Strategic Plan. In addition, some upgrading will be carried out to the existing collection system downstream of the Cork Road to allow for development in the Ardnacloghy Area. Should this area develop subsequent to the completion of the waste water treatment plant, Option C may become the optimum solution.

3.4.4.3 Hydraulic Modelling

It was decided that, where possible, the collection system in Carrigaline should be separated. The extent of the proposed separation is discussed in section 3.4.4.

A future model was set up which was based on the existing model, with additional sewers input for areas which are currently not connected or are yet to be developed, as well as the proposed interceptor sewers. The design loadings arrived at in section 3.4.3 were input into the model, and the model run to identify areas where upgrading of sewers was required.

It was not considered necessary to model the less critical sewers, and it was decided to model all sewers which could feasibly require a sewer size greater than the minimum sizes considered for the project of 225mm diameter for foul sewers and 300mm diameter for storm sewers.

As much of the Carrigaline catchment is low lying and high tide levels have caused flooding in the past, it was decided to run the future 6 DWF model and the future storm model with an assumed high tide level of 3.5mOD to ensure that no flooding occurs during periods of high tide.

The proposed network was examined for storms of different durations for the various return periods considered. It was generally found that the 30 minute storm was the most critical. Resultant tables and plans from the HydroWorks simulations for the foul (2.5 DWF) and storm networks with storms of two year (surcharging), five year (flooding) and twenty year (excessive flooding) return periods and 30 minute durations are included in Appendix F. Plans and results for the foul (6 DWF) network with the 5 year, 30 minute storm are also included to show the level of flooding predicted for a high tide event.

It was found from the model that during prolonged heavy rainfall events, the manholes at the Dandy Bridge, south of the Owenboy River, become surcharged by depth as they are close to the high tide level. It is proposed that these manholes be sealed to prevent flooding.

3.4.4.4 Recommendations

Proposals for upgrading the foul sewer collection system are shown in figure 3.4.2. Figure 3.4.3 shows a schematic of the storm sewer proposals. The overall layout plans are shown in Drawing Nrs A5670-N220, N221, N222 and N223. Detailed Plans and Longitudinal sections are shown in drawing numbers A5670-N224 to N232.

Area South of the Owenboy River

The proposals for upgrading the catchment south of the Owenboy River are as follows:

New 750 mm diameter southern interceptor sewer (Reference Drawing Number A5670-N228).

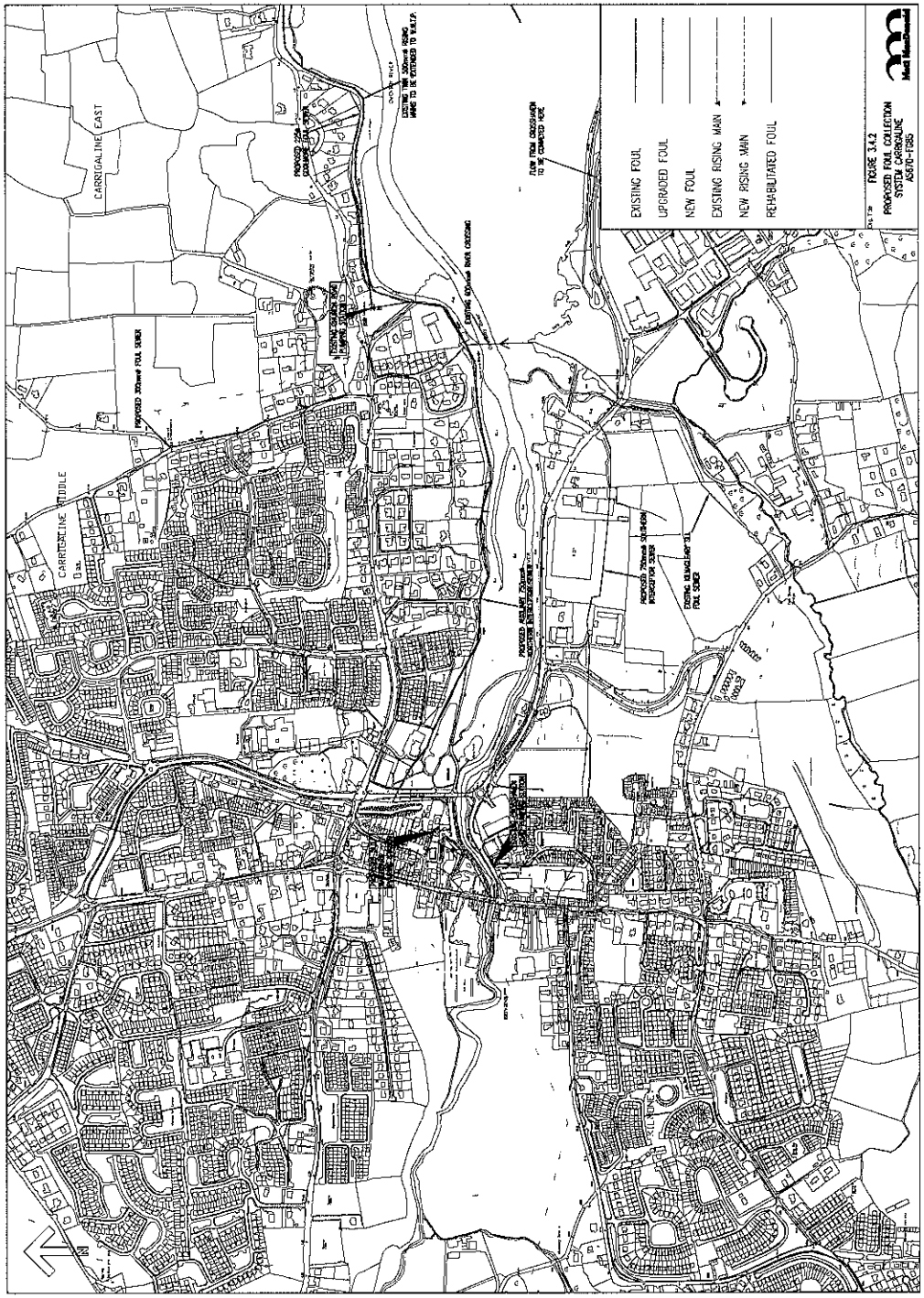
The existing southern interceptor sewer between manhole MH N087 to MH N097 is to be utilised as a storm sewer. A new 750 mm diameter southern interceptor sewer will be laid, along the route of the existing sewer, from FN001 as far as MH N098 to cater for existing and future flows.

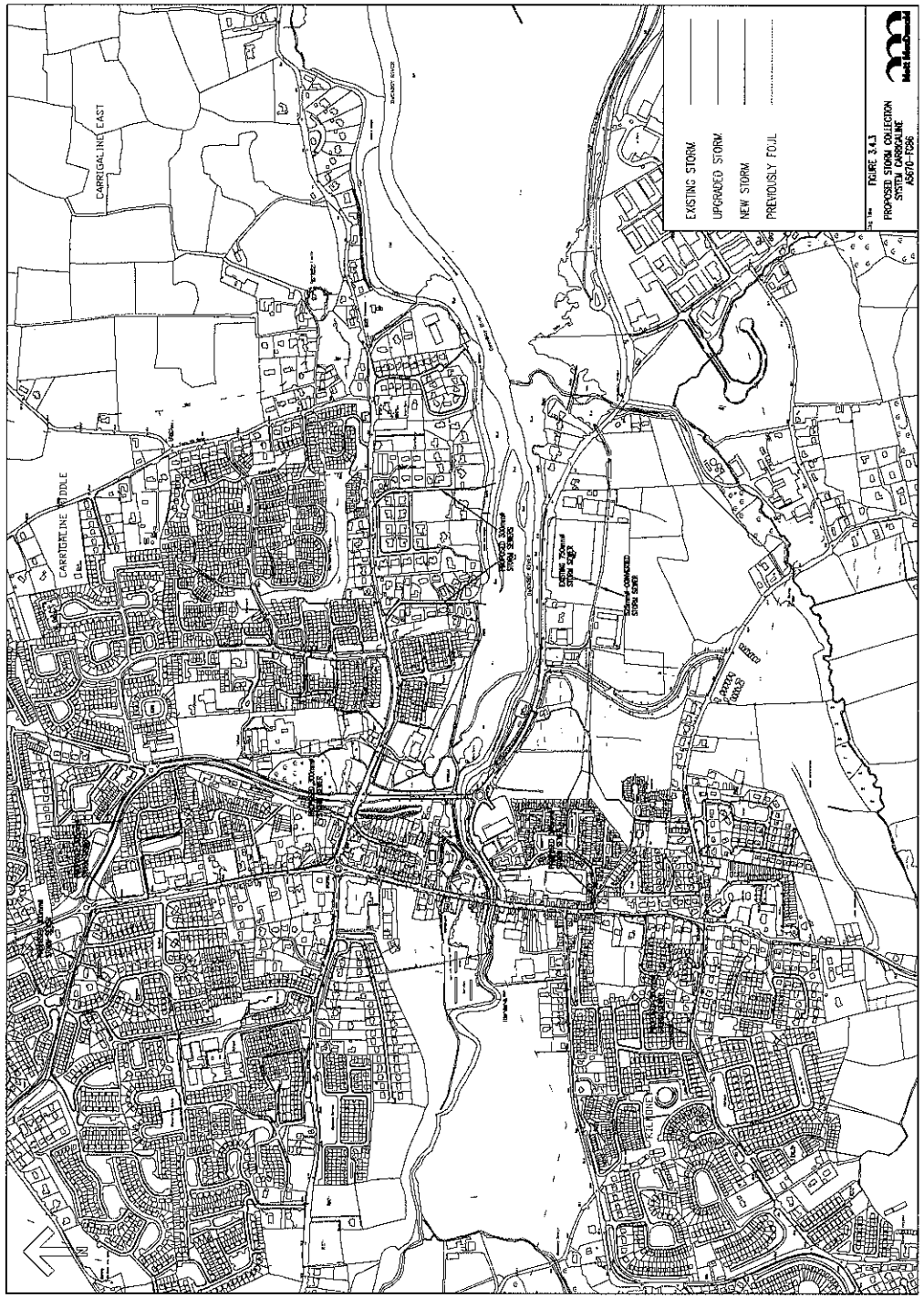
Rehabilitation of the River Crossing (Reference Drawing Number A5670-N212)

The existing 600mm diameter foul sewer between manholes MH N098 to N101, which crosses under the Owenboy River, is to be rehabilitated by the insertion of a liner. This work should be subject to further investigations as the existing precast concrete sewer is suspected to be the source of infiltration. If the river crossing pipeline is found to be intact this item of work need not be undertaken.

New foul sewers Kilnagleary/The Dandy Bride (Reference Drawing Numbers A5670-N225)

225mm and 300mm diameter sewers are to be laid to service lands at Kilnagleary and the lands south-west of the Dandy Bridge. This extension of the existing foul sewer system will connect to the proposed new 750mm diameter interceptor sewer at Manhole FN012 adjacent to the Crosshaven Road.





Upgrading of under capacity sewers (Reference Drawing Number A5670-N228)

The analysis of the existing system has identified the following sections of sewer which are presently surcharged or which require upgrading to cater for the future loads. The section of the existing foul sewer between manholes N084 and new manhole FN001 needs to be increased in diameter to a 600mm and 750mm sewer. If the existing sewer is found to be in good condition then a rider sewer may be laid in lieu of replacement.

Southern Interceptor Storm Sewer (Reference Drg. Nr. A5670-N231)

It is proposed to utilise the existing southern interceptor foul sewer as a storm sewer. This is intended to supplement the capacity of the existing storm sewer. This additional capacity will allow for the separation of storm flows from the Upper Kilmoney Road area. Both storm sewers are to be interconnected to utilise the full storage volume at all times. Manholes are to be sealed below the 2.5 mOD ground level.

New storm sewer for Upper Kilmoney Road (Reference Drg. Nrs. A5670-N231 & N232)

It is proposed to construct a new storm sewer along the Upper Kilmoney Road. This storm sewer will vary in diameter from 300 mm to 375 mm and is intended to separate storm water from the existing combined sewer at this location. The proposed storm sewer will extend from manhole FNS 201 in Upper Kilmoney Road to manhole XNS 087 at the existing southern interceptor sewer. This sewer will also intercept the existing road drainage ditches on Church Hill between the Upper and Lower Kilmoney Roads.

Crosshaven Road Pumping Station

It is proposed to reduce the flows to the Crosshaven Road Pumping Station by diverting flows from north of the Owenboy River to the Old Waterpark Pumping Station, and discontinuing the use of the existing river crossing adjacent to Carrigaline Bridge. The foul pumps will be replaced with pumps of a lower capacity (10 l/s) to reduce the pumping of storm flows to the treatment plant. The existing foul sump is sufficient for future flows, and a storm holding tank is not required.

It is proposed to install a larger overflow weir with screens in the foul sump. A new storm sump will be constructed adjacent to the existing storm manhole. During low tide events storm flows will discharge by gravity through the existing outfall pipe. To cater for high tide events, storm pumps will be installed to lift storm flows to a sufficient level to allow gravity discharge against high tides through the existing outfall pipe. The combined capacity required is 400 l/s, and it is proposed to install 4 pumps in a duty/assist/assist/standby arrangement.

<u>Area North of the Owenboy River</u>

Proposals for upgrading the foul sewer collection system north of the Owenboy River are as follows:

New auxiliary sewer for Northern Interceptor Sewer (Reference Drawing Number A5670-N229)

It is proposed to construct a rider sewer to be laid parallel to the existing Northern Interceptor Sewer. The existing northern interceptor sewer is in good condition but does not have the capacity to deal with increased loads from future developments. The proposed new relief sewer would provide additional

capacity to direct foul flows to the Church Road Pumping Station. This proposal involves the construction of the following:

- 103 meters of 525mm diameter sewer between manholes FN 300 and N161.
- 1068 metres of 750mm diameter sewer between manholes FN 302 and FN 317.
- 76 metres of 900mm diameter sewer between MH FN317 and FN318.
- 78 metres of 1050mm diameter sewer between MH FN318 and FN 319.

Fern Hill Road Sewer (Reference Drawing Number A5670-N224)

It is proposed to construct a new 300mm dia. foul sewer along Fern Hill Road from a point approximately 100m North of Leacht Cross Roads southwards to tie to the existing foul sewer in Church Road. This new foul sewer will service existing properties on Fern Hill Road and is sized to allow for future development in the Shannon Park Area.

Coolmore Gravity Sewer (Refer Drg. Nr. A5670-N221)

It is proposed to construct a 225mm diameter sewer from the Coolmore Rising Main Header Manhole FN400 to the Church Road Pumping Station. This gravity sewer will direct foul flows from the Coolmore Area to the main pumping station at Church Road and will also service existing properties along the route of the sewer.

Gravity Sewer North of Church Road (Refer Drg. Nr. A5670-N220)

There are six properties fronting onto Church Road which are serviced by septic tanks. It is proposed to connect these properties to the collection system by laying a 150mm dia. foul sewer at the rear of the properties, to exit onto Church Road and to connect to the existing foul sewer at Wesley Estate.

Upgrading of Existing Sewers (Reference Drg. Nr. A5670-N226 & N227)

The 300mm dia. existing foul sewer in Dan Desmond Terrace does not have capacity to cater for the future loads which will arise from the development of lands in Ardnacloughy Area. It is proposed to lay a second 300 dia. sewer or replace the existing sewer from MH N136A with a 450mm dia. sewer to tie to the existing 450 mm dia. sewer at MH N138.

The existing 300 mm dia. combined sewer commencing at Carrigaline Cross Roads is known to flood at present. It is proposed to upgrade this section of sewer with a 450 mm dia. pipeline between MH N006 to N156B and with a 600mm dia. pipeline between N156B to N156C. This 600 mm dia. sewer is to extend to tie to the new manhole MH FN300. An internal inspection of the sewers between manholes N006 and N005 identified instances of infiltration which will be eliminated by the upgrade.

New storm sewer from Cork Road to Church Road (Reference Drawing nr. A5670-N232)

It is proposed to construct a new 300 mm dia. storm sewer from manhole FNS 300 on the Cork Road to existing manhole NS0655 outside the County Council Offices on Church Road.

Ballinrea Road to Dan Desmond Terrace (Reference Drg. Nr. A5670-N230)

It is proposed to construct a new storm sewer (300 mm dia.–375 mm dia.) from Manholes FNS 101 on the Ballinrea Road to existing Manhole NS57 in Dan Desmond Terrace.

Sunview and Riverview Housing Estates (Reference Drg. Nrs. A5670-N222 and N223)

It is proposed to construct new 300mm dia. storm sewers in Sunview and Riverview Estates to separate road drainage from the combined system in these areas. These new storm sewers will have separate new outfalls to the Owenboy River.

Church Road Pumping Station

The existing Church Road Pumping Station has adequate capacity for the existing flow but further upgrading will be required to cater for the ultimate loads when the entire catchment has been developed.

The pumping station has four pumps (2 duty/2 assist). The output of each pump is shown on record drawings to be 160 litres/sec. It is estimated that the maximum output of the pumping station is approximately 460 litres/sec with all four pumps in operation. These existing pumps are relatively new and should have a working life for another 5 to 10 years. However, the pumps have inadequate capacity for the design flows and the pumps will need to be upgraded. The existing twin 500 mm dia. rising mains have sufficient capacity to cater for the design loading. Modification will have to be made to divert the rising mains to the waste water treatment plant.

The ultimate flow arriving at the pumping station is estimated to be 556 litres/sec. This flow represents the maximum inflow rate when all of the catchment has been developed. The existing pumping station includes for space for two additional pumps. This will allow for the capacity of the pumping station to be increased. It is proposed to install two additional pumps to increase the total pumping station capacity to 600 l/s.

<u>Town Centre</u>

Proposals for upgrading the foul sewers in the centre of the town are as follows:

Upgrading of Existing Sewers (Refer Drg. Nr A5670-N226)

It is proposed to replace the existing sewer which runs from Main Street to Old Waterpark Estate between MH N012 and N001 with a 450 mm dia. sewer. This section between MH N001 and MH N001A will be a 750 mm dia. sewer and the last section from MH N001A to the new pumping station will be a 900 mm dia. sewer.

Diversion of flows to Old Waterpark Pumping Station

It is proposed to divert those flows from north of the Owenboy River currently discharging to Crosshaven Road Pumping Station to the new Old Waterpark Pumping Station. This diversion will be effected by means of a 450mm dia. sewer from the existing manhole at the river crossing through the car park to the new Old Waterpark Pumping Station.

Proposed Old Waterpark Pumping Station (Reference Drg. Nr. A5670-N234)

It is proposed that the existing Old Waterpark Pumping Station be abandoned and a new pumping station be constructed on the same site.

The Pumping Station will provide for foul and storm pumps. Two foul pumps will be installed each with a duty of 16 l/s which represents a flow of 6 times dry weather flow. The pumps will be submersible type pumps which will operate on a duty/standby basis.

It is proposed that 4 nr. storm pumps be installed in a wet well/dry well arrangement and operate on a duty/assist/assist/standby basis. The combined pump duty will be 400 l/s. It is proposed that an above ground structure be constructed over the storm dry well to house control panels and other electrical equipment.

The pumping station shall also incorporate a storm holding tank with a capacity of 220m^3. This is intended to store the first foul flush which shall be pumped with the foul flow when the rainfall event has subsided. Flows in excess of 6 DWF will overflow once the storm holding tank has been filled. The overflow will be located in a chamber upstream of the storm holding tank and 6 mm screens will be installed to maintain solids in the flow to the foul pumps.

Page Not Used

3.5 Passage West/Monkstown

3.5.1 General

Passage West, Glenbrook and Monkstown are adjacent towns/villages which stretch for approximately 4 km along the western side of Cork Harbour.

Monkstown village is situated on the South Eastern slope of a hill and many of the existing houses date back over a century. It is envisaged that Monkstown will not see major housing development in the future. The woodland area surrounding Monkstown Castle and the Golf course has recently seen low density individual site development.

Glenbrook is located on the narrow section of the channel facing the Great Island. A car ferry now links Glenbrook with Carrigaloe on the Great Island which has increased the traffic in the area. Like Monkstown existing houses in Glenbrook date back to the 19th Century. North Glenbrook has improved visually with the construction of apartments along the coastal road otherwise the area has not seen recent development.

The existing (2001) hydraulic loading and drainage system is described in Section 2.5. This section presents the recommendations with regard to future population and hydraulic loading for the design of the collection system. The design hydraulic and organic loadings for the Waste Water Treatment Plant are presented in Section 4.

A design population for Passage West/Monkstown is given at in section 3.5.2.

The design loading for the collection system is presented in Section 3.5.3.

The future collection system is discussed in Section 3.5.4.

The estimated cost of the proposed scheme is presented in Section 6.

3.5.2 Future Population

3.5.2.1 Local Area Plan

The 2005 Carrigaline Local Area Plan covers the Passage West / Monkstown area. This was examined to identify the areas zoned for development.

Approximately 35 ha of residentially zoned land in the Local Area Plan remains undeveloped (areas shaded green in figure 3.5.1). When this is developed a further 1,261 houses can be expected.

3.5.2.2 Cork Area Strategic Plan

The Cork Area Strategic Plan is a planning strategy to guide the development of the Cork region over the next 20 years. The Interim report on the Cork Area Strategic Plan was reviewed and there were no areas targeted for development in the Passage West/Monkstown region.

3.5.2.3 Infill Housing

There are vacant lands within the existing developed areas on which infill development is likely to occur within the design horizon of this report. The areas identified for infill housing are shown on figure 3.5.1. This will provide for an additional 540 houses when fully developed.

3.5.2.4 Future Design Population

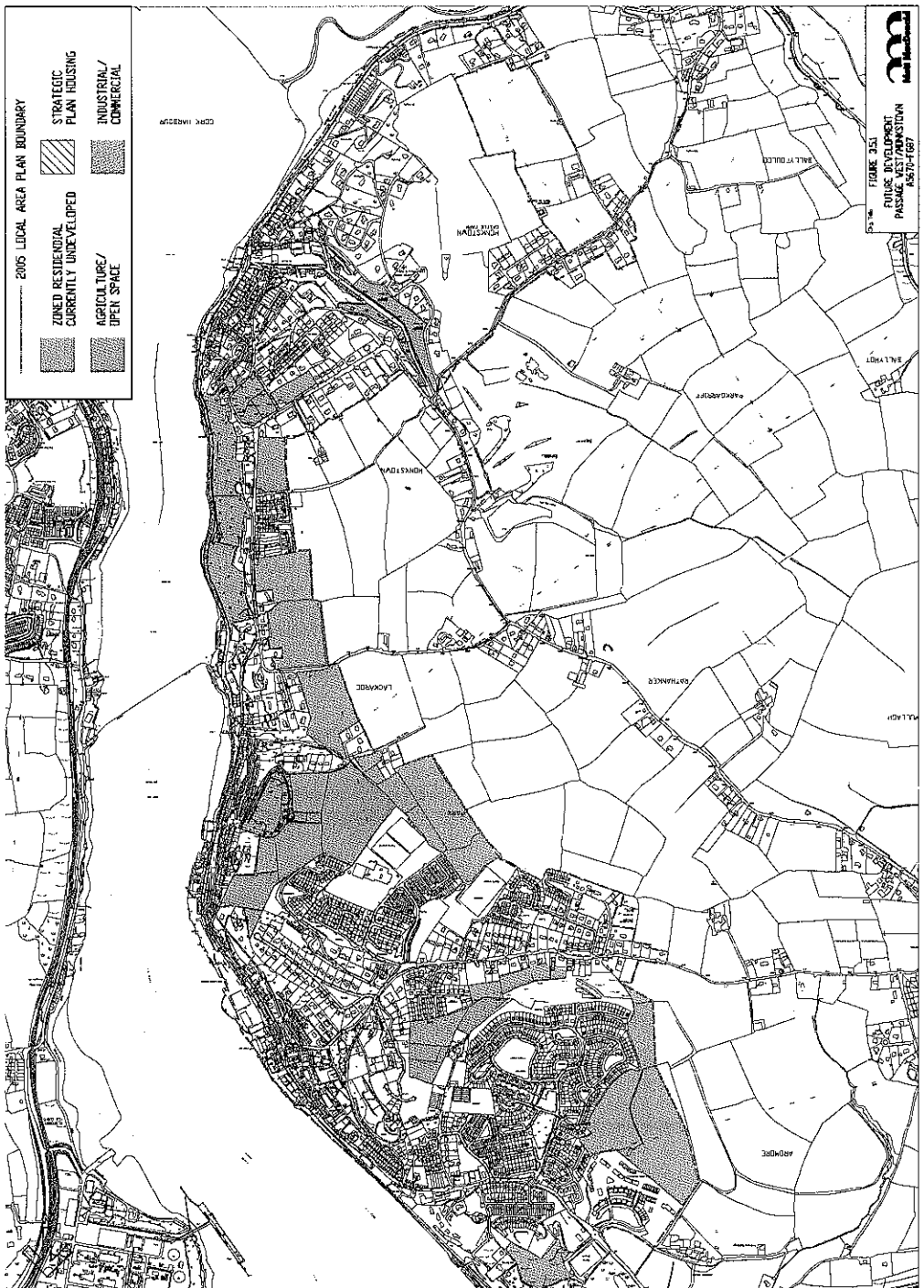
The estimated existing and future number of houses within the Passage West / Monkstown catchment is summarised as follows:

Existing Nr. of Houses:	2,297
Development Plans:	1,261
Strategic Plan Development:	0
Infill Housing:	540
Total	**4,098**

The housing occupancy, taken as 3 persons / house, is applied to the total number of houses to arrive at a design population.

Future Nr. of Houses:	4,098
House Occupancy:	3.0
Design Population:	12,294

A design population of 12,294 is taken for the Passage West / Monkstown Catchment.



3.5.3 Future Flows and Loads

3.5.3.1 Domestic Loading

A design future population of 12,294 has been estimated for Passage West/Monkstown. Table 3.5.1 below summarises the design loading to the collection system and the ultimate loading to the Waste Water treatment plant resulting from the expected domestic population.

Table 3.5.1 - Passage West/Monkstown Design Domestic Loading

	Flow m^3/d	BOD kg/d	SS kg/d
Design population	12,294		
Domestic Loading	150 l/head/day	60 g/head/day	70 g/head/day
Design Domestic Loading	1,844 m^3/day	738 kg/ day	861 kg/day

3.5.3.2 Non-Domestic Loading

Commercial Loading

The existing commercial loadings for the Passage West/Monkstown area are presented in Section 2.5.3.2.

A review of the existing water records on water usage has indicated that the commercial flow element (including institutional) represents approximately 16% of the domestic flow element. This is consistent with similar estimates carried out for other areas. The future commercial loading is therefore taken as 16% of the future domestic loading.

Table 3.5.2 summarises the components of the design loadings from commercial activities. The BOD and SS loadings are on the basis that commercial Waste Water corresponds to the characteristics of the domestic Waste Water as an average flow.

Table 3.5.2 - Passage West/Monkstown Design Commercial Loading

	Flow m^3/d	BOD kg/d	SS kg/d
Design Commercial Loading	295	118	138

Industrial Loading

There were no areas zoned for industrial development in the Passage West/Monkstown area. There are therefore no allowances made for future Industrial discharges in the design loading from this area.

Institutional Loading

Institutional loading is taken to be equal to the current (2009) institutional loading, with any increase in institutional loading included for in the increase in commercial loading.

Table 3.5.3 summarises the components of the design loadings from institutional sources.

Table 3.5.3	Passage West / Monkstown Design Institutional Loading		
	Flow m^3/d	BOD kg/d	SS kg/d
Design Institutional Loading	46	18	21

3.5.3.3 Infiltration

Investigation into the volumes of infiltration in the collection system are described in Section 2.

Recommendations concerning the reduction of infiltration are described in 3.5.4 below. However, it is recognised that the complete elimination of infiltration to the existing sewer network is not possible nor would it be cost effective to reduce the infiltration levels below recognised acceptable values. An allowance of 50 l/h/day will therefore be made in the design loading for infiltration within the Passage West/Monkstown catchment. Based on a design population of 12,294 this equates to an allowance of $615m^3$/day.

3.5.3.4 Summary

The Appendix F contains the loadings from each sub-catchment as defined on Drawing A5670-N400. The impact of recent development plans is discussed in Section 3.5.5 and provides the overall load summary.

The apportionment of the design loading throughout the catchment is based on development plan proposals. Drawing A5670-N400 shows the sub-catchments defined as part of this report and Appendix F contains the loadings from each. These flows were used for the design of the collection system. Table 3.5.4 below summarises the design loadings for Passage West / Monkstown.

Table 3.5.4			Passage West / Monkstown Design Load Summary
	Flow (m^3/d)	BOD (kg/d)	SS (kg/d)
Domestic	1,844	738	861
Infiltration	615	0	0
Institutional	46	18	21
Commercial	295	118	138
Industrial	0	0	0
Total	2,800	874	1020

3.5.4 Future Collection System

3.5.4.1 Conceptual Design

The analysis of the various options for Waste Water collection and treatment are presented in Chapter 4. The preferred option includes for the pumping of Waste Water from Cobh to the Monkstown catchment.

As described in section 2.5.4.1, the existing collection system in Passage West/Monkstown currently discharges to three main outfall points in Passage West, Glenbrook and Monkstown.

The preferred future Passage West/Monkstown collection system will eliminate the three major existing outfall points. Flows will be directed to the proposed Waste Water Treatment Plant site at Shanbally.

The receiving waters at West Passage are designated Sensitive Waters. In accordance with the DEHLG publication 'Procedures and Criteria in relation to Storm Water Overflows' it will be necessary to limit overflows to 20% of rainfall runoff. This can be achieved by either increasing pump rates, or providing storage, or a combination of both. In general, due to the topography of the catchment, there is limited space available for providing significant storage. The design allows for storage to be provided to the extent practical and pump rates at the pump stations increased as required to limit the overflows.

The future collection system will include for the flows from twin rising mains crossing the Harbour from Carrigaloe to a site adjacent to the Glenbrook ferry crossing.

New pumping stations will be located in Passage West, Glenbrook, Monkstown and Raffeen to pump flows forward to the Waste Water Treatment Plant.

The existing sewer network, with the exception of the newer residential estates, is presently served by a combined sewer system. Proposals have been made for the separation of storm and foul flows where it has been considered feasible and economical.

Storm sewers have not been proposed for future development of greenfield sites. It has been assumed that on site storm water management will be implemented to limit discharges to current discharge rates. In most cases the natural fall of the land is away from the existing catchment boundary. Furthermore, for some of the areas for future development, the optimum disposal route will depend on the phasing of the development of the particular area.

It will not be possible to separate the storm and the foul from the backs of houses which will continue to flow to the existing foul sewers. It is recommended that overflows will outfall to the river via 6mm screens.

Under the proposed scheme existing sewers within the Passage West/Monkstown catchment will be upgraded to cater for flows from future development areas. Future development areas will have a separate system and storm flows from these areas will be directed to the River. It is also recommended that existing sewers that require rehabilitation be repaired or replaced.

3.5.4.2 Options

The assessment of the collection system in the Passage/Glenbrook/Monkstown area presented options with regard to the location of the pumping stations. The options that were considered within each of the population centres are described below:

Passage West

The only alternatives that were considered within the Passage West collection system concerned the direction of the flow from the Highlands Estate on Old Church Road. At present this flow is directed to the gravity sewer which runs down Back Road to a gravity sewer located on the Cork Road. In the preferred scheme it is proposed that this flow should be diverted down Old Church Road to the Passage West Central Pumping Station.

Glenbrook

The existing Glenbrook Pumping Station pumps to a communitor and outfall at the location of the ferry crossing. In the conceptual design Waste Water from Cobh will be pumped across the harbour to Glenbrook. The alternatives that were considered concerned the transfer of the pump flows from Cobh and the pump flows from Glenbrook to the proposed new pumping station at Monkstown. The following options were considered:

a. Accept the flows from Cobh at the header chamber to be constructed at Glenbrook in the green space south of the ferry crossing. A new rising main would be laid from the existing Glenbrook Pumping Station to the new header chamber. The combined flows would gravitate to the new Monstown Pumping Station through a combination of a pressure main and a gravity sewer.
b. Continue the rising main from Cobh and Glenbrook Pumping Stations to a point along the Monkstown Road where a gravity flow can be achieved to the Monkstown Pumping Station.

The advantage of option A is that it allows for a single pipeline from the header chamber to the Monkstown Pumping Station. This will result in savings in capital costs. However, this option will require a structure to be built above ground and odour treatment will have to be incorporated into the design of the structure. Velocities in the pipelines would vary during pumping cycles and over the design life of the scheme.

In Option B the two rising mains would increase in length by approximately 350 metres. However, this option is considered to offer advantages with regard to the maintenance of the pipelines. Velocities in the pipelines would be controlled by the separate pumping stations and there would be no requirement for above ground structures.

Option B is considered the preferred option for the following reasons:

- Pipeline velocities will be maintained above self cleansing velocities at all times.
- No requirement for above ground structure and odour control at the Glenbrook Ferry crossing site.

Monkstown

The alternatives that were considered at Monkstown concerned the location of the proposed new pumping station and the length of the rising main.

a. The existing pumping station is located on the Sand Quay which serves as a boat yard and a slip-way for the local Sailing Club. Whilst the area of the boatyard is large enough to accommodate the new pumping station it was considered that a large pumping station at this location would cause disruption during construction and permanent loss of an area currently used by the Sailing Club. In addition, this location would likely attract objections from local residents and the general public.
b. The alternative is a site within the rear of the public park adjacent to the Glen Road. This site is secluded and is in public ownership. The precise location is in the corner of the car park which is seldom used. The disadvantage of this site is that the land rises towards the proposed site which makes the pump sump a deeper structure than in Option A.

Option B is considered to be the preferred site as it is large enough to accommodate the proposed pumping station and is more acceptable from a social aspect.

The options concerning the length of the rising mains included the following:

a. Extending the rising main all the way to the new Raffeen Pumping Station. Pump flows from the Coast Road Pumping Station to the Monkstown Pumping Station.
b. Extending the rising main only to a point where a gravity flow can be achieved to the new Raffeen Pumping Station. A new rising main from the Coast Road Pumping Station would discharge to this gravity section.

Option B was considered the preferred option as it eliminates double pumping of the flow from the Coast Road Pumping Station. In addition, the gravity section will provide for flows from adjacent properties which are presently served by septic tanks.

Raffeen

A new pumping station is required in Raffeen to service properties in the vicinity of same and to deliver the main Waste Water flow to the site for the proposed Waste Water treatment plant. No alternatives to the identified site were considered worthy of detailed examination. The preferred site is at the low point in the catchment. Lands will have to be reclaimed between the Coast Road and the disused railway track to accommodate the pumping station. There has already been some land reclamation at this site and this proposal is a natural extension of same.

3.5.4.3 Hydraulic Modelling

It was decided that, where possible, the collection system in Passage West and Monkstown should be separated. The extent of the proposed separation is discussed in section 3.5.4.

A future model was set up which was based on the existing model, with additional sewers input for areas which are currently not connected or yet to be developed, as well as the proposed interceptor sewers. The design loadings arrived at in section 3.5.3 were input into the model, and the model run to identify areas where upgrading of sewers was required.

It was not considered necessary to model the less critical sewers, and it was decided to model all sewers which could feasibly require a sewer size greater than the minimum sizes considered for the project of 225mm diameter for foul sewers and 300mm diameter for storm sewers.

As much of the Passage West/Monkstown catchment is low lying and high tide levels have caused flooding in the past, it was decided to run the future 6 DWF model and the future storm model with an assumed high tide level of 3.5mOD to ensure that no flooding occurs during periods of high tide.

The proposed network was examined for storms of different durations for the various return periods considered. It was generally found that the 30 minute storm was the most critical. Resultant tables and plans from the HydroWorks simulations for the foul (2.5 DWF) and storm networks with storms of two year (surcharging), five year (flooding) and twenty year (excessive flooding) return periods and 30 minute durations are included in Appendix F. Plans and results for the foul (6 DWF) network with the 5 year, 30 minute storm are also included to show the level of flooding predicted for a high tide event.

It was found from the model that during prolonged heavy rainfall events, some of the manholes along the main road through the catchment become surcharged by depth as they are close to the high tide level. It is recommended that all manhole covers below 3.5mOD be sealed to prevent flooding.

3.5.4.4 Recommendations

Proposals for upgrading the Passage West/Monkstown collection system are shown in Figure 3.5.2. and Figure 3.5.3. The overall layout plans for this area are given in Drawings A5670-N420 to N423. Detailed Plans and Longitudinal Sections are shown in Drawing Nrs. A5670-N424 to N433.

Passage West

Gravity sewer to Passage West Pumping Station (Reference Drg. Nr. A5670-N424)

Waste Water from the newer housing estates located to the north of the town gravitates to the existing pumping station at the Cork Road. This pumping station pumps the Waste Water to a section of gravity sewer which flows to an existing comminutor and outfalls north of the junction of the Back Road and the Cork Road. It is proposed to intercept the flow to the outfall at manhole P011 and lay a new gravity sewer southwards along the main road to the Passage West Central Pumping Station. The existing comminutor and outfall will become redundant. The new gravity sewer will be 600 mm dia. over the entire length between manhole P011 and Passage West Pumping Station.

Old Church Road Sewer (Reference Drg. Nr. A5670-N425)

The existing 300 mm dia. combined sewer in Old Church Road is to be diverted at the junction with the Back Road. A new gravity sewer will continue from this junction down Church Road to connect to the upgraded gravity sewer leading to Passage West Central Pumping Station. This sewer will increase in size to sizes ranging from 375 mm to 900 mm diameter.

Passage West Central Pumping Station and Rising Main (Reference Drg. Nrs. A5670-N424 and N434)

The existing Passage West Pumping Station located in the public park will be replaced with a new pumping station with a design capacity of 250 l/s. This flow is significantly in excess of 6 times the dry weather flow due to the requirement to limit overflows to 20% of rainfall runoff. A storm water holding tank is also proposed. This has been sized at 274m^3 based on the size of tank that could practicably be built on the site. It is proposed that the existing pumping station will be made redundant on commissioning of the new pumping station.

The new pumping station will comprise of three number submersible type pumps operating on a duty/assist/standby basis. Flows in excess of 250 l/s will discharge to the river via a 900 mm dia. overflow pipe and 6mm dia. screens. A new 450 mm dia. rising main will be laid from the pumping station along Back Street, Strand Street and Dock Street, to discharge to manhole P094E at St. Lucia Place.

Cork Road Pumping Station (Reference Drg. Nr. A5670-N420)

The existing pumping station on the Cork Road serving the North-West portion of Passage West consists of two submersible pumps operating on a duty/standby basis. The results of flow surveys and pump draw down tests suggest that the pumps have a capacity of 15 l/sec. A draw down test with two pumps operating suggests an output of 21 l/s. Records show that the pumps were installed in 1991. The required output of the pumping station to cater for future flows is 32 l/s which represents a flow rate of six times dry weather flow. The volume of the existing wet well is adequate to cater for the future flow. However, it is proposed that the existing pumps be replaced to cater for future flows and that minor structural alterations be made to the existing valve chamber.

The existing rising main from the pumping station is 150 mm dia. UPVC pipeline. This pipeline would be adequate to cater for the future flow.

Glenbrook

Glenbrook Gravity Sewers (Reference Drg. Nr. A5670- N426)

The pump flow from the Passage West Pumping Station discharges to a gravity sewer which runs through Glenbrook to the Glenbrook Pumping Station. The existing gravity sewer does not have capacity to cater for the future pumped and gravity flows and needs to be upgraded. The existing sewer is a 375 mm dia. pipeline along its entire length. This needs to be upgraded to pipe sizes ranging from 600 mm dia. to 750 mm dia.

Foul Flows from the Carrigmahon Estate gravitate to the communitor and outfall at Glenbrook. It is proposed to intercept this flow at manhole P140F and lay a new 600 mm dia. gravity sewer along Glenbrook Road to the new Glenbrook Pumping Station. A section of the existing sewer upstream of manhole P140F is to be increased in size to a 300 mm dia. pipeline.

Glenbrook Pumping Station (Reference Drg. Nr. A5670-N435)

The existing Glenbrook Pumping Station receives flows from the existing Passage West Pumping Station and gravity Flows from the Glenbrook Area. These flows are pumped through a 200 mm dia. rising main and communitor and outfall at the point of the ferry crossing.

The existing pumping station comprises two submersible pumps which operate on a duty/standby basis. The output of the pumps as measured from draw down tests is estimated to be 28 l/s. The required capacity at the future Glenbrook Pumping Station is 350 l/s. The large increase in the required capacity of this pumping station is due to the input from the Passage West Central Pumping Station, and the additional flow from the Carrigmahon, and Glenbrook areas.

It is proposed that a new pumping station be constructed to comprise of three submersible pumps with a combined output of 350 l/s. The pumps will operate on a duty/assist/standby basis. This flow is significantly in excess of 6 times the dry weather flow due to the requirement to limit overflows to 20% of rainfall runoff. A storm water holding tank is also proposed. This has been sized at 90m^3 based on the size of tank that could practicably be built on the site. It is proposed that the existing pumping station and comminutor station will be made redundant on commissioning of the new pumping station.

Flows in excess of 350 l/s will discharge to the river via 6 mm screens.

Cobh and Glenbrook Rising Mains (Reference Drg. Nr. A5670-N427)

The flow gravitating to the existing Glenbrook Pumping Station is pumped to a communitor and outfall at the location of the ferry crossing. In the conceptual design it is also proposed that flows from the Cobh areas will be pumped across the harbour to a point adjacent to the existing communitor at Glenbrook.

It is proposed that the twin 710 mm OD HPPE rising mains from the harbour crossing will combine into a single 710 mm OD HPPE pipeline and continue along the coast road to the header manhole, FP500. It is also proposed that the new rising main from the Glenbrook Pumping Station extend from the existing communitor station site along the same length as the 710 mm OD HPPE rising main from Cobh to discharge to the same header manhole FP500.

Monkstown

Glenbrook/Cobh Gravity Sewer (Reference Drg. Nr. A5670-N427)

It is proposed to construct a 1,050 mm dia. gravity sewer from manhole FP500 to the proposed new pumping station at Monkstown. This gravity sewer will cater for pumped flows from the Glenbrook and Cobh areas. A connection will be made to the gravity sewer at manhole FP509 from the existing collection system in Monkstown.

Monkstown Storm Sewer (Reference Drg. Nr. A5670-N428)

It is proposed to construct a new 300 mm diameter storm sewer commencing at manhole FPS100 in Scotchman's Road which shall collect storm flows along Scotchman's Road, Diamond Road, parts of Sydenham's Terrace passing the Church and onto Glen Road. This storm sewer shall discharge to the existing outfall at manhole FPS124.

Rathanker Gravity Sewer

It is proposed to construct a 225 mm dia. gravity foul sewer servicing existing residential properties in the Rathanker area. This gravity sewer will discharge to manhole P199 on the gravity line near Monkstown Golf Club.

Monkstown Pumping Station & Rising Main (Reference Drg. Nrs. A5670-N429 and N436)

It is proposed that a new pumping station will be constructed on a portion of the existing car park within the public park adjacent to the Glen Road. The proposed pumping station will have a maximum pump output of 965 l/s with three pumps operating on a Duty/Assist/Standby basis. The station will be a wet well/dry well arrangement with an above ground structure to house control panels and other electrical equipment. The rising main from the pumping station will be a 850 mm dia. pipeline which shall be laid along the Coast Road to a header manhole, FP600. A 900 mm dia. gravity sewer will direct the Waste Water from the header chamber to the proposed new pumping station at Raffeen.

Raffeen

Raffeen Pumping Station & Rising Main (Reference Drg. Nrs. A5670-N431, N432 & N437)

It is proposed to construct a new pumping station at Raffeen to pump the Waste Water from the lower harbour area to the proposed new Waste Water treatment plant site. This proposed new pumping station is to be located on reclaimed land at Strawhall between the Coast Road and the old railway track.

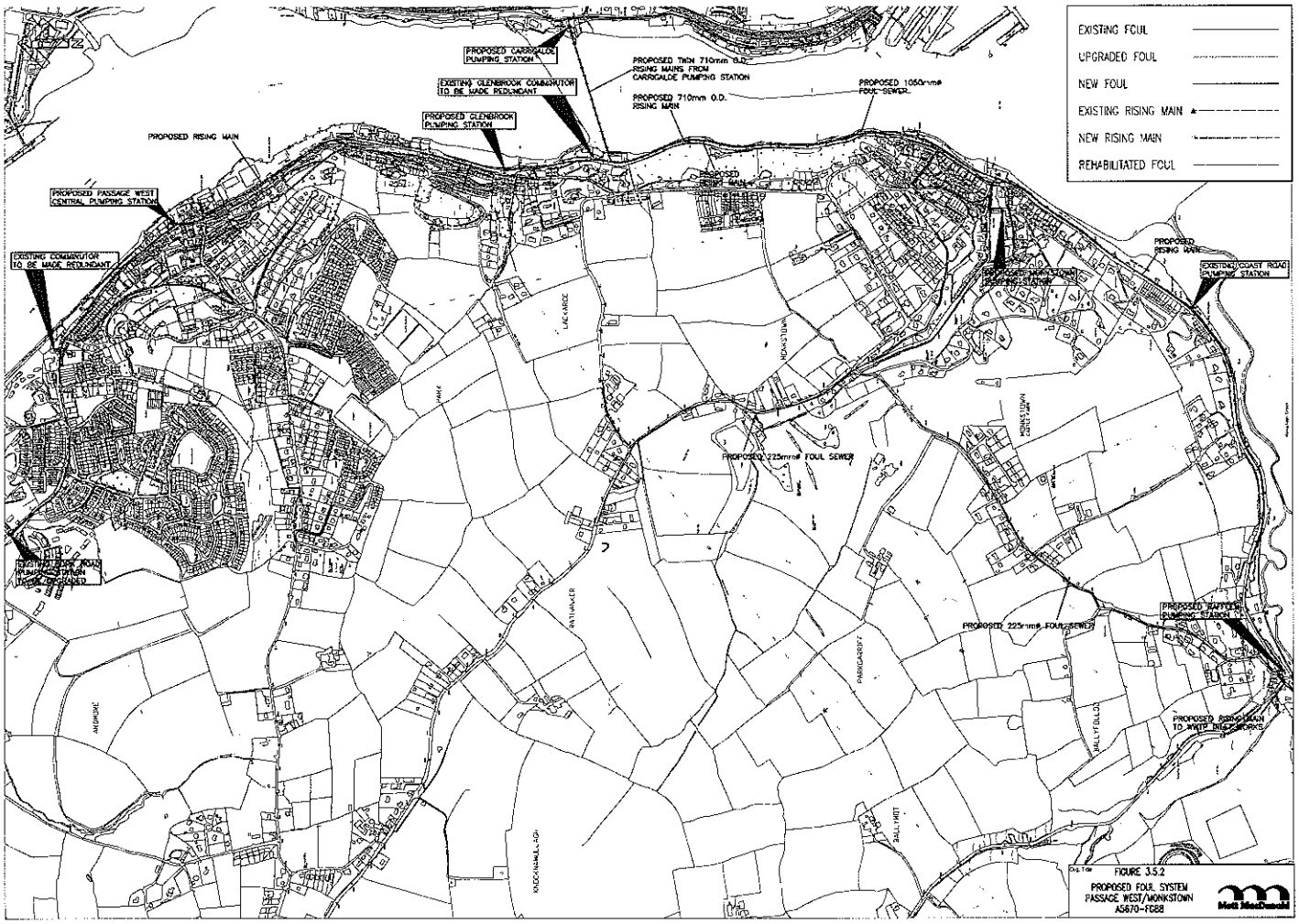
The design capacity for the Raffeen Pumping Station shall be 975 l/s. The pumping station will comprise three pumps operating on a duty/assist/standby basis constructed in a wet well/dry well arrangement. The rising main from the pumping station will be a 850 mm dia. pipeline. The proposed route of the pipeline is shown on Drg Nr's A5670-N431and N432.

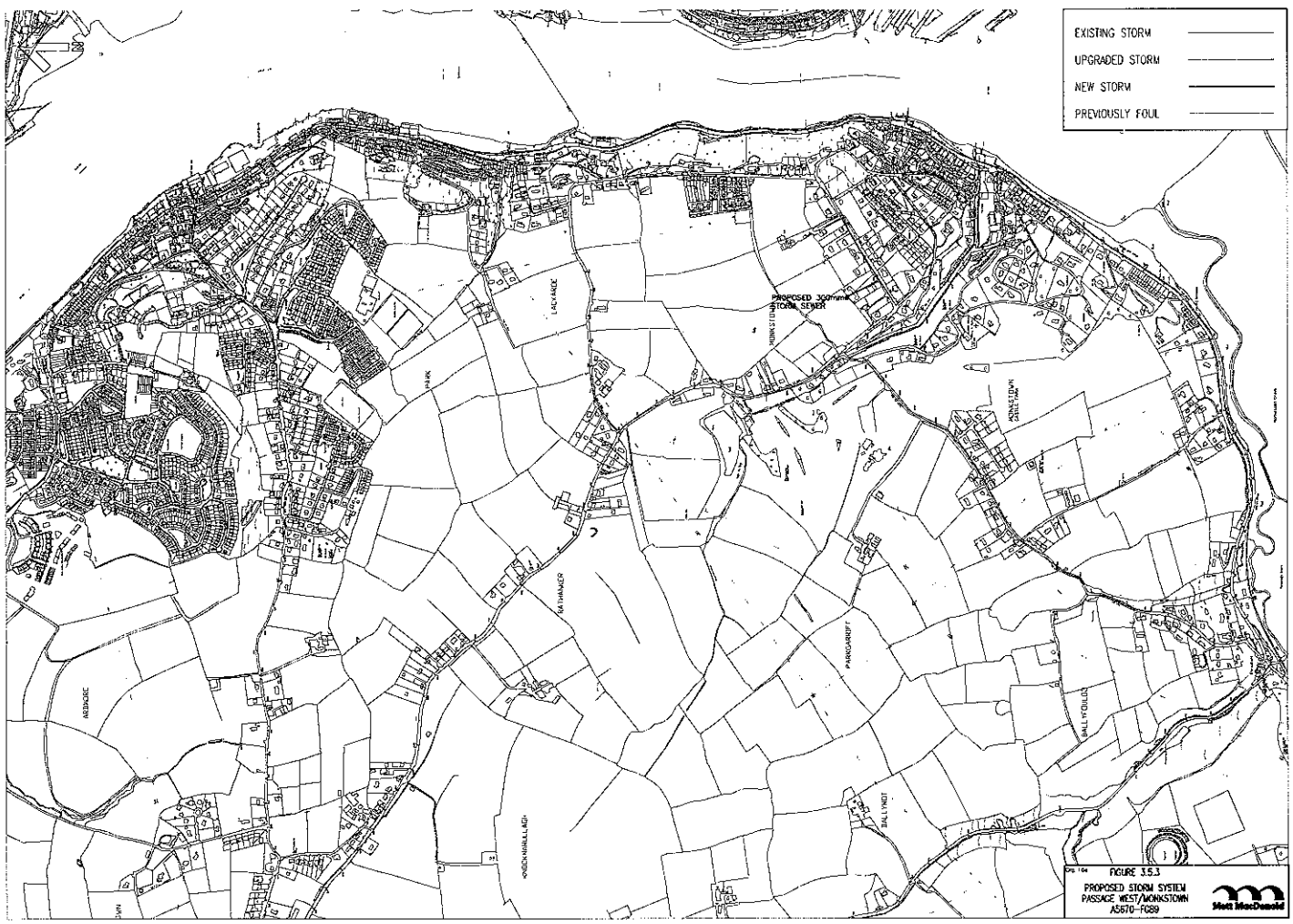
Raffeen Gravity Sewer Reference Drg. Nr. A5670-N430

It is proposed to construct a 225 mm dia. gravity foul sewer servicing existing residential properties in the Raffeen area. This gravity sewer will discharge to manhole FP612 on the gravity line from the Monkstown Pumping Station.

Raffeen Village Collection System

It is proposed to construct a 225 mm dia. gravity foul sewer servicing existing residential properties in Raffeen Village which is adjacent to the rising main route to the waste water treatment plant. This gravity sewer will discharge to a package pump station which will pump flows to the proposed Raffeen Pumping Station.


EXISTING FOUL
UPGRADED FOUL
NEW FOUL
EXISTING RISING MAIN
NEW RISING MAIN
REHABILITATED FOUL
PROPOSED CARRIGALOE PUMPING STATION
EXISTING GLENBROOK COMMUNITOR TO BE MADE REDUNDANT
PROPOSED GLENBROOK PUMPING STATION
PROPOSED TWIN 710mm O.D. RISING MAINS FROM CARRIGALOE PUMPING STATION
PROPOSED 710mm O.D. RISING MAIN
PROPOSED 1050mm∅ FOUL SEWER
PROPOSED RISING MAIN
PROPOSED PASSAGE WEST CENTRAL PUMPING STATION
EXISTING COMMUNITOR TO BE MADE REDUNDANT
EXISTING COAST ROAD PUMPING STATION MADE REDUNDANT
EXISTING COAST ROAD PUMPING STATION
PROPOSED 225mm∅ FOUL SEWER
PROPOSED RAFFO'S PUMPING STATION
PROPOSED RISING MAIN TO WWTP DISCHARGE
FIGURE 3.5.2
PROPOSED FOUL SYSTEM
PASSAGE WEST/MONKSTOWN
A5670-FG88
Matt MacDonald


EXISTING STORM
UPGRADED STORM
NEW STORM
PREVIOUSLY FOUL
PROPOSED 300mm∅ STORM SEWER
FIGURE 3.5.3
PROPOSED STORM SYSTEM
PASSAGE WEST/MONKSTOWN
A5670-FG89
Matt MacDonald

3.6 Ringaskiddy

3.6.1 General

Ringaskiddy is situated approximately 15km from Cork City, in the South-East of the Lower Harbour Sewerage Scheme Area. Ringaskiddy is a well-established passenger ferry terminal and the ferry embarkation point is located north of Ringaskiddy Village. Other facilities in the area include the Irish Naval Base and Irish Steel (recently closed down) located on Haulbowline Island, North of Ringaskiddy Village. Spike Island, East of Ringaskiddy Village, houses a maximum-security prison.

The Port of Cork Company have loading activities in Ringaskiddy. These include dry bulk, roll-on roll-off and bulk liquid port facilities.

The development of approximately 400 ha of former I.D.A. lands in the Ringaskiddy catchment, has made Ringaskiddy one of the foremost industrial areas for the production of pharmaceutical products.

A drainage system is in place to serve the industrially zoned lands. Trunk sewers have been laid for effluent and surface water. Discharge of the screened effluent is via marine outfall to deep water.

Improvement in road infrastructure for the recent industrial development has decreased travel times to/from Cork City.

Ringaskiddy Village is a small community consisting of ribbon development along the route to Haulbowline Island. Traffic in the village is mainly made up of ferry passengers, shipping related transportation and the industrial workforce. The Shanbally and Coolmore domestic development consists of North to South ribbon developments.

The existing hydraulic loading and drainage system is presented in Section 2.6. This section presents the recommendations with regard to future population and hydraulic loading for the design of the collection system. The design hydraulic and organic loadings for the Waste Water Treatment Plant are presented in Section 4.

The design population for Ringaskiddy is set out at in Section 3.6.2.

The design loading for the collection system is presented in Section 3.6.3.

The future collection system is discussed in Section 3.6.4.

The estimated cost of the proposed scheme is presented in Section 6.

3.6.2 Future Population

3.6.2.1 Local Area Plan

The 2005 Carrigaline Local Area Plan covers the Ringaskiddy area. This was examined to identify the areas zoned for development within the Ringaskiddy catchment.

Some of this zoned land has already been developed.

The area of land yet to be developed is approximately 3.6 ha. These lands are zoned for residential development which when developed will result in an additional 45 houses.

3.6.2.2 Cork Area Strategic Plan

The interim report on the Cork Area Strategic Plan does not envisage any strategic development zones in the Ringaskiddy area.

3.6.2.3 Infill Housing

Within the existing development limits there are vacant lands on which infill development is likely to occur within the design horizon of the proposed scheme. The area of vacant lands will accommodate an additional 116 houses when fully developed.

3.6.2.4 Future Design Population

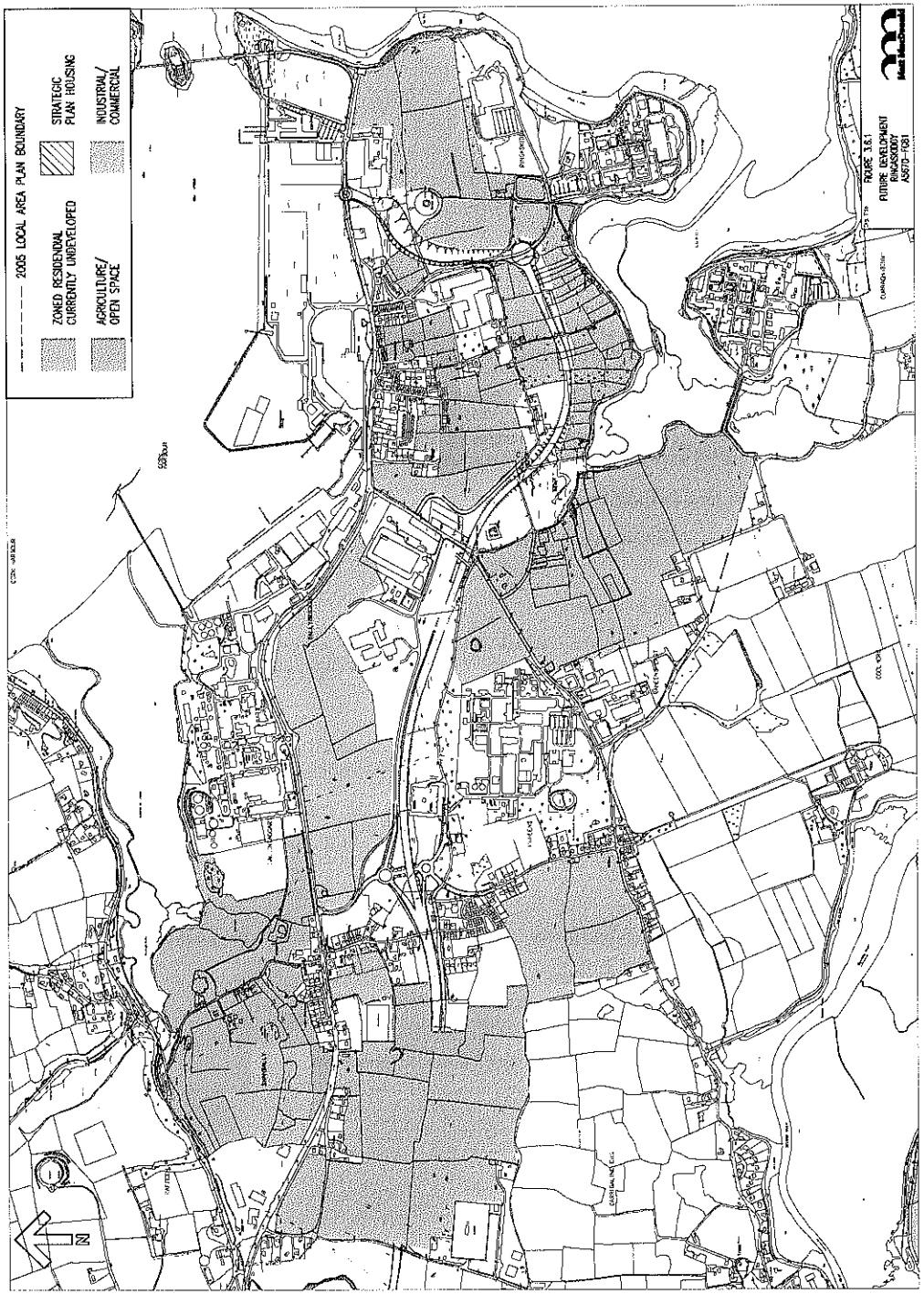
The estimated existing and future number of houses within the Ringaskiddy catchment is summarised as follows:

Existing Nr. of Houses:	455
Development Plans:	45
Strategic Plan Development:	0
Infill Housing:	116
Total	**629**

The housing occupancy, taken as 3 persons / house, is applied to the total number of houses to arrive at a design population.

Future Nr. of Houses:	629
House Occupancy:	3.0
Design Population:	1,887

A design population of 1,887 is taken for the Ringaskiddy Catchment.



3.6.3 Future Flows and Loads

3.6.3.1 Domestic Loading

A design population of 1,887 has been established for Ringaskiddy. Table 3.6.1 below summarises the design loading to the collection system and ultimate loading to the Waste Water treatment plant from the estimated domestic population.

Table 3.6.1			Ringaskiddy Design Domestic Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Population	1,887		
Domestic Loading	150 l/head/day	60 g/head/day	70 g/head/day
Design Domestic Loading	283 m^3/d	113 kg/d	132 kg/d

3.6.3.2 Non-Domestic Loading

Commercial Loading

The existing commercial loadings in the Ringaskiddy catchment are presented in Section 2.6.3.

A review of the existing records on water usage has indicated that the commercial flow element (including institutional) represents approximately 16% of the domestic flow element. This is consistent with similar estimates carried out for other areas. The design commercial loading is therefore taken as 16% of the future domestic loading.

Table 3.6.2 summarises the components of the design loadings from commercial activities. The BOD and SS loadings are based on domestic strength effluent.

Table 3.6.2			Ringaskiddy Design Commercial Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Commercial Loading	45	18	21

Industrial Loading

Although there are significant lands (358 ha) zoned for industrial development in Ringaskiddy, it is not proposed to allow for the development of these lands within the preliminary report. These industries are likely to deveopm their own waste water treatment plants to deal with the specific nature of their effluent.

Institutional Loading

Institutional loading is taken to be equal to the current (2009) institutional loading (including the marine college), with any increase in institutional loading included for in the increase in commercial loading.

Table 3.6.3 summarises the components of the design loadings from institutional sources.

Table 3.6.3			Ringaskiddy Design Institutional Loading
	Flow m^3/d	BOD kg/d	SS kg/d
Design Institutional Loading	111	44	52

3.6.3.3 Infiltration

Seawater can freely flow back through the outfall pipes in Ringaskiddy Village during all phases of the tide. This occurs as no flap valve or such device is fitted to outfall pipes. It is anticipated that this source of infiltration will be eliminated by the provision of separate foul sewers. For the purpose of design in the collection system in Ringaskiddy an allowance of 50 l/head/day is made within the Ringaskiddy catchment. Based on a design population of 1,887 this equates to an allowance of 94 m^3/day for infiltration.

3.6.3.4 Summary

The apportionment of the design loading throughout the catchment is based on development plan proposals. Drawing A5670-N300 shows the sub-catchments defined as part of this report and Appendix F contains the loadings from each. These flows were used for the design of the collection system. Table 3.6.4 below summarises the design loadings for Passage West / Monkstown.

Table 3.6.4			Ringaskiddy Design Load Summary
	Flow (m^3/d)	BOD (kg/d)	SS (kg/d)
Domestic	283	113	132
Infiltration	94	0	0
Institutional	111	44	52
Commercial	45	18	21
Industrial	0	0	0
Total	533	175	205

3.6.4 Future Collection System

3.6.4.1 Conceptual Design

The analysis of the various options for Waste Water collection and treatment are presented in Chapter 4. The location of the preferred Waste Water Treatment Plant is in Shanbally.

In order to convey flows from the Ringaskiddy catchment to the proposed Waste Water Treatment Plant, four new small pumping stations are proposed. These will be located at Ringaskiddy village, Barnahely, Shanbally and Coolmore. Waste Water from Ringaskiddy will be pumped to Shanbally from where it will be pumped to the future Waste Water treatment plant. The Barnahealy Pumping Station will pump to the Ringaskiddy Pumping Station catchment. The effluent from the Coolmore catchment will be pumped directly to the waste water treatment plant.

Separation of foul and storm flows is only practical in Ringaskiddy Village where the trunk sewer collects all foul and storm flows. Most of the stormwater in Shanbally and Coolmore drains to either the stream near the existing Shanbally Pumping Station or is collected in the existing IDA storm sewer, which discharges south of Coolmore near Rabbit Point.

The majority of the existing network at Ringaskiddy is a combined system, and it is proposed to separate these flows where possible. Storm sewers are proposed on the main roads to separate flows where possible (from roads and front of houses) and to intercept any dedicated storm sewers from individual developments which currently discharge to the combined sewer. Storm sewers have not been proposed for future development of Greenfield sites. It has been assumed that on site storm water management will be implemented to limit discharges to current discharge rates. In most cases the natural fall of the land is away from the existing catchment boundary. Furthermore, for some of the areas for future development, the optimum disposal route will depend on the phasing of the development of the particular area.

3.6.4.2 Options

Ringaskiddy Pumping

In the assessment of the future requirement for the Ringaskiddy catchment options were considered as to the most appropriate route to transfer Waste Water from the village to the site for the Waste Water treatment plant. The alternatives that were considered included:

a. A route through the industrial estate along the line of the existing IDA gravity sewer.
b. A route along the main road to Shanbally.

Option A has the advantage that most of the rising main will be along an existing sewer wayleave which is in open space. However, the static head is much greater than the alternative route.

Option B involves laying the rising main adjacent to the main road. Initial surveys suggest that it will be possible to lay the rising main at least partially in the grass verge therefore avoiding road reinstatement costs and major traffic disruption. Option B was considered the preferred option as operation costs for the pumping station will be lower due to the lower pumping head.

Coolmore Pumping Station

Options are also available regarding the pump station at Coolmore. The alternatives that were considered included:

a. Locating the pump station near Rabbit Point, pumping to a gravity sewer discharging at Church Road pumping station in Carrigaline.
b. Locating the pump station at Coolmore Crossroads, with overflows discharging via 6mm screens to the adjacent storm sewer.

Although Option A allows more properties to connect to the sewer it involves double pumping. Also, the last 900m of sewer before the pump station is needed to be 525mm diameter due to the flatness of the topography. Option B was considered to be the preferred option as both the capital and operating costs will be lower.

3.6.4.3 Hydraulic Modelling

It was decided that, where possible, the collection system in Ringaskiddy should be separated. Certain areas within the catchment are assumed to take only foul flows and roof runoff and so need not be further separated.

A future model was set up which was based on the existing model, with additional sewers input for areas which are currently not connected or are yet to be developed, as well as the proposed interceptor sewers. The design loadings arrived at in section 3.6.3 were input into the model, and the model run to identify areas where upgrading of sewers was required.

The existing network within Ringaskiddy Village was found to have insufficient capacity for the design foul flows, but had capacity for the design storm flows, the existing sewer is converted to a dedicated storm sewer, with all foul connections diverted to a new foul sewer adjacent to the existing sewer.

It was not considered necessary to model the less critical sewers, and it was decided to model all sewers which could feasibly require a sewer size greater than the minimum sizes considered for the project of 225mm diameter for foul sewers and 300mm diameter for storm sewers.

As much of the Ringaskiddy catchment is low lying and high tide levels have caused flooding in the past, it was decided to run the future 6 DWF model and the future storm model with an assumed high tide level of 3.5mOD to ensure that no flooding occurs during periods of high tide.

The proposed network was examined for storms of different durations for the various return periods considered. It was generally found that the 30 minute storm was the most critical. Resultant tables and plans from the HydroWorks simulations for the foul (2.5 DWF) and storm networks with storms of two year (surcharging), five year (flooding) and twenty year (excessive flooding) return periods and 30 minute durations are included in Appendix F. Plans and results for the foul (6DWF) network with the 5 year, 30 minute storm are also included to show the level of flooding predicted for a high tide event.

It was found from the model that during prolonged heavy rainfall events, some of the manholes near the proposed Ringaskiddy Village Pumping Station become surcharged by depth as they are close to the high tide level. It is proposed that these manhole covers be sealed to prevent flooding.

3.6.4.4 Recommendations

Fig. 3.6.2 contains a schematic of the proposals for the upgrading of foul sewer collection system in Ringaskiddy. Figure 3.6.3 shows the storm sewer proposals for Ringaskiddy. The overall layout plans for the area are shown on Drawings Nr's A5670-N320, N321 and N322. Details of the plans and longitudinal sections are shown on Drawing Nrs. A5670-N323, N324, N325 & N326.

<u>Ringaskiddy Village</u>

New Foul Trunk Sewers and Gravity Sewers (Ref. Drg. Nrs. A5670-N323 & N324)

Two new trunk sewers are proposed along the main road in Ringaskiddy between MHs FR340 and FR336 and between MHs FR324 and FR336. Pipeline sizes range from 225mm to 450mm diameter. It is also proposed to lay new foul sewers to tie to the new trunk sewer. A 225 mm dia. sewer is proposed between MHs FR 320 and FR324, to serve existing properties in the roadway leading to Barnahely Cottage. A second 225 mm dia. sewer is proposed between manholes FR309 and FR328 to serve properties on the roadway leading to St. Carthage Place with a short branch sewer to MH FR 315. A third 225 mm dia. sewer is proposed between MHs FR332 and FR334. The provision of these sewers will separate foul flows from the existing combined sewer which will remain as a storm sewer.

New Pumping Station in Ringaskiddy Village (Ref. Drg. Nr. A5670-N322)

The design dry weather flow (DWF) for the Ringaskiddy Village Catchment is 203.7 m^3/day. This DWF includes for future residential development and also the proposed Marine College.

The new Ringaskiddy Village Pumping Station is to be located near the junction of the main road and the entrance to the ferry terminal. This submersible pumping station will be designed to pump 15 l/s, which is approximately 6 times the dry weather flow (DWF). The rising main from the pumping station will discharge to a header chamber south of the main entrance to Pfizers/ADM on the main Ringaskiddy Road. Two pumps are proposed operating on a duty/standby basis. Flows in excess of 6 DWF will overflow into the existing outfall pipe. The rising main will be a 125mm diameter pipeline and will discharge to header MH FR216.

New Gravity Sewer from Ringaskiddy Village to Shanbally Pumping Station (Ref. Drg. Nr. A5670-N326)

It is proposed to lay a 225mm diameter foul sewer from the header MH, FR216 opposite the entrance to Pfizers/ADM to a new pumping station at Shanbally. This sewer will convey the 15l/s from Ringaskiddy Village Pumping Station.

New local Pumping Station Nr. 3 at Ringaskiddy School, Barnahely (Reference Drg. Nr. A5670-N322)

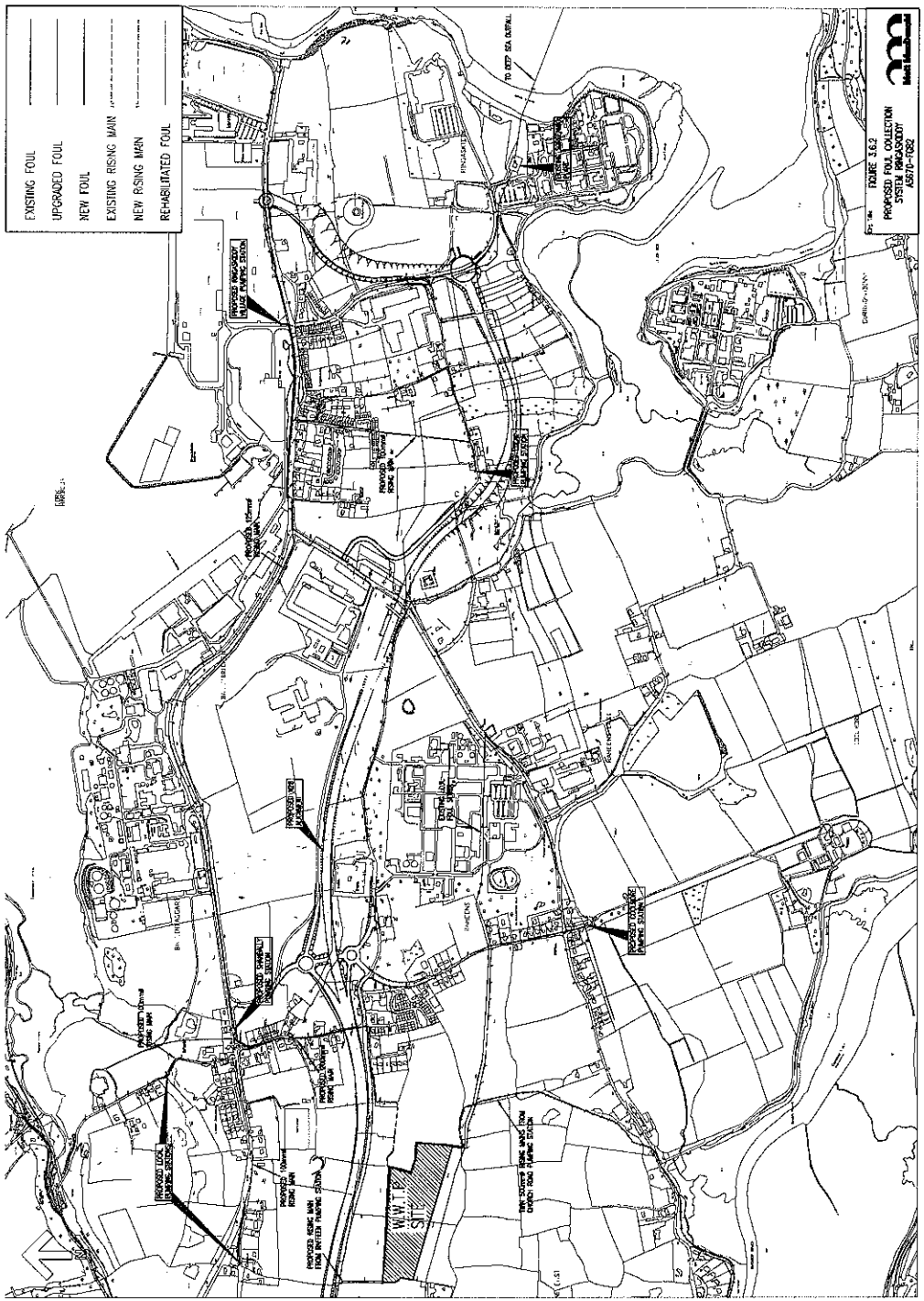
It is proposed to construct a small local pumping station west of Ringaskiddy National School with associated gravity sewers and rising mains to service the existing dwellings and the school south of the village.

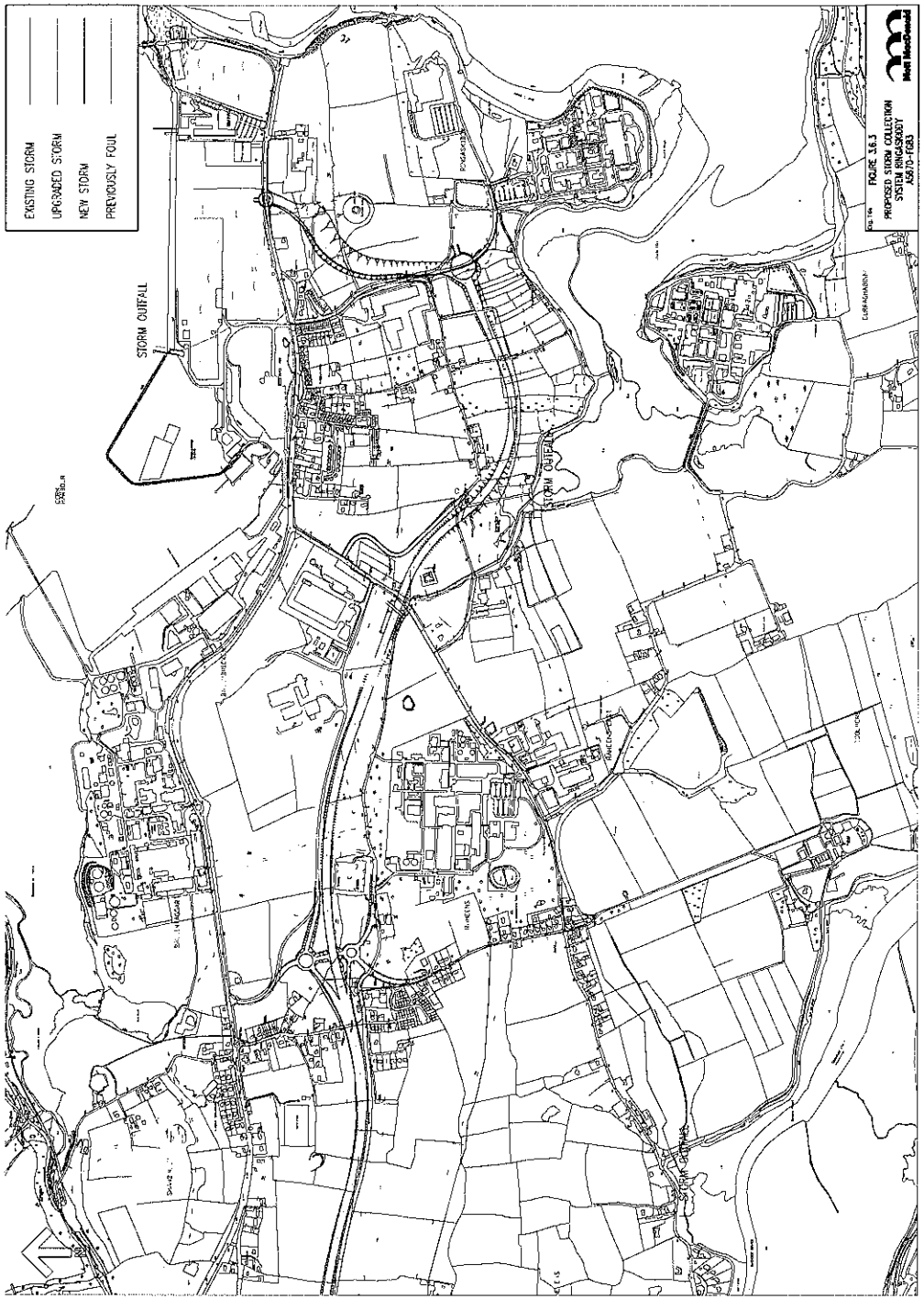
<u>Shanbally</u>

New Pumping Station in Shanbally and rising mains to Waste Water Treatment Plant inlet works
(Reference. Drg. Nrs. A5670-N320 & -N321)

The existing pumping station in Shanbally is to be replaced. A new pumping station is to be constructed to cater for pumped flows from Ringaskiddy Village and flows from the immediate catchment. A pump rate of 30 l/s is proposed which equates to 6 DWF. The existing pumping station will be utilised as an overflow chamber where flows in excess of 6 DWF will be diverted to the nearby watercourse using the overflow from the existing sump.

The rising main from the new pumping station will be a 200mm diameter main. This rising main will be laid to the proposed treatment plant inlet works.





Local Pumping Stations and Rising Mains (Reference Drg. Nr. A5670-N321)

It is proposed to construct small pumping stations with associated gravity pipelines and rising mains to service existing dwellings in the vicinity of Shanbally. The gravity sewers will be 225 mm dia. pipelines and the rising mains will be 100 mm diameter.

Treated Effluent Outfall Upgrade (Reference Drg. Nr. A5670-N326)

It is necessary to upgrade approximately 430m of the existing outfall pipeline in the vicinity of the proposed waste water treatment plant to a 900mm diameter pipeline. While these works are close to the waste water treatment plant, they are outside of the treatment plant site and as such are recommended to be carried out as part of the collection system works.

Coolmore

New Coolmore Foul Sewer and Pumping Station (Reference Drg. Nrs. A5670-N320 & N325)

The existing developments south of the IDA foul sewer are all connected to septic tanks. It is proposed to lay a 300mm diameter foul sewer to cater for these dwellings. The sewer will gravitate to the proposed Coolmore Pumping Station. The proposed pumping station will be a small submersible station with duty/standby pumps. The combined pump station capacity will be approximately 10 litres/sec and will pump directly to the waste water treatment plant.

4. Wastewater Conveyance, Treatment and Disposal Schemes

4.1 General

The objective of this Preliminary Report is to make recommendations with respect to the provision of wastewater treatment for the towns and villages in the lower Cork Harbour area. In addition to municipal wastewater, the treatment of industrial effluent and sludge are also to be addressed. This section of the Report assesses whether one joint scheme serving all of the specified population centres or a number of smaller schemes serving sections of the catchment is the optimum solution. It should be noted that the flows and loads presented in this section do not reflect the actual design load of the WWTP. The figures used here are for comparison of options only.

4.1.1 Existing Wastewater Systems

4.1.1.1 Municipal Wastewater

At present wastewater produced in the towns and villages in the Lower Harbour area is discharged in an untreated condition into Cork Harbour at numerous dispersed locations. While collection systems exist in Cobh, Passage West, Monkstown, Ringaskiddy, Shanbally, Coolmore, Carrigaline and Crosshaven, none of these systems provides complete wastewater treatment.

Wastewater generated in Passage West is discharged at two separate locations, into the Inner Harbour opposite IFI, and into the West Passage of Cork Harbour near the Glenbrook-Carrigaloe Ferry terminal. Comminutors are installed on both these discharges to provide screening and screenings maceration. All screenings are macerated and retained in the flow, with no facility provided for the removal of screenings.

A similar system is also provided on the wastewater discharge from Monkstown. This comminutor is located at Monkstown boat yard.

Due to the topography of Cobh, the town is served by a number of separate sewerage systems, each with its own discharge point. There are approximately nine significant wastewater outfalls from Cobh, ranging in size from 150 mm diameter to 750 mm diameter. The principle and largest outfall (750 mm diameter) located at White Point is provided with comminutors, while the other discharges along the waterfront of Cobh do not receive any form of screening.

Wastewater in Carrigaline is collected in the existing sewerage network and conveyed to a main pump station. Wastewater from Crosshaven discharges into the collection system upstream of this pump station. Screening (by use of comminutors) is provided at the main Carrigaline Pump Station. From there the wastewater is pumped into the foul sewer serving the IDA industrial zones of Ringaskiddy. This foul sewer discharges into Cork Harbour via a long sea outfall at Ringaskiddy. Fine screening is provided on the discharge to the outfall.

Domestic wastewater generated in Shanbally gravitates to a main pump station, from where it is pumped to the IDA foul sewer serving the Ringaskiddy industrial area.

Domestic wastewater generated in Coolmore and at Coolmore Cross Roads is treated in a number of individual septic tanks prior to discharge into the Owenboy Estuary. Domestic wastewater generated in Ringaskiddy village is collected in a main sewer that gravitates to an outfall into Cork Harbour near

Ringaskiddy Ferry Port. The domestic wastewater generated in Raffeen is collected and treated in a communal septic tank prior to discharge into the harbour.

Sections 2 and 3 of this report identify the existing and future flows and loads in more detail.

4.1.1.2 Industrial effluent contribution

In general, industries in the area to be served by the Cork Harbour Main Drainage Scheme operate their own wastewater treatment plants to provide sufficient treatment prior to discharge to the receiving waters of Cork Harbour. Discharges from these industries are not governed by the Urban Waste Water Directive, but either by IPC licences issued by the EPA or licences issued by the Cork County Council. Industries in the Ringaskiddy area discharge treated effluent into a common IDA sewer connected to a deep sea outfall at the mouth of Cork Harbour. This industrial wastewater is not covered by the scope of this scheme.

The principal industry in Carrigaline is Kerry Bio-Science (formerly Quest), which has a licence to discharge partially treated effluent at the same strength as domestic sewage, into the local authority sewerage system. Pepsi also has a licence to discharge to the local authority sewerage system. Since these are existing licensed contributors to the sewerage system, their contribution will be included in this scheme.

4.1.1.3 Sludge

Under the National Sludge Strategy (1994), the country was divided into regions for the purpose of managing sludge on a regional basis, with Region 19 covering the lower Cork Harbour area. The principal population centres in this region are Cobh, Passage West, Monkstown, Ringaskiddy, Carrigaline, Crosshaven, Shanbally, Coolmore and Minane Bridge. The current Sludge Management Plan for County Cork (March 2000) recommends that the hub centre for the treatment of municipal sludge arising in Region 19 be located in Ringaskiddy. At present the only municipal sludge being produced in this region is from the septic tanks including the one at Minane Bridge which has a design population of 100 p.e.

4.1.2 Future Requirements for Evaluation of Options

4.1.2.1 Wastewater Flows & Loadings

To meet the needs of the Lower Cork Harbour area, it is necessary to take into account future development. Section 3 of this Preliminary Report sets out the basis for calculation and determination of the future wastewater flows and loads which could be produced in each of the population centres for the purposes of collection system design.

The flows and loads used for the evaluation of options were calculated based on information available during the preparation of the initial issue of this report in 2001. These flows and loads are presented in Appendix G1 for information purposes. It should be noted that these figures do not represent the final design loading of the WWTP. The design loading for the year 2035 is presented in Section 5.

4.1.2.2 Sludge

The current Sludge Management Plan for County Cork (March 2000) recommends that all municipal sludge produced in Region 19 be treated at a hub centre to be located in Ringaskiddy. The principal population centres in this region are Cobh, Passage West, Monkstown, Ringaskiddy, Carrigaline, Crosshaven, Shanbally, Coolmore, Aghada, Whitegate and Minane Bridge. Besides the population centres to be served

by the Cork Harbour Main Drainage Scheme, the only other municipal sludge contributor to be considered is the septic tank at Minane Bridge which has a design population of 100 p.e. As discussed in Section 5.1.2.5, Aghada and Whitegate are not expected to contribute to the sludge load. For this reason the suitability for provision of sludge treatment facilities is used as a criterion in the selection of a site for a wastewater treatment plant only for locations in the general Ringaskiddy area.

The Sludge Management Plan for County Cork also recognises the potential for co-treatment of municipal wastewater sludge and biological industrial sludges at a hub centre located in the Ringaskiddy area. There are significant volumes of biological wastewater sludge produced by the pharmaceutical industries located in the Ringaskiddy area. However, there are currently a number of active proposals being pursued by commercial interests for the provision of treatment facilities for these industrial sludges (including biological industrial sludges) in the Ringaskiddy area. These proposals recognise the potential for co-treatment and have sufficient treatment capacity within their preliminary designs to accept and treat the municipal sludge produced by the Cork Harbour Main Drainage Scheme.

However, the success or time-scale for completion of such plant(s) is uncertain, and one might not be operational by the time that the Cork Harbour wastewater treatment plant is commissioned and producing sludge. Such proposals could not therefore be relied upon as a solution for the treatment of sludge produced by the Cork Harbour Main Drainage Scheme.

Another alternative would be to transport the industrial sludges to the Cork Harbour wastewater treatment plant, for co-treatment with the municipal wastewater sludges. However, this would be in direct competition with some of the commercial proposals currently being pursued, which are based on the principal supply of sludge coming from the pharmaceutical companies in Ringaskiddy. In which case there would be no guarantee of a continuous supply of industrial sludge to the Cork Harbour treatment plant, where the sludge treatment facilities could become partly redundant. In addition, the co-treatment of municipal and industrial sludges would reduce the number of acceptable options for beneficial reuse of the treated sludge.

It is therefore considered prudent to make allowance at this stage for the provision of a system for the treatment of municipal sludge at the proposed Cork Harbour wastewater treatment plant, and not for the treatment of industrial biological sludges.

The amount of sludge produced by the proposed wastewater treatment system(s) depends on the biological treatment system employed, its loading rates, and the type of sludge treatment system used. Since the proposed wastewater treatment system will be constructed using the Design/Build/Operate procurement route, neither the wastewater nor sludge treatment systems to be used can be defined at this stage. However, on the basis of conventional systems treating similar quantities of municipal wastewater, the biological sludge produced can be expected to be up to 4,500 kg dry solids per day. The issue of sludge quantities and treatment systems is dealt with in more detail in Section 5.5.

4.2 Identification of Suitable WWTP Sites

4.2.1 Site Selection Criteria

The criteria used in the selection of a suitable site for the provision of a wastewater treatment facility are listed below.

- **Availability of sufficient site area** to accommodate a wastewater treatment facility, incorporating a suitable treatment plant layout with associated landscaping and access roads, to serve either the immediate locality or the overall catchment area of the scheme. Since the wastewater and sludge treatment facilities will be constructed using the Design/Build/Operate procurement route, it is the successful contractor who will undertake the process and plant design. To ensure provision of a site area sufficiently conservative to accommodate alternative treatment plant designs, the site area required was estimated on the basis of a conventional activated sludge treatment process with preliminary treatment. The maximum site area required is estimated at approximately 5 hectares.
- **Land zoning** of the area based on the 1996 County Development plan for South Cork with May 1999 variations.
- **Elevation** - A minimum site elevation of 7.5 m OD is required to prevent flooding and to facilitate a gravity discharge of treated effluent against a high tide. A maximum site elevation 20 m OD is considered acceptable to minimise the pumping head required and operating costs of the system for conveying the raw wastewater to the site. Ideally the site elevation should be between 9 and 15 m OD to ensure gravity flow of wastewater through the wastewater treatment system on site. Sites at a higher elevation were also considered and evaluated, especially in Passage/Monkstown area, where there is very little low-level land available.
- **Distance from the treated effluent outfall point** should be as short as possible to optimise the discharge head available from the treatment plant site.
- **Distance from nearest habitable dwelling** – Preferably this should be further than 100 m, unless the dwelling is to be purchased as part of the site acquisition.
- **Distance from population centres** will affect the transmission systems conveying the raw wastewater to the treatment plant.
- **Access to the site**, which should be adequate during the construction and operational stages. Allowance must be made for the transport by road of sludge from other wastewater treatment plants for further treatment at this site if more than one plant is to be provided to serve the catchment. Similarly, there will be regular traffic movement associated with sludge being taken off site for sites which will not incorporate advanced sludge treatment, thickened sludge will be transported off site, while the site incorporating the advanced sludge treatment facility will have much smaller quantities of treated sludge transported off site.
- **The Cork County Sludge Management Plan** (current draft of March 2000) recommends that a hub centre for the treatment of municipal wastewater sludge produced by the Lower Cork Harbour towns be provided at Ringaskiddy. Therefore, sites considered in the general areas of Carrigaline and Ringaskiddy must satisfy the requirements for **suitability to act as a hub centre for the treatment of sludge**. This criterion is not relevant for treatment plant sites in other areas. The site area required for sludge treatment was estimated on the basis of conventional advanced sludge treatment technologies, thereby ensuring that the site area would be sufficient to accommodate alternative technologies. A site area of approx. 7 hectares is required to accommodate a wastewater treatment plant and sludge treatment facility.
- **Environmental impact** on the human environment and on flora and fauna should not be significant.
- **Capital cost** of constructing a wastewater treatment plant and associated collection and discharge systems.

- **Operating and Maintenance costs** for a wastewater treatment plant with associated collection and discharge systems.

4.2.2 Site Selection and Preliminary Evaluation

4.2.2.1 Identification of Suitable Sites

Initially 19 potential site locations were identified in the Lower Cork Harbour catchment area and these were subjected to a preliminary evaluation. The object of this preliminary evaluation is to identify the optimum sites for construction and operation of a wastewater treatment plant serving a single population centre, a number of population centres, or the entire catchment area to be served. It is also used to identify optimum locations in the general Ringaskiddy area for a hub centre for the treatment of sludge produced in the South Cork area (i.e. Region 19). The approximate location of these sites is shown on Fig Nr. 4.2.2, while they are shown in greater detail on Drawing Nr. A5670-N004 attached.

Of these 19 sites, 10 had been identified in previous reports (Cork Main Drainage Preliminary Report in 1992, Cork Main Drainage Supplementary Report in 1993, Cobh Sewerage Scheme Review Report in 1997) and evaluated as potential sites for the WWTP serving the Cork Main Drainage Scheme.

The raw wastewater from Crosshaven is pumped to Carrigaline, and is included as part of the Carrigaline load for treatment. Passage West and Monkstown are treated as a single population centre due to their close proximity to each other. The raw wastewater from Shanbally and Coolmore will be incorporated into the flows from either Ringaskiddy or Carrigaline, depending on the location of the treatment plant. They are not specifically mentioned in the following evaluations due to the small scale of their flow contributions.

1. Ringaskiddy - East of Ringaskiddy village, adjacent to the IDA Industrial Zone

2. Loughbeg - South of Ringaskiddy village and to the west of the existing wastewater screening plant on the existing IDA outfall

3. Loughbeg West – Between Raheens East and the Glaxo-SmithKline Beecham Facility

4. Curraghbinny - South of the Glaxo-SmithKline Beecham Facility

5. Barnahely - Adjacent to the Novartis Facility to the west of Ringaskiddy

6. Whitegate - West of the Oil Refinery

7. Carrigaline Pumping Station - Adjacent to the Carrigaline to Ringaskiddy road

8. Coolmore - Between Coolmore Crossroads and Coolmore House

9. Rushbrooke - Old Gasworks site adjacent to the Cork Dockyard

10. White Point - The site of a demolished factory in Cobh

11. Marino - Across the road from the IFI Facility at Marino Point on Great Island

12. Ballydulea - North East of Cobh on Great Island

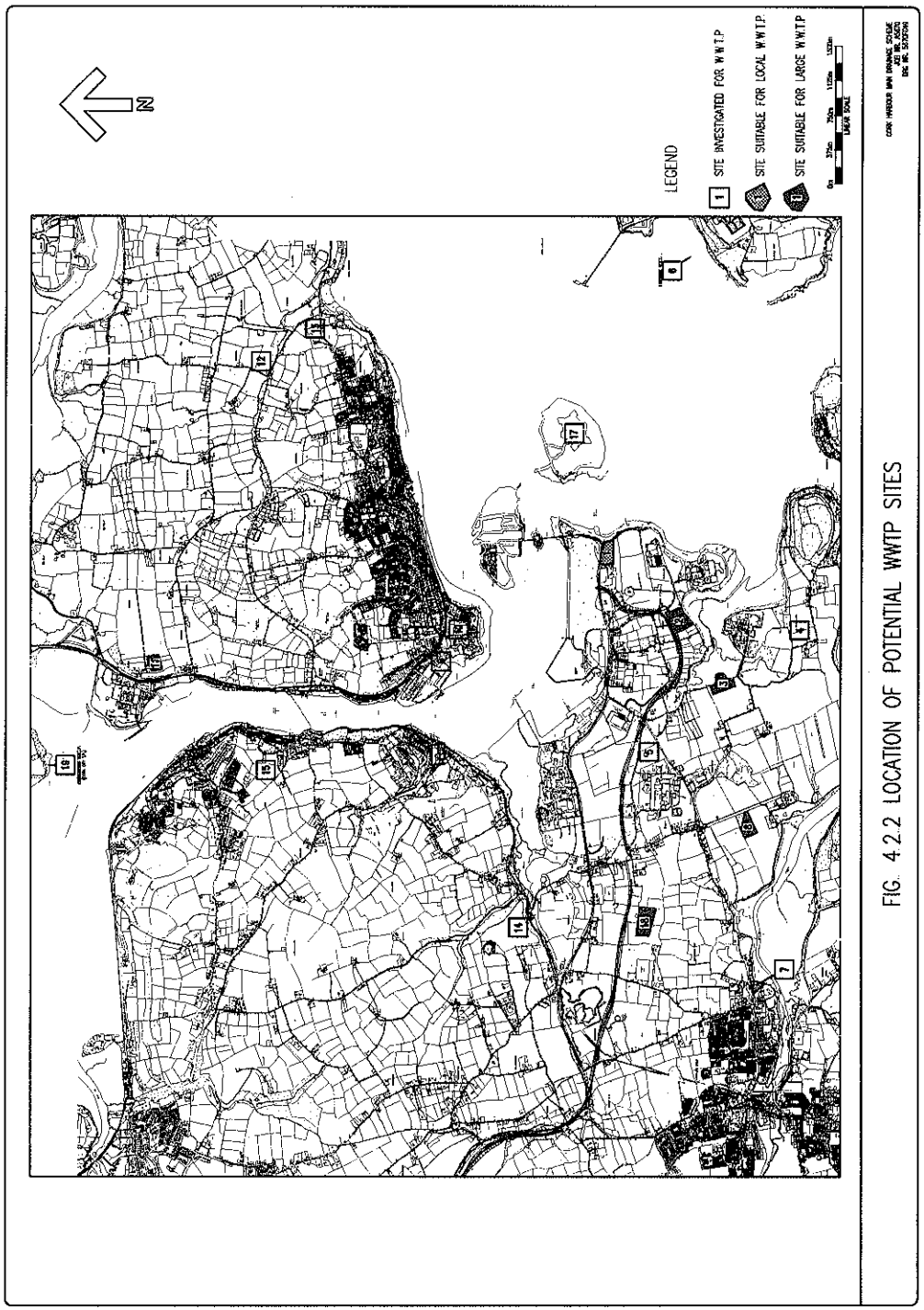


FIG. 4.2.2 LOCATION OF POTENTIAL WWTP SITES

13. Cuskinny - East of Cobh on Great Island

14. Raffeen - South West of Monkstown, between Raffeen village and Raffeen House

15. Maulbaun - Between Passage West and Monkstown

16. Ardmore - North West of Passage West

17. Spike Island

18. Carrigaline East - Between Carrigaline and Shanballymore

19. Carrigrenan on Little Island - site of the Cork Main Drainage Wastewater Treatment Plant

4.2.2.2 Preliminary Site Evaluation

(1) Ringaskiddy

Location: East of Ringaskiddy village, adjacent to the IDA Zone G Industrial Zone and opposite the access road to Haulbowline.

Present use: The site is not currently being used, and is covered with bushes and high grass. It is generally used for grazing of cattle.

Zoning: The site is located in an industrial zone (for industries dependent on port facilities or with considerable water requirements).

Availability: There is an unused site area of approx. 3.4 hectares at this location. The site forms part of a larger site which has been selected by Indaver Ireland for the construction and operation of a waste management facility. A planning application relating to this proposal has been submitted to Cork County Council. There may therefore be difficulties in acquiring the site.

Elevation: The site elevation varies from 3.5 to 40 m OD, being steep and elevated at the southern side, while the northern portion is relatively flat and at a low level.

Outfall proximity: The site is close to the existing IDA outfall from Loughbeg, Ringaskiddy (approx. 1100 m), and also relatively close to a potential outfall location at White Point (across the harbour at Cobh). However, since there is a hill between the site and the existing IDA outfall, the plant would have to be constructed on the higher more visible portion of the site if gravity flow of the treated effluent to the outfall is to be achieved. Otherwise it would be necessary to pump the treated effluent to the outfall.

Nearest dwellings: The nearest habitable dwelling is more than 100 m from the site, and is separated from the site by a scrap metal processing facility.

Distance from population centres: The site is close to Ringaskiddy Village (1 km), relatively close (2.5 km) to Cobh (although a deep water crossing would be required), and within 6 km of Carrigaline.

Access: The site is adjacent to the existing road leading to Haulbowline, with direct access from the N28 and a good road network in the Ringaskiddy area.

Suitability for use as a hub centre: While the road network to the site is excellent, the site area is too small to accommodate sludge treatment facilities.

Environmental impact: The site is very exposed to view from both Cobh and Monkstown, and would require a high level of screening and landscaping to reduce visual impact. Due to the distance of the site from the nearest dwellings and the village of Ringaskiddy, and the imposition of adequate restrictions with regard to odour and noise at the boundaries of the site, there should be no significant impacts expected. With regard to flora and fauna, the site is not considered a significant habitat.

Comments: This site had been identified and evaluated as part of the Supplementary Report for the Cork Main Drainage Scheme as a potential location for a wastewater treatment plant serving Cork City and Environs. However, it was considered unsuitable for a plant of such a scale so far from the city.

The Southern area of the site is very steep, elevated and exposed to view from Cobh and Monkstown, and does not appear suitable for construction. Extensive screening and landscaping would be required, with the elevated area being difficult to screen. There is relatively flat area measuring approximately 120 m x 260 m adjacent to the road at the northern end of the site. This would not be sufficient to accommodate a wastewater treatment plant serving the entire catchment, but would be sufficient to accommodate a local plant or pump station.

The scrap metal processing facility, adjacent to the eastern side of the site, is constructed on made-up ground, suggesting difficult ground conditions for construction. Similarly the nearby land area beside the road to Haulbowline was reclaimed. This area is owned mainly by the Port of Cork Company, which plans to develop it, and also to reclaim more land to cater for future development of the port. The Cork Institute of Technology has built a Maritime College on the other portion of the reclaimed land directly opposite the site.

This site satisfies most of the site suitability criteria, and is considered for further evaluation on the basis of accommodating a local wastewater treatment plant.

(2) Loughbeg

Location: South of Ringaskiddy village, west of existing wastewater screening plant at the IDA outfall, and close to the Pfizer Warner Lambert Facility at Loughbeg.

Present use: This site comprises of grazing fields with hedges, thick bushes and trees along the boundaries.

Zoning: This site is located in an industrial zone (for industries dependent on port facilities or with considerable water requirements).

Availability: There is a considerable amount of land in private ownership available in this area.

Elevation: The site elevation is generally below 15 m OD

Outfall proximity: The site is close to the existing IDA sewer and outfall (500 m).

Nearest dwellings: The houses nearest to the site are to the south and are derelict, with one being used as a workshop for a small boat yard. The nearest habitable dwellings are located about 200 m to the north of the site.

Distance from population centres: The site is close to the village of Ringaskiddy (700 m), and within 5 km of Carrigaline, and 3.5 km from Cobh (although a deep water crossing would be required).

Access: There is a good road network in the Ringaskiddy area. A short access road (< 100 m) would need to be constructed from the road between Ringaskiddy and the Pfizer Warner Lambert Facility.

Suitability for hub centre: The site location would be suitable for construction and operation of a hub centre for sludge treatment. The site is well screened, has good road network, and has plenty of space available. Its location in the heart of the Ringaskiddy industrial area would also make it a suitable site for the acceptance and co-treatment of industrial sludges with the municipal sludge.

Environmental impact: The site is located in an industrial area, and is well screened, resulting in minimal visual impact. With regard to flora & fauna, there would possibly be some minor negative impact on the fauna of adjacent Lough Beg, which is classified as a proposed Natural Heritage Area (pNHA 1066). It is designated in the Cork County Development Plan as an Ecology Protection area (ornithological). Due its location in the industrial zone near two very large chemical manufacturing facilities, normal mitigating measures on site, and the absence of nearby habitable dwellings, there would be no adverse negative impact.

Comments: There is considerable land area available along Lough Beg to the west. The site is very well screened, and is located close to the existing network of sewers and the IDA sewer. On the basis of the preliminary evaluation, it is considered to be worthy of more detailed evaluation in terms of accommodating a wastewater treatment plant serving the entire catchment, as well as a hub centre for sludge treatment.

(3) Loughbeg West

Location: East of Raheens East, and to the west of Lough Beg near the Glaxo-SmithKline Beecham Facility. It is also close to a site selected by Cara Environmental Technology for a proposed waste management facility.

Present use: The site area is made up of grassland.

Zoning: The site is in an industrial zone (zoned for industries dependent on port facilities or with considerable water requirements).

Availability: There is ample land available in private ownership at this location.

Elevation: Most of the site area is below 15 m OD

Outfall proximity: The site is relatively close (approximately 1 km) to the existing IDA sewer leading to the existing outfall, but due to the site elevation and distance to the outfall pumping would be required to convey the treated effluent to the outfall pipe.

Nearest dwellings: The site is more than 100 m from the nearest habitable dwellings.

Distance from population centres: The site is relatively close to Ringaskiddy (1.5 km) and Coolmore, 4 km from Carrigaline and approximately 6 km from Cobh (although a deep water crossing would be required).

Access: There is good access to the site from the road to the Glaxo-SmithKline Beecham facility.

Suitability for hub centre: The site location is suitable, being near the geographical centre of the lower Cork Harbour area, and having a good road network. The site is also sufficiently large to accommodate the necessary facilities. Its location would also make it suitable for the acceptance and treatment of industrial sludges.

Environmental impact: The site is visually quite exposed, and would require extensive screening and landscaping to reduce visual impact. With regard to flora & fauna, there would possibly be some minor negative impact on the fauna of adjacent Lough Beg, which is classified as a proposed Natural Heritage Area (pNHA 1066). It is designated in the Cork County Development Plan as an Ecology Protection Area (ornithological). Due the location of this site in the industrial zone with two large chemical manufacturing facilities nearby, incorporation of normal mitigating measures on site, and the absence of nearby dwellings, there would be no adverse negative impact.

Comment: On the basis of the preliminary evaluation, this site is considered to be worthy of more detailed evaluation in terms of accommodating a wastewater treatment plant serving the entire catchment, as well as a hub centre for sludge treatment.

(4) Curraghbinny

Location: South of the Glaxo-SmithKline Beecham Facility. It is the most southerly site identified.

Present use: The site is currently in agricultural use as a grazing field.

Zoning: This site is located in an area zoned for agriculture.

Availability: There is limited site area available (approximately 5 ha.).

Elevation: Most of the site area is below 15 m OD declining from south to north.

Outfall proximity: The site is relatively close to the deep-water channel at Camden, and is approximately 3 kilometres from the existing IDA sewer leading to the outfall from Ringaskiddy. It would be necessary to pump the treated effluent to this sewer to reach the outfall.

Nearest dwellings: The nearest habitable dwellings (Curraghbinny village) are just over 100 m from this site.

Distance from population centres: The site is over 3 km from Ringaskiddy and 4 km from Crosshaven, but is approximately 6 km from Carrigaline, 7 km from Cobh and 12 km from Passage West.

Access: To facilitate the associated level of traffic movements, the local road to Curraghbinny would require major improvement over a distance of approximately 1 km.

Suitability for hub centre: The site is considered unsuitable because of its inadequate size, the level of road improvements required, and the visually exposed nature of the site from Curraghbinny and Curraghbinny Woods.

Environmental impact: The site is located close to Lough Beg, which is classified as pNHA 1066 and is designated in the Cork County Development Plan as an Ecology Protection area (ornithological). It is also reasonably close to Curraghbinny Woods, with the area classified as a scenic landscape. It is visually exposed to the north, south and to the east, requiring screening and landscaping on these boundaries to isolate it from view.

Comments: The principal disadvantage associated with this site is the distance from it to the population centres and the outfall. The limited site area available and poor access to the site (with the local road to Curraghbinny village being too narrow and requiring major improvements) are also seen as major disadvantages. The site is adjacent to a proposed NHA and is exposed to view from Curraghbinny woods and village. It is considered unsuitable as a location for either a local wastewater treatment plant or for one serving the entire catchment area.

(5) Barnahely

Location: Adjacent to the Novartis Facility to the west of Ringaskiddy.

Present use: The site is currently in agricultural use as grassland.

Zoning: The site is located in an area zoned for industrial use.

Availability: The site is not available for acquisition, because the area is owned by IDA and Novartis and is reserved for future industrial expansion.

Elevation: The site elevation is generally between 15 and 30 m OD, declining steeply from north to south.

Outfall proximity: The site is very close to the IDA sewer leading to the existing IDA outfall.

Nearest dwellings: There are no habitable dwellings visible from the site, with the nearest dwellings of Barnahely Cottage more than 100 m away.

Distance from population centres: The site is close to Ringaskiddy, Coolmore and Shanbally, in the geographical centre of the lower Cork Harbour area. It is approximately 3.5 km from Carrigaline, and 4.5 km from Cobh.

Access: The site is adjacent to the main Carrigaline to Ringaskiddy road, providing excellent access for traffic associated with a wastewater treatment plant.

Suitability for hub centre: The site is not suitable due to its limited size.

Environmental impact: The site is visually exposed to the south, and is also visible from the main road. Screening and adequate landscaping would be required along the southern and eastern boundaries. The site is close to the extensive Novartis pharmaceutical plant, and its environmental impacts could be reduced by incorporating sufficient control measures in the treatment plant design.

Comments: While there are many advantages to this site location and it satisfies many of the site selection criteria, it's availability may cause difficulty.

(6) Whitegate

Location: This site is located on the eastern side of the harbour, to the south-west of the oil refinery.

Present use: The area is currently in agricultural use as grassland.

Zoning: This area is not currently zoned.

Availability: Sufficient land to accommodate a wastewater treatment plant serving the entire catchment could be purchased in this general area.

Elevation: The site is very elevated at an elevation ranging from 55 to 69 m OD, with insufficient land available at lower elevations. This would result in high pumping costs.

Outfall proximity: The site is close to a potential new outfall location in the deep-water channel at Rams Head.

Nearest dwellings: This site is more than 100 m from the nearest habitable dwellings.

Distance from population centres: This site is quite remote from all of the specified population centres to be serviced, and being on the opposite side of the harbour it would necessitate the construction of extensive deep water channel crossings to convey the raw wastewater for treatment.

Access: There is good road access to the site from the roads leading to the oil refinery.

Suitability for hub centre: Not applicable.

Environmental impact: Provided that the usual mitigation measures are adopted, no significant impact would be envisaged. Screening and landscaping would be required to reduce the visual impact of the wastewater treatment plant.

Comments: The site is too far from population centres, is very elevated and exposed resulting in extremely high pumping costs, and is therefore excluded from further evaluation. This site had also been identified in the Cork Main Drainage Scheme Supplementary Report, and was excluded from further evaluation for similar reasons.

(7) Carrigaline Pumping Station

Location: This site is located in the eastern outskirts of Carrigaline, adjacent to the Carrigaline to Ringaskiddy road. It is to the south-west of the lower Cork Harbour area.

Present use: The site accommodates the main raw wastewater pumping station serving the town of Carrigaline. It comprises of a pump house, two comminutors, an access road, and some peripheral screening.

Zoning: While the site itself is not zoned for future development, it is close to a residential area and an area zoned for future residential development.

Availability: This is a readily available site, although space is too restricted to accommodate a conventional treatment plant serving the future population of Carrigaline, Coolmore and Crosshaven (44,000 p.e. approx.). It would be sufficient only to accommodate a very compact, low footprint treatment plant. There would not be sufficient space available for any further expansions beyond that.

Elevation: The site elevation varies up to 15 m OD.

Outfall proximity: At present this pump station is used to pump the wastewater from Carrigaline Sewerage Scheme to the IDA sewer and outfall at Ringaskiddy. The existing rising mains which are in place are adequate to accommodate the future predicted flows from the Carrigaline, Crosshaven and Coolmore Cross areas. While the site is located close to the Owenboy River, the river is tidal at this location, and the discharge of treated effluent to the river would have to be controlled by a tidal clock. Furthermore, a licensed Oyster bed is located is located downstream and therefore the waste water may require additional treatment (disinfection) to protect the viability of the Oyster beds. Strong objections would be expected to such a discharge since the Owenboy Estuary is a pNHA.

Nearest dwellings: The site is surrounded by residential areas, with three houses overlooking the site from higher ground to the north. Strong objections to the construction of a wastewater treatment plant in this location would be expected.

Distance from population centres: The site is very close to Carrigaline, with all wastewater from Carrigaline currently being conveyed to this point, and provision for conveyance of the Crosshaven wastewater to this point currently being constructed. The site is also close to Coolmore/ Shanbally.

Access: There is good road access to this site.

Suitability for hub centre: This site is not suitable because it is too small and too close to a residential area.

Environmental impact: The site is immediately adjacent to a residential area and the proposed NHA (pNHA 1990) of the Owenboy Estuary. The feasibility of discharging treated effluent to the Owenboy River (pNHA) would depend on the tide levels in the river and may require provision of a greater level of wastewater treatment including disinfection. Adherence to very strict boundary conditions with regard to odour and noise levels would be required.

The County Development Plan recommends the extension of an amenity walking route to Carrigaline Castle, which would be along the boundary of this site. Strong objections to the construction of a wastewater treatment plant on this site would be expected.

Comments: The higher degree of treatment necessary at this site to facilitate discharge to the Owenboy River, would also increase the treatment costs at this site. It may therefore prove preferable to pump the treated effluent to the existing IDA sewer and outfall, using the existing pumping system and rising mains.

Due to space limitations on site only a very compact wastewater treatment plant serving Carrigaline and Crosshaven could be constructed on site with a future loading from approximately 44,000 p.e. Such a plant

would have to be housed in a sensitively designed building with limited space available for vegetative screening. There would not be sufficient space available to incorporate sludge treatment facilities or nutrient removal using conventional technologies. Similarly, there would be no space to accommodate any future expansions. The site is given further consideration only on the basis of such a plant or for a pumping station.

The limited site area available and the proximity of nearby residences, three of which overlook the site from higher ground on the north, are the main disadvantages of this site. Extensive screening would be required. Strong objections to the construction of a wastewater treatment plant would be expected.

(8) Coolmore

Location: South of Coolmore Crossroads, and north of Coolmore House.

Present use: This site is used for agriculture. There is a nearby quarry owned by John A. Woods Ltd., to the east of the site, and while not currently in use, it may be returned to use at some time in the future.

Zoning: This area is zoned for agricultural use.

Availability: This site is in private ownership.

Elevation: Most of this area is below 15 m OD, with some parts climbing to 30 m OD.

Outfall proximity: At present raw wastewater from Carrigaline Sewerage Scheme is pumped to the IDA sewer running to the north of Coolmore. Treated effluent from the Coolmore site would require pumping to reach this sewer. Alternatively there is potential to discharge treated effluent to the Owenboy River downstream of the licensed oyster beds. However, this would require that the discharge of treated waste water be controlled by a tidal clock and a greater level of treatment may be required due to the close proximity of the oyster beds. The Owenboy is a proposed natural heritage area (pNHA 1990) and therefore any proposal to discharge treated urban waste water would likely receive strong objections from third parties. This increased level of treatment would result in greater treatment costs. On preliminary assessment it would appear that the best option for discharge of treated effluent from this site would be to pump to the existing IDA sewer (1 km away) and outfall.

Nearest dwellings: South of the site there are two houses as well as Coolmore House, with a crèche, a horse riding school, guest house, and farm. The site is well screened from existing dwellings by mature trees and woods.

Distance from population centres: The site is close to Coolmore, Carrigaline (2 km), Shanbally (2 km) and approximately 3 km from Ringaskiddy. It is approx. 8 km from both Cobh (via a marine crossing) and Passage West.

Access: Access to the site will be off the existing roadway to Coolmore House. However, a major improvement of this roadway will be required to accommodate the level of traffic associated with its construction and operation. The existing mature trees on the access roadway would be retained.

Suitability for hub centre: The site itself is suitable for the construction of a hub centre for the treatment of sludge because there is plenty of space available, and improved access to the site could be provided

without difficulty. The proximity of this site to the Ringaskiddy industrial area makes it suitable for acceptance of industrial sludges for treatment.

Environmental impact: This site is adjacent to an area classified as a scenic landscape, and close to the Owenboy River pNHA. It is relatively well sheltered from view by mature trees and woods, and will not require significant additional screening to reduce the visual impact. Provided that adequate mitigation measures are employed with regard to odour and noise, there should not be any significant impact on nearby residences. There will, however, be an increase in traffic movements.

Comments: The site is located in the midst of agricultural land currently set out in paddocks and being actively farmed. It is well sheltered and screened from view. There is a disused quarry to the east of the site, but this may be returned to service at some time in the future. Due to the distance from the site to the existing IDA sewer, and the difference in elevation, it would be necessary to pump the treated effluent from the treatment plant to the IDA sewer. Since this site satisfies many of the site selection criteria it is given further consideration for accommodation of a full scale wastewater treatment plant serving the entire catchment area, as well as a hub centre for sludge treatment.

(9) Rushbrook Old Gasworks

Location: This site is located in Rushbrook, west from the centre of Cobh, and partially in the old gas works and partially in the Cork Dockyard.

Present use: The site had been disused and left as waste land with heavy vegetation (mature trees and bushes), and the ruins of buildings.

Zoning: The Old Gasworks section is zoned for residential development, while part of the Cork Dockyard is zoned for industrial use.

Availability: The site area is approx. 1.3 hectares, which is insufficient for a wastewater treatment plant serving the entire catchment, but may be capable of accommodating a low-footprint plant serving Cobh, Passage West and Monkstown. Planning permission is actively being sought for residential units on the part of the site zoned for housing in the Cobh Development Plan. On the Cork Dockyards portion of the site there are also active proposals for the construction of warehouses.

Elevation: The site elevation ranges from 3 – 14 m OD.

Outfall proximity: This site is very close to deep water and to the existing principal outfall serving Cobh.

Nearest dwellings: There are a number of dwellings immediately adjacent to the site, and strong objections to construction of a wastewater treatment plant would be expected.

Distance from population centres: It is located at the edge of Cobh and is very close to Monkstown and Passage West (a river crossing would be required).

Access: Access to the site is via a narrow bridge over the railway line. This access would need to be upgraded.

Suitability for hub centre: Not applicable.

Environmental impact: Mitigation measures would be required to minimise the impact on adjacent houses, with screening and landscaping required to isolate it. However, there is insufficient space available for provision of adequate screening. Adherence to very strict boundary conditions would be required with regard to odour and noise. Strong objections to the construction of a wastewater treatment plant on this site would be expected from nearby residents.

Comments: This site is too small to accommodate a treatment plant for the complete scheme, and could have been used for a local treatment plant serving Cobh, Passage West and Monkstown. While it had been recommended in the Cobh Sewerage Scheme Review Report as the most suitable site for a wastewater treatment plant serving Cobh, subsequent zoning and developments have rendered it unsuitable for either a large scale or local wastewater treatment plant. Strong objections to such a development could be expected. It may however be a suitable site for a pumping station, and is given further consideration only on this basis.

(10) White Point

Location: This is the site of a recently demolished factory building at White Point, to the west of Cobh town centre.

Present use: While the site had been disused, dwelling houses are now being built on the site.

Zoning: Part of this site is zoned for industrial use, and part is zoned as open space.

Availability: The site area is approx. 1.6 ha. However, the site is not now available for construction of a wastewater treatment plant.

Elevation: The site elevation is 14 – 16 m OD.

Outfall proximity: There is an existing outfall from Cobh Sewerage Scheme at this location.

Nearest dwellings: The site is surrounded by houses.

Distance from population centres: The site is very close to Cobh, and also to Monkstown and Passage West (a river crossing would be required)

Access: There is good access to the site via the existing roads.

Suitability for hub centre: Not applicable.

Environmental impact: The site is surrounded by houses, and while exposed to view from eastern upper part of Cobh, it is generally well screened. Due to the limited area of the site it would be difficult to provide adequate screening and landscaping necessary to isolate the site from adjacent houses. Adherence to strict noise and odour level conditions would be required in such a location.

Comments: The site is very close to the existing outfall and to Cobh town centre, and had been recommended in the Cobh Sewerage Scheme Report as the second best location for a wastewater treatment plant serving Cobh. However, the site is not now available, with the construction of dwelling houses having commenced on site. It may be a suitable location for the construction of a pump station, and

is given further consideration only on this basis. Strong objections would be expected due to the proximity of nearby dwellings.

(11) Marino

Location: This site is located directly opposite IFI site at Marino Point, to the east of the main road to Cobh.

Present use: The site area is made up of a disused storage area, some grazing fields and cornfields.

Zoning: The site area is currently zoned for agricultural and forestry use.

Availability: There is adequate land area available

Elevation: Most of the site area is between 20 and 30 m OD

Outfall proximity: The site is very close to a potential discharge point at Marino Point.

Nearest dwellings: The nearest habitable dwellings are 100 m south of the site, with the site being well screened from their view.

Distance from population centres: The site is close to Passage West and Monkstown (a river crossing from Passage West would be required), and also to Cobh (4.5 km), with the Cork Strategic Plan anticipating that future development in Cobh would be in a northerly direction, i.e. towards this site. It is much further (approximately 11 km) from the other population centres of Carrigaline and Ringaskiddy.

Access: There is good access to the site which is located close to the main road and railway to Cobh.

Suitability for hub centre: Not applicable, but there would be sufficient area available and the site would be suitable for the provision of sludge treatment facilities for the sludge produced on site.

Environmental impact: Since the site is visible from Passage West and Carrigrennan, the visual impact would be mainly on these areas. Although there is screening already on site with some trees and bushes along fences, additional screening and landscaping would be required to minimise visual impact. Any impact with regard to odour and noise would be mitigated by the adoption of standard mitigation measures on site. The absence of nearby residences means that the impact would be insignificant in comparison with the impact of the nearby IFI production plant.

Comments: There is adequate land area available at this site for current and predicted future needs.

Discharges of treated effluent into Cork Harbour at Marino would require provision of a greater degree of wastewater treatment including nutrient removal, since the inner Cork Harbour waters are designated as sensitive in the near future. This would increase the cost of wastewater treatment at this site location.

The site is clearly visible from Carrigrennan (site of wastewater treatment plant serving the Cork Main Drainage Scheme) and may give rise to difficulties due to the proximity of two large WWTPs so close to each other. This site had been considered in the Cork Main Drainage Scheme Supplementary Report for construction of a wastewater treatment plant serving Cork, Cobh and the harbour area. However, the site selected at Carrigrennan was more suitable for the Cork Main Drainage Scheme.

This site satisfies many of the site selection criteria, and is evaluated in greater detail in terms of construction of a wastewater treatment plant serving the population centres of the lower harbour area.

(12) Ballydulea

Location: This site is located in the townland of Ballydulea, east of Ballywilliam Bridge on Great Island.

Present use: The site's present use is agricultural as grazing land.

Zoning: The area is currently zoned for agricultural and forestry use.

Availability: It is estimated that 15 ha are available at this location.

Elevation: The site elevation ranges from 4 to 35 m OD.

Outfall proximity: This site is approximately 1100 m from the nearest potential outfall point, in the deep water channel south of Cuskinny at the eastern side of Cobh.

Nearest dwellings: There is an Infectious Diseases Hospital approx. 200 m to the east of the site, with no habitable dwellings in the immediate vicinity.

Distance from population centres: The site is reasonably close to Cobh, although high lift pumping of the raw wastewater from Cobh would be required. It is considered as remote (approximately 13 km from Carrigaline) from the other population centres.

Access: There is good access to the site from the existing road network.

Suitability for hub centre: Not applicable.

Environmental impact: The site is adjacent to the Cuskinny Marsh, which is a nature reserve. Both the construction and operating phases of a wastewater treatment plant would impact on this. It is also located in a scenic area and is exposed to view from a golf course and some residences. Extensive mitigation measures would be required to reduce the visual and environmental impact of a wastewater treatment plant in this location.

Comments: The site is too far from population centres (other than Cobh) and from potential outfall locations, and too close to a nature reserve to be considered as a suitable site for a wastewater treatment plant serving the Lower Cork Harbour area or for Cobh. This site had been considered in the Supplementary Report to the Cork Main Drainage Scheme, but had been discounted for similar reasons.

(13) Cuskinny

Location: This site is located to the east of Cobh at Cuskinny, close to Cuskinny Marsh.

Present use: The site is currently being used for agriculture as grassland.

Zoning: The site area is zoned for agricultural or forestry use. The Cobh Development Plan requires that "the hillsides above Cuskinny Bay and Carrigaloe [...] need to be protected, and have been zone so as to protect their existing agricultural or woodland use". Alternative use would therefore not be acceptable.

Availability: Approx. 2 ha is available. This area would be suitable only for a wastewater treatment plant serving Cobh.

Elevation: The site is located on the side of a hill with a steep fall across the site.

Outfall proximity: An outfall could be potentially located at the deep water channel south of Cuskinny.

Nearest dwellings: There are a number of houses less than 100 m from the site.

Distance from population centres: The site is relatively close to Cobh, although it would be necessary to use high lift pumping to convey the raw wastewater to the site. It is far from the other population centres.

Access: There is good access to the site via existing roads.

Suitability for hub centre: Not applicable.

Environmental impact: The site is adjacent to the Cuskinny Marsh, which is a nature reserve and proposed Natural Heritage Area (pHNA 1987), and both the construction and operating phases of a wastewater treatment plant would impact on this. It is also located in a scenic area, and is exposed to view from dwelling houses located on the nearby hill. Extensive screening would be required. The site is also quite close to Cuskinny Bay, which is the main bathing area for Cobh. This site location could be classified as sensitive.

Comments: Generally the site appears unsuitable for a wastewater treatment plant due mainly to the proximity of the nature reserve at Cuskinny Marsh and the residential area. Also the visually exposed nature of the site from overlooking residential areas and from nearby Cuskinny Marsh would also be seen as disadvantages. The site is remote from the population centres other than Cobh. The site is also quite steep making vehicular access difficult. It is not considered further in this evaluation.

This site had been identified and evaluated in the Cobh Sewerage Scheme Report, but was not recommended for construction of a treatment plant serving Cobh (mainly because of the higher capital and running costs, associated with the high lift pumping to the plant).

(14) Raffeen

Location: This site is located on high grounds between Raffeen village and Raffeen House, and is south-west of the existing landfill site.

Present use: It is currently in agricultural use as grassland. There is a an overhead high tension power cable crossing the site, with a pylon located in the middle of the site.

Zoning: This area is zoned for agricultural use.

Availability: Sufficient land area is available but only at a high elevation.

Elevation: The site is very steep and elevated, with its elevation between 30 and 60 m OD. This elevation would result in high pumping costs.

Outfall proximity: This site is far from the deep water and any acceptable potential outfall location. It would be necessary to pump the treated effluent to the IDA sewer south of Shanbally for discharge via the existing outfall from Ringaskiddy.

Nearest dwellings: The nearest habitable dwellings are more than 200 m away, and the site is well screened from their view.

Distance from population centres: It is relatively close to Monkstown (3 km), Passage West (6 km), Carrigaline (5 km) and Ringaskiddy (4 km).

Access: There is no access to the site at present, and construction of an access road from the existing public roadway would be difficult due to steep gradient.

Suitability for hub centre: This site would not be suitable because the gradient across the site is too steep and it is too exposed to view. Potential access routes to the site would also be very steep with associated construction and operational difficulties.

Environmental Impact: The site is located on agricultural land, exposed to view from Raffeen Creek Golf Course and nearby houses. Its elevation would make it difficult to screen. Provided that normal mitigation measures are employed on site, there should be no significant impact from odour or noise. Otherwise, its environmental impact would be less than that due to the operational landfill site located immediately to the north-east of the site.

Comments: Generally the site does not appear to be suitable for construction of either a wastewater treatment plant or a pumping station, due to its distance from a potential outfall, its elevation and also due to its inaccessibility. It does not receive any further consideration in this preliminary evaluation.

(15) Maulbaun

Location: This site is located on high grounds south of Passage West, in the townland of Maulbaun.

Present use: The site is currently in agricultural use as grassland.

Zoning: The adjacent area is zoned partly for residential use, partly for agricultural use, and with some area designated as open space. the Cork County Development Plan also requires tree planting in this area.

Availability: 18.5 ha, but this is likely to decrease due to residential development on three sides of the site.

Elevation: The site is very elevated (70 to 80 m OD), since there is no available land at a lower elevation.

Outfall proximity: The site is relatively close to deep water off Passage West, downstream of Marino Point. However, since the receiving waters of the inner Cork Harbour area are likely to be designated as sensitive, an increased level of wastewater treatment in the form of nutrient removal will be required for any wastewater discharge to it, resulting in higher treatment costs.

Nearest dwellings: It is very close to new houses and housing estates.

Distance from population centres: It is between Passage West and Monkstown area, with a river crossing required to convey wastewater from the Cobh Sewerage Scheme to the site. Carrigaline is approximately 9 km from this site.

Access: The site is adjacent to the existing public road.

Suitability for hub centre: Not applicable.

Environmental Impact: The site is located close to a housing area, and is very exposed. Adherence to very stringent noise and odour constraints would be required. Extensive screening and more expensive construction methods would be required to reduce the visual impact of a wastewater treatment plant in this location. Strong objections would be expected.

Comments: Site is very elevated and would require considerable high lift pumping of the raw wastewater to reach the site. A greater degree of treatment would be required at this site to facilitate discharge of treated effluent into the inner harbour waters. Both of these issues would result in higher operating costs for the scheme. The site is exposed to view and very close to residential development. Generally the site does not appear to be suitable for construction of either a local wastewater treatment plant or one serving the entire lower harbour area. It is therefore not considered further in this evaluation.

This site had been identified and evaluated as a potential location for a wastewater treatment plant serving the Cork Main Drainage Scheme, but was eliminated on the basis of its site elevation and associated pumping requirements.

(16) Ardmore

Location: This site is located in the marsh and wetlands area to the north-west of Passage West, in the townland of Ardmore.

Present use: It is not currently being used, and is a marsh with thick vegetation, bushes and trees.

Zoning: The site area is zoned for agricultural use, with the adjacent site having an option for low density housing with tree planting.

Availability: Approx. 1 ha is available at this location, making it suitable only for a wastewater treatment plant serving the Passage West and Monkstown areas. There is insufficient area available to accommodate a larger treatment plant serving the entire catchment area of the lower harbour.

Elevation: The site elevation is less than 10 m OD.

Outfall proximity: The site is relatively close to deep water at Marino Point. However, since the receiving waters of the inner Cork Harbour area are designated as sensitive, a greater degree of wastewater treatment including nutrient removal would be required for any wastewater discharging to it, resulting in higher treatment costs.

Nearest dwellings: The nearest dwellings are on the other side of the road, approx. 200 m from the site.

Distance from population centres: The site is close to Passage West and Monkstown area but a considerable distance from Carrigaline, Ringaskiddy and Cobh.

Access: The site is adjacent to the existing main road from Cork to Passage West.

Suitability for hub centre: Not applicable.

Environmental Impact: The site is located close to a residential housing area and an amenity walkway. Construction would require removal of a significant amount of green, wildlife habitat area. On this basis strong objections would be expected.

Comments: Very difficult ground conditions are anticipated, with part of the area requiring reclamation. Due to the low elevation of the site, it may be necessary to provide for pumping of the treated effluent to the outfall and against high tide. The site's proximity to new housing estates, the amenity walkway, and the wildlife habitat may generate objections. Provided that adequate screening, landscaping, odour control and noise attenuation measures are adopted, these may be overcome. However, since the receiving waters of the inner Cork Harbour area are designated as sensitive, additional treatment in the form of nutrient removal will be required for any discharge to it, resulting in higher wastewater treatment costs.

This site may be acceptable as a site for a treatment plant serving only the Passage West and Monkstown areas, and is considered further only on this basis.

An alternative site at the opposite side of the road and at a higher elevation had been identified and evaluated as part of the 1992 Preliminary Report for Cork Main Drainage Scheme. Its proximity to residential development and the site elevation had eliminated it from further consideration.

(17) Spike Island

Location: Spike Island, east of Ringaskiddy

Present use: The principle use of Spike Island is as a prison.

Zoning: This site has not been zoned in the current Cork County Development Plan.

Availability: A site is not available on Spike Island.

Elevation: The maximum elevation of the site is approximately 30 m OD

Outfall proximity: Spike Island is close to potential deep water outfall locations.

Nearest dwellings: Because of the size of the island, all parts of the island including the prison would be close to the plant.

Distance from population centres: Relatively close to Ringaskiddy and Cobh (harbour crossing required), while further from Carrigaline (8 km), Passage West (11.5 km) and Monkstown. (8.5 km)

Access: There is no vehicular access to Spike Island from the mainland at present, but the Port of Cork Company is considering construction of a bridge from Ringaskiddy to the island as part of a Strategic Development Plan.

Suitability for hub centre: Due to lack of road access, and the uncertainty in the time scale of the future construction of road access, the site is not suitable.

Environmental Impact: The site is very exposed to view from almost all areas of the lower Cork Harbour.

Comments: Due to the proximity of the prison on the island and its associated security implications, the site access difficulties and the high degree of visual exposure of the site, it is considered unsuitable for construction of a wastewater treatment plant either to serve Ringaskiddy or the entire catchment.

(18) Carrigaline East

Location: This site is located in the townland of Shanbally to the north-east of Carrigaline, east of the ESB and Bord Gais stations, and north of the existing IDA sewer.

Present use: The current use of the site is agricultural, mainly as grazing fields.

Zoning: This area is reserved for future industrial development but has not yet been zoned. It is considered suitable for industries which are not dependent on port or water supply facilities, and may be used for a project outside the chemical/pharmaceutical sector.

Availability: There is a usable area of approximately 9 hectares available between the overhead high tension power lines which run from west to east.

Elevation: The site elevation ranges from 25 to 38 m OD.

Outfall proximity: The site is very close to, and at a higher elevation than the existing IDA sewer leading to the outfall at Ringaskiddy. Due to the site elevation it should be possible for the treated effluent to gravitate to this sewer for discharge.

Nearest dwellings: There are no habitable dwellings in the vicinity of the site, with the nearest existing dwelling being more than 275 m from the site.

Distance from population centres: This site is close to Carrigaline (2 km), Coolmore, Shanbally and Ringaskiddy and not too far from Cobh (8.5 km), Passage West (7.5 km) and Monkstown (5.5km). The existing rising main conveying wastewater from Carrigaline terminates within 300 m of the site.

Access: There is no direct access at the present to this site, but an existing access road to the adjacent Bord Gais station could be upgraded and extended by approximately 100m. In addition it would be necessary to upgrade 500 m of the public road from the N28.

Suitability for hub centre: The site location is suitable with adequate space available. The increased level of traffic associated with a hub centre for sludge treatment could be accommodated by local road improvements. Alternatively, if all of the municipal wastewater produced in the Lower Harbour area is treated at this site, the only sludge to be transported to the site for treatment would be from the septic tanks in the area.

Environmental Impact: This site is located within 250 m of a major ESB electrical sub station and a Bord Gais substation on the western side, and is 150 m from a playing field to the east. It is also approx. 100 m from a proposed relief road to Ringaskiddy which would run to the north of the site. The surrounding area is

largely agricultural or zoned for industrial use. It is therefore likely that there are no significant environmental impacts associated with this development provided that standard mitigation measures are adopted. Since the site is located close to the top of the hill, with a scenic landscape to the south, vegetative screening should be provided.

Comments: This site location is relatively central in the lower Cork Harbour area and would not require excessively long raw wastewater mains to the site. The isolated nature of the site, and the surrounding land uses should reduce the number of objections to the development. The site is adjacent to and at a higher elevation to the existing IDA sewer to the outfall off Ringaskiddy, enabling gravity discharge of the treated effluent. This site location satisfies many of the selection criteria and is considered suitable for both a wastewater treatment plant serving the lower harbour area as well as a hub centre for the treatment of sludge produced in the region (19).

(19) Carrigrennan

Location: This site is the location of the wastewater treatment plant serving the Cork Main Drainage Scheme, and is at the south-eastern end of Little Island at Carrigrennan.

Present use: The Cork wastewater treatment plant is currently under construction on this site.

Zoning: The site is reserved for a municipal wastewater treatment plant

Availability: The site area is 32 ha. The Cork wastewater treatment plant is designed based on a population equivalent of approx. 450,000 PE, with an additional 20 % spare capacity provided. Treatment of the municipal wastewater generated in the specified lower harbour towns would represent an increase of over 15% in plant throughput, and would only leave less than 5 % spare capacity for increase in loads. Treatment of only the Cobh, Passage West and Monkstown wastewater would represent an increase of 7.5 % in plant throughput, with adequate spare capacity remaining.

Elevation: The site elevation ranges from 2 to 22 m OD.

Outfall proximity: An outfall is being provided from the site to the deep water at Marino Point.

Nearest dwellings: The site is more than 200 m from the nearest habitable dwellings.

Distance from population centres: While this is relatively close to Passage (1 km), Monkstown (4.5 km) and Cobh (4.5 km), it is far from Carrigaline(10 km) and Ringaskiddy (11 km) in the Lower Harbour area.

Access: A good access roadway is currently being constructed for the proposed Cork Wastewater Treatment Plant.

Suitability for hub centre: While the site satisfies the selection criteria for a hub centre for the treatment of sludge, it is not considered because the current planning permission does not include for importation of sludge to site for treatment. Also the current draft of the County Sludge Management Plan (March 2000) recommends Ringaskiddy as the sludge treatment centre for the Lower Harbour area.

Environmental impact: The Environmental Impact Statement prepared for the Cork Main Drainage wastewater treatment plant on this site indicated no major environmental impact, with some possible visual

impact and a minor impact on nearby scattered houses. Vegetative screening and sensitive landscaping are being incorporated into the plant design.

Comments: The receiving water in the inner Cork Harbour area is likely to be designated as a sensitive area in the near future. This will mean that all wastewater discharging to it will have to undergo nutrient removal, resulting in greater treatment costs compared with the treatment costs for wastewater discharging to receiving waters in the lower harbour.

While there will be spare treatment capacity in the Cork wastewater treatment plant, it is not sufficient to facilitate the treatment of all of the wastewater generated in the lower harbour area. It would however be sufficient for the treatment of wastewater from Cobh, Passage West and Monkstown (in addition to Cork City and environs), and is evaluated further on this basis only.

On the basis of the difficulties experienced in obtaining planning permission for the Cork wastewater treatment plant at this site and the opposition to the project, strong objections to the provision of wastewater treatment for the population centres of the lower harbour at this site can be expected.

4.2.2.3 Summary of Preliminary Site Evaluation

The preliminary evaluation identified some of the potential sites as being unsuitable for the location of a wastewater treatment plant serving part or all of the Cork Lower Harbour catchment, or for the location of a hub centre for the treatment of sludge, and not worthy of further detailed consideration. Those sites considered unsuitable and the principle disadvantages are listed below.

(4) Curraghbinny
- Distance from population centres and treated effluent outfall,
- Visibly exposed nature of the site,
- Proximity to Curraghbinny Woods and pNHA 1066,
- Requirement for improvements to local access roads.

(5) Barnahely
- Unavailability of the site which is owned by Novartis and reserved for future plant expansions.

(6) Whitegate
- Distance from population centres,
- High site elevation.

(9) Rushbrooke
- Housing development under construction on part of the site. (The remainder of the site may accommodate a local pump station.)

(10) White Point
- Housing development under construction on part of the site. (The remainder of the may accommodate a local pump station.)

(12) Ballydulea
- Distance from population centres and potential outfall point,
- Proximity to nature reserve,
- Exposed and visible nature of the site,

- Steep gradient across the site.

(13) Cuskinny
- Distance from population centres and potential outfall point,
- Proximity to nature reserve and residential area,
- Scenic nature of area in which the site is located, which is also visually exposed,
- The area is zoned to protect its existing agricultural use,
- Steep gradient across the site.

(14) Raffeen
- Distance from a potential outfall,
- High elevation of site with resultant high pumping costs,
- Steep gradient across the site
- Site inaccessibility.

(15) Maulbaun
- Proximity on three sides to residential areas,
- High site elevation,
- Steep gradient across the site
- Visually exposed nature of the site.

(17) Spike Island
- Lack of vehicular access,
- Site is exposed and visible from almost entire lower harbour area,
- Difficulties expected with construction.

The following 5 sites were identified as having good potential to accommodate wastewater treatment facilities for the entire catchment to be served and to act as a hub centre for the treatment of sludge from the Region. These are then subjected to a more detailed evaluation in terms of their incorporation into the overall scheme.

(2) Loughbeg

(3) Loughbeg West

(8) Coolmore

(11) Marino (wastewater treatment only and not sludge treatment)

(18) Carrigaline East

A further 4 sites were identified as having good potential to accommodate local wastewater treatment facilities or pump stations. These were included on this basis only in the detailed evaluation in terms of their incorporation into the overall scheme.

(1) Ringaskiddy –local treatment plant serving Ringaskiddy only.

(7) Carrigaline Pump Station - Local treatment plant or pump station serving Carrigaline and Crosshaven only

(16) Ardmore –Conditionally suitable only for a local treatment plant serving Passage West and Monkstown

(19) Carrigrennan WWTP - serving Cobh, Passage West and Monkstown

4.3 Identification of Scheme Options for Wastewater Collection, Treatment and Disposal

The preferred scheme for the lower Cork Harbour area will comprise of the optimum collection and conveyance system to convey the raw wastewater from each population centre to the optimum treatment plant location(s), wastewater treatment, and optimum conveyance of the treated effluent to the receiving waters. It is therefore necessary to investigate the options for provision of treatment in either one or in multiple treatment plants. Each potential treatment plant site has associated with it a number of alternative conveyance systems depending on which or how many population centres it is to serve. In arriving at the preferred scheme, all practical options available are first identified and then evaluated on a preliminary basis.

The raw wastewater from Crosshaven is pumped to Carrigaline and is included as part of the Carrigaline load for treatment. Passage West and Monkstown are treated as a single population centre due to their close proximity to each other. The raw wastewater from Shanbally and Coolmore will be incorporated into the flows from either Ringaskiddy or Carrigaline, depending on the location of the treatment plant. They are not specifically mentioned in the following evaluations due to the scale of their flows.

4.3.1 Sewerage Scheme Options

The following basic concepts of sewerage scheme in the lower Cork Harbour area have been considered.

(1) **One treatment plant**, serving all of the specified population centres in the Lower Harbour area.

(2) **Two treatment plants**, with each plant serving one or more population centre.

(3) **Three treatment plants**, including the treatment of part of the overall load at the Cork wastewater treatment plant at Carrigrennan.

(4) **Four treatment plants**, with one serving each major population centre.

4.3.1.1 One Treatment Plant

Five possible sites have been identified for the location of a single wastewater treatment plant serving the lower Cork Harbour area. These are located in three different areas:

A – Carrigaline, with potential sites at Carrigaline East (Site Nr. 18) and Coolmore (Site Nr. 8)

B – Ringaskiddy with potential sites at Loughbeg (Site Nr. 2) and Loughbeg West (Site Nr. 3)

C – Cobh with a potential site at Marino (Site Nr. 11).

A preliminary evaluation of these options has been undertaken, and is summarised in the following table. The provision of a marine crossing is a requirement for all options.

Table Nr. 4.3.1.1Options for a Single Wastewater Treatment Plant

Area	Site	Advantages	Disadvantages	Result
A Carrigaline	Nr. 18 Carrigaline East	• use of existing rising main from Carrigaline • use of existing outfall • gravity flow to outfall • Remote from existing residential areas • Close to the industrial area	• Existing access to the site is poor • Far from Cobh	for further evaluation
	Nr. 8 Coolmore	• use of 70 % of existing rising main from Carrigaline • use of existing outfall • Reasonably remote from existing residential areas • Close to the industrial area	• pumping necessary to reach the outfall • Existing access to the site is poor • further from the population centres than site Nr. 18	Not further considered as Site Nr. 18 is more suitable
B Ringaskiddy	Nr. 2 Loughbeg	• use of existing rising main from Carrigaline • use of existing outfall • Reasonably remote from existing residential areas • good access road	• pumping necessary to reach the outfall	for further evaluation
	Nr. 3 Loughbeg West	• use of existing rising main from Carrigaline • use of existing outfall • Reasonably remote from existing residential areas • good access road	• pumping necessary to reach the outfall • further from outfall and population centres than site Nr. 2	Not further considered as site Nr. 2 is more suitable
C Cobh	Nr. 11 Marino	• Reasonably remote from existing residential areas • Good access to the site • Close to existing industry	• new outfall required in the inner harbour • Nutrient removal required • Proximity to Cork WWTP at Carrigrennan • far from Carrigaline & Crosshaven	Not considered further

The table shows that from this preliminary evaluation the two most advantageous options for the location of the single plant for the entire Lower Harbour area are Site Nr. 18 at Carrigaline East and Site Nr. 2 at Loughbeg. The proximity of the Marino site to the Cork wastewater treatment plant at Carrigrennan and the distance from Crosshaven, Carrigaline and Ringaskiddy to the site are seen as the principal disadvantages to constructing a plant of this scale at Marino.

Only the sites at Carrigaline East and Loughbeg were considered suitable and evaluated in detail with regard to provision of a single wastewater treatment plant to serve the entire catchment area.

4.3.1.2 Two Treatment Plants

Twelve potential scheme options were identified for evaluation on the basis of wastewater generated in the catchment being treated in two separate plants, with at least one plant located in the Carrigaline-Ringaskiddy area. Sludge treatment would be provided at the Carrigaline-Ringaskiddy plant.

In addition to the three preferred sites identified for "One Treatment Plant" options, sites at Ardmore near Passage West, the Cork wastewater treatment plant at Carrigrennan, and at Carrigaline pump station were considered on the basis of accommodating treatment plants serving local populations only.

A preliminary evaluation of these site locations has been carried out with the results summarised in Table 4.3.1.2. This evaluation reduced the number of "Two Treatment Plants" options from twelve to six, for further evaluation.

Construction of a wastewater treatment plant at the site of the pump station in Carrigaline was eliminated from further evaluation due to space limitations on site for a plant of this scale, and the potential environmental impact on surrounding residential area.

Construction of two wastewater treatment plants on the Ringaskiddy peninsula (Sites Nr. 18 and 2) was considered viable only if the wastewater from Cobh, Passage West, Monkstown, Carrigaline and Crosshaven be treated at the Carrigaline East site, and the Ringaskiddy plant treat only the local flows. Of the three options evaluated using these two sites, this option would have the shortest marine crossing, and would require pumping of the least quantity of treated effluent to the outfall.

Table 4.3.1.2 Options for Two Wastewater Treatment Plants Serving the Lower Harbour

Option	Site Nr.	Treatment Plant Catchments	Advantages	Disadvantages	Result
I	11	C	No marine crossings Use of existing outfall by Site Nr. 18	New outfall required for Site Nr. 11 Nutrient removal required for Site Nr. 11	For further evaluation
	18	CR,R, PM			
II	11	C,PM	Both plants are close to the population centres served Use of existing outfall by Site Nr. 18	1 Marine crossing required New outfall required for Site Nr. 11 Nutrient removal required for Site Nr. 11	For further evaluation
	18	CR,R			
III	11	C,PM	Use of existing outfall by Site Nr. 2	As per II but in addition, Pumping of treated effluent to outfall from Site Nr. 2 Site Nr. 2 is further from Carrigaline than Site Nr. 18	Ruled out (in favour of II)
	2	CR,R			
IV	11	C	No marine crossings Use of existing outfall by Site Nr. 2	As III above	Ruled out (as above)
	2	CR, PM,R			

Option	Site Nr.	Treatment Plant Catchments	Advantages	Disadvantages	Result
V	19	C	Use of Cork WWTP at Carrigrennan No new outfalls required Both plants are close to the population centres served Only one site to be acquired	1 Marine crossing required Higher treatment costs at Site Nr. 19 due to nutrient removal	For further evaluation
	18	CR,R,PM			
VI	19	C,PM	As V above	2 marine crossings required Higher treatment costs than V due to nutrient removal at Site Nr. 19	For further evaluation
	18	CR,R			
VII	16	PM	Shortest distance between population centres and wwtps	1 Marine crossing required Nutrient removal required for Site Nr.16 New outfall required for Site Nr. 16 Pumping treated effluent to outfall from Site Nr. 2	For further evaluation
	2	C,CR,R			
VIII	16	PM	Both plants are close to the population centres served	1 Marine crossing required New outfall required for Site Nr. 16 Nutrient removal required for Site Nr.16 route from Cobh to site Nr. 18 is via PM	Ruled out
	18	C,CR,R			
IX	18	C,CR,PM	Existing outfall to be used by both sites	Both plants close to each other 1 Marine crossing required	For further evaluation
	2	R			
X	18	CR,PM	Existing outfall to be used by both sites Both sites are close to the population centres served	Both plants close to each other Longer marine crossing required More treated effluent to be pumped to outfall	Ruled out
	2	R,C			
XI	18	CR	Existing outfall to be used by both sites	Both plants close to each other 2 Marine crossings required More treated effluent to be pumped to outfall	Ruled out
	2	R,C,PM			
XII	7	CR	Existing outfall to be used by both sites	Limited area at site Nr. 7 High cost of construction at site Nr. 7 due to location significant environmental impact at site Nr. 7 2 Marine crossings required	Ruled out
	2	R,C,PM			

Site Locations:

2. Loughbeg
7. Carrigaline Pump Station
11. Marino
16. Ardmore (Passage West)
18. Carrigaline East
19. Carrigrennan

Catchments:

CR – Carrigaline
R – Ringaskiddy
C – Cobh
PM – Passage West and Monkstown

4.3.1.3 Three Treatment Plants

A preliminary evaluation of suitable site locations has been carried out where options for three wastewater treatment plants are being considered. Five potential schemes were identified and evaluated. Table 4.3.1.3 summarises the results of this preliminary evaluation, which identified two schemes for further analysis.

Table 4.3.1.3 Options for Three Wastewater Treatment Plants Serving the Lower Harbour

Option	Site Nr.	Treatment plant catchments	Advantages	Disadvantages	Result
I	2	R	Plants close to population centres	One marine crossing required One new outfall required for Site Nr. 11 Nutrient removal required for Site Nr. 11 Sites Nrs. 2 & 18 close to each other	For further evaluation
	11	C,PM			
	18	CR			
II	2	R	No marine crossings	Passage/Monkstown is further from Site Nr. 18 than Site Nr. 11 Two plants close to each other One new outfall required	Ruled out
	11	C			
	18	CR,PM			
III	11	C	No marine crossings Plants close to population centres	Two new outfalls required (11 & 16) Nutrient removal required at Site Nrs 11 and 16	For further evaluation
	16	PM			
	18	CR,R			
IV	2	CR,R	No marine crossings	Two new outfalls required at Site Nrs. 11 & 16) Nutrient removal required at Site Nrs 11 and 16 Carrigaline further from Site Nr. 2 than Site Nr. 18 Increased pumping to outfall	Ruled out
	11	C			
	16	PM			
V	2	C,R	Plants close to population centres	Two plants close to each other One marine crossing required One new outfall required at Site Nr. 16 Nutrient removal required for Site Nr. 16 Increased pumping to outfall	Ruled out
	16	PM			
	18	CR			

Site Locations:	Catchments:
2. Loughbeg	CR – Carrigaline
11. Marino	R – Ringaskiddy
16. Ardmore (Passage West)	C – Cobh
18. Carrigaline East	PM – Passage West and Monkstown

4.3.1.4 Four Treatment Plants

A preliminary evaluation has been carried out of suitable site locations where options for four wastewater treatment plants are being considered, i.e. one plant serving each nearby population centre.

Passage/ Monkstown: The only suitable site location is at site Nr. 16 Ardmore

Plant for Cobh: The only suitable location is at site Nr. 11 Marino.

Plant for Carrigaline: There are three potential locations – Site Nr. 7 at Carrigaline Pumping Station, Site Nr. 8 at Coolmore and Site Nr. 18 at Carrigaline East. Following preliminary evaluations, Site Nr. 18 is identified as the most suitable from engineering and environmental perspectives.

Plant for Ringaskiddy: There are three potential locations – Site Nr. 1 at Ringaskiddy, Site Nr. 2 at Loughbeg and Site Nr. 3 at Loughbeg West. Of these sites, Site Nr. 2 is the most suitable from engineering and environmental perspectives.

This scheme option, with a local treatment plant provided at each of the four major population centres, was ruled out at this stage, due to the similarity between it and the "three treatment plants" options.

The "Three Treatment Plant" option with local treatment provided for Passage West and Monkstown (Site Nr. 16), Cobh (Site Nr. 11), and a combined plant for Carrigaline and Ringaskiddy (Site Nr. 18) is considered more suitable than the four treatment plants option.

4.3.1.5 Results of Preliminary Evaluation of Scheme Options

The foregoing preliminary evaluations reduced the number of potential collection, treatment and disposal schemes for further evaluation to ten.

Only two options utilising a single treatment plant to serve the entire catchment area were considered worthy of further evaluation. In both cases the treatment plant would be located to the south of the catchment, with one option locating the treatment plant at Loughbeg near Ringaskiddy and the second option favouring a site at Carrigaline East.

Six options for serving the entire catchment area using two treatment plants were considered worthy of further evaluation. Five of these options included a treatment plant location at Carrigaline East in various combinations with locations at Marino, Loughbeg, and Carrigrennan. The sixth option for further evaluation included plants at Ardmore (near Passage West) and Loughbeg.

Only two options utilising three treatment plants to serve the entire catchment area were considered worthy of further evaluation. Both of these options included treatment plant locations at Carrigaline East and Marino, with the third plant located at either Loughbeg or Ardmore.

The ten schemes identified above were subjected to a detailed financial evaluation, taking into account capital, operating and maintenance costs. This evaluation is set out in Table 4.3.2.

4.3.2 Schemes for Detailed Evaluation

The schemes considered for detailed evaluation are listed below in Table 4.3.2, and described in the following sections 4.3.2.1 to 4.3.2.10 inclusive. The individual collection systems and sewer networks serving each population centre are dealt with in previous sections of this Preliminary Report. This section deals only with those sections of the collection systems that are affected by the location of the wastewater treatment plant serving that town. The more detailed schematics referred to in the various sections are included in Appendix G1.

The scheme options, together with their relevant collection and conveyance systems for each town, are shown schematically in the following sections. Since the wastewater from Crosshaven is to be pumped to Carrigaline (currently under construction), it is not specifically mentioned in the scheme evaluations, and is included within the Carrigaline contribution. Similarly, because of the scale of their contribution, the flows from Coolmore and Shanbally are not specifically mentioned in all cases, but would generally be included with the Ringaskiddy flows.

Where marine crossings are required, a screening and grit removal system would be incorporated immediately upstream of the crossing. This is necessary to prevent gross solids from settling out in the submerged pipes or causing blockages, during periods of low flow or no flow. It is of particular importance since portions of the collection systems are combined systems, and would therefore contain grit. For security of service, two separate pipes, which would operate in a duty/standby mode, would be provided for each crossing.

Table 4.3.2 Schemes for Further Evaluation

Option Nr	No of treatment plants	Treatment Plant location (Site Nr.)	Catchment Served	Marine crossings	No of outfalls
1.	One	Loughbeg (2)	Entire project area	2	1 exist.
2.	One	Carrigaline East (18)	Entire project area	1	1 exist.
3.	Two	Carrigaline East (18) Marino (11)	CR,R,PM C	-	1 new +1 exist.
4.	Two	Carrigaline East (18) Marino (11)	CR,R C,PM	1	1 new +1 exist.
5.	Three	Carrigaline East (18) Marino (11) Loughbeg (2)	CR C,PM R	1	1 new +1 exist.
6.	Two	Carrigaline East (18) Loughbeg (2)	CR,PM,C R	1	1 exist.
7.	Two (incl. Cork WWTP at Carrigrennan)	Carrigaline East (18) Carrigrennan (19)	CR,PM,R C	1	2 exist.
8.	Two (incl. Cork WWTP at	Carrigaline East (18) Carrigrennan (19)	CR,R C,PM	2	2 exist.

Option Nr	No of treatment plants	Treatment Plant location (Site Nr.)	Catchment Served	Marine crossings	No of outfalls
	Carrigrennan)				
9.	Three	Ardmore (16) Carrigaline East (18) Marino (11)	PM CR,R C	-	2 new +1 exist.
10.	Two	Ardmore (16) Loughbeg (2)	PM C,CR,R	1	1 new +1 exist.

4.3.2.1 Option1

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in a single wastewater treatment plant. This plant would be located at Loughbeg near Ringaskiddy. The outline of this scheme is shown on Fig Nr. 4.3.2.1A and described below.

Wastewater from Passage West and Monkstown would be conveyed, by pumping and gravity flow, along the route of the main road (R610) to a location between the two at Glenbrook. Twin rising mains would be used to convey the wastewater across the harbour from Glenbrook to Carrigaloe, and on to a new pumping station to be constructed at White Point at the south western side of Cobh. This would require the construction of a new pump station to the south of Monkstown, as well as the upgrading of five existing pumping/comminutor stations in the Passage West and Monkstown areas. Refer to Fig. Nr. 4.3.2.1B.

Wastewater flows from Cobh town, including the Strategic Development area to the north of the town would be conveyed by a combination of pumped and gravity flows to the White Point pump station. This option would require the construction of eight new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected. Refer to Fig. Nr. 4.3.2.1C.

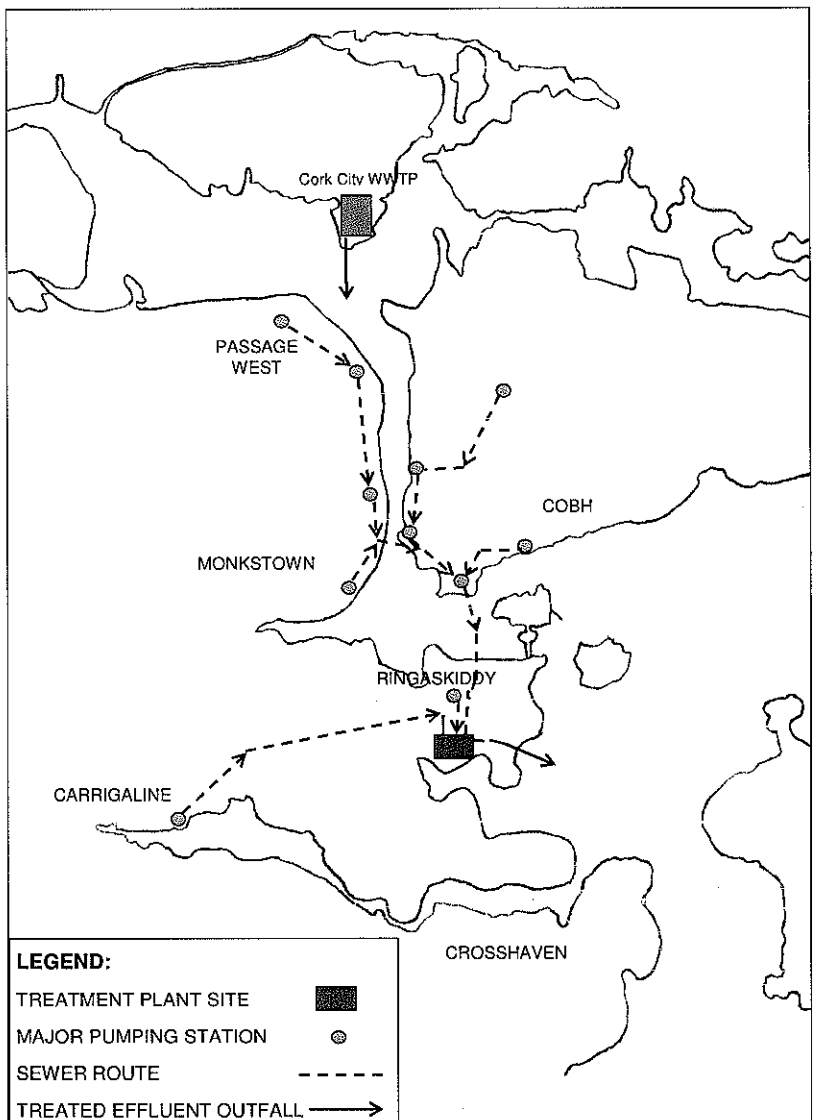
From White Point the wastewater would be pumped via twin rising mains across Cork Harbour to a new header chamber to be constructed on the hill south of Ringaskiddy. The optimum route for this marine crossing is to the west of Haulbowline Island, due to the ground conditions and space limitations on the island, as well as construction difficulties along the access road to the island. Wastewater from Ringaskiddy village would also be pumped to this header chamber, from where it would gravitate to the treatment plant to be located at Loughbeg. Refer to Fig. Nr. 4.3.2.1E.

Carrigaline would be served by upgrading its main pump station, with flows being pumped via the existing rising main to the point where it now connects with the IDA sewer. Here it would be connected to a new gravity sewer to be laid alongside the IDA sewer, to provide a gravity flow to the treatment plant site at Loughbeg. Flow from Shanbally and Coolmore would also be pumped to this new sewer. Refer to Fig. Nr. 4.3.2.1D.

Treated effluent from the Loughbeg treatment plant would be pumped into the existing IDA gravity sewer and nearby outfall. While this option would make use of the existing IDA outfall, it would be necessary to construct two major marine crossings of the main shipping channel, i.e. from Monkstown to Rushbrooke and the longer (and larger) crossing from White Point to Ringaskiddy.

CONCEPTUAL DESIGN

OPTION 1



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.1A

4.3.2.2 Option 2

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in a single wastewater treatment plant to be located to the east of Carrigaline in the townland of Shanbally. The outline of this scheme is shown on Fig Nr. 4.3.2.2A and described below.

Wastewater from Passage West and Monkstown would be pumped south along the route of the main road (R610) to Raffeen Creek. This would require the upgrading of four existing pumping/comminutor stations, as well as the provision of pumped and gravity mains along the main road R610. It would also require the construction of a new pump station at Raffeen Creek. Refer to Fig. Nr. 4.3.2.2B

All wastewater produced in Cobh would be conveyed by a combination of pumping and gravity flow to a new pump station to be located at Carrigaloe to the north west of Cobh town. (Refer to Fig. Nr. 4.3.2.2C) Twin mains would be used to convey the wastewater across the harbour from the Carrigaloe pump station to a new header chamber to be located near Glenbrook. Here it would be combined with flows from Passage West for onward flow to Raffeen Creek. This option would require the construction of seven new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected.

From Raffeen Creek the Passage West, Monkstown and Cobh flows would be pumped along the route of the R610 to Raffeen Bridge, and then South to the treatment plant site at Carrigaline East. Refer to Fig. Nr. 4.3.2.2D.

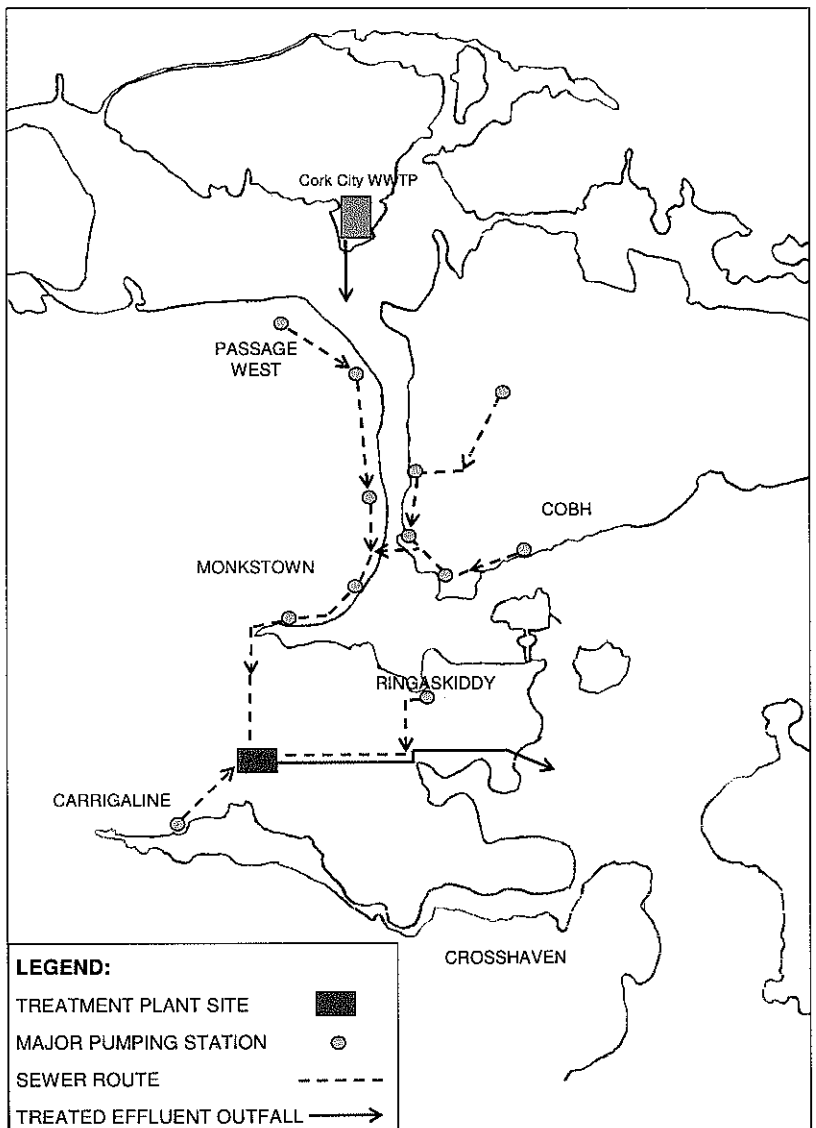
Carrigaline would be served by upgrading its main pump station, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. Here it would be diverted to the nearby treatment plant site.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the Carrigaline East treatment plant site. This rising main would be laid in part alongside the existing IDA sewer. Refer to Fig. Nr. 4.3.2.2E.

Treated effluent would gravitate to the existing IDA gravity sewer alongside the Carrigaline East site, for discharge via the existing outfall near Loughbeg. By routing the wastewater from Cobh across Cork Harbour to Monkstown for conveyance to the treatment plant site, only the shorter marine crossing of the shipping channel is necessary.

CONCEPTUAL DESIGN

OPTION 2



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.2A

4.3.2.3 Option 3

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in two separate wastewater treatment plants. One plant would be located to the east of Carrigaline in the townland of Shanbally, and would serve the population centres of Carrigaline, Ringaskiddy, Passage West and Monkstown. The second plant would be located at Marino to the north of Cobh, and would provide treatment for wastewater flows from Cobh only. This option is shown schematically on Fig Nr. 4.3.2.3A and described below.

All wastewater produced in Cobh would be conveyed by a combination of pumping and gravity flow to a new pump station to be located near Carrigaloe. From there it would be pumped to the treatment plant site at Marino along the route of the main Cobh road (R624). (Refer to Fig. Nr. 4.3.2.3C) Wastewater from the Strategic Development area to the north of Cobh would be pumped directly to the treatment plant. This option would require the construction of six new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected. Treated effluent from the Marino treatment plant would be discharged via a new outfall to be constructed in the deep water off Marino Point. Since the receiving water in the inner harbour is to be classified as sensitive, it would be necessary to incorporate nutrient removal at the treatment plant.

Wastewater from Passage West and Monkstown would be pumped south along the route of the main road (R610) to Raffeen Creek. (Refer to Fig. Nr. 4.3.2.3B.) This option would require the upgrading of five existing pumping/comminutor stations en route, in addition to construction of a new pump station at Raffeen Creek. It would also require provision of pumped and gravity mains along the main road.

From Raffeen Creek the Passage West and Monkstown flows would be pumped along the R610 route to Raffeen Bridge and then South to the treatment plant site at Carrigaline East. (Refer to Fig. Nr. 4.3.2.3D) while the pipeline route from Passage West and Monkstown to Carrigaline East is the same as for Option 2, the pipework and pumping systems would be smaller with less flow since there would be no flow contribution from Cobh.

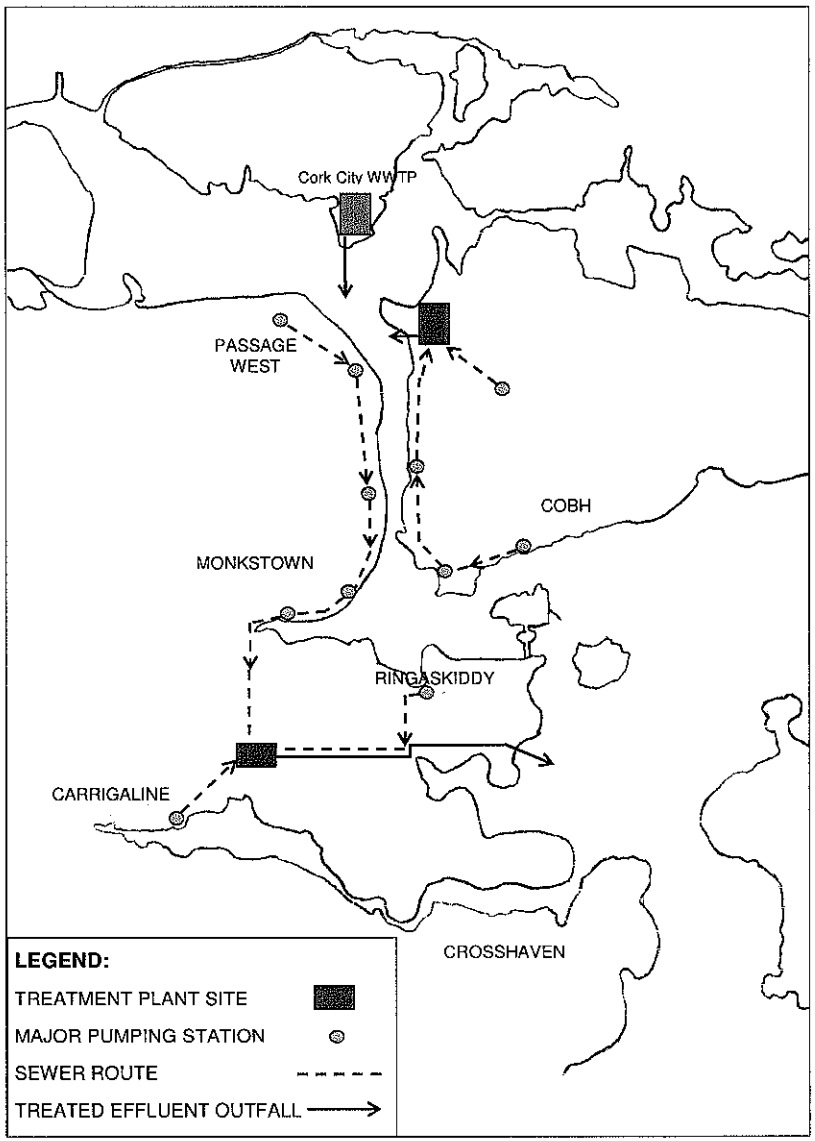
To serve Carrigaline its main pump station would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. Here it would be diverted to the nearby treatment plant site.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the treatment plant site. (Refer to Fig. Nr. 4.3.2.3E.) This rising main would be laid in part alongside the existing IDA sewer.

Treated effluent from the Carrigaline East plant would gravitate to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg. The gravity pipe from the treatment plant to the IDA sewer would be smaller for this option than for Option 2 due to the lower flow (no flow contribution from Cobh).

By treating the Cobh wastewater at Marino on Great Island, and the wastewater produced on the western side of Cork Harbour at Carrigaline East, no marine crossings would be required. It would however be necessary to construct a new outfall at Marino. It would also be necessary to provide a higher standard of wastewater treatment (including nutrient removal) at the Marino plant since it would discharge into the inner harbour.

CONCEPTUAL DESIGN
OPTION 3



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.3A

4.3.2.4 Option 4

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in two separate wastewater treatment plants, with one located to the east of Carrigaline in the townland of Shanbally, and the second located at Marino to the north of Cobh. This is similar to Option 3 except that the wastewater from Passage West and Monkstown would be treated at the Marino with the flows from Cobh, while the plant at Carrigaline East would serve the population centres of Carrigaline and Ringaskiddy. This option is shown schematically on Fig Nr. 4.3.2.4A and described below.

All wastewater produced in Cobh would be conveyed by a combination of pumping and gravity flow to a new pump station to be located near Carrigaloe. (Refer to Fig. Nr. 4.3.2.4C) from there it would be pumped to the treatment plant site at Marino along the route of the main Cork/Cobh road (R624). Wastewater from the Strategic Development area to the north of Cobh would be pumped directly to the treatment plant. This option would require the construction of six new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected. The pump station at Carrigaloe and the rising main to the treatment plant site would be larger for this option than for Option 3 due to the increased flow, i.e. contribution from Passage West and Monkstown.

Wastewater from Passage West would be pumped south along the main road to a point at Glenbrook, while flows from Monkstown would be pumped north to the same point. (Refer to Fig. Nr. 4.3.2.4B.) From there the wastewater would be conveyed across the harbour via twin mains to Carrigaloe. This would require the upgrading of five existing pumping/comminutor stations en route in addition to a new pump station in the Passage West/Monkstown area. It would also require provision of pumped and gravity mains along the main road R610.

Treated effluent would be discharged from the Marino plant via a new outfall to be constructed in the deep water off Marino Point. Since the receiving water in the inner harbour is to be classified as sensitive, it would be necessary to incorporate nutrient removal at the treatment plant.

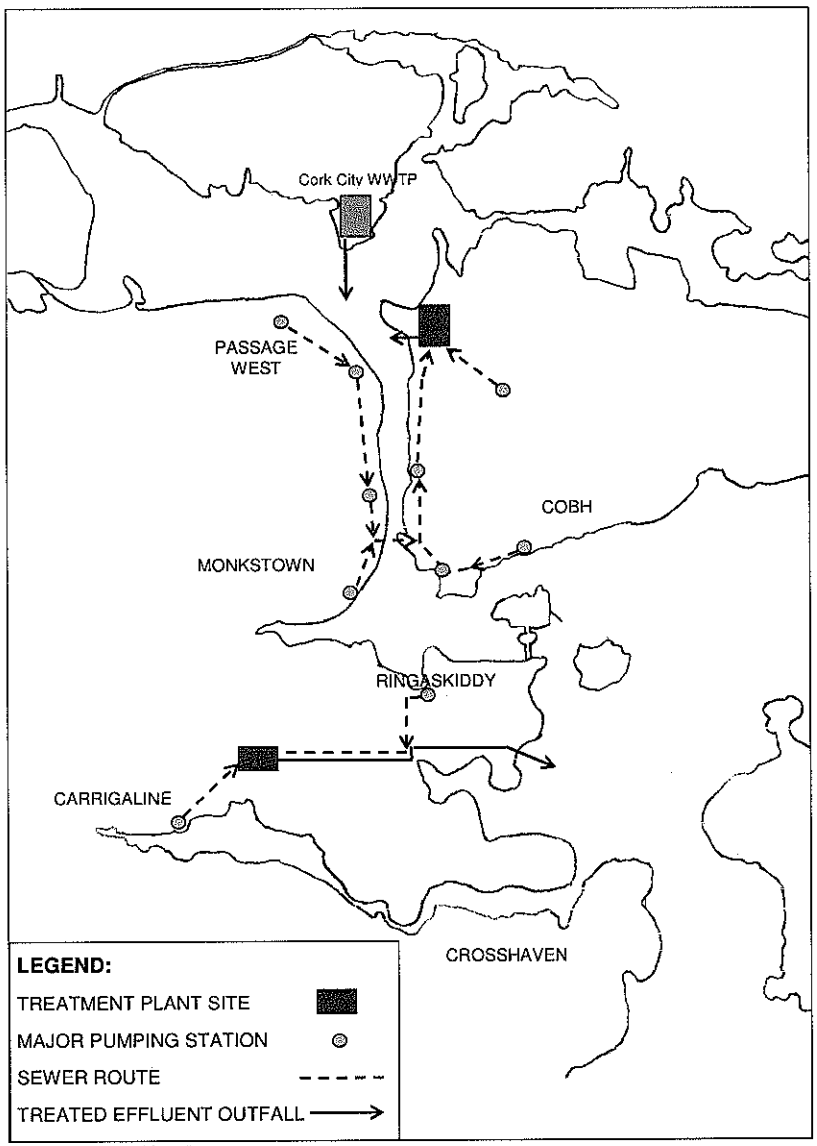
To serve Carrigaline its main pump station would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. (Refer to Fig. Nr. 4.3.2.4D) Here it would be diverted to the nearby treatment plant site.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the treatment plant site. (Refer to Fig. Nr. 4.3.2.4E.) This rising main would be laid in part alongside the existing IDA sewer.

Treated effluent would gravitate to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg. The gravity pipe from the treatment plant to the IDA sewer would be smaller for this option than for Options 2 and 3 due to the lower flow (no flow contribution from Cobh, Passage West and Monkstown). However, the pipework from Cobh to the Marino site would increase in size.

While only one marine crossing of the main shipping channel (Monkstown to Rushbrooke) would be required for this option, it would be necessary to construct a new outfall from the Marino site. It would also be necessary to provide a higher standard of wastewater treatment (including nutrient removal) at the Marino plant since it would discharge into the inner harbour.

CONCEPTUAL DESIGN
OPTION 4



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.4A

4.3.2.5 Option 5

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in three separate wastewater treatment plants. This option is similar to Option 4 except that the wastewater from Ringaskiddy would be treated at a separate treatment plant to be located at Loughbeg. The second plant would be located to the east of Carrigaline in the townland of Shanbally and would serve only Carrigaline, while the third would be located at Marino to the north of Cobh and would serve Cobh, Passage West and Monkstown. This option is shown schematically on Fig Nr. 4.3.2.5A and described below.

All wastewater produced in Cobh would be conveyed by a combination of pumping and gravity flow to a new pump station to the population centres of be located near Carrigaloe. (Refer to Fig. Nr. 4.3.2.5C) from there it would be pumped along the route of the main Cobh road (R624) to the treatment plant site at Marino. Wastewater from the Strategic Development area to the north of Cobh would be pumped directly to the treatment plant. This option would require the construction of six new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected. The pump station at Carrigaloe and the rising main to the treatment plant site would be larger for this option than for Option 3 due to the increased flow, i.e. contribution from Passage West and Monkstown.

Wastewater from Passage West would be pumped south along the main road to Glenbrook, while flows from Monkstown would be pumped north to the same point. (Refer to Fig. Nr. 4.3.2.5B.) From there the wastewater would be conveyed across the harbour via twin mains to the Carrigaloe pump station. This would require the upgrading of five existing pumping/comminutor stations en route in addition to a new main pump station in the Passage West/Monkstown area for the marine crossing. It would also require provision of pumped and gravity mains along the main road R610.

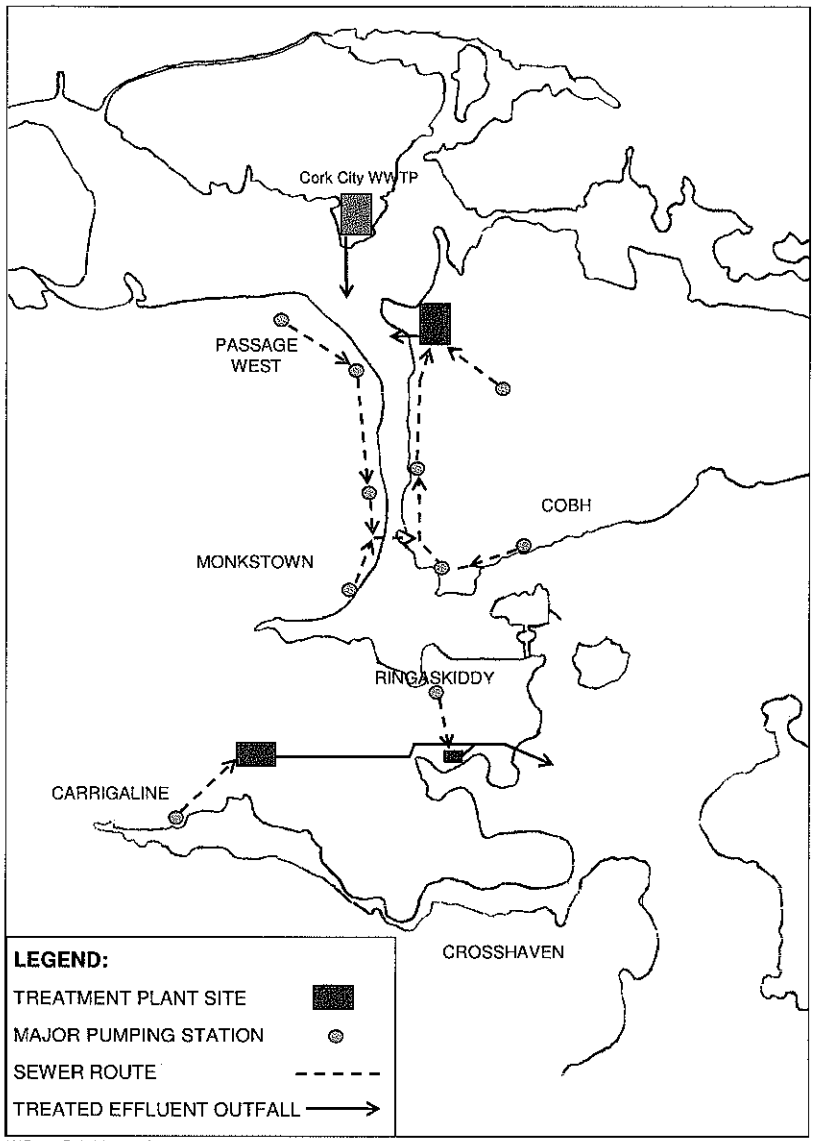
Treated effluent would be discharged from the plant at Marino via a new outfall to be constructed in the deep water off Marino Point. Since the receiving water in the inner harbour is to be classified as sensitive, it would be necessary to incorporate nutrient removal at the treatment plant. The collection and treatment scheme covered by this option for Cobh, Passage West and Monkstown are the same as for Option 4.

To serve Carrigaline its main pump station would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. (Refer to Fig. Nr. 4.3.2.5D) Here it would be diverted to the nearby treatment plant site.

Treated effluent would gravitate to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg. The gravity pipe from the treatment plant to the IDA sewer would be smaller than for Options 2,3 and 4 because only the Carrigaline flow would be treated at the Carrigaline East plant in this option.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the treatment plant site at Loughbeg. (Refer to Fig. Nr. 4.3.2.5E) Treated effluent from this site would be pumped to the existing IDA sewer and outfall. It would be necessary to provide a higher standard of wastewater treatment (including nutrient removal) at the Marino site than at the other sites. This would result in increased treatment costs. As for Option 4 this scheme would require one crossing of the main shipping channel (Monkstown to Rushbrooke) as well as the construction of a new outfall at Marino. It would also require the purchase of three treatment plant sites.

CONCEPTUAL DESIGN
OPTION 5



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.5A

4.3.2.6 Option 6

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in two wastewater treatment plants. It is similar to Option 2, with one plant located to the east of Carrigaline in the townland of Shanbally but with a second (and much smaller) plant located to the south of Ringaskiddy at Loughbeg. The Loughbeg treatment plant would serve only the Ringaskiddy area, while Cobh, Passage West, Monkstown and Carrigaline would be served by the Carrigaline East plant. This option is shown schematically on Fig Nr. 4.3.2.6A and described below.

Wastewater from Passage West and Monkstown would be pumped south along the main road (R610) to Raffeen Creek. (Refer to Fig. Nr. 4.3.2.6B.) This would require the upgrading of four existing pumping/comminutor stations, as well as provision of pumped and gravity mains along the main road R610. It would also require the provision of a new pump station at Raffeen Creek.

All wastewater produced in Cobh would be conveyed by a combination of pumping and gravity flow to a new pump station to be located at Carrigaloe. (Refer to Fig. Nr. 4.3.2.6C) Twin mains would be used to convey the wastewater across the harbour from Carrigaloe to a new header chamber to be located south of Glenbrook near Monkstown. Here it would be combined with flows from Passage West and Monkstown. This option would require the construction of seven new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected.

From Raffeen Creek the Passage West, Monkstown and Cobh flows would be pumped along the R610 to Raffeen Bridge and then South to the treatment plant site at Carrigaline East. (Refer to Fig. Nr. 4.3.2.6D)

The pump station in Carrigaline would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. Here it would be diverted to the nearby treatment plant site.

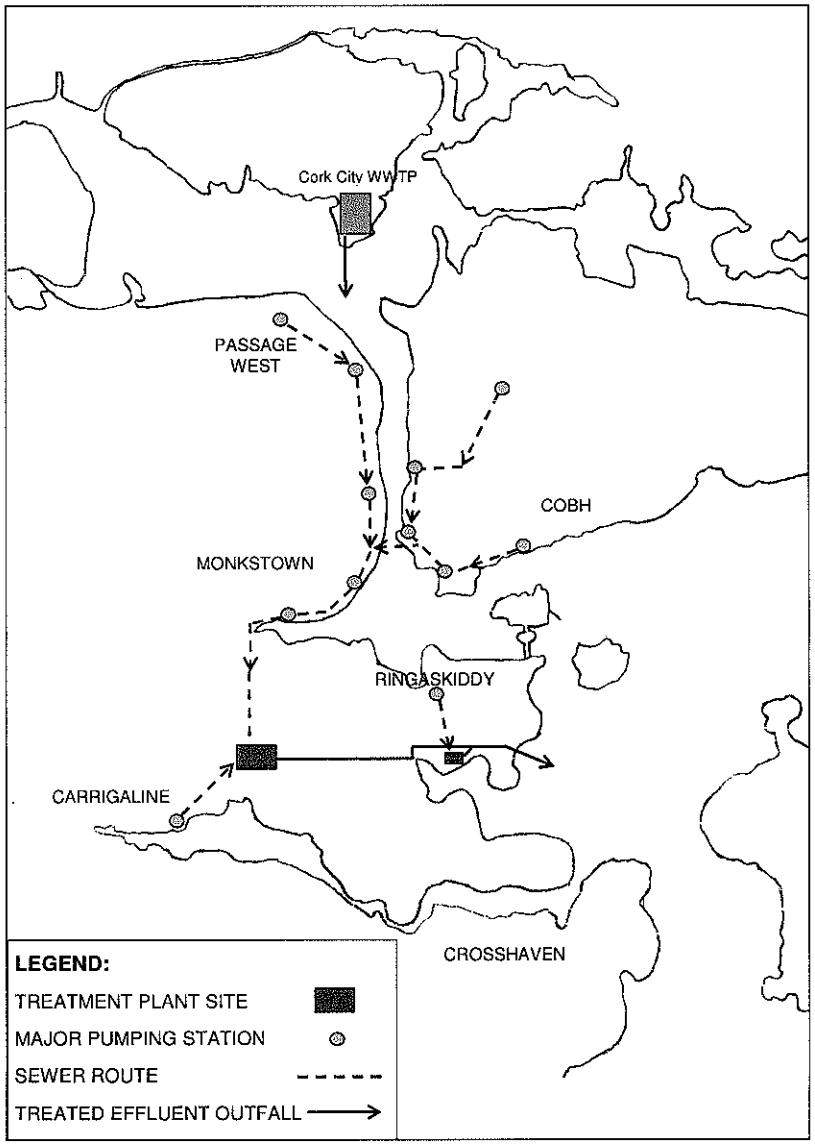
Treated effluent would gravitate to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the second treatment plant site at Loughbeg. (Refer to Fig. Nr. 4.3.2.6E) Treated effluent from this site would be pumped to the existing IDA sewer and outfall.

This option is identical to Option 2 other than the provision of separate treatment for Ringaskiddy at Loughbeg. While the rising main from Ringaskiddy to the treatment plant site would be shorter, additional pumping would be required, as well as purchase of a second site. The marine works required would be the same, with one marine crossing and no new outfall required, since both treatment plant would discharge through the existing IDA outfall.

CONCEPTUAL DESIGN

OPTION 6



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.6A

4.3.2.7 Option 7

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in two separate wastewater treatment plants. It is similar to Option 3, with one plant to be located to the east of Carrigaline in the townland of Shanbally, and serving the population centres of Carrigaline, Ringaskiddy, Passage West and Monkstown. However, in this option Cobh would be served by the Cork wastewater treatment plant at Carrigrennan on Little Island (currently under construction as part of the Cork Main Drainage Scheme). This option is shown schematically on Fig Nr. 4.3.2.7A and described below.

All wastewater produced in Cobh, including the Strategic Development area to the north of Cobh, would be conveyed by a combination of pumping and gravity flow to a new pump station to be located near Carrigaloe. (Refer to Fig. Nr. 4.3.2.7C.) From there it would be pumped along the route of the main Cork/Cobh road (R624) to Marino, and then across the harbour to the Cork wastewater treatment plant at Carrigrennan on Little Island. This option would require the construction of six new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected. Treated effluent would be discharged from the plant via the outfall currently being constructed as part of the Cork Main Drainage Scheme in the deep water off Marino Point.

Wastewater from Passage West and Monkstown would be pumped south along the main road to Raffeen Creek. (Refer to Fig. Nr. 4.3.2.7B.) This would require the upgrading of five existing pumping/comminutor stations en route, in addition to provision of a new pump station at Raffeen Creek. It would also require provision of pumped and gravity mains along the main road (R610).

From Raffeen Creek the Passage West and Monkstown flows would be pumped along the R610 to Raffeen Bridge and then South to the treatment plant site at Carrigaline East. (Refer to Fig. Nr. 4.3.2.7D) the pipeline and pumping system from Passage West and Monkstown to Carrigaline East is the same as for Option 3.

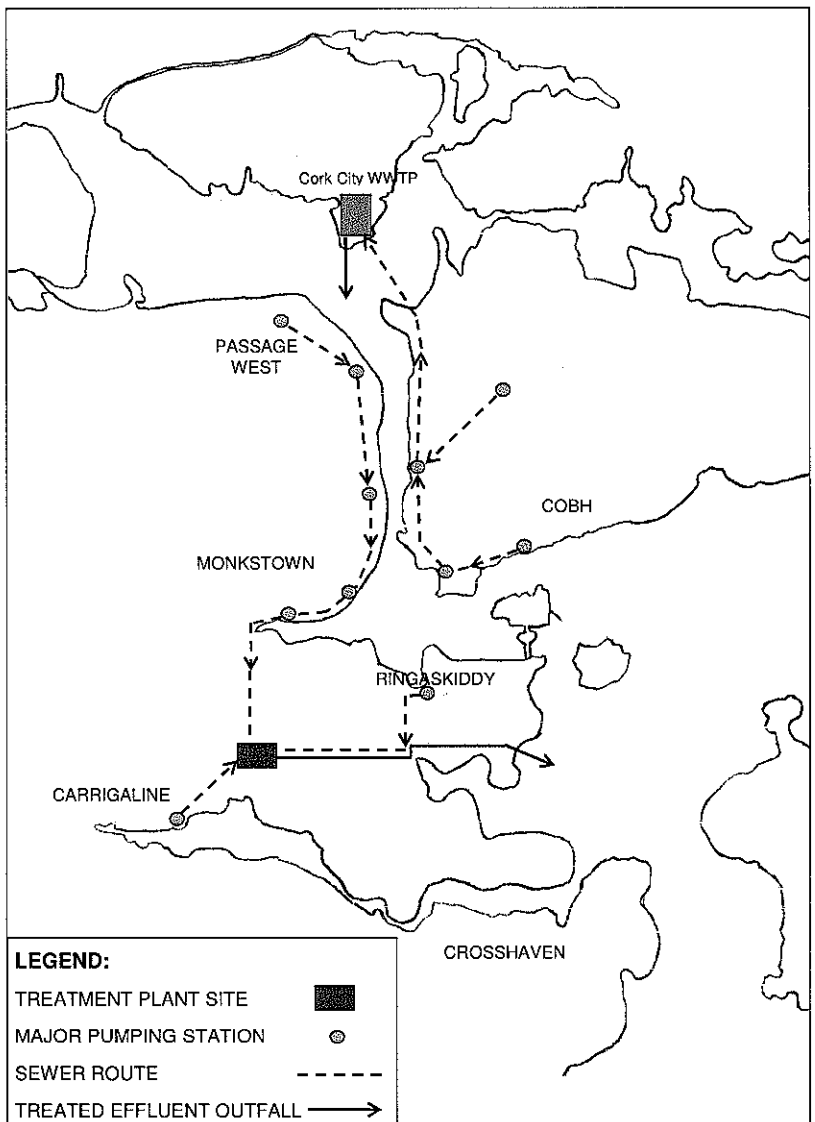
To serve Carrigaline its main pump station would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. Here it would be diverted to the nearby treatment plant site.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the Carrigaline East treatment plant site. (Refer to Fig. Nr. 4.3.2.7E.) This rising main would be laid in part alongside the existing IDA sewer.

Treated effluent would gravitate from the Carrigaline East plant to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg.

The pipework to and from the Carrigaline East treatment plant site would be the same as for Option 3. However, greater pumping head and a longer rising main would be required to convey the Cobh wastewater for treatment. While this option would require a marine crossing, it will not be across the main shipping channel. No new outfalls would need to be constructed for this option. The treatment costs would be higher for the wastewater from Cobh, since it would be subjected to a higher standard of treatment (including nutrient removal) at the Carrigrennan plant.

CONCEPTUAL DESIGN
OPTION 7



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.7A

4.3.2.8 Option 8

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in two separate wastewater treatment plants. It is similar to Option 4, except that the Cobh, Passage West and Monkstown flows would be treated at the Cork wastewater treatment plant in Carrigrennan (currently under construction as part of the Cork Main Drainage Scheme). The second plant at Carrigaline East would serve the population centres of Carrigaline and Ringaskiddy. This option is shown schematically on Fig Nr. 4.3.2.8A and described below.

All wastewater produced in Cobh, including the Strategic Development area to the north of Cobh, would be conveyed by a combination of pumping and gravity flow to a new pump station to be located near Carrigaloe. (Refer to Fig. Nr. 4.3.2.8C) this option would require the construction of six new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected.

Wastewater from Passage West would be pumped south along the main road to Glenbrook, while flows from Monkstown would be pumped north to the same point. (Refer to Fig. Nr. 4.3.2.8B.) From there the wastewater would be conveyed across the harbour via twin mains to the Carrigaloe pump station. This would require the upgrading of five existing pumping/comminutor stations en route in addition to a new pump station in the Passage West/Monkstown area. It would also require provision of pumped and gravity mains along the main road R610.

From the proposed Carrigaloe pump station the combined flows would be pumped north along the main Cork/Cobh road (R624) to Marino, and then across the harbour to the Cork wastewater treatment plant at Carrigrennan on Little Island. The pump station at Carrigaloe and the rising main to the treatment plant site would be larger for this option than for Option 7 due to the increased flow, i.e. contribution from Passage West and Monkstown. Treated effluent would be discharged from the plant via the new outfall (currently being constructed as part of the Cork Main Drainage Scheme) into the deep water off Marino Point.

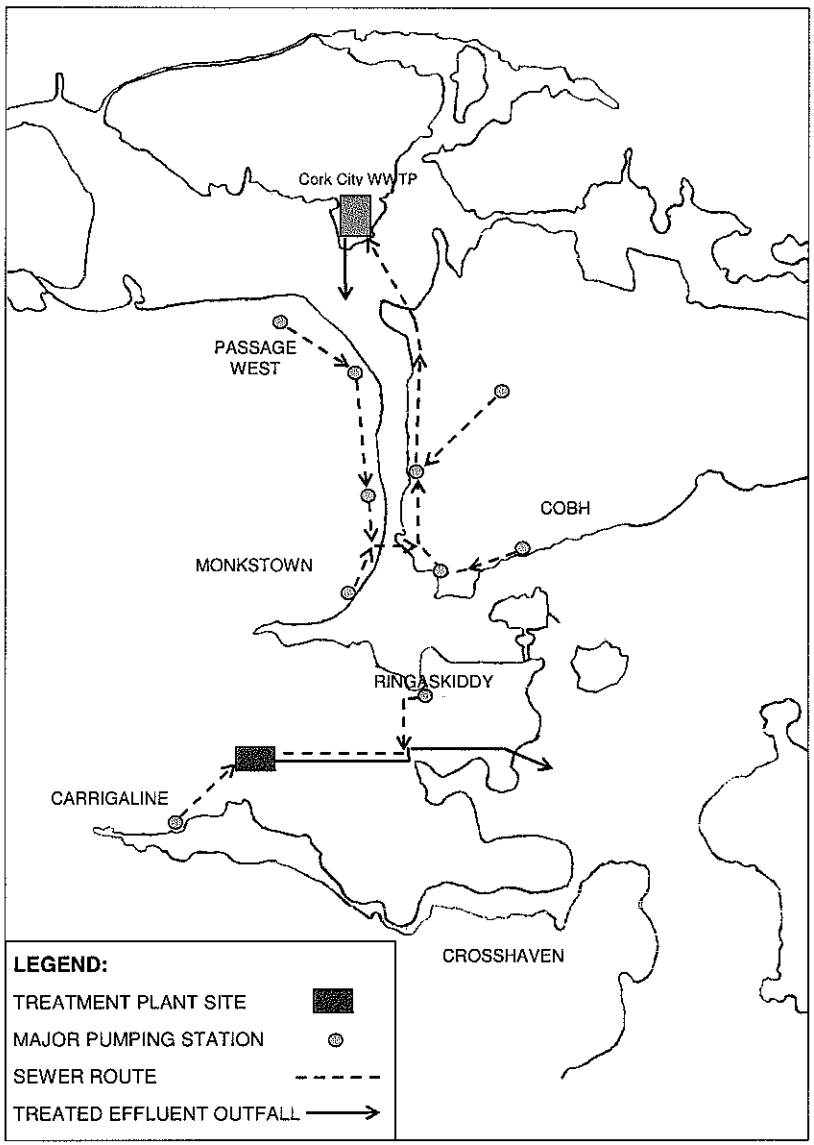
To serve Carrigaline its main pump station would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. (Refer to Fig. Nr. 4.3.2.8D) Here it would be diverted to the nearby treatment plant site.

Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the Carrigaline East treatment plant site. (Refer to Fig. Nr. 4.3.2.8E.) This rising main would be laid in part alongside the existing IDA sewer.

Treated effluent would gravitate to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg.

The pipework to and from the Carrigaline East site would be the same as for Option 4. However, greater pumping head and larger mains would be required to convey the Cobh, Passage West and Monkstown flows for treatment. A second marine crossing would be required (but not across the main shipping channel), but no new outfall would be required. The treatment costs would be higher for the wastewater from Cobh, Passage West and Monkstown since it would be subjected to a higher standard of treatment (including nutrient removal) at the Carrigrennan plant.

CONCEPTUAL DESIGN
OPTION 8



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.8A

4.3.2.9 Option 9

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in three separate wastewater treatment plants. One located at Marino to the north of Cobh would serve Cobh. The second plant located to the east of Carrigaline in the townland of Shanbally would serve the population centres of Carrigaline and Ringaskiddy, while a third plant located at Ardmore to the north of Passage West would serve the Passage West and Monkstown areas. This option is shown schematically on Fig Nr. 4.3.2.9A.

The collection and treatment system proposed for Cobh in this option is the same as that proposed in Option 3. (Refer to Fig. Nr. 4.3.2.9C) all wastewater produced in Cobh would be conveyed by a combination of pumping and gravity flow to a new pump station to be located near Carrigaloe. From there it would be pumped along the route of the main Cork/Cobh road (R624) to the treatment plant site at Marino. Wastewater from the Strategic Development area to the north of Cobh would be pumped directly to the Marino treatment plant site. This option would require the construction of six new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected. Treated effluent from this site would be discharged via a new outfall to be constructed in the deep water off Marino Point.

The collection, treatment and disposal system that is proposed for Carrigaline and Ringaskiddy in this option is the same as that in Option 4. To serve Carrigaline its main pump station would be upgraded, with flow being pumped via the existing rising main to the point where this now connects with the IDA sewer. (Refer to Fig. Nr. 4.3.2.9D) Here the rising main would be diverted to the nearby treatment plant site.

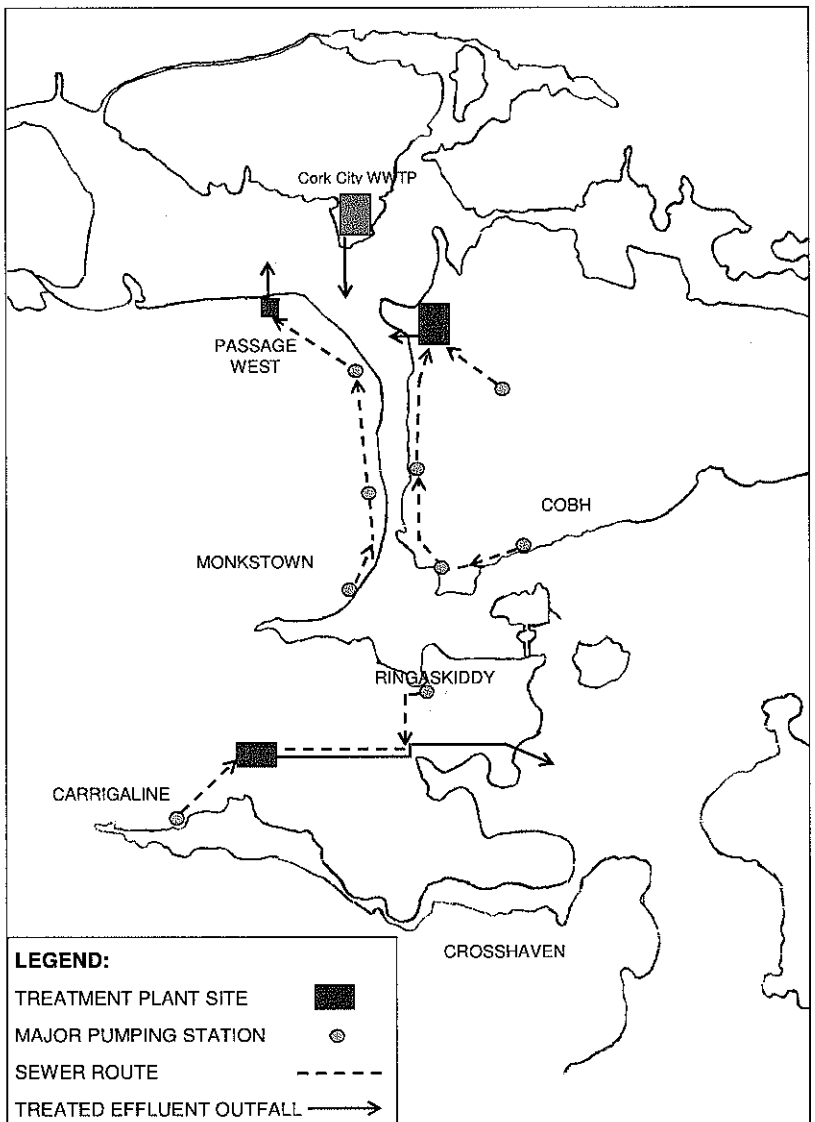
Flow from Shanbally and Coolmore would be combined with the flow from Ringaskiddy and pumped to the Carrigaline East treatment plant site. (Refer to Fig. Nr. 4.3.2.9E.) This pumped main would be laid in part alongside the existing IDA sewer.

Treated effluent from the Carrigaline East site would gravitate to the existing IDA gravity sewer alongside the site, for discharge via the existing outfall near Loughbeg. The gravity pipe from the treatment plant to the IDA sewer would be smaller for this option than for Option 2 due to the lower flow (no flow contribution from Cobh, Passage West or Monkstown).

Wastewater from Monkstown and Passage West would be pumped north along the route of the main road from Carrigaline (R610) to the proposed site at Ardmore immediately north of Passage West. (Refer to Fig. Nr. 4.3.2.9B.) This would require the upgrading of four existing pumping/comminutor stations en route, in addition to a new pump station at Raffeen Creek. It would also require provision of pumped and gravity mains along the main road R610. Treated effluent would be discharged from this site via a new outfall to be constructed into the inner section of Cork Harbour.

While this option would not require any marine crossings, it would be necessary to construct two new outfalls in the inner harbour. It would also be necessary to provide a higher standard of wastewater treatment (including nutrient removal) at the two plants discharging into the inner harbour resulting in increased treatment costs. This option would require the purchase of three treatment plant sites.

CONCEPTUAL DESIGN
OPTION 9



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.9A

4.3.2.10 Option 10

This option is based on the treatment of all of the raw wastewater produced in the lower harbour area in two separate wastewater treatment plants. It is similar to Option 1 except that the wastewater flows from Passage West and Monkstown would be treated in a treatment plant located at Ardmore to the north of Passage West. The second treatment plant would be located at Loughbeg near Ringaskiddy, and it would treat the wastewater from Carrigaline, Ringaskiddy and Cobh. This option is shown schematically in Fig. Nr. 4.3.2.10A and described below.

Wastewater from Monkstown and Passage West would be pumped north along the main road from Carrigaline (R610) to the proposed site at Ardmore immediately north of Passage West. (Refer to Fig. Nr. 4.3.2.10B.) This would require the upgrading of four existing pumping/comminutor stations en route, in addition to a new pump station at Raffeen Creek. It would also require provision of pumped and gravity mains along the main road R610. Treated effluent would be discharged from this site via a new outfall to be constructed into the inner section of Cork Harbour.

Wastewater in Cobh would be conveyed by a combination of pumping and gravity flows to a new pumping station to be located at White Point to the south west of Cobh. (Refer to Fig. Nr. 4.3.2.10C) this option would require the construction of eight new pump stations in Cobh, in addition to those necessary regardless of which overall scheme is selected.

From White Point the wastewater would be pumped via a twin rising main across Cork Harbour to a new header chamber to be located at the top of the hill south of Ringaskiddy. (Refer to Fig. Nr. 4.3.2.10E) the optimum route for this twin main is to the west of Haulbowline Island, due to ground conditions and space limitations on the island, as well as construction difficulties along the access road to the island. Wastewater flows from Ringaskiddy would also be pumped to this header chamber. From here the wastewater would gravitate to the proposed treatment plant site at Loughbeg.

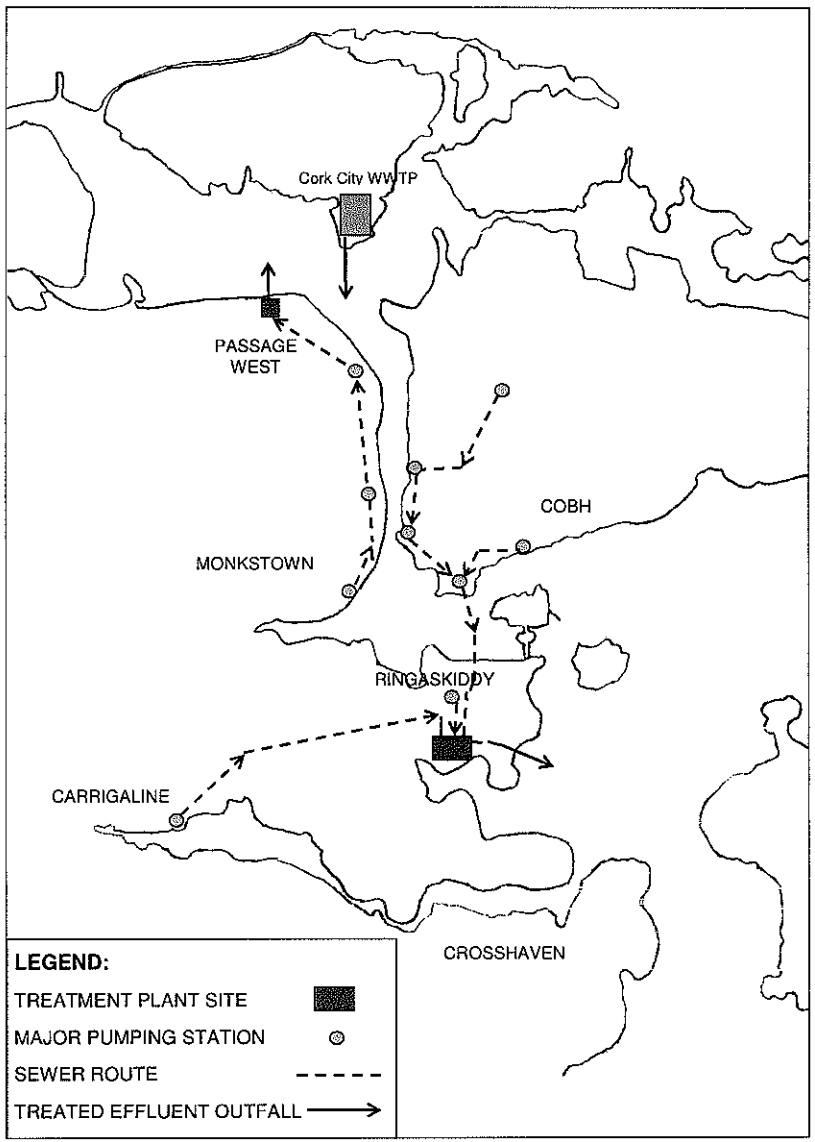
To serve Carrigaline its main pump station would be upgraded, with flow from Carrigaline being pumped via the existing rising main to the point where this now connects with the IDA sewer. (Refer to Fig. Nr. 4.3.2.10D) Here it would be connected to a new gravity sewer to be laid alongside the IDA sewer to provide a gravity flow to the treatment plant site at Loughbeg. Flow from Shanbally and Coolmore would also be pumped to this new gravity sewer.

Treated effluent from the Loughbeg site would be pumped into the existing IDA gravity sewer and nearby outfall.

Unlike Option 1 this option would require only one marine crossing of the main shipping channel (White Point, Cobh to Ringaskiddy). However, it would be necessary to construct a new outfall at Ardmore near Passage West for discharging into the inner harbour. It would also be necessary to provide a higher standard of treatment (including nutrient removal) for the wastewater at this plant. The treated effluent from the Loughbeg site, which represents more then 85 % of the wastewater in the entire catchment, would have to be pumped to its outfall.

CONCEPTUAL DESIGN

OPTION 10



H:\PowerPoint\A5670\Overall options.ppt

FIG. NR 4.3.2.10A

4.4 Evaluation of Selected Scheme Options.

A detailed economic evaluation of these ten options was then undertaken at an early stage in the project to determine the preferred scheme. The population figures (and associated loadings) used in this evaluation vary slightly from those predicted by the more recent population predictions included in previous sections of this report. However, these differences are covered by the sensitivity analysis incorporated into the cost evaluation, and do not in fact alter the selection of the preferred scheme. This is addressed in more detail in Section 4.5.

The evaluation described below considered capital, operating and maintenance costs for each element of each option. Some elements of the schemes, such as the sewerage and collection systems within each town, which would be common to all options and would not be affected by the location of the wastewater treatment plant, are not included in the scheme comparisons. The evaluation did take into account major pump stations, conveyance pipework to the treatment plants, the wastewater treatment plants, the treated effluent outlet pipework, plus outfalls, where required. The costs given in this evaluation are therefore the relative costs of each scheme and not the absolute costs of each scheme.

The maximum flows and loads generated by each population centre were calculated on the basis of the future (collection system) populations and developments which could arise in each of the population centres in the lower Cork Harbour area. (Note that these are greater than the flows and loads estimated for the design year 2035). It was these higher values which were then used to estimate the flows and loads to each potential wastewater treatment plant for each of the different scheme options. These flows and loads are set out in Table 4.4.1.1 below. This data was then used to undertake outline designs of the wastewater treatment plants and calculate the capital and operating costs of each.

The wastewater treatment facilities for this project will most likely be constructed using the Design/Build/Operate procurement method, with the type of treatment system and associated technology to be used being selected and designed by the successful contractor. The population equivalents for each of the potential treatment plants are within the range suitable for conventional activated sludge plants, and this was the treatment option used for comparing costs between the different options. The Loughbeg plant for Options 5 and 6 was also sized and costed on the basis of using rotating biological contactors (RBCs), which are a suitable alternative for populations of this size (3,000 p.e.). Outline designs of both treatment technologies are shown schematically in Fig 4.4.1A and 4.4.1B.

It is noted that the evaluation of the selected scheme options was prepared as part of the initial issue of this preliminary report in 2001. As such the relevant costs are expressed in IR£.

Table 4.4.1.1 Flows and Loads for WwTWs under Different Scheme Options

Option	Treatment Plant location (Site Nr.)	Domestic Flow	Comm Ind/Inst Flow	Infiltration	DWF	Ave. Flow	BOD Load	SS Load	Pop. Equiv
		(m^3/d)	(m^3/d)	(m^3/d)	(m^3/d)	(m^3/d)	Kg/d	Kg/d	p.e.
1.	Loughbeg	8,443	2,988	2,814	14,245	19,321	4,140	4,686	69,007
2.	Carrigaline (18)	8,443	2,988	2,814	14,245	19,321	4,140	4,686	69,007
3.	Carrigaline (18)	5,320	2,274	1,773	9,368	12,647	2,606	2,953	43,425
	Marino (11)	3,123	714	1,041	4,878	6,585	1,535	1,733	25,582
4.	Carrigaline (18)	4,297	2,074	1,432	7,803	10,534	2,112	2,399	35,204
	Marino (11)	4,146	914	1,382	6,443	8,698	2,028	2,287	33,804
5.	Carrigaline (18)	4,004	1,997	1,335	7,335	9,902	1,961	2,204	32,690
	Marino (11)	293	76	98	467	630	151	159	2,513
	Loughbeg (2)	4,146	914	1,382	6,443	8,698	2,028	2,287	33,804
6.	Carrigaline (18)	8,150	2,912	2,717	13,778	18,600	3,990	4,527	66,494
	Loughbeg (2)	293	76	98	467	630	151	159	2,513
7.	Carrigaline (18)	5,320	2,274	1,773	9,368	12,647	2,606	2,953	43,425
	Carrigrenan (19)	3,123	714	1,041	4,878	6,585	1,535	1,733	25,582
8.	Carrigaline (18)	4,297	2,074	1,432	7,803	10,534	2,112	2,399	35,204
	Carrigrenan (19)	4,146	914	1,382	6,443	8,698	2,028	2,287	33,804
9.	Ardmore (16)	1,023	200	341	1,565	2,425	493	553	8,221
	Carrigaline (18)	3,123	713	1,041	4,877	7,560	1,534	1,733	25,581
	Marino (11)	4,296	2,074	1,432	7,802	12,094	2,112	2,398	35,203
10.	Ardmore (16)	1,023	200	341	1,565	2,425	493	553	8,221
	Loughbeg (2)	7,419	2,787	2,473	12,680	19,654	3,647	4,132	60,785

Note:- The population equivalent figures and associated loadings set out above are less than the future (collection system) population and loading figures used earlier in this report for designing the future scheme infrastructure because the scheme evaluation and cost analysis was undertaken at an earlier stage in the project to enable design to proceed on the optimum scheme. An allowance was made for such changes in the sensitivity analysis. The difference in these figures does not alter the selection of the optimum scheme as discussed in Section 4.4.4.

Fig Nr. 4.4.1 – Generic Treatment Systems

Fig Nr. 4.4.1 A – Activated Sludge System

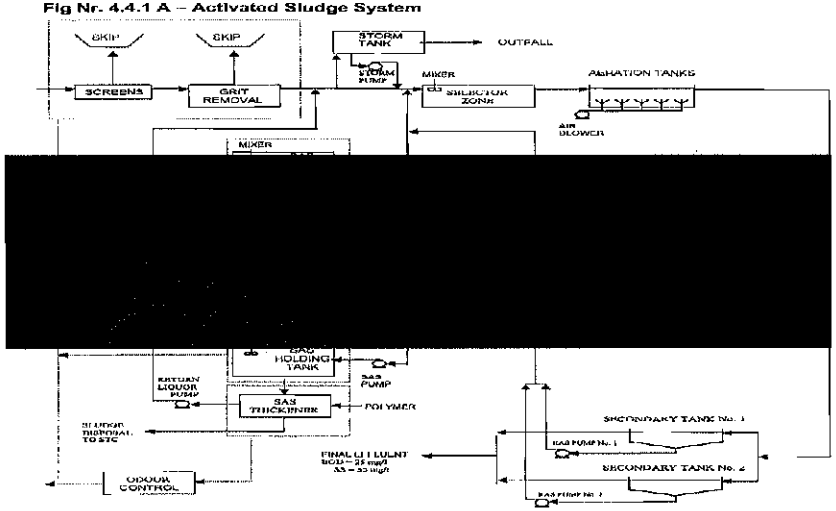
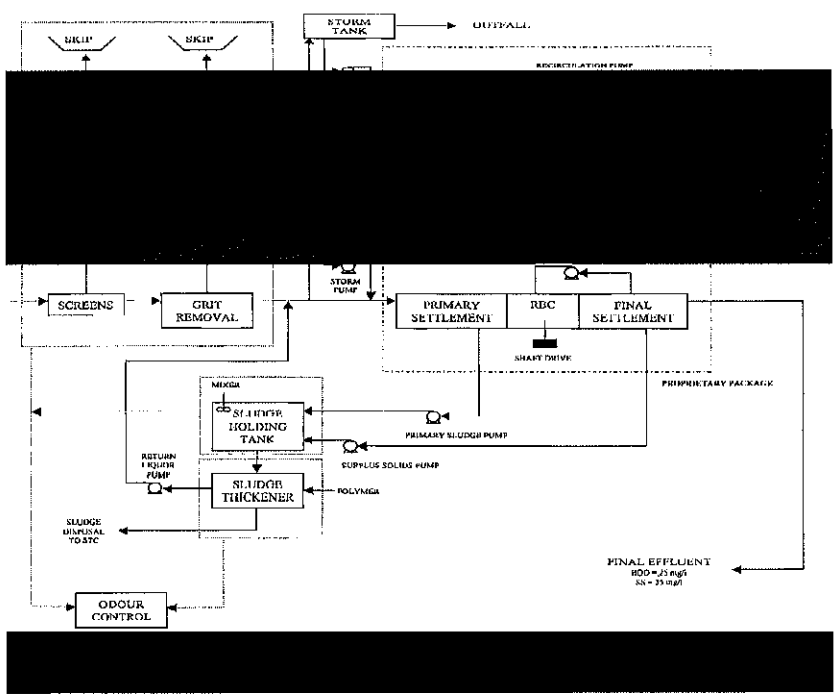


Fig Nr. 4.4.1 B RBC System



4.4.1 Key Assumptions

The economic evaluation and comparison of the different scheme options is based on a number of fundamental assumptions set out below.

Treated effluent standards will be in compliance with the Urban Waste Water Treatment Regulations, 2001 (S.I. No.254 of 2001) with wastewater receiving secondary treatment.

It is noted that since the initial preparation of this report the Urban Waste Water Treatment (Amendment) Regulations, 2004 (S.I. 440 of 2004) have designated the Inner Harbour as sensitive waters. This will require the addition of nutrient removal facilities at any treatment plants discharging to the Inner Harbour, thus increasing the WWTP capital and operating costs. These additional costs have not been included in the assessment of the preferred scheme option. Of the options considered, this would affect treatment plants located at Passage West, Marino and Carrigrennan, increasing the cost of Options 3, 4, 5, 7, 8, 9 and 10.

Sludge treatment (other than thickening and dewatering) has not been included at any of the WWTPs, since this will be provided only at a location in the Ringaskiddy area.

4.4.1.1 Outline Design for Pumping Stations and Wastewater Treatment Plants

The following assumptions have been used in the sizing of the pumping stations:

- Typical operating efficiencies of 80 % were used for the pumps.
- For pumping stations with a design discharge of less than 50 l/s, the costs were based on provision of a package pumping station. This would contain two pumps operating on a duty/standby basis.
- For pumping stations with a design output of between 50 l/s and 100 l/s, the pumping station was assumed to include a single duty and a single standby pump.
- For pumping stations with a design discharge of greater than 100 l/s, three pumps would be provided, to operate in a duty/assist/standby configuration.
- Screening and grit removal was included at each pump station immediately upstream of a marine crossing.

The following assumptions were made in the design of the wastewater treatment plants:

- The treated effluent quality required has been assumed to be that required under the Urban Waste Water Treatment Regulations (S.I. No. 254 of 2001), i.e. BOD_5 concentration < 25 mg/l, suspended solids concentration < 35 mg/l.
- The average flow to the treatment plant has been assumed to be 1.35 times DWF, with a peak flow of 6 DWF being pumped to the treatment plant.
- Preliminary treatment comprising of screening, screenings treatment, grit removal and flow measurement (using a flume) has been assumed. All necessary channels and penstocks have been included for costing purposes. The preliminary treatment stage was sized for a flow of 6 DWF.
-
- The screening and grit removal plant would be housed in a building from which the air would be extracted and vented through an odour treatment unit. The volume of this building was assumed to be 100 m^3 for all WWTPs considered.
- Flows in excess of 3 DWF reaching the WWTP would overflow to on-site storm water settlement tanks.

- Two storm water settlement tanks have been included for each WWTP, with a total retention time of 2 hours at 3DWF being provided. It was assumed that one duty pump would empty the tanks, with the percentage of time of operation at 10 %.
- Primary settlement has not been included in the wastewater treatment plants for the evaluation of alternative scheme options. Primary settlement had been a requirement for all wastewater treatment plants serving a population equivalent of over 5,000 (Department of the Environment Circular letter L6/94). However, under the Design/Build/Operate procurement system, which will be used for the construction of the wastewater treatment plant, the treatment system proposed by the successful contractor might not include or require the provision of primary settlement. For comparison of treatment plants it has therefore been omitted.

The following assumptions were made with respect to the design of the secondary treatment stage of the wastewater treatment plants, i.e. the activated sludge systems:

- The hourly design loads were assumed to be twice (the peak factor) the given daily loads.
- The retention time in the selector zone (at the inlet to the aeration tanks) at average flow was assumed to be 1.5 hours. The mixing requirement in the selector zone was assumed to be 5 W/m^3.
- The aeration system was designed to treat a maximum flow of 3 DWF.
- The design operating MLSS concentration in the aeration tanks was assumed to be 2,800 mg/l.
- The design operating F/M ratio was assumed to be 0.23 kg BOD/kg MLSS.day for plants where no nitrogen removal was required, and 0.13 kg BOD/kg MLSS.day for plants with nitrogen removal.
- The assumed specific O_2 requirement is 0.9 kg O_2/kg BOD.
- The aeration system was assumed to be a fine bubble diffused air (FBDA) system, with a specific O_2 production efficiency of 1.3 kg O_2/kWh under actual operating conditions.
- It is assumed that two secondary settlement tanks (operating in parallel) would be used, each with an upward flow velocity of 1.0 m^3/m^2/h at 3 DWF.
- It was assumed that there would be one duty Return Activated Sludge pump dedicated to each secondary settlement tank (each working with a head of 5 m). These pumps were sized based on achieving a maximum underflow rate of 0.8 m/h. (A standby would be provided for each duty pump.)
- The sludge yield was assumed to be 100% (kg MLSS/kgBOD removed). This is a typical value for an ASP with no primary settlement.
- It was assumed there would be one common duty (with a standby) Surplus Activated Sludge pump working with a head of 5 m.
- The Surplus Activated Sludge Holding Tank was designed for a retention time of 48 hours. The mixing requirement was assumed to be 7 W/m^3.
- The SAS dewatering belt press is designed based on a loading of 200 kg/m/h and an operating day of 16 hours. The required polymer dosing is assumed to be 5 kg/t DS of SAS. It is assumed that the SAS dewatering belt press produces a sludge of 18% w/w and that the sludge cake density is 900 kg/m^3.

The following assumptions were made with respect to the design of the rotating biological contactors:

- The hourly design loads were assumed to be 1.5 (the peak factor) times the given daily loads.
- The RBC was designed to treat a maximum flow of 3 DWF.
- The power consumption for the RBC is estimated as 360 kWh/d.
- The RBC package plant was assumed to include a primary settlement zone, a RBC and a secondary settlement zone with associated recycle pumps.
- 60% suspended solids removal was assumed in the primary settlement zone, with a corresponding dry solids concentration in the primary sludge of 4% w/w. The frequency of primary desludging was assumed to be 10 min/hour. It was assumed that there would be one duty desludging pump dedicated to each settlement zone, with each working against a discharge head of 5 m.
- It was assumed that 30% of the BOD load would be removed in the primary settlement zone.

- Surplus solids production at 0.9 kg d.s./kg BOD removed was assumed. The surplus sludge would have a solids concentration of 0.5% w/w. It was assumed that one duty surplus solids pump working against a discharge head of 5 m would be provided.
- A retention time of 48 hours would be provided in the sludge holding tanks, two of which would be provided. The mixing requirement in the sludge holding tank was assumed to be 7 W/m^3.
- The sludge dewatering belt press is designed based on a loading of 200 kg/m/h and an operating day of 16 hours duration. The required polymer dosing is assumed to be 5 kg/t of sludge. It is assumed that the sludge dewatering belt press produces a sludge of 18% w/w and that the sludge cake density is 900 kg/m^3.

Regardless of the secondary treatment process employed,

- Supernatant liquor from the sludge thickening and dewatering plants would be returned for treatment in the main process stream using one duty pump with a typical head of 5 m.
- The number of air changes per hour for all areas to be provided with odour control was assumed to be 2.
- Scum removal and washwater systems were included in the indirect costs.
- Ultraviolet disinfection was not included for any of the WWTPs.

4.4.2 Costing Methodology

The economic comparison of the different scheme options was undertaken at the earliest stage in this project using costs expressed in IR£. Since the same rates were applied to all the scheme options, conversion of the currency to Euro for the cost comparison process will not impact on the choice of the optimum option. The costs presented in the following tables and in Section 4.4 only of this Preliminary Report are expressed in IR£.

The following costs have been excluded from the evaluation, but are included later in this report in the calculation of the overall cost of the preferred scheme.

- Any non-variable Opex costs such as the provision of central telemetry facilities, senior management etc.
- Historical costs and debt recovery.
- Collection systems within the population centres
- Hub centre for the treatment of sludge.

The Capital Expenditure (Capex) costs included within this analysis and evaluation cover

- Gravity sewers
- Wastewater pumping stations;
- Rising mains,
- Wastewater treatment plants,
- Marine crossings,
- Marine outfalls.

These costs do not include for any planning constraints, or any exceptionally high standards of finish. These factors are accommodated in the Sensitivity Analysis.

The costs used in the following costing exercise were based on two principle sources.

- Quotations from contractors working in the Cork area
- Costs derived from statistical cost models

The costs for the following items were calculated on the basis of contractors' quotations:
- Pipework
- Marine crossings and outfalls,
- Package pump stations

The statistical cost models used were those produced by the Water Research Council (WRc) and contained in Technical Report Number 61 (TR61) – Water Industry Construction Cost Estimation Manual (WICCEM). These costs are based on data collected from water companies in the United Kingdom. Consequently a factor for local calibration for the Republic of Ireland and for currency exchange rate was applied to the costs from the models. The current volatility of the construction industry in Ireland makes the local calibration difficult to predict with confidence. The calibration factor for Ireland is greater than the 0.75 commonly used in Northern Ireland. The uncertainty is compounded by the difficulty of predicting the longevity of the current construction boom. This uncertainty is addressed further in the sensitivity analysis in Section 4.4.3.

The WICCEM costing methodology utilises numerical models that express the direct cost of an item as a function of its design parameters. These typically take the form:

$$\text{Direct cost (£'000)} = A + BX^C$$

Where X represents a design parameter and A, B and C are constants that make up the cost model. For example the civil cost of a pump station is given by the equation:

$$\text{Direct Cost (£'000)} = 15.81 + 0.896 \times T\_POW$$

In which T_POW is the total installed power in kilowatts.

4.4.2.1 Direct Costs

WICCEM considers the direct costs to be those which "relate to the cost of individual items or processes". The indirect costs must be added to these. The indirect costs are those costs within the contract which are not specific to any one item or process, for example, general items, landscaping and interconnecting pipework. WICCEM contains three cost models for the indirect costs – for Civil, Mechanical and Electrical (M&E), and combined Civil and Mechanical and Electrical contracts. For this costing study, the separate Civil and M&E. models were used since the data is available and a more accurate result is achieved. These were applied to the appropriate total of direct costs. In addition to the indirect costs, other factors were included to achieve the outturn costs.

4.4.2.2 Indirect Costs

The Civil Indirect Costs include:
- General Items (Mainly CESSM Class A)
  - Insurance
  - Accommodation and equipment for the engineer,
  - Testing of the Works,
  - Method related charges,
- Fixed Charges
  - Non-specific provisional sums (e.g. telephone),
  - Site investigations (CESSM Class B),

  - Adjustment item (+/-)
- Dayworks
  - Labour, plant materials (including profit)
- Pipework
  - Interconnecting pipework (including valves, fittings, etc.),
  - General chambers and manholes,
  - Site drainage,
  - Washwater systems,
  - Diversions of existing pipelines
- Siteworks
  - General earthworks and site clearance,
  - Landscaping,
  - Gates and fencing,
  - General brickwork, blockwork and timber,
  - Miscellaneous siteworks
- Roads and pavings
  - Inter-site roads and paths.

The Mechanical and Electrical Indirect Costs are those items within the M&E contract which are not directly attributable to any one process. The WICCEM methodology does not include for control and telemetry, which in this analysis have been included as M&E. indirect costs, in addition to the indirect cost generated by the WICCEM cost model. The telemetry costs included are for the outstations only, since the central station is the same for all options, and excluded from the scheme comparisons.

4.4.2.3 Outturn Costs

The following multiplier was assumed in order to achieve the outturn costs:
- 10% for design and construction

4.4.2.4 Operating Costs

The operating costs were estimated on an annual basis and were discounted to give present costs. The following assumptions were used to generate the operating costs:
- The Net Present Value (NPV) calculation was based on a discount rate of 6 % over 40 years.
- Replacement of mechanical plant occurs after 20 years (direct costs).
- The maintenance costs were assumed to be 4 % of the M&E cost per annum (taking account of the less frequent maintenance such as impeller replacement after 10 years).
- Electricity costs were assumed to be IR£0.08 per kWhr.
- Operating efficiency of pumps at 80 %
- No separate odour control costs have been included in the pump station costs, as the odour strategy is to prevent the occurrence of septicity in the rising mains with chemical dosing, the cost of which has been included in the cost of the rising mains. (The costs associated with odour control equipment at the wastewater treatment plants have been included.)
- A cost of IR£10 per hour for skilled operators and a cost of IR£5 per hour for unskilled operators were used.

4.4.2.5 Costing Methodology for the Collection System and the Treated Effluent Discharge

Quotations were obtained from contractors undertaking similar work in the Cork area for gravity sewers, rising mains, package pump stations, marine crossings and marine outfalls. Costs were obtained for pipework in standard ground conditions as well as in rock, both in fields and in a roadway. No allowance was made for the cost of obtaining wayleaves or for compensation to landowners.

The following assumptions were made for the purposes of costing the gravity sewers:
- The sewers and manholes would be constructed in pre-cast reinforced concrete.
- Where pipelines are attached to bridges, steel pipes would be used for their added rigidity. The associated cost was assumed to be twice the pipe costs to allow for attaching the pipe to the bridge. For bridges over roads or railways, the cost was assumed to be three times the pipe cost to allow for the inconvenience associated with short possessions.

The following assumptions were made with regard to the costing of the rising mains:
- Polyethylene pipes were assumed with an SDR ratio of 11 up to a diameter of 515 mm ID. The SDR for larger pipes are listed with the unit pipe rates in Appendix G5.
- Costs for air valves and washouts were included as a function of the total cost. A value of 8 % of the rising main cost was used on the basis that the area is hilly.
- The rising mains would be dosed with chemicals to suppress septicity where necessary. The cost of chemical dosing was assumed to be IR£4 per kg.

The following assumptions have been used in the costing of the pumping stations:
- The total installed power used in the cost model included duty/assist and standby pumps.
- The staffing requirement for each pumping station is shown in Table 4.4.2.5.1 below. It sets out the number of visits required for pumping stations of different capacities with and without screening and grit removal facilities. It also sets out the time required for each visit, and the total time required for each class of pumping station. It was assumed that each visit requires two semi-skilled operators and that 1 ½ hours travel/admin time is required for each visit.
- The costing of screening and grit removal has been added as a surcharge onto the basic pumping station cost where it is to be provided. This applies only to the pump stations immediately upstream of the marine crossings in the conveyance system, and also at the inlet to each of the wastewater treatment plants. The cost model used is based on stand-alone preliminary treatment works. Consequently, no separate costs have been included for distribution channels or penstocks, as these were assumed to be included in the pumping station cost model.
- No separate odour control costs have been included with the pumping station costs as the odour strategy adopted is the prevention of the occurrence of septicity in the rising mains by dosing with chemicals, the cost of which has been included under the rising mains costs

Table 4.4.2.5.1 Staffing Requirements for Pump Stations

Pump Station Capacity (l/s)	Pump station without screening or grit removal			Pump Station with Screening and Grit removal		
	Nr. of visits per week	Time per visit (hr)	Staff time per week	Nr. of visits per week	Time per visit (hr)	Staff time per week
0 – 99	0.5	1	2 x 2.5	4	1	2 x 2.5
100 – 499	1	1	2 x 2.5	4	2	2 x 3.5
500 - 999	2	2	2 x 3.5	7	3	2 x 4.5
> 1,000	3	2	2 x 3.5	7	4	2 x 5.5

The costs of the marine crossings have been calculated on the basis of quotations received from contractors undertaking similar works in Cork Harbour. Combining the marine works costs for each option, rather than costing each on an individual basis reflects the savings on mobilisation costs gained by the close proximity of the different sites. The costs for marine works were based on the following assumptions:
- A backhoe dredger would be used.
- Initial backfill would be gravel haunch over the pipes and further material would be taken from the existing shipping channel.
- Where blasting would be required, a further cost of IR£1,000 per meter would be added.
- The marine conditions on site allow for working 12 months per year.

4.4.2.6 Costing Methodology for the Wastewater Treatment Plants

Capital Costs

Direct civil costs for major items of plant have been calculated according to the Water Industry Construction Cost Estimation Manual (WICCEM), TR61, prepared by the Water Research Centre. Mechanical and Electrical Direct Costs for major plant items have been similarly been calculated according to the Water Industry Construction Cost Estimation Manual (WICCEM), TR61, prepared by the Water Research Centre.

The following indirect costs have been included for both the activated sludge plant and rotating biological contactor designs:
- Civil and Mechanical and Electrical indirect costs for major plant items have been calculated according to the Water Industry Construction Cost Estimation Manual (WICCEM), TR61, prepared by the Water Research Centre.
- The cost of buildings was assumed to be 10 % of civil direct costs.
- The cost of design work was assumed to be 10 % of the total direct costs.
- An allowance of 15 % of the total direct costs was made for contingencies.
- A cost of IR£20,000 was included for the provision of an access road to each site.
- For the transfer of raw wastewater to Carrigrennan (Options 7 and 8), the capital costs have been estimated at IR£149,000 per 1,000 p.e.

Operating Costs

The basic Mechanical and Electrical operating costs have been assumed to be equal to 4 % of the total Mechanical and Electrical capital cost based on statistical reports. For the transfer of raw wastewater to Carrigrennan (Options 7 and 8) the operating costs have been assumed to be IR£36/m^3. Onto these costs were added the cost of sludge transportation, screenings and grit transportation and disposal, staffing, energy consumption and chemicals.

In accordance with the current draft (March 2000) of the Cork County Sludge Management Plan, it was assumed that the sludge treatment centre would be located at either Loughbeg near Ringaskiddy, or at Carrigaline East. The following table shows the assumed location for the sludge treatment centre for each of the scheme options.

Table 4.4.2.6.1 Location of Sludge Treatment Centres

Option	WWTP/Transfer	Location	Nearest STC location	Dist to nearest STC (km)
1	WWTP	Loughbeg	Loughbeg	0
2	WWTP	Carrigaline	Carrigaline	0
3	WWTP	Carrigaline	Carrigaline	0
	WWTP	Marino	Carrigaline	8
4	WWTP	Carrigaline	Carrigaline	0
	WWTP	Marino	Carrigaline	8
5	WWTP	Carrigaline	Loughbeg	6
	WWTP	Loughbeg	Loughbeg	0
	WWTP	Marino	Loughbeg	12
6	WWTP	Carrigaline	Carrigaline	0
	WWTP	Loughbeg	Carrigaline	6
7	WWTP	Carrigaline	Carrigaline	0
	Transfer	Carrigrennan	Carrigrennan	0
8	WWTP	Carrigaline	Carrigaline	0
	Transfer	Carrigrennan	Carrigrennan	0
9	WWTP	Ardmore (P/M)	Carrigaline	7
	WWTP	Marino	Carrigaline	8
	WWTP	Carrigaline	Carrigaline	0
10	WWTP	Ardmore (P/M)	Loughbeg	7
	WWTP	Loughbeg	Loughbeg	0

The following assumptions were made when costing the transportation of sludge:

- The capacity of the sludge cake skips has been assumed to be 9 m^3.
- It was assumed that the time required for loading and unloading sludge is 30 minutes.
- The average speed of the sludge tanker has been assumed to be 25 mph.
- The unit cost of haulage was assumed to be IR£33/h.

The screenings and grit removed from the wastewater at the WWTP site would be disposed of to landfill. It is noted that the nearest landfill sites, which are located at Kinsale Road, Rossmore and Rafeen Creek each has a limited life span, with the closure of the Kinsale Road landfill pending. There are proposals to provide a new landfill site at Bottlehill (planning permission pending) located approximately 10 miles north of Cork City. For the purposes of this cost analysis it was assumed that this would be the disposal route for the screenings and grit for each of the WWTP site locations. Table 4.4.2.6.2 shows the assumed distances from each of the potential WWTPs considered to the landfill site.

Table 4.4.2.6.2 Distance from Proposed Bottlehill Landfill to Potential WWTPs

Option	WWTP - Transfer	Location	Distance to Bottlehill (km)
1	WWTP	Loughbeg	38
2	WWTP	Carrigaline	35
3	WWTP	Carrigaline	35

Option	WWTP - Transfer	Location	Distance to Bottlehill (km)
	WWTP	Marino	37
4	WWTP	Carrigaline	35
	WWTP	Marino	37
5	WWTP	Carrigaline	34
	WWTP	Loughbeg	38
	WWTP	Marino	37
6	WWTP	Carrigaline	35
	WWTP	Loughbeg	38
7	WWTP	Carrigaline	35
	Transfer	Carrigrennan	29
8	WWTP	Carrigaline	35
	Transfer	Carrigrennan	29
9	WWTP	Ardmore (P/M)	30
	WWTP	Marino	37
	WWTP	Carrigaline	35
10	WWTP	Ardmore (P/M)	30
	WWTP	Loughbeg	38

The following assumptions have been made when costing the transportation of screens and grit:

- The unit production of screenings was assumed to be 0.0218 m^3/1,000 pe.d.
- The density of screenings collected was assumed to be 900 kg/m^3.
- The unit production of grit was assumed to be 0.092 m^3/1,000 m^3 wastewater flow.
- The density of grit collected was assumed to be 1,600 kg/m^3.
- The capacity of grit and screenings skips was assumed to be 9 m^3 for all WWTPs.
- It was assumed that the time required for loading and unloading screenings and grit is 30 minutes.
- The average speed of the disposal truck has been assumed to be 25 mph.
- The charge for disposal of screenings and grit is assumed to be IR£46.50/tonne ("polluter pays" principle).

Staffing

The following assumptions were made with regard to staffing costs:

- Where part of the wastewater would be transferred to Carrigrennan half the time of a plant manager at IR£30,000 per annum was included. Otherwise, the plant manager was assumed to be allocated on a full-time basis to this scheme.
- All WWTPs serving population equivalents greater than 25,000 were assumed to require one full-time unskilled operator costing IR£8/hour.
- All WWTPs serving population equivalents less than 25,000 were assumed to require 0.25 full-time unskilled operator costing IR£5/hour
- For every hour of work by an unskilled operator it was assumed that 20 minutes of work would be required by a skilled operator costing IR£10/hour.

4.4.3 Comparative Cost of Alternative Scheme Options

An economic analysis was carried out to demonstrate the relative costs associated with the 10 options proposed for the Cork Harbour Main Drainage Scheme. The results of this analysis are given in Table 4.4.3.1 and on the corresponding chart. A summary of the costs of the different elements of each of these options is provided in the spreadsheets at the end of this section. These spreadsheets give a breakdown of the capital, operating and maintenance costs as well as the replacement costs for mechanical plant and equipment. These also show in pie-chart format a comparison of the Capex and Opex costs, as well as a comparison between the costs of the collection/conveyance system and the cost of the wastewater treatment system. The breakdown of cost elements for all options is shown in Appendix G6.

Table 4.4.3.1 Relative Costs for Alternative Options for Wastewater Collection and Treatment

Option Nr	No of treatment plants	Plant locations (Site Nr)	Cost IR£ M	Rank
	1	Loughbeg (2)	30.01	7
	1	Carrigaline East (18)	27.59	1
	2	Carrigaline East (18) Marino (11)	27.81	2
	2	Carrigaline East (18) Marino (11)	29.24	5
	3	Carrigaline East (18) Marino (11) Loughbeg (2)	30.70	10
	2	Carrigaline East (18) Loughbeg (2)	29.48	6
	2 (incl. Cork City WwTP at Carrigrenan)	Carrigaline East (18) Carrigrenan (19)	28.54	3
	2 (incl. Cork City WwTP at Carrigrenan)	Carrigaline East (18) Carrigrenan (19)	30.27	8
	3	Ardmore (16) Carrigaline East (18) Marino (11)	30.30	9
	2	Ardmore (16) Loughbeg (2)	28.70	4

The above table shows that Option 2, which incorporates one wastewater treatment plant located at Carrigaline East serving the entire catchment, is the most economically advantageous option, subject to sensitivity analysis. It is the least expensive by a margin of just IR£220,000, with the first three options separated by only £950,000.

There is a difference of approximately IR£2.42 million in the comparative costs of Options 1 and 2, both of which have only one WWTP. The Option 1 WWTP is located at Loughbeg, while the Option 2 WWTP is located at Carrigaline East. It can be seen from the detailed Cost Option Study that the two marine crossings required for the Loughbeg WWTP and the longer conveyance system results in this option being more expensive than the Carrigaline East Option. In addition, it is necessary in Option 1 to pump all of the treated effluent from the WWTP site to the outfall, resulting in this option having the highest pumping costs of the options considered.

The principal difference in terms of cost between Option 2 and Option 3 is the higher wastewater treatment plant costs due to the provision of two treatment plants. Option 3 does however, have the lowest conveyance costs. The higher WWTP cost exceeds the savings associated with these lower pumping and conveyance costs.

The principle difference between Options 3 and 4 is that in Option 3 the wastewater from Passage West and Monkstown is conveyed to the Carrigaline East site for treatment, while in Option 4 it is conveyed to the Marino site for treatment. This results in higher construction costs for the conveyance and pumping systems for Option 4, causing it to be IR£1.43 million more expensive than Option 3.

Option 5 is similar to Option 4 except that a third WWTP is included to treat the wastewater from Ringaskiddy. The additional WWTP results in an increase of IR£1.46 million over the cost of Option 4.

Options 2 and 6 are similar, except that a separate WWTP is provided in Option 6 for the wastewater from Ringaskiddy. While Option 6 does have lower costs for the conveyance system, the requirement to pump treated effluent from the Loughbeg site to the outfall together with the increased construction costs associated with a second treatment plant are responsible for the difference in cost of IR£1.89 million.

Option 7 is similar to Option 3, except that the wastewater from Cobh is pumped to the Cork Wastewater Treatment Plant at Carrigrennan for treatment instead of a new WWTP at Marino. This reduces the wastewater treatment plant costs by IR£1.86 million for Option 7, but the higher costs associated with the longer marine crossing and rising mains results in Option 7 being IR£730,000 more expensive than Option 3.

Option 8 is similar to Option 7 but includes the provision of pumping of the wastewater from Passage West and Monkstown to the Carrigrennan WWTP. The additional marine crossing and the higher treatment costs at the Carrigrennan WWTP are responsible for this option being IR£1.73 million more expensive than Option 7.

Option 9 provides for local WWTPs at Ardmore near Passage West, and at Marino in addition to one at Carrigaline East. While this option does not require any marine crossing, it does require two new outfalls, and while it has the lowest pumping costs it has the highest wastewater treatment costs of all of the options considered.

Option 10 is similar to Option 1 except that the wastewater from Passage West and Monkstown is pumped to Ardmore to the North of Passage West for treatment. This option has considerably lower pumping costs than Option 1, since the flow to be pumped to Loughbeg is smaller. Option 10 is IR£1.31 million less expensive than Option 1.

In summary it can be seen that the most economical option is for the provision of a single wastewater treatment plant at Carrigaline East to treat all of the wastewater generated by the population centres in the Lower Cork Harbour area. It can also be seen that those options incorporating three wastewater treatment plants are among the most expensive options considered.

4.4.3.1 Sensitivity Analysis

A sensitivity analysis was carried out on the results of the costing study for each option to account for the risks and uncertainty associated with the prediction of costs. A Risk Log is set out in Table 4.4.3.2 below to identify these key risks and the elements that they affect.

Table 4.4.3.2 Risk Log

	Risk / Uncertainty	Sensitivity	Min	Max
a	Civil design and costing uncertainty	Civil Capital Cost	80%	120%
b	M&E design and costing uncertainty	Mechanical Capital Cost	80%	120%
c	WWTP design and costing uncertainty	WwTP Costs	80%	120%
d	Pumping station design and costing uncertainty	Pumping Station Costs	80%	120%
e	Marine construction – physical risks and design and costing uncertainty	Marine Civil Cost	80%	140%
f	Pipework design and costing uncertainty	Pipework Costs	80%	120%
g	Operation risks	Transport		120%
		Power		120%
		Labour		110%
		Chemicals		120%
h	Inflation to 2007	Civil Cost		141%
		M&E Cost		145%
		Chemicals		86%
		Power		159%
		Labour		154%
		Transport		123%
		Telemetry & Control		145%

A further analysis was carried out to examine the effect of calculating the Net Present Value of the Operation and Maintenance Costs based on a discount rate of 5% over 20 years. This did not impact on the order of top six ranking options.

The results of the sensitivity analysis are given at the end of Section 4 and summarised below.

(a) Civil Costs

The risk in costing the civil components is associated with both the outline design and the cost calculation.

An increase of 20% in civil cost generated a change in the ranking of the two most economical options, with Option 2 becoming IR£110,000 more expensive than Option 3. Option 3 which has the lowest capital costs was least affected by this change and became the most economical option. However, the requirement for nutrient removal at the Marino WWTP in Option 3 and the greater growth rate expected in the Carrigaline and Crosshaven areas would be expected to offset this effect. Option 7, which also has low civil costs due to the use of the Cork City wastewater treatment plant at Carrigrennan, was not greatly affected and retained its third place ranking. Option 5 remained as the most uneconomical option.

A reduction of 20% in civil costs had no effect on overall ranking of the options, with Option 2 remaining most economical, and Option 3 remaining the second most economical option. Option 5 remained as the most expensive option.

(b) Mechanical &Electrical Costs

Similar uncertainty arising from design and cost assumptions occurs with the Mechanical and Electrical components. In this case the uncertainty includes the precise piece of equipment that will be bought and how the equipment will be configured.

The 20 % increase in costs produced no significant change in the ranking of the options, with Options 2 and 3 remaining as the most economical options. Options 5 and 9 (both with three WWTPs) remained as the most expensive options.

A decrease of 20% in Mechanical and Electrical costs generated a change in the ranking of the two most economical options, with Option 2 becoming IR£220,000 more expensive than Option 3.

(c) Wastewater Treatment Plant Costs

The uncertainty of predicting costs is increased where there is a more significant lack of design data. The design of the wastewater treatment plants would be uncertain as a result of the process assumptions made and the need to provide flexibility to Design/Build contractors, as well as the civil and mechanical simplifications used for the design.

An increase in WWTP costs resulted in an increase in the cost differences between the options (IR£1,020,000 between the two least expensive options). The affect was greatest on the options with 2 or 3 treatment plants. Options 2, 3 and 7 remained the least, second and third least expensive options respectively.

The reduction of up to 20 % in WWTP costs caused significant rearrangement of the ranking of the options. Options 3 with two treatment plants (one located at Marino and one at Carrigaline East), became the least expensive option with option 2 being just IR£580,000 more expensive.

(d) Pumping Station Costs

The pumping station cost model used is not as detailed as the method used for costing the wastewater treatment plants or pipelines. It is therefore important that this source of error be investigated in isolation.

An increase of 20% in pumping station costs generated a change in the ranking of the two most economical options, with Option 2 becoming just IR£20,000 more expensive than Option 3. However, the requirement for nutrient removal at the Marino WWTP in Option 3 and the greater growth rate expected in the Carrigaline and Crosshaven areas would be expected to offset this effect. Option 5 remained as the most uneconomical option.

A reduction of 20% in pumping station costs had no effect on overall ranking of the options, with Option 2 remaining most economical, and Option 3 remaining the second most economical option. Option 5 remained as the most expensive option.

(e) Marine Construction Costs

Marine construction costs are significantly more difficult to predict than terrestrial costs. The nature of the work also means that corrective action in the case of an unforeseen event occurring can be very costly. This is due to the specialist and heavy nature of the plant involved, and the inherent risks of marine and geotechnical work. For this reason in the sensitivity analysis a larger range of factors is used for the marine construction cost.

The marine work associated with Option 2 comprises a crossing of the West Passage of Cork Harbour in the Monkstown Area. It should be noted that a contingency for excavation in rock has already been included in the costing of this crossing. This contingency has not been added to the costing of the Marino Outfall required in Options 3, 4, 5 and 9, or in the costing of the crossing between Marino and Carrigrenan required in Options 7 and 8. This is because the shipping passage is not as wide at this point (Marino) and a covering of alluvial deposits is considered more likely (due to lower velocities). However, there are two factors that make the crossing at Monkstown more difficult. Firstly, there is less room available close to Monkstown for a stringing yard, and the floating in of pipes to the Monkstown crossing would cause more interference with shipping than at the Marino site. Secondly the Monkstown crossing also has steep approaches on the banks of the estuary, and these would be likely to cause problems during construction.

Surprisingly, an increase in the marine civil costs to 140% did not significantly change the ranking of the three most economical options. The option most sensitive to marine cost variations is Option 1 with two marine crossings. Option 3 was the least affected option having no marine crossing and became the least expensive option. However Options 2 is just IR£60,000 more expensive than Option 3.

A reduction of 20% in marine civil costs had no significant effect on overall ranking of the options.

(f) Pipework Costs

The risks associated with predicting pipeline costs include changes of alignment that may take a pipe in or out of a road or hard ground. Unforeseen ground conditions and land ownership issues also affect the costing.

Increasing pipework costs resulted in Option 3 becoming just IR£219 less expensive than Option 2.

Reducing the pipework costs caused no changes in the ranking, with the difference between Option 2 and the other options increasing.

(g) Operation Risks

The balance of operation and capital expenditure varies between the options, which makes the ranking susceptible to variations in operation costs. This could occur for economic, legislative, environmental or other reasons. Operation risks include risk of increase in the price of transport, power, chemicals and labour.

Increases in these costs caused no significant changes in the ranking of the options. However, again Option 2 was the most affected and the differences between first four options decreased.

(h) Inflation to 2009

The assessment of the various scheme options was prepared as part of the initial issue of this Preliminary Report in 2001. Since 2001 there has been significant inflation in the construction industry in Ireland, as

well as significant increase in the cost of labour and power. This has been followed in recent years by a recession and a reduction in some costs. In order to examine the possible impact of this on the selection of the preferred scheme option, a sensitivity analysis was carried out. The inflation values used, together with the source of the data on inflation, is presented below.

M&E	145%	Beama Indices
Civil – Terrestrial	141%	Construction Cost Index from Society of Chartered Surveyers
Civil – Marine	141%	As above
WwTW	100%	Inflation included under other headings
Pumping Stations	100%	Inflation included under other headings
Chemicals (RM)	86%	CSO, WPI Chemicals
Pipework	100%	Inflation included under other headings
Power	159%	CSO, Energy
Labour	154%	CSO, Industrial Civil Servants
Transport	123%	CSO, CPI Transport
Telemetry & Control	145%	Taken as same as M&E above

The increase in costs produced no significant change in the ranking of the options, with Options 2 and 3 remaining as the most economical options and the difference between Option 2 and the other options increasing.

Table 4.3.3.1 below gives the results for Option 2 for each of the sensitivity analyses carried out.

Table 4.4.3.3 Summary of Sensitivity Analyses Results for Option 2

Scenario	Rank of Option 2	%age cheaper than next cheapest option	%age higher than next cheapest option
Base Case	1	0.8%	
20% increase in civil costs	2		0.4%
20% decrease in civil costs	1	2.1%	
20% increase in M&E costs	1	2.3%	
20% decrease in M&E costs	1		0.8%
20% increase in WWTP costs	1	3.3%	
20% decrease in WWTP costs	2		2.3%
20% increase in pumping station costs	1		0.1%
20% decrease in pumping station costs	1	1.7%	
40% increase in marine crossing costs	1		0.2%
20% decrease in marine crossing costs	1	1.3%	

Scenario	Rank of Option 2	%age cheaper than next cheapest option	%age higher than next cheapest option
20% increase in pipework costs	1		0.0%
20% decrease in pipework costs	1	1.6%	
20% increase in cost of transport and rising main chemicals. 10% increase in labour	1	0.6%	
Inflation to 2009	1	1.4%	

Option 2 is the cheapest option for the majority of the scenarios considered, and was the second cheapest option for the other scenarios. In all scenarios where Option 2 was the second cheapest, the cheapest Option was Option 3.

4.4.3.2 Results of Cost Analysis

On the basis of the foregoing cost comparisons (Table 4.4.3.1), Option 2 was identified as the least cost option. Option 3 was the second cheapest option, with an estimated cost 0.8% above that of Option 2.

The sensitivity analysis, summarised in Table 4.4.3.3 above, identified Option 2 as the cheapest option for 10 of the 16 scenarios considered. Option 3 was the cheapest of the other six scenarios, with Option 2 second cheapest in these instances.

It is considered likely that the receiving waters of the Inner Harbour will be designated as sensitive areas in the future. This would necessitate the installation of nutrient reduction equipment at any treatment plant discharging into these waters, thus increasing both the capital and operating costs of the treatment plant. Of the options considered, this would affect treatment plants located at Passage West, Marino and Carrigrennan, increasing the cost of Options 3, 4, 5, 7, 8, 9 and 10. This would further increase the cost benefits associated with Option 2 as opposed to the other options considered.

An estimate has been made of the long term population figures expected in the population centres around the lower Cork Harbour area. This predicts greater growth in Carrigaline and Crosshaven than in other areas, resulting in a greater population of the wastewater ultimately being contributed by those areas. This will further increase the cost effectiveness of Option 2 as the WWTP is closer to the source of the greatest proportion of the raw wastewater.

4.5 Identification of Most Advantageous Scheme

The cost analysis of the various options in Section 4.4 above identified Option 2 as the most cost effective of the options considered. The preliminary evaluation of the various WWTP sites in Section 4.2.2 identified this location as one of the more advantageous locations. The main advantageous with this option are summarised below:

- Most cost effective.
- One single WWTP which is preferable from a management perspective.
- Utilises the existing IDA outfall.
- Discharge is to the outer harbour (less sensitive waters).
- Site is now zoned for utilities and infrastructure use.
- Site is remote from existing residential dwellings.
- Site has sufficient scope to provide for future expansion and the incorporation of a sludge hub centre.
- Adequate access can easily be provided to the site.
- Services readily accessible (power, water, gas).
- Site is central to the population centres being considered.

5. Wastewater and Sludge Treatment

5.1 Loadings for Treatment

5.1.1 Existing Treatment Systems and Loading

5.1.1.1 Existing Municipal Wastewater

At present wastewater produced in the towns and villages in the Lower Harbour area is discharged in an untreated condition into Cork Harbour at numerous dispersed locations. While collection systems exist in Cobh, Passage West, Monkstown, Ringaskiddy, Shanbally, Coolmore, Carrigaline and Crosshaven, none of these systems provides complete wastewater treatment.

The domestic wastewater generated by the smaller population centres of Raffeen, Coolmore and Coolmore Cross Roads is collected and treated in local septic tanks prior to discharge. Wastewater from Carrigaline is screened by passing it through comminutors at the main pump station in Carrigaline, prior to being pumped to the IDA sewer to Ringaskiddy. It is further screened prior to discharge at the head of the IDA outfall in Ringaskiddy. The only type of wastewater treatment provided for discharges from the other population centres is solids disintegration to 6 mm using comminutors, with the solids retained in the flow.

The above population centres contribute a combined load of in excess of 11,521 m^3/day of raw wastewater containing 2,406 kg BOD/day to the receiving waters of Cork Harbour (based on 2001 data). A breakdown of these municipal wastewater flows and loads is set out in Table 5.1.1.1. The high volumes of wastewater being discharged are due to excessive levels of infiltration in some areas of the catchment. The issue of infiltration and proposed remedial actions is addressed in Sections 2 and 3 of this Preliminary Report.

In general, industries in the area to be served by this scheme operate their own wastewater treatment plants which provide treatment prior to discharge to the receiving waters of Cork Harbour. Industries in the Ringaskiddy area discharge their treated effluent to an IDA sewer connected to a deep sea outfall at the mouth of Cork Harbour. This industrial wastewater is not covered by the scope of this scheme. In Carrigaline, the principal industry is Kerry Bio-Solids (formerly Quest), which has a licence to discharge treated effluent at the same strength as raw domestic effluent into the local authority foul sewerage system. Their contribution is also included in this scheme. There are no other significant existing industrial loads to be considered. Table 5.1.1.1 provides the existing industrial contribution to be taken into account for the Cork Harbour Main Drainage Scheme.

Wastewater from the commercial and institutional sectors in each population centre is also considered in addition to infiltration into the collection system.

The basis for the determination of flows and loads is provided in Section 3 of this report.

Table 5.1.1.1 Existing Wastewater Discharges from Lower Harbour Towns & Villages for Year 2001

Category	Parameter	Cobh	Passage West & Monkstown	Ringaskiddy Shanbally & Coolmore	Carrigaline	Crosshaven	Total
Domestic	Flow (m^3/day)	1,608	760	179	1,917	300	4,764
	BOD (kg/day)	643	304	71	767	120	1,905
	Ss (kg/day)	750	355	83	895	140	2,223
Infiltration	Flow (m^3/day)	> 697	> 1,000	60	3,130	100	> 4,987
Commercial	Flow (m^3/day)	293	122	29	342	48	834
	BOD (kg/day)	117	49	11	139	19	335
	Ss (kg/day)	136	57	13	162	22	390
Institutional	Flow (m^3/day)	178	37	5	114	Incl.	334
	BOD (kg/day)	72	19	3	57	Incl.	151
	Ss (kg/day)	84	22	3	66	Incl.	175
Industrial	Flow (m^3/day)	0	0	0	607	0	607
	BOD (kg/day)	0	0	0	16	0	16
	Ss (kg/day)	0	0	0	22	0	22
Total	Flow (m^3/day)	> 2,776	> 1,919	273	6,105	448	> 11,521
	BOD (kg/day)	832	371	86	978	139	2,406
	Ss (kg/day)	971	433	100	1,145	162	2,811
	Pop. Equiv.	13,865	6,189	1,426	16,305	2,317	40,102

5.1.1.2 Sludge

At present there are no full scale municipal wastewater treatment plants in operation in the region covered by this project (Sludge Region 19 as defined in the Cork County Sludge Management Plan). There is however a septic tank serving a population of 100 p.e. in Minane Bridge, and a number of smaller septic tanks in operation in Raffeen and Coolmore.

The sludge produced by the industrial wastewater treatment plants in this region is not considered as contributing to this scheme. (Refer to Section 4.1.2.2)

5.1.2 Future Loadings

To meet the needs of the Lower Cork Harbour area up the year 2030, it is necessary to take into account likely future development in the area to be served by the Cork Harbour Main Drainage Scheme Waste Water Treatment Plant.

Section 3 of this Preliminary Report sets out in detail the basis for the calculation and determination of the maximum future wastewater flows and loads which could be produced in each of the population centres based on full development. By providing collection systems and infrastructure of sufficient size for each area to accommodate this level of development and the maximum flows possible, maximum flexibility is afforded in the location of such developments within the catchment area to the year 2030.

However, in the sizing and costing of the proposed wastewater treatment plant, it is the loading predictions for 2030 which are used. The methodology used to determine the 2030 loadings is set out in the following sections.

5.1.2.1 Current Domestic Wastewater Loading

The most up to date information available on the population of the catchment is from the 2006 Census. The census information is available on both a District Electoral Division (DED) basis and a town basis. However neither of these boundaries match the boundaries of the various catchments considered in this report although the town boundaries are reasonably close to the catchment boundaries.

The GeoDirectory is a GIS database of postal addresses and is updated regularly. Using this database it is possible to identify the number of houses within both the DED boundaries and the CSO town boundaries, and also within the various catchments considered in this report. Two versions of this database were used, August 2000 and December 2006.

The census results can be used to determine the average number of persons living in each property, and also to estimate the number of properties unoccupied in each catchment. This information is available for each of the catchments considered within the report with the exception of Ringaskiddy and Shanbally. However the populations of these catchments are relatively small and it is considered reasonably to use the results calculated for Carrigaline for both of these catchments.

This information from the Census is then used to convert the number of houses (from the GeoDirectory) in each catchment into a population for each catchment.

The census also provides information on the occupancy status of houses on a DED basis. Assuming a similar proportion of houses are unoccupied on the night of the Census and in December 2006, the number of occupied houses in each of the catchments was estimated as 87.6% of all properties.

Table 5.1.2.1 Calculation of Current Catchment Populations

Catchment	Houses (Dec-06)	Occupied Houses (Dec-06) 1	House Occupancy Rate 2	Population
Carrigaline	5,273	4,619	3.00	13,857
Cobh	5,154	4,515	2.70	12,191
Passage West / Monkstown	2,313	2,026	2.81	5,693
Ringaskiddy	305	267	3.00	801
Crosshaven	818	717	2.68	1,922
Total				34,464

Note:
4. Based on Census data available for Carrigaline, Cobh, Passage West / Monkstown and Crosshaven, on average 12.4% of houses unoccupied.
5. Occupancy rate for Ringaskiddy taken as same as Carrigaline as no information available for Ringaskiddy.

The December 2006 population to be served by the proposed waste water treatment plant is taken as 34,464.

5.1.2.2 Future Domestic Wastewater Loading

As the proposed waste water treatment plant will be required to treat flows up to the year 2035, it is necessary to consider the population growth up to the year 2035. A number of publications were referred

to in order to derive a design population for the year 2035. These publications are listed in Table 5.1.2.2 A below.

Table 5.1.2.2 A Population Projection Publications

Publication	Publication Date	Projection Year
CSO Population & Labour Force Projections	2008	2041
Cork Area Strategic Plan (CASP)	2001	2020
SWRBD Population Forecasting (Draft)	2006	2015

The CSO Population & Labour Force Projections were prepared in 1999 and do not take account of the significant immigration that has taken place in the last few years. However it does provide projections beyond the design horizon of the proposed treatment plant. It is noted that although these projections are prepared on a nationwide basis they do provide some indication of the likely populations trends to the year 2031.

CASP was prepared in 2001 and similarly does not take account of the significant immigration that has taken place in the last few years. The base population used in the SWRBD methodology is from the 2002 Census, and again does not adequately account for the significant immigration that has taken place in the last few years. Furthermore the extent of the catchment considered by both of these studies does not necessarily correspond to the catchments contributing to the proposed waste water treatment plant. It can be seen from Table 5.1.2.2 B below that the 2020 population as predicted by each of these publications has been almost reached by 2006, if the catchments are considered approximately equivalent.

Table 5.1.2.2 B CASP / SWRBD Population Projections

Publication	Population	Year	Population	Year
CASP	26,170	2000	34,590	2020
SWRBD	25,593	2002	33,260	2020
Existing Population	34,464	2006		

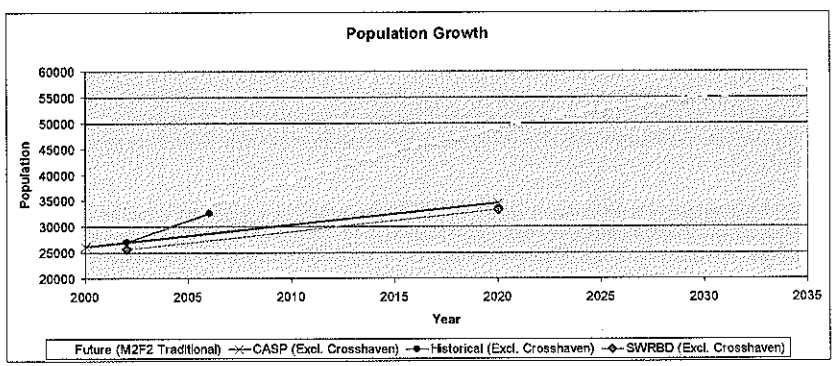
Note: Crosshaven excluded as both CASP and SWRBD include Myrtleville etc with Crosshaven

The CSO Population and Labour Force Projections give projected 2041 populations for Ireland under various population growth scenarios. The report considers various scenarios for migration (M0, M1 & M2) and fertility (F1 & F2). The M2 and F2 scenarios represent moderate migration and moderate fertility and are considered the most suitable for the purposes of this report.

The CSO Population and Labour Force Projections give the estimated population for the country as a whole. This includes both built up areas which are likely to develop faster than the country as a whole and rural areas which are likely to develop slower than the country as a whole. The CSO projections are based on an average growth of 2.0% per annum over the period 2002 to 2006. The observed growth rate in the catchments to be served by the proposed waste water treatment plant over the same period is 3.2% per annum. The observed growth rate in the catchments is 1.6 times the projected growth for the country as a whole. It is considered likely that the catchments will continue to grow at 1.6 times the region as a whole.

These population growth rates were applied to the existing population within the catchment of the proposed waste water treatment plant as shown in Figure 5.1.2.2 A below. The observed population growth from 2002 to 2007 (excluding Crosshaven) and the CASP and SWRBD population projections (excluding Crosshaven) are also shown on Figure 5.1.2.2 A for comparison purposes.

Figure 5.1.2.2 B Population Growth Comparisons



The population of the catchment in 2035 is estimated to be 57,246 for the purposes of the design of the waste water treatment plant.

5.1.2.3 Future Commercial / Institutional / Industrial Wastewater Loading

The future commercial waste water loading is taken as 16% of the domestic loading (based on observed loadings from similar catchments).

The institutional loading is taken to be equal to the existing institutional loading based on enrolment data from the 2008 / 2009 school year and data available for other institutions in the catchment.

The main industrial contributor in the existing schemes is Kerry Bio-Solids in Carrigaline. As discussed in Section 3.4.3.2 it is assumed that Kerry Bio-Solids will discharge up to 600 m^3/d at domestic strength. It is noted that Kerry Bio-Solids' discharge licence allows a discharge of 1,200m^3/day, however meter records indicate an actual discharge of approximately 200m^3/day. A discharge of 600 m^3/day is considered appropriate for the purposes of this report.

The other significant industrial contributor is Pepsi, again in Carrigaline. An allowance of 200 m^3/day has been provided based on it's licence. Again, this has been allowed at domestic strength.

Future industrial growth is calculated based on zoned lands from the relevant Local Area Plans. Industrial effluent is assumed to be at domestic strength, and a flow of 21 m^3/hectare/day has been allowed.

The industrial zoned lands in Ringaskiddy are assumed to be large scale industries with their own treatment systems discharging directly to the IDA sewer (in common with the existing industrial

development in Ringaskiddy). As such no allowance for the development of these zoned lands has been made in the design of the waste water treatment plant.

The estimated industrial loads are presented in Table 5.1.2.3 A below.

Table 5.1.2.2 B Estimated Industrial Loading

	Zoning	Area (Ha)	Flow (m^3/day)	BOD (kg/day)	SS (kg/day)	pe
Cobh	I-01	11.4	239	96	112	1600
	Dockyard 1	5	105	42	49	700
Carrigaline	I-01	9.7	204	82	95	1367
	(Pepsi) I-02	9.7	200	80	93	1333
	I-03	6.2	130	52	61	867
	Kerry Bio-Solids		600	240	280	4000
Passage West / Monkstown	No Industrial Zoning					
Ringaskiddy	No Industrial Zoning					
Crosshaven	No Industrial Zoning					
TOTAL						9,867

Note:
6. Majority of existing buildings at Cobh Dockyard are protected structures. Area of site likely to develop taken as 5 hectares.

5.1.2.4 Summary of Future Waste Water Loading

The future waste water loading is summarized in Table 5.1.2.4 A below.

Table 5.1.2.4 A Waste Water Discharges from Lower Harbour Towns & villages for Year 2030

Category	Parameter	Cobh	Passage West & Monkstown	Ringaskiddy Shanbally & Coolmore	Carrigaline	Crosshaven	Total
Domestic	Flow (m^3/day)	3,038	1,418	199	3,453	479	8,587
	BOD (kg/day)	1215	567	80	1381	192	3,435
	SS (kg/day)	1,418	662	93	1,611	224	4,008
Infiltration	Flow (m^3/day)	1013	473	66	1151	160	2,863
Commercial	Flow (m^3/day)	486	227	32	552	77	1,374
	BOD (kg/day)	194	91	13	221	31	550
	SS (kg/day)	227	106	15	258	36	642
Institutional	Flow (m^3/day)	128	46	44	111	36.2	365
	BOD (kg/day)	51	18	18	44	14	145
	SS (kg/day)	60	21	21	52	17	171
Industrial	Flow (m^3/day)	344	0	0	1,134	0	1,478
	BOD (kg/day)	138	0	0	454	0	592
	SS (kg/day)	161	0	0	345	0	506
Total	Flow (m^3/day)	5,009	2,164	341	6,401	752	14,667
	BOD (kg/day)	1,598	676	111	2,100	237	4,722
	SS (kg/day)	1,866	789	129	2,266	277	5,327
	Pop. Equiv.	26,633	11,267	1,850	35,000	3,950	78,700

An allowance of 80,000 pe has been made for the design of the waste water treatment plant.

5.1.2.5 Future Sludge Loading

The current Sludge Management Plan for County Cork (March 2000) recommends that all municipal sludge produced in Region 19 be treated at a hub centre to be located in Ringaskiddy. The principal population centres in Region 19 are Cobh, Passage West, Monkstown, Ringaskiddy, Carrigaline, Crosshaven, Shanbally, Coolmore, Aghada, Whitegate and Minane Bridge. Besides the population centres to be served by the Cork Harbour Main Drainage Scheme, the only other municipal sludge contributor to be considered is the septic tank at Minane Bridge which has a design population of 100 p.e. Aghada and Whitegate are located at the opposite side of Cork Harbour, and as yet do not have a full-scale wastewater treatment plant. When such a plant is commissioned sludge produced on site and transported from Whitegate to the Cork Harbour Wastewater Treatment Plant would have to pass the Midleton hub centre for Region 21. It is therefore expected that the municipal sludge produced in Whitegate be transported to Midleton for treatment, since the Midleton treatment plant is less than half the distance from Whitegate to the proposed Carrigaline East site of the Cork Harbour Plant.

The Sludge Management Plan for County Cork also recognises the potential for co-treatment of municipal wastewater sludge and biological industrial sludges at a hub centre located in the Ringaskiddy area. As outlined in Section 4.1.2.2 above, no provision will be made in the design of the sludge treatment system at the Cork Harbour Wastewater Treatment Plant for the treatment of biological industrial sludges produced in the Region.

5.2 Receiving Waters

5.2.1 Introduction

The subject of water quality in this section encompasses existing water quality (chemical and biological) and models future water quality based on the development of the proposed WWTP and Collection System. University College Cork (UCC) were commissioned to conduct a detailed hydrodynamic and water quality modelling study of the proposed WWTP discharge, thereby assessing the likely impacts of the development on water quality.

5.2.2 Methodology

A literature review was conducted to assess the baseline information available for water quality in Cork Harbour. Sources of information included:

- Cork County Council
- Cork City Council
- Environmental Protection Agency
- Directive 2006/7/EC Concerning the management of bathing water quality and repealing Directive 76/160/EEC
- Bathing Water Quality Regulations (S.I. No 79 of 2008)
- European Communities (Quality of Shellfish Waters) Regulations 2006 (S.I. No. 268 of 2006)
- European Communities (Quality of Shellfish Waters) (Regulations) Regulations 2009 (S.I. No. 55 of 2009)
- Urban Waste Water Treatment Directive 91/271/EEC (amended by 98/15/EC): Urban Waste Water Treatment Regulations 2001 (S.I. No 254 of 2001) and Amendment (S.I. No. 440 of 2004)

A hydrodynamic study for Cork Lower Harbour was conducted by University College Cork (UCC), the findings of which are presented in this section. A computer model, called the 'OH_2' model covering an area from the Old Head of Kinsale to the Waterworks weir in Cork City was developed. This model simulates the release, transport and decay of various micro-organisms in Cork Lower Harbour and the surrounding area due to discharges of untreated and treated waste. In order to determine the improvement in water quality the OH_2 model was configured in two different ways. Firstly it was configured to simulate the release of untreated waste from the towns of Cobh, Passage West, Monkstown, Glenbrook, Ringaskiddy, Crosshaven and Carrigaline and secondly it was configured to simulate the release of treated waste from the proposed WWTP at Carrigaline. By comparing the results of these two cases the improvement in water quality as a result of the proposed WWTP can be estimated. A proper comparison requires the same population is used in both cases and in this study the projected population loadings for 2010 were used. This model was also run for the design flows from the 80,000 pe waste water treatment plant in order to allow an assessment of the impact on water quality at the design flows. The detailed methodology is outlined in the full report which is presented in Appendix G.

There are a number of storm water overflows in the proposed system, generally located at pumping stations. Although for most of the time these overflows will not discharge into the receiving waters, they do have the potential to cause environmental damage when they do overflow. The hydrodynamic model was also run with overflows occurring at all of the storm water overflows, as well as the design flow from the 80,000 pe waste water treatment plant. In order to model the overflows information was required on the flow rate during the overflows, and the sewage concentration within the overflow. The time series rainfall events were used to simulate the worst storm events in a typical year, and the worst of these used for each

individual overflow. For each of these worst case overflow events, the concentration of contaminants in the overflow was calculated assuming all flows are fully mixed in the sewerage network. It is noted that this is a slightly conservative approach as the solids retained in the sewerage network will tend to have a higher concentration of contaminants than the overflows. Nevertheless, this was considered to be an appropriate methodology to examine the potential impacts of the overflow events.

5.2.3 Existing Environment

5.2.3.1 Background

Cork Harbour is the second largest natural Harbour in the world. It consists of two main sections: the Upper Harbour including the Lee Estuary and Lough Mahon and the Lower Harbour. The Outer and Lower Harbours are connected by an east channel and west channel. The west channel is the larger of the two and the majority of the tidal exchange volume occurs through the west channel. Salinity within the Harbour varies greatly. The Upper Harbour is characterised by estuarine salinities and the Lower Harbour by salinities characteristic of coastal marine waters.

When considering the receiving environment, it should be noted that a number of types of geographic areas are generally regarded as being particularly sensitive and significant in an environmental context. Many of these geographic areas are officially designated for protection. One such geographic area type is the coastal zone (EPA, 2002 – EIS Guidelines). Another geographic area type is that which is classified or protected under legislation, including Special areas of Conservation (SAC) with protected species or habitats designated under the *Habitats Directive 92/43/EEC* and Special Protection areas (SPA) for birds designated under the *Birds Directive (79/409/EEC)*.

Within the Lower Harbour area there are a number of protected conservation areas namely, Cork Harbour SPA and the Great Island Channel SAC. Two nationally important designated sites are also present, Monkstown Creek Natural Heritage area (NHA) and Owenboy River NHA. The west passage of the River Lee is designated a sensitive water under the Urban Waste Water Treatment (UWWT) Directive, however, the Lower Harbour area is not designated as a sensitive water under the UWWT Directive.

Under the Bathing Water Quality Regulations 2008 (S.I. No. 79 of 2008), each local authority is required to identify bathing waters where a large number of people are expected to bathe within their functional area by no later than 24th March 2011. Cork County Council has identified eight bathing areas in the Lower Harbour Area, as listed in Table 5.23A.

Table 5.2.3A Bathing Waters in Cork Lower Harbour

Location	Grid Reference	Distance from Discharge Point
Gobby	E 179480, N 064680	2.97 km
Luch	E179150, N 063410	2.40 km
Curraghbinny Pier	E179800, N 061800	1.75 km
Grab-all Bay	E180950, N061300	1.28 km
White Bay	E 182700, N061500	1.65 km
Church Bay	E180750, N060240	2.37 km
Myrtleville	E179700, N058900	3.92 km
Fountainstown	E178650, N 058050	5.23 km

Under the Bathing Water Quality Regulations, the local authority is required to complete a bathing water profile for each bathing water, which includes the following:

- A description of the physical, geographical and hydrological characteristics of the bathing water, and of other surface waters in the catchment area of the bathing water concerned, that could be a source of pollution, which are relevant to the purpose of this Directive and as provided for in Directive 2000/60/EC;
- An identification and assessment of causes of pollution that might affect bathing waters and impair bathers' health;
- An assessment of the potential for proliferation of cyanobacteria;
- An assessment of the potential for proliferation of macro-algae or phytoplankton;
- If the assessment under point (b) shows that there is a risk of short-term pollution, the following information:
  - the anticipated nature, frequency and duration of expected short-term pollution;
  - details of any remaining causes of pollution, including management measures taken and the time schedule for their elimination;
  - management measures taken during short-term pollution and the identity and contact details of bodies responsible for taking such action;
- The location of the monitoring point.

The local authority is required to monitor the quality of the waters a minimum of four times during each bathing season (three samples in areas of geographical constraint). The bathing waters are sampled in respect to intestinal enterococci and *Escherichia coli.* The parameters and reference methods are set out in Table 5.2.3B.

Table 5.2.3B Monitoring Parameters for Coastal Bathing Waters

	Parameter	Excellent Quality	Good Quality	Sufficient Quality	Reference Methods of Analysis
1	Intestinal enterococci (cfu/100ml)	100*	200*	185**	ISO 7899-1 or ISO 7899-2
2	*Escherichia coli*	250*	500*	500**	ISO 9308-3 or ISO 9308-1

* Based upon a 95-percentile evaluation

** Based upon a 90-percentile evaluation

Source: Bathing Water Quality Regulations 2008

The bathing waters are also to be visually inspected for pollution such as tarry residues, glass, plastic, rubber or any other waste. Where the bathing water profile established in relation to a bathing water indicates a potential for cyanobacterial proliferation, the local authority must carry out appropriate monitoring to enable timely identification of health risks. Where the bathing water profile established in relation to a bathing water indicates a tendency for proliferation of macro-algae or marine phytoplankton, the local authority must undertake investigations to determine their acceptability and health risks.

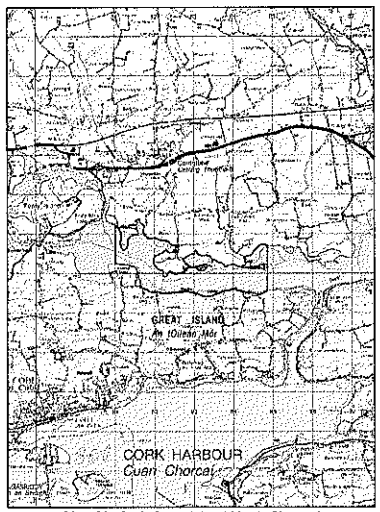
Under the *Quality of Shellfish Waters Regulations* (2006), as amended, there are a number newly designated shellfish waters in Cork Harbour, however the discharge point is not located in a designated shellfish water. The distances from the discharge point to each of the designated shellfish waters are presented in Table 5.2.3C. The locations of the designated shellfish waters are illustrated on Figure 5.2.3A.

Table 5.2.3C Designated Shellfish Waters

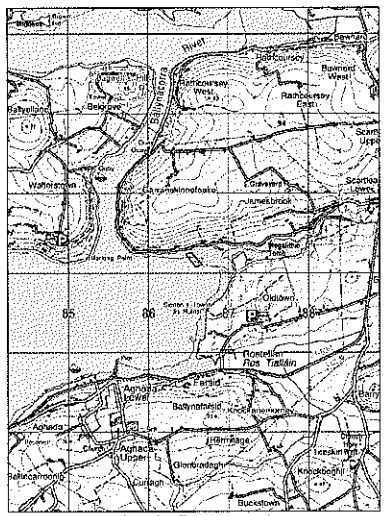
Designated Shellfish Site	Distance from Discharge Point
Cork Great Island North Channel	7.4 km
Rostellan South	6.5 km
Rostellan North	6.9 km
Rostellan West (proposed & at Public Consultation)	6.1 km

There are mandatory quality values for a number of parameters including suspended solids and metals that apply to the designated shellfish waters Under the Quality of Shellfish Waters Regulations 2006. In terms of faecal coliforms, a Guide value of ≤300 MPN/100mls in the shellfish flesh or intervalvular liquid is specified.

Figure 5.2.3A – Designated Shellfish Waters in Cork Harbour (source: Department of the Environment, Heritage and Local Government)

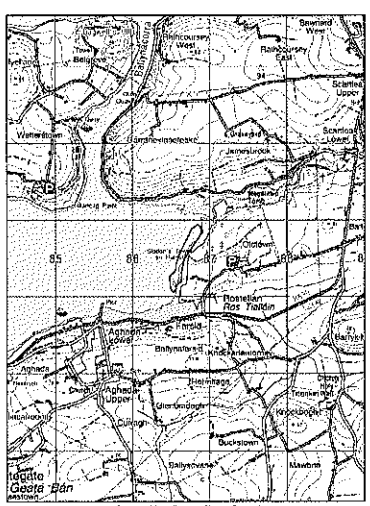


Map 39: Cork Great Island North Channel

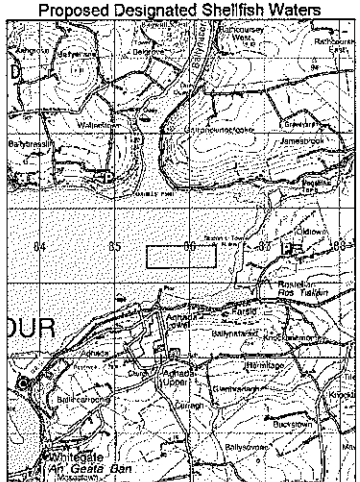


Map 38a: Rostellan North

Proposed Designated Shellfish Waters



Map 38b: Rostellan South



Map 38c: Rostellan West

5.2.3.2 Existing Water Quality in Cork Lower Harbour

Nutrient Enrichment, Accelerated Growth and Undesirable Disturbance

Water quality in Cork Harbour is monitored by the EPA. In order to assess the trophic status of Ireland's estuaries and bays the Assessment of Trophic Status of Estuaries and Bays in Ireland (ATSEBI) system was established. To investigate the eutrophic status of estuarine and coastal waters, three criteria are assessed, namely nutrient enrichment, accelerated growth of algae and other higher plants and undesirable disturbance to the balance of organisms present and to the quality of the water concerned.

Nutrient enrichment is quantified by Dissolved Inorganic Nitrogen (DIN) and Molybdate Reactive Phosphorous (MRP). DIN is the sum of oxidised nitrogen (nitrate and nitrite) and ammonium and is considered to represent available nitrogen for uptake by plants. Phosphorous is present in natural waters in various forms of phosphate. Orthophosphate is the predominant form and regarded as the main form of biologically available phosphorous. However, other forms of phosphate may also occur and phosphate concentrations are quantified as MRP as this incorporates the more reactive portions of other forms of phosphate in addition to orthophosphate and represents the biologically available phosphorous in water. Accelerated growth of algae and other higher plants is quantified by chlorophyll concentration. Undesirable disturbance is quantified by the percentage saturation of dissolved oxygen (DO) in the water.

Based on criteria levels of nutrient enrichment (DIN and MRP), chlorophyll levels and percentage saturation of DO, the trophic status of the water can be classified into eutrophic, potentially eutrophic, intermediate and unpolluted based on the following:

- Eutrophic waterbodies – criteria breached for each parameter
- Potentially eutrophic – criteria breached for two parameters and the third falls within 15% of the criterion value
- Intermediate – criteria for one/two of the parameters breached
- Unpolluted – no breach of criteria levels for each of the three parameters.

Data published by the EPA for the sampling periods 1995-1999 and 1999-2003 (EPA, 2005) demonstrated that the Lough Mahon area of Cork Harbour remained eutrophic; the north channel (Great Island) had improved from eutrophic to intermediate; the Owenacurra estuary had disimproved from potentially eutrophic to eutrophic; Cork Harbour disimproved from unpolluted to intermediate and the Lee estuary remained at intermediate.

Water quality data from Cork City Council for 2005-2007 in Table 5.2.3B *Water quality results 2005-2007* illustrates that DIN during the summer period has decreased and is below the criterion value in Cork Harbour, with the exception of Blackrock Castle. MRP levels are below the criteria in both summer and winter periods. The median chlorophyll concentration was higher than the criterion value at Blackrock Castle and Mid Lough Mahon, however chlorophyll concentrations have decreased compared to previous years. Levels of percentage saturation of dissolved oxygen were above the critical values, with the exception of Blackrock Castle where the 5 percentile value was lower than the critical value. The Lower Harbour exceeded the criteria for winter DIN and this was the only parameter breached during 2005-2007. In comparison with published data for Cork Harbour over the period 1999-2005 (EPA, 2005), water quality within Cork Harbour has exhibited an improvement over the last two years. Carrigrennan WWTP, which treats wastewater from Cork City, commenced operation in 2005 and from the results presented in Table

5.2.3B *Water quality results 2005-2007* an improvement in water quality has been observed within this time period.

Table 5.2.3B: Water quality results 2005-2007 (Cork City Council)

Water Body	DIN (mg/l N) median		MRP (ug/l P) median		Chlorophyll (ug/l) median	Chlorophyll (ug/l) 90%ile	D.O. %Saturation 5%ile	D.O. %Saturation 95%ile
	W	*S*	*W*	*S*	*S*	*S*	*S*	*S*
Waterworks	**3.840 (2.6)**	2.335 (2.6)	34 (60)	26 (60)	3.5 (15)	4.2 (30)	85* (70)	129* (130)
Tivoli	2.375 (2.6)	1.018 (2.6)	45 (60)	39 (60)	13.6 (15)	28.1 (30)	71* (70)	111* (130)
Blackrock Castle	**1.732 (0.697)**	**0.722 (0.697)**	46 (48)	31 (48)	**13.5 (11.9)**	23.4 (23.9)	**75 (76)**	113 (124)
Mid L.Mahon	**1.570 (0.633)**	0.34 (0.633)	43 (47)	21 (47)	11.5 (11.7)	**26.7 (23.3)**	79 (77)	115 (123)
End L.Mahon	**1.366 (0.569)**	0.289 (0.569)	40 (46)	15 (46)	10.6 (11.4)	17.7 (22.8)	81 (77)	120 (123)
Hawbowline	**0.974 (0.442)**	0.163 (0.442)	35 (43)	8 (43)	6.4 (10.8)	11.4 (21.7)	83 (78)	114 (122)
Lower Harbour	**0.509 (0.378)**	0.038 (0.378)	25 (42)	5 (42)	3.8 (10.6)	7.1 (21.1)	81 (79)	117 (121)
End Harbour	**0.364 (0.314)**	0.038 (0.314)	21 (41)	5 (41)	3.9 (10.3)	5.3 (20.6)	80 (79)	115 (121)
* some samples were tested in laboratory				note: data in brackets is criteria value				

DIN – dissolved inorganic nitrogen and considered to represent bio-available Nitrogen; MRP – Molybdate Reactive Phosphorous and considered to represent bio-available dissolved inorganic phosphorous; Chlorophyll – Chlorophyll concentration; D.O. % Saturation – Dissolved oxygen relative to normal for ambient temperature and pressure; W – Winter sampling; S – Summer sampling.

At present (EPA data 2006-2008), water quality in the Lower Harbour area is classed as 'intermediate' and from the data presented in Table 5.2.3B *Water quality results 2005-2007*, the only parameter which exceeded the criterion value was winter levels of DIN.

Bacteria

The Lower Harbour area is not designated as a shellfish water, however, there are newly designated shellfish waters within 6-7km of the discharge point. There are also a number of bathing areas downstream of the discharge. Faecal coliforms are present in waste (human and animal) and levels of faecal coliforms in water are proof of faecal contamination and indicate that pathogenic organisms may be present in water. Data from Cork City Council for the period 2005-2007 was assessed to identify levels of faecal coliforms in Cork Lower Harbour. Figures 5.2.3C *Faecal coliform concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007)*.and 5.2.3D *Faecal coliform concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007)* illustrate levels of faecal coliforms in the Lower Harbour over the period May 2005 to January 2007 during high and low tide. No sampling data was available for the months of January 2006 and May 2006 for low tide sampling and for June 2005, January 2006, May 2006 and December 2006 for high tide sampling. There are no published data on *E. coli* or intestinal enterococci in Cork Lower Harbour at present.

Norovirus

There is no published data on concentrations of *Norovirus* in Cork Lower Harbour to date and there are no legislative requirements to monitor *Norovirus* in Ireland at present. However, *Norovirus* was included as part of this study in order to determine the impact of the discharge from the WWTP.

Figure 5.2.3.C: Faecal Coliform Concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007).

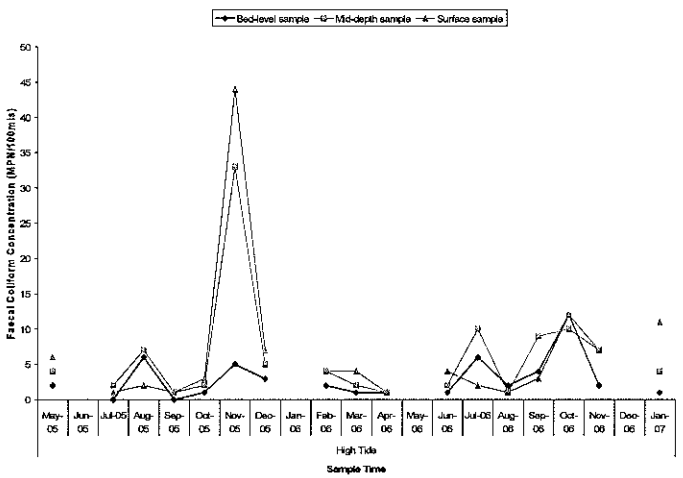
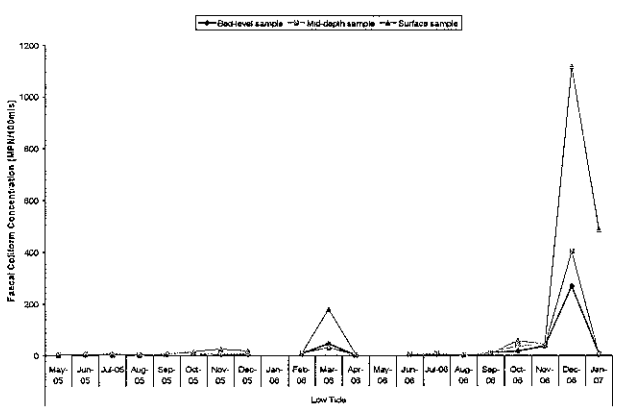


Figure 5.2.3D: Faecal Coliforms Concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007).



The data presented in Figures 5.2.3.C *Faecal coliform concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007)*, and 5.2.3D *Faecal coliform concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007)* illustrates that faecal coliform concentration in Cork Lower Harbour during high tide reached a maximum of 44 MPN/100mls in November 2005. During low tide faecal coliform concentration is generally higher and reached a peak of 1,120 MPN/100mls in December 2006.

Under the *Bathing Water Quality Regulations 2008* specify a standard of 100 intestinal enterococci (cfu/100ml) and 250 *Escherichia coli* (cfu/100ml) in a 95-percentile evaluation for excellent quality coastal waters, however, no data on intestinal enterococci or *E. coli* is available for Cork Lower Harbour at present due to the change in sampling parameters.

Existing Wastewater Discharges from Cork Lower Harbour Catchment

At present, untreated raw effluent is being discharged from Cobh, Passage West, Monkstown, Carrigaline, Ringaskiddy and Crosshaven at numerous outfall locations around Cork Lower Harbour. The existing discharges at outfalls in Cork Lower Harbour are presented in Table 5.2.3C *Outfall locations and discharge rates (2001 data).*

Table 5.2.3C: Outfall Locations and Discharge Rates (2001 Data)

Existing Scenario (2001)						
Outfall Location	**Catchment**	**Co-Ordinates**	**Status**	**Flow (DWF)**	**Faecal Coliform Conc**	**Faecal Coliform**
				m^3/day	fc/ m^3	fc
IDA Outfall -	Crosshaven, Carrigaline, Shanbally	E181358, N62522	Untreated	4,075.03	1E+11	4.08.E+14
Monkstown	Monkstown	E178550, N69225	Untreated	185.33	1E+11	1.85.E+13
Glenbrook	Glenbrook	E177180, N67449	Untreated	327.08	1E+11	3.27.E+13
Passage West	Passage West	E177243, N66523	Untreated	547.01	1E+11	5.47.E+13
Pilots Pier Outfall	Part of Cobh	E180796, N66551	Untreated	353.81	1E+11	3.54.E+13
Corbett Outfall	Part of Cobh	E180440, N66507	Untreated	178.10	1E+11	1.78.E+13
Kings Quay Outfall	Part of Cobh	E180016, N66416	Untreated	444.95	1E+11	4.45.E+13
West Beach Outfall	Part of Cobh	E179808, N66375	Untreated	668.31	1E+11	6.68.E+13
White Point Outfall	Part of Cobh	E178247, N65576	Untreated	634.80	1E+11	6.35.E+13
Ringaskiddy Village Outfall	Ringaskiddy Village	E178202, N64724	Untreated	101.29	1E+11	1.01.E+13
Total Catchment				7,515.71		7.52E+14
Total Ringaskiddy Outfall				4,075.03		4.08E+14

It is proposed to collect wastewater from the Cork Lower Harbour catchment area and treat the effluent at a WWTP in the townland of Shanbally. The treated effluent will then by discharged at the existing Ringaskiddy IDA outfall, resulting in a reduction in the number of outfall points in Cork Lower Harbour.

The hydrodynamic study conducted by UCC modelled the existing flow rates and loadings of effluent from the Lower Harbour catchment area. The concentrations indicated are not representative of the actual water quality in the Harbour, but of the concentrations in the Harbour due to the untreated discharges in the Lower Harbour area.

Faecal Coliforms and *E. coli*

Due to the loadings and die-off rates of faecal coliforms and *E. coli* being identical, the following section is representative of levels of faecal coliforms and *E. coli*. The maximum number of faecal coliforms/*E. coli* during repeating spring tides ranged from 2 to 1,500 faecal coliforms/*E. coli* per 100ml across the harbour, with the exception of the areas in the immediate vicinity of the outfalls. The results of the repeating neap tides were similar. Figure 5.2.3D *Location of fifteen points of interest within Cork Lower Harbour* illustrates the location of fifteen points of interest within Cork Lower Harbour and Table 5.2.3D *Average and maximum concentrations of faecal coliforms/E. coli at fifteen points of interest in Cork Lower Harbour* lists the maximum and average concentration of faecal coliforms/*E. coli* at these points following the discharge of untreated effluent (without overflows) from the Lower Harbour area in 2010.

Figure 5.2.3D: Location of fifteen points of interest within Cork Lower Harbour

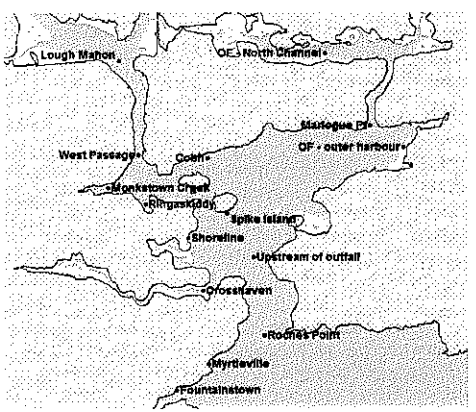


Table 5.2.3D: Average and maximum concentrations of faecal coliforms/*E. coli* at fifteen points of interest in Cork Lower Harbour (untreated in 2010)

Year	2010		2010	
Treatment	Untreated		Untreated	
Repeating Tide	Spring	Neap	Spring	Neap
	AVG	AVG	MAX	MAX
Fountainstown	0.29	0.09	1.0	0.5
Myrtleville	0.79	1.75	3.7	4.5
Roches Point	63.79	77.24	354.3	555.8
Crosshaven	5.96	1.28	24.5	5.6
Ringaskiddy	18.86	7.89	59.1	23.8
Monkstown Ck	11.56	8.47	33.8	118.1
Oyster F - NC	0.02	0.00	7.8	0.0
Marlogue Point	3.62	0.04	36.1	1.1
Oyster F - Outer	0.04	0.00	3.7	0.0
Cobh	113.10	153.99	478.4	475.4
Spike Island	14.22	19.24	66.0	97.0
Shoreline	2.71	0.89	15.2	14.0
Upstream Outfall	115.62	289.31	1838.8	2294.3
West Passage	77.28	112.43	194.4	245.6
Lough Mahon	63.40	58.61	215.0	188.4
All concentrations are expressed in number of faecal coliforms/E. coli per 100ml				

Norovirus

The maximum number of *Norovirus* in the harbour for the untreated waste simulation ranged from 2 to 18,000 *Norovirus* per cubic metre. Table 5.2.3E *Average and maximum concentrations of Norovirus at fifteen points of interest in 2010,* lists the concentrations of *Norovirus* at fifteen points of interest in Cork Lower Harbour following the discharge of untreated effluent from the Lower Harbour area.

Table 5.2.3E: Average and maximum concentrations of *Norovirus* at fifteen points of interest (untreated in 2010)

Year	2010	2010
Treatment	Untreated	Untreated
	Max	Average
Fountainstown	3,886	1,008
Myrtleville	4,542	1,505
Roches Point	6,478	2,650
Crosshaven	7,940	2,507
Ringaskiddy	11,740	7,423
Monkstown Ck	12,214	7,239
Oyster F – NC	5,870	1,331
Marlogue Point	10,772	3,341
Oyster F - Outer	5,475	2,550
Cobh	16,152	8,452
Spike Island	10,048	4,008
Shoreline	8,967	3,984
Upstream Outfall	14,991	3,787
West Passage	15,318	8,766
Lough Mahon	14,730	7,518
All concentrations are expressed in number of Norovirus per m^3.		
The average values are for the 20 day viral pulse		

Organic Nitrogen, Ammonia and Nitrate

Maximum concentrations of organic nitrogen at the fifteen points of interest ranged from 0.000844 mg/L in the North Channel to 0.004708mg/L upstream of the IDA outfall. Concentrations of ammonia ranged between 0.000655-0.008214mg/L and concentrations of nitrate ranged between 0.000684-0.004048mg/L. Average concentrations at these points were considerably less and are presented in Table 5.2.3F *Maximum and average concentrations of nitrogen, ammonia and nitrate at fifteen points of interest in Cork Lower Harbour.*

Table 5.2.3F: Maximum and average concentrations of nitrogen, ammonia and nitrate at fifteen points of interest in Cork Lower Harbour.

	Nitrogen (mg/L)		Ammonia (mg/L)		Nitrate (mg/L)	
Year	2010	2010	2010	2010	2010	2010
	MAX	AVG	MAX	AVG	MAX	AVG
Fountainstown	0.000321	0.000138	0.000655	0.000276	0.000684	0.000244
Myrtleville	0.000413	0.000222	0.000836	0.000434	0.000832	0.000315
Roches Point	0.001366	0.000408	0.002529	0.000737	0.001582	0.000285
Crosshaven	0.001325	0.000434	0.002549	0.000832	0.001792	0.000542
Ringaskiddy	0.001831	0.001204	0.003655	0.002332	0.003576	0.001666
Monkstown	0.001853	0.001125	0.003688	0.002192	0.003527	0.001637
Oyster F - NC	0.000805	0.000124	0.001640	0.000261	0.001813	0.000325
Marlogue Point	0.002090	0.000416	0.003966	0.000820	0.002705	0.000692
Oyster F - OH	0.000884	0.000277	0.001756	0.000569	0.001812	0.000603
Cobh	0.002976	0.001697	0.005501	0.003152	0.004048	0.001612
Spike Island	0.001770	0.000663	0.003422	0.001249	0.002581	0.000705
Shoreline	0.001344	0.000352	0.002647	0.000675	0.002279	0.000439
Up. Outfall	0.004708	0.000660	0.008214	0.001196	0.002188	0.000482
West Passage	0.002601	0.001408	0.004962	0.002646	0.003609	0.00151
Lough Mahon	0.002517	0.001264	0.00480	0.002390	0.003512	0.001450

5.2.4 Impact Assessment

Operational Phase Impacts

WWTP and Collection System

At present the population centres in the Lower Harbour area discharge untreated effluent into the harbour at several outfalls. The proposed WWTP and upgraded collection system will have a positive impact on water quality in Cork Lower Harbour due to the secondary treatment of the sewage from the Lower Harbour area and discharge of the treated effluent through a single outfall into the deep water channel in the Lower Harbour.

A hydrodynamic modelling study conducted by UCC was used to estimate the relative reduction in faecal coliforms, *Norovirus*, organic nitrogen, ammonia and nitrate following treatment in the proposed WWTP. The upgraded collection system will result in a reduction in the number of outfalls to a single outfall into the deep water channel near Dognose Bank.

For the year 2010, the model includes for the effect of the discharge only and 15 points of interest were considered. The model for 2035 was conducted for 21 points of interest. In relation to the results for 2035 (design year), the model compares the effect of the discharge with the effect of the discharge plus a stormwater overflow event. The maximum values are presented for the discharge only (continuous discharge over 3 days) and the discharge plus the stormwater overflow event (continuous primary discharge over 7 days with overflow events at 17 overflow points occurring simultaneously on day 4). The full study conducted by UCC is presented in Appendix G. It should be noted that the impact assessment in this section considers the impact of the proposed WWTP and collection system on the waters of Cork Lower Harbour - wastewater from the Lower Harbour catchment area is only one of many factors contributing to water quality in the Harbour.

Faecal Coliforms and *E. coli*

It was assumed that there are $1.0*10^{11}$ faecal coliforms/*E. coli* in every cubic metre of raw sewage (Tchobanoglous *et al.*, 2003) which is equivalent to $1.0*10^{7}$ faecal coliforms/*E. coli* in every 100ml. Due to the concentrations and die-off rates of faecal coliforms and *E. coli* being identical, the results of the hydrodynamic model are identical for both species. It was also assumed and that the proposed WWTP will remove 90% of the organic matter. Therefore there are $1.0*10^{10}$ faecal coliforms/*E. coli* in every cubic metre of treated effluent which is equivalent to $1.0*10^{6}$ faecal coliforms/*E. coli* per 100ml.

Comparison of the concentrations of faecal coliforms/*E. coli* in untreated and treated effluent revealed that there is an 80% relative reduction in the number of indicator organisms following secondary treatment in the WWTP in 2010. For the inner harbour and the East and West Passages a 95% relative reduction in the number of indicator organisms was found in 2010. This represents a significant reduction in the numbers of faecal coliforms/*E. coli* discharged from the Lower Harbour area. At all fifteen points of interest, the concentrations of faecal coliforms/*E. coli* from the discharge are well below the 250 cfu/100ml limit for excellent quality bathing waters.

A model was also run for the design year of 2035 to compare levels of concentrations of faecal coliforms/*E. coli* from the discharge alone versus the discharge plus a stormwater overflow event. Table 5.2.4B presents the concentrations for spring and neap tides. As would be expected, the concentrations near the outfall are high. At all bathing water locations and shellfish designated areas of the harbour the concentrations of faecal coliforms/*E. coli* are below the concentration for 'excellent quality' bathing waters, with the exception of White Point during a stormwater event. However, the modelling work was based on the worst storm event in a typical year, and overflows affecting these bathing waters are not expected to exceed three incidents per year. This would cause these waters to be considered as being subject to short-term pollution under the 2008 Bathing Water Quality Regulations, and the waters may still be classified as 'excellent quality' subject to various management measures.

Table 5.2.4A: Average and maximum concentrations of faecal coliforms/*E. coli* in Cork Lower Harbour in 2010

Year	2010		2010	
Treatment	Untreated	Treated	Untreated	Treated
Repeating Tide	Spring	Neap	Spring	Neap
	MAX	MAX	AVG	AVG
Fountainstown	0.2	0.1	0.05	0.02
Myrtleville	0.7	0.8	0.14	0.32
Roches Point	65.3	102.5	11.65	14.25
Crosshaven	3.8	1.5	0.95	0.19
Ringaskiddy	0.0	0.0	0.01	0.00
Monkstown Ck	0.0	0.0	0.01	0.00
Oyster F - NC	0.1	0.0	0.00	0.00
Marlogue Point	0.3	0.0	0.04	0.00
Oyster F - Outer	0.6	0.4	0.00	0.00
Cobh	23.2	0.9	5.32	0.05
Spike Island	9.1	17.8	1.55	3.16
Shoreline	2.2	1.2	0.56	0.10
Upstream Outfall	333.7	423.0	20.12	53.32
West Passage	1.0	0.0	0.08	0.00
Lough Mahon	0.1	0.0	0.01	0.00

All concentrations are expressed in number of faecal coliforms/E. coli per 100ml.

Table 5.2.4B: Maximum concentrations of faecal coliforms/*E. coli* in Cork Lower Harbour in 2035

Location	Repeating Spring Tide (T90=12hrs)		Repeating Spring Tide (T90=24hrs)		Repeating Neap Tide (T90=12hrs)		Repeating Neap Tide (T90=24hrs)	
Year	2035		2035		2035		2035	
	D	D+O	D	D+O	D	D+O	D	D+O
Fountainstown	0.6	0.6	2.9	2.9	0.2	0.2	2.6	2.6
Myrtleville	0.6	0.6	3.0	3.0	1.9	2.1	8.3	8.9
Roches Point	98.9	98.9	118.2	118.2	139.0	142.0	191.9	197.1
Crosshaven	5.1	8.2	14.7	20.4	1.4	2.3	9.9	11.4
Ringaskiddy	0.0	5.0	0.5	16.4	0.0	2.8	0.0	10.5
Monkstown Creek	0.0	166.8	0.5	172.9	0.0	101.2	0.1	237.6

Location	Repeating Spring Tide (T90=12hrs)		Repeating Spring Tide (T90=24hrs)		Repeating Neap Tide (T90=12hrs)		Repeating Neap Tide (T90=24hrs)	
Oyster Farm – North Channel	0.0	0.4	0.1	2.4	0.0	0.0	0.0	0.0
Marlogue Point	3.4	34.7	10.4	62.2	0.0	0.3	0.4	2.1
Oyster Farm – Outer Harbour	0.1	2.9	0.9	11.1	0.1	2.0	2.1	9.0
Cobh	39.0	39.0	65.7	81.3	2.4	30.0	15.0	72.6
Spike Island	12.8	12.8	29.9	30.2	27.6	35.1	58.9	73.7
Shoreline	3.0	3.4	11.3	12.3	1.7	2.5	9.6	13.1
Near Outfall	890.3	890.3	932.6	932.6	1067.7	1067.7	1146.3	1146.3
West Passage	2.8	126.3	9.0	151.0	0.0	138.4	0.1	205.2
Lough Mahon	0.2	172.8	1.4	200.0	0.0	278.7	0.0	340.2
White Point	25.5	820.1	49.6	889.9	0.3	1111.7	2.3	1304.5
Gobby	6.0	6.0	16.8	17.8	2.2	2.6	11.0	13.5
Curraghbinny	5.6	5.9	15.6	16.4	1.7	2.6	10.8	14.6
White Bay	4.6	7.8	15.7	17.2	7.9	15.8	24.2	43.4
Grab-all Bay	2.2	2.2	7.5	7.5	5.7	12.5	23.5	33.1
Church Bay	7.6	11.8	13.4	18.9	10.6	11.0	34.2	37.4

D – Discharge continuous over 3 days; D+O – Discharge over 7 days with overflow event on day 4

Intestinal Enterococci

The Bathing Water Quality Regulations require levels of less than 100 intestinal enterococci (cfu/100mls) in a 95-percentile evaluation for 'excellent quality' bathing waters and levels of less than 200 cfu/100mls for 'good quality' bathing waters. The results of the hydrodynamic model for 2010 predict that the treated effluent from the Cork Lower Harbour Area will contribute a maximum level of ca. 19 cfu/100mls (during neap tides) upstream of the outfall and concentrations decrease with distance from the outfall point. Average concentrations at the fifteen points of interest ranged from 0.00 - 2.91 cfu/100mls. Refer to Table 5.2.4C *Average and maximum levels of intestinal enterococci in Cork Lower Harbour following the discharge of treated effluent from the Lower Harbour area in 2010* for levels of intestinal enterococci at fifteen points of interest in Cork Lower Harbour.

A model was also run for the design year of 2035 to compare levels of concentrations of intestinal enterococci from the discharge alone versus the discharge plus a stormwater overflow event. Table 5.2.4D presents the concentrations for spring and neap tides. At all bathing water locations and shellfish waters, the concentrations of intestinal enterococci from the discharge and overflows are all below 100 cfu/100mls. The highest concentrations are near the primary outfall and White Point. However, the concentrations are all lower than the 100 cfu/100mls required to achieve 'excellent' quality bathing waters.

Table 5.2.4C: Average and maximum levels of intestinal enterococci in Cork Lower Harbour in 2010

Year	2010		2010	
Repeating Tide	Spring		Neap	
	MAX	AVG	MAX	AVG
Fountainstown	0.05	0.02	0.05	0.01
Myrtleville	0.11	0.04	0.19	0.09
Roches Point	3.18	0.67	5.78	1.01

Year	2010		2010	
Repeating Tide	Spring		Neap	
	MAX	AVG	MAX	AVG
Crosshaven	0.45	0.14	0.37	0.06
Ringaskiddy	0.01	0.01	0.00	0.00
Monkstown Ck	0.02	0.01	0.00	0.00
Oyster F - NC	0.04	0.00	0.00	0.00
Marlogue Point	0.08	0.01	0.04	0.00
Oyster F - Outer	0.13	0.00	0.20	0.00
Cobh	1.60	0.42	0.30	0.02
Spike Island	0.86	0.20	1.60	0.44
Shoreline	0.34	0.07	0.30	0.03
Upstream Outfall	14.28	1.03	19.18	2.91
West Passage	0.17	0.02	0.01	0.00
Lough Mahon	0.04	0.00	0.00	0.00

Table 5.2.4D: Maximum levels of intestinal enterococci in Cork Lower Harbour in 2035

Year	2035	2035	2035	2035
Repeating Tide	Spring (D)	Spring (D+O)	Neap (D)	Neap (D+O)
Fountainstown	0.12	0.12	0.1	0.1
Myrtleville	0.12	0.12	0.33	0.35
Roches Point	4.73	4.73	7.68	7.89
Crosshaven	0.59	0.82	0.4	0.46
Ringaskiddy	0.02	0.66	0	0.42
Monkstown	0.02	6.92	0	9.5
O Farm - NC	0.01	0.1	0	0
Marlogue Point	0.42	2.49	0.02	0.08
O Farm - OH	0.04	0.44	0.08	0.36
Cobh	2.63	3.25	0.6	2.9
Spike Island	1.19	1.21	2.35	2.95
Shoreline	0.45	0.49	0.38	0.53
Near Outfall	37.3	37.3	45.85	45.85
West Passage	0.36	6.04	0	8.21
Lough Mahon	0.06	8	0	13.61
White Point	1.98	35.6	0.09	52.18
Gobby	0.67	0.71	0.44	0.54
Curraghbinny	0.62	0.66	0.43	0.59
White Bay	0.63	0.69	0.97	1.74
Grab-all Bay	0.3	0.3	0.94	1.32
Church Bay	0.53	0.76	1.37	1.5

D – Discharge continuous over 3 days; D+O – Discharge over 7 days with overflow event on day 4

Norovirus

It was conservatively assumed that there are 50 million *Norovirus*/m^3 in raw sewage and that the WWTP will remove 90% of the organic matter such that after treatment there are 5 million *Norovirus*/m^3 in treated effluent. Previous studies have estimated 20 million *Norovirus*/m^3 in raw sewage (Pommepuy *et al.*, 2004). Comparison of the concentrations of *Norovirus* in untreated and treated effluent discharged into the harbour in 2010 from the Lower Harbour area revealed that there is an 80% relative reduction in the concentration of *Norovirus* following secondary treatment in the WWTP in the entire harbour area with the exception of the area immediately adjacent to the outfall. For areas of the Inner harbour the improvement was much greater with a 95% relative reduction in *Norovirus*. Table 5.2.4E *Average and maximum concentrations of Norovirus in Cork Lower Harbour in 2010* details the *Norovirus* levels at the fifteen points of interest.

Table 5.2.4E: Average and maximum concentrations of *Norovirus* in Cork Lower Harbour in 2010

Year	2010	2010
Repeating Tide	Treated	Treated
	AVERAGE	MAX
Fountainstown	195	695
Myrtleville	285	798
Roches Point	532	1254
Crosshaven	368	917
Ringaskiddy	219	550
Monkstown Ck	186	556
Oyster F – NC	89	550
Marlogue Point	252	933
Oyster F - Outer	219	545
Cobh	430	1374
Spike Island	523	1203
Shoreline	496	1028
Upstream Outfall	701	3157
West Passage	205	817
Lough Mahon	98	471
All concentrations are expressed in no. of Norovirus per m^3		
The average values are for the 20 day viral pulse		

Organic nitrogen, ammonia and nitrate

Table 5.2.4F *Concentration of organic nitrogen, ammonia and nitrate in raw and treated sewage* details the concentrations of organic nitrogen, ammonia and nitrate in untreated and treated sewage. Table 5.2.4G *Maximum concentrations of nitrogen, ammonia and nitrate in the Lower Harbour area in 2010* lists the concentrations of nitrogen, ammonia and nitrate at fifteen points of interest following the discharge of untreated and treated effluent from the Lower Harbour area. The concentrations of each of these species of nitrogen in the harbour was found to decrease following secondary treatment of the effluent, with the exception of organic nitrogen concentrations at Fountainstown, Myrtleville, Roches Point and upstream of the IDA outfall. These slight increases are due to the discharge of all treated effluent through a single outfall, compared to the present scenario where there are numerous outfall points. It is evident that the proposed development will reduce considerably the forcing on primary production in the Inner Harbour

(Lough Mahon) and in the North Channel behind Great Island. There is also an improvement throughout the Outer Harbour with the possible exception of the immediate vicinity of the diffuser itself. As discussed previously, DIN levels in the harbour have exceeded the criterion value during winter sampling periods in recent years.

Table 5.2.4F: Concentration of Organic Nitrogen, Ammonia and Nitrate in Raw and Treated Sewage

Nutrient	Raw Sewage	Treated Sewage
Organic Nitrogen	15mg/l	15mg/l
Ammonia	25mg/l	12.5mg/l
Nitrate	1mg/l	1mg/l

Table 5.2.4G Maximum concentrations of nitrogen, ammonia and nitrate in the Lower Harbour area in 2010.

	Nitrogen (mg/L)		Ammonia (mg/L).		Nitrate (mg/L)	
	2010	2010	2010	2010	2010	2010
	MAX (untreated)	MAX (treated)	MAX (untreated)	MAX (treated)	MAX (untreated)	MAX (treated)
Fountainstown	0.000321	0.000432	0.000655	0.000553	0.000584	0.00046149
Myrtleville	0.000413	0.000500	0.000836	0.000631	0.000832	0.00050580
Roches Point	0.001366	0.001779	0.002529	0.001785	0.001582	0.00073657
Crosshaven	0.001325	0.001038	0.002549	0.001156	0.001792	0.00067713
Ringaskiddy	0.001831	0.000393	0.003655	0.000543	0.003576	0.00064122
Monkstown	0.001853	0.000413	0.003688	0.000560	0.003527	0.00060934
Oyster F - NC	0.000805	0.000390	0.001640	0.000526	0.001813	0.00056257
Marlogue Point	0.002090	0.000689	0.003966	0.000850	0.002705	0.00070098
Oyster F - OH	0.000884	0.000809	0.001756	0.000954	0.001812	0.00064305
Cobh	0.002976	0.001831	0.005501	0.001858	0.004048	0.00081516
Spike Island	0.001770	0.001385	0.003422	0.001472	0.002581	0.00074446
Shoreline	0.001344	0.000976	0.002647	0.001060	0.002279	0.00067418
Up. Outfall	0.004708	0.006471	0.008214	0.005683	0.002188	0.00105842
West Passage	0.002601	0.000870	0.004962	0.001027	0.003609	0.00074542
Lough Mahon	0.002517	0.000471	0.004800	0.000614	0.003512	0.00062927

A model was also run to compare concentrations of organic nitrogen, ammonia and nitrate from the discharge alone in the design year 2035 with concentrations from the discharge plus a stormwater overflow event at 11 overflow locations. Table 5.2.4H, I and J present the modelled concentrations of organic nitrogen, ammonia and nitrate at the 21 points of interest around the harbour. The concentrations from the discharge are presented and the concentrations from the discharge plus a stormater overflow event at 11 overflow locations. Concentrations of organic nitrogen at Fountainstown, Myrtleville, Roches Point, Crosshaven, Spike Island and near the outfall were found to increase slightly for both the discharge alone and the discharge plus the stormwater overflow. This is due to the treated effluent being discharged through a single outfall. All other locations were found to have a lower concentration of organic nitrogen. The concentrations of nitrate at all locations in 2035 (including the stormwater overflow event) were found to be lower than the existing modelled scenario and the concentrations of ammonia in 2035 were all found

to be lower than the existing scenario, with the exception of Fountainstown and near the IDA outfall. The stormwater overflow event modelled, resulted in very small increases in the concentrations of the three nitrogen species at all locations and the effect was very slight overall.

Table 5.2.4H Maximum concentrations of organic nitrogen in 2035

Year	2035	2035	2035	2035
Repeating Tide	Spring (D)	Spring (D+O)	Neap (D)	Neap (D+O)
Fountainstown	0.000595971	0.00060683	0.000990368	0.00100436
Myrtleville	0.000659684	0.000664884	0.0018467	0.00187127
Roches Point	0.00235956	0.00236105	0.0048408	0.00493344
Crosshaven	0.00139368	0.0014054	0.00329813	0.00347006
Ringaskiddy	0.000584219	0.000652899	0.000472892	0.000653512
Monkstown	0.000611729	0.000701848	0.000412356	0.00061869
O Farm - NC	0.000243078	0.000287357	0.00000476	0.0000159
Marlogue Point	0.00129393	0.00132723	0.000642876	0.000796296
O Farm - OH	0.000293777	0.000341623	0.0000285	0.0000696
Cobh	0.00246975	0.00250419	0.00250856	0.00275369
Spike Island	0.00181247	0.00182609	0.00611542	0.00634344
Shoreline	0.00107092	0.00109349	0.00248344	0.00266602
Near Outfall	0.0158008	0.0158338	0.0240152	0.0242594
West Passage	0.00104097	0.00109628	0.0006562	0.00099883
Lough Mahon	0.000668007	0.000783732	0.000112376	0.000506615
White Point	0.00214763	0.00218058	0.00160546	0.00259929
Gobby	0.00147476	0.00149229	0.00276591	0.00296221
Curraghbinny	0.00141607	0.00142785	0.00332785	0.00351853
White Bay	0.0015626	0.00157995	0.00375141	0.00394069
Grab-all Bay	0.00110303	0.00111529	0.00328506	0.0034628
Church Bay	0.00106974	0.00108009	0.00326687	0.00336238

D – Discharge only; D+O – Discharge plus overflow event

Table 5.2.4I Maximum concentrations of ammonia in 2035

Year	2035	2035	2035	2035
Repeating Tide	Spring (D)	Spring (D+O)	Neap (D)	Neap (D+O)
Fountainstown	0.000689	0.000710822	0.00121819	0.00125716
Myrtleville	0.000766	0.000776648	0.00220031	0.00226596
Roches Point	0.002164	0.00219562	0.00555491	0.00577458
Crosshaven	0.001479	0.0015094	0.00442414	0.00483428
Ringaskiddy	0.000813	0.000949558	0.000789932	0.00119951
Monkstown	0.000823	0.000992851	0.000687101	0.00113547
O Farm - NC	0.000379	0.000479774	0.0000092	0.0000358
Marlogue Point	0.001492	0.00156226	0.00106187	0.00141144
O Farm - OH	0.000447	0.000546542	0.0000537	0.000150048
Cobh	0.002467	0.00253901	0.0035758	0.00410295
Spike Island	0.001859	0.00186201	0.0073886	0.00787696
Shoreline	0.001216	0.00126955	0.0035801	0.00399681

Year	2035	2035	2035	2035
Repeating Tide	Spring (D)	Spring (D+O)	Neap (D)	Neap (D+O)
Near Outfall	0.01359	0.0136607	0.0222593	0.0227934
West Passage	0.001268	0.00137545	0.00106508	0.00166562
Lough Mahon	0.000891	0.00117855	0.000198531	0.000853972
White Point	0.002227	0.00294475	0.00245071	0.00434521
Gobby	0.001568	0.00160526	0.0038563	0.00430072
Curraghbinny	0.001498	0.00152833	0.00446	0.00486981
White Bay	0.001675	0.00171258	0.00456812	0.00499266
Grab-all Bay	0.001232	0.00127028	0.00440373	0.00481644
Church Bay	0.001186	0.00121164	0.00401905	0.00423895

D – Discharge only; D+O – Discharge plus overflow event

Table 5.2.4J Maximum concentrations of nitrate in 2035

Year	2035	2035	2035	2035
Repeating Tide	Spring (D)	Spring (D+O)	Neap (D)	Neap (D+O)
Fountainstown	0.000511689	0.000637159	0.000976457	0.00126324
Myrtleville	0.000496711	0.000541859	0.00164007	0.00201972
Roches Point	0.000774783	0.000887428	0.00410426	0.00521525
Crosshaven	0.000804371	0.00123832	0.00471967	0.0066906
Ringaskiddy	0.000928996	0.00130578	0.00145651	0.00327032
Monkstown	0.000921184	0.00132228	0.0012354	0.00296218
O Farm - NC	0.000577484	0.00106058	0.0000236	0.000174897
Marlogue Point	0.00101778	0.00130193	0.00186068	0.0035078
O Farm - OH	0.00063785	0.00111067	0.000129316	0.000644875
Cobh	0.00108634	0.00135099	0.00448886	0.0070129
Spike Island	0.00101741	0.00128527	0.00612152	0.00848513
Shoreline	0.00084622	0.00107078	0.00458041	0.00683121
Near Outfall	0.0019289	0.00213117	0.00712616	0.00937204
West Passage	0.00102205	0.00134735	0.00180242	0.00364029
Lough Mahon	0.000919028	0.00131993	0.000409527	0.0013012
White Point	0.00107099	0.00135691	0.00356844	0.00596266
Gobby	0.000860151	0.0010617	0.00457998	0.00686584
Curraghbinny	0.000805422	0.00120165	0.00472114	0.00669747
White Bay	0.000823231	0.000951407	0.00384346	0.00544282
Grab-all Bay	0.000762105	0.000884209	0.00474429	0.00660637
Church Bay	0.000651558	0.000739149	0.00337912	0.00442189

D – Discharge only; D+O – Discharge plus overflow event

From the data presented above, water quality in Cork Lower Harbour is expected to improve with the operation of a WWTP in the Lower Harbour area due to reductions in the concentrations of faecal coliforms, intestinal enterococci, *Norovirus*, organic nitrogen, ammonia and nitrate entering the Harbour.

5.3 Required Treated Effluent Standard

The Urban Waste Water Treatment Regulations, 2001 (S.I. No. 254 of 2001) requires Cork County Council to provide for "secondary treatment or an equivalent treatment on the commencement of these Regulations, or such later date not being later than 31st December 2005, as the European Commission may agree pursuant to a request under Article 8 of the Directive, in respect of all discharges from agglomerations with a population equivalent of more than 15,000".

This requirement applies to Carrigaline which has a 2001 population equivalent of 16,305. The Regulations also require the provision of secondary treatment by 31st December 2005 in respect of discharges from agglomerations with a population equivalent of between 10,000 and 15,000 (applies to Cobh with 2001 population equivalent of 13,865), and in respect of all discharges to estuaries from agglomerations with a population equivalent of between 2,000 and 10,000 (applies to Passage West/Monkstown and Crosshaven with 2001 population equivalents of 6,189 and 2,320 respectively).

In addition, the Regulations also require the provision of appropriate treatment by 31st December 2005 in respect of discharges to coastal waters from agglomerations with a population equivalent of less than 10,000.

The Regulations also state that "more stringent requirements than those specified in Parts 1 and 2 of the Second Schedule shall be applied to discharges from a treatment plant where this is required to ensure that the receiving waters satisfy any other relevant Community Directives".

Since there are no designated bathing areas or Blue Flag beaches or marinas in the vicinity of the outfall, compliance with the Quality of Bathing Waters (Amendment) regulations, 1996 is not a legislative requirement.

In the Cork Harbour area there are no areas designated under the Quality of Shellfish Waters Regulations, 1994, and therefore treatment of wastewater to achieve compliance with these regulations is not a legislative requirement. As can be seen from Section 5.2 above, provision of secondary treatment for the municipal wastewater will result in a decrease in the pollution loading on the receiving waters, and will have no negative impact on the existing shellfish production areas.

It is only the main channel of the River Lee upstream of the Lee Road Waterworks in Cork City which is designated under the European Communities (Quality of Salmonid Waters) Regulations 1988. Therefore, these regulations do not impact on the treated effluent standard required for the Cork Harbour Main Drainage Scheme.

Cork Harbour is not covered by the Local Government (Water Pollution) Act 1977 (Water Quality Standards for Phosphorus) regulations, 1998 which are applicable only to Rivers and Lakes.

On this basis the standards which shall apply to the treated effluent from the proposed Cork Harbour Wastewater Treatment Plant will be as follows:

- BOD_5 < 25 mg/l
- COD < 125 mg/l
- Suspended Solids < 35 mg/l

Nutrient removal or reduction will not be required.

5.4 Future Treatment Requirements

5.4.1 Wastewater Treatment Requirements

To achieve the treated effluent standards specified it is necessary to provide at a minimum preliminary treatment followed by secondary treatment of the wastewater prior to discharge.

5.4.1.1 Preliminary Treatment

Septicity Control

There is a strong potential for septic conditions to arise in the collection and conveyance systems en route from the wastewater sources in the different towns to the wastewater treatment plant due to the length of the conveyance system and the distance from the population centres to the treatment plant.

Parts of the town of Cobh are approximately 12 km in sewer length from the proposed wastewater treatment plant, with Passage West and Crosshaven being up to 11 km in terms of sewer length from the proposed plant. The resultant residence time in the sewer network and conveyance system would be expected to give rise to septic conditions in the wastewater.

To overcome this, it is intended to provide septicity control in the form of chemical addition at critical pump stations and locations in the collection/conveyance system. Pre-treatment of the wastewater at the wastewater treatment plant is also necessary to address the risk of residual septicity in the wastewater.

Screening

Screening of the raw wastewater is essential

- to prevent blockage or malfunction of downstream equipment due to build up or deposition of gross solid material (rags, plastics etc.), to protect downstream equipment from damage,
- to ensure good quality treated effluent with no visible wastewater derived debris floating near the outfall and,
- to maintain a good quality sludge product.

To prevent deposition and accumulation of solids in the submerged marine crossing of the conveyance system from Cobh to Monkstown, screening will be provided at the upstream end of the crossing. These screenings will be macerated and returned to the wastewater flow. This will minimise labour and space requirements as well as nuisance potential at the Cobh site. (Refer to Section 3 of this Preliminary Report.)

Screening to 6mm will be necessary at the Cork Harbour Wastewater Treatment Plant to remove the macerated screenings produced at Cobh.

Grit removal

Removal of grit from the raw wastewater prevents its deposition and build up in downstream stages of treatment, reduces the corrosive wear on pump and other mechanical equipment, and also improves the quality of sludge produced. Generally grit particles of less than 0.2 mm in size are acceptable and cause few problems.

The proposed modifications to the Cobh Sewerage Scheme will result in a partially combined collection system. Upstream of the harbour crossing of the conveyance system from Cobh to Monkstown, a grit removal system will be provided. This is necessary to prevent the deposition and accumulation of grit in the submerged pipework during periods of low or no wastewater flow. This will reduce the cleaning requirements of this submerged marine crossing and reduce the risk of blockage. As a result there will be no significant quantities of grit in the wastewater flow from Cobh to the treatment plant.

Storm Water Management

The proposals for upgrading the sewerage systems of Passage West, Monkstown, Carrigaline and Ringaskiddy will separate the foul and storm water collection systems where feasible. There will however, be a significant storm/surface water contribution to the wastewater flow to the treatment plant. It is therefore recommended that grit removal be provided at the inlet to the wastewater treatment plant. However, it is acknowledged that the wastewater treatment plant contractor may elect to omit the grit removal process from the preliminary treatment stage, and operate the treatment plant with higher maintenance costs due to carryover of grit through the treatment plant.

Due to the partially combined nature of the collection systems and the provision of combined storm overflows in each of the towns being served, the peak flow of wastewater to the treatment plant will be 6 DWF. It is not practical from a process operation perspective to construct the full treatment plant with a hydraulic capacity corresponding to 6 DWF. This would result in much larger process units being provided, with these being sized based on the peak hydraulic throughput at the plant. This will result in excessive sludge residence times in the treatment tanks at low flows, with increased risk of de-nitrification and associated operational difficulties.

To optimise the operation of the main treatment processes on site, it will be necessary to restrict the flow receiving full treatment to approximately 3 DWF. This will be achieved by the incorporation of a storm water overflow downstream of the screening and grit removal systems. This location will eliminate the necessity for a separate storm water screening system. To reduce the impact of the storm water discharge on the receiving waters settlement facilities with a retention time of 2 hours should be provided for the excess 3 DWF of flow. If the peak flow of 6 DWF is sustained for more than 2 hours, the storm water would then overflow from the settlement tank to the treated effluent discharge pipe line.

The inlet works to the treatment plant shall incorporate an automatic monitoring and sampling system so that "representative samples can be obtained of the incoming waste water" in accordance with the Urban Waste Water Treatment Regulations, 2001.

Due to the potential for odours being generated by the pre-treatment and preliminary treatment processes this section of the treatment plant should be housed and vented through an odour control system. When housing and containing the preliminary treatment processes it becomes necessary to ensure that all equipment installed therein is suitable for the application and complies with the relevant hazardous area zoning.

5.4.1.2 Primary Treatment

Primary treatment of wastewater comprises of settlement of the raw wastewater resulting in the partial removal of suspended solids (50 – 70 % for typical municipal wastewater) and in the reduction in concentration of BOD (approximately 20 - 40 % for typical municipal wastewater).

The principle advantage of primary settlement is that it provides for a simple means of removing approximately 30 % of the BOD and 60 % of the suspended solids from the wastewater with a very low energy requirement. This reduces the loading on the secondary treatment stage, resulting in a reduction in tank volumes and energy requirements. While the primary sludge produced can be odorous it is ideally suited to treatment by anaerobic digestion with consequent energy recovery.

The proposed wastewater treatment plant will be constructed using the Design/Build/Operate procurement route with the selection of the treatment process being the responsibility of the successful contractor. There are some secondary treatment processes which can provide the necessary standard of treatment without primary settlement, and therefore do not produce a primary sludge.

5.4.1.3 Secondary Treatment

As specified in Section 5.3 and 5.4.1, secondary treatment of the wastewater is an essential requirement of the Cork Harbour Wastewater Treatment Plant. It is therefore necessary for the treated effluent to comply with the discharge standards set out in the Urban Waste Water Treatment Regulations 2001, i.e.

BOD_5 < 25 mg/l

COD < 125 mg/l

Suspended Solids < 35 mg/l

5.4.1.4 Tertiary Treatment

The receiving waters of Outer Cork Harbour are not designated as a sensitive area under the Urban Waste Water Treatment Regulations 2001. As discussed in Section 5.3 above nutrient removal or reduction is not required. Due to the absence of designated bathing areas or shellfish production areas in the immediate vicinity of the treated effluent outfall, disinfection of the treated effluent is not required.

5.4.2 Sludge Treatment Requirements

Initially all sludges produced on site will first be thickened to reduce their volume, and the size of the main sludge treatment processes. The sludge thickening processes are optimised by providing separate systems for the primary and secondary sludges.

The type of sludge treatment system to be employed at the Cork Harbour Wastewater Treatment Plant depends on the ultimate end use of the biosolids product, and also on the type of wastewater treatment process producing the sludge.

The Cork County Sludge Management Plan (March 2000) recommends Advanced Fluidised Composting, which is a sludge destruction technology, as the sludge treatment technology to be used at a sludge treatment centre. This is on the basis of co-treatment of municipal wastewater and industrial biological sludges to produce a biosolids product which may not be suitable for beneficial reuse in agriculture due to industrial constituents in the sludge.

However, as outlined in Sections 4.1.2.2 and 5.1.2.5 provision is not being made for the co-treatment of municipal wastewater and industrial biological sludges at the proposed Cork Harbour Wastewater Treatment Plant.

In the absence of industrial sludge contribution to the sludge being treated, the ultimate end use of the biosolids product is not restricted to disposal to landfill, and could include beneficial reuse in agriculture. Similarly, the type of sludge treatment technology to be employed will not be restricted to the solids destruction technologies such as Advanced Fluidised Composting.

It is acknowledged that agricultural land in the Cork Harbour area is unsuitable for landspreading of the biosolids product and has a nutrient surplus in terms of phosphorus. In addition, 40 % of agricultural land in the Cork Harbour tidal area lies on an extremely vulnerable, regionally important aquifer. However, based on phosphorus balances undertaken for the Cork County Sludge Management Plan, there is sufficient spare capacity in County Cork as a whole to facilitate the landspreading on agricultural land of all of the municipal wastewater sludge produced in the county. The contractor responsible for operating the wastewater and sludge treatment plant may therefore transport the biosolids further afield from Region 19 for landspreading on suitable agricultural land.

If the treated sludge is to be reused as biosolids in agriculture, it will be necessary for the biosolids product to comply with the Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 (as amended by the Waste Management (Use of Sewerage Sludge in Agriculture) (Amendment) Regulations 2001), and the Codes of Good Practice for the Use of Biosolids in Agriculture. The latter sets out a list of acceptable sludge treatment technologies which will attain a specified microbial standard in the sludge and a biosolids product suitable for use in agriculture. The acceptable technologies are:-

- Mesophilic anaerobic digestion with pre- or post- pasteurisation
- Thermophilic anaerobic digestion
- Thermophilic aerobic digestion
- Composting (windrows or aerated piles)
- Alkaline Stabilisation
- Thermal Drying

The type of technology to be used is not limited to this list, as other innovative technologies may be developed which would also produce a biosolids product of acceptable quality. However, not all of the above technologies may be suitable for use at the Cork Harbour Wastewater Treatment Plant.

Alternatively, the successful contractor may determine that it would be more economical to employ a solids destruction form of sludge treatment (such as Advanced Fluidised Composting) on site, and dispose of the end product to landfill. Either option would be compatible with the general recommendations of the Cork County Sludge Management Plan (March 2000). The sludge treatment technologies for both options are discussed in more detail in Section 5.5.

However, Article 14 of the Urban Waste Water Treatment Directive (91/271/EEC) states that "sludge arising from waste water treatment shall be re-used whenever appropriate." (Refer also to Circular L6/94 from Department of the Environment) Since some income can be obtained from the "beneficial reuse" option it is most likely that this will be the option preferred by the contractor. In which case the sludge treatment process employed should produce a biosolids product compatible with this end use.

To facilitate the ultimate end use of the biosolids (e.g., seasonal nature of landspreading) it will be necessary to provide adequate storage at the wastewater treatment plant for the biosolids product. It will also be necessary to provide for storage on site for untreated sludge to facilitate repairs and routine maintenance of the sludge treatment equipment.

While the Sludge Management Plan recommends the provision of reception and screening facilities for imported sludges at the hub centre, it is expected that the only sludges which will be delivered to this site will be from septic tanks on an infrequent basis. Such sludges will generally be at approximately 1.5 % dry solids concentration and anaerobic in nature. These will be mixed with the sludge produced on site and thickened in an enclosed/covered sludge thickening system.

The Cork Harbour Wastewater Treatment Plant will be constructed using the Design/Build/Operate procurement system. The treatment processes and types technology which will be employed will therefore be selected by the successful contractor. However, certain minimum requirements will be imposed on the contractor with regard to the following

- The quality of the treated effluent to be discharged from the wastewater treatment plant, i.e., BOD at < 25 mg/l, COD at < 125 mg/l, suspended solids at < 35 mg/l
- The provision of screening to 6 mm, with the subsequent treatment of the screenings,
- Pre-treatment of the raw wastewater to address the issue of septicity,
- Enclosure of the preliminary treatment system, with the air space vented and connected to an odour control system,

5.5 Wastewater Treatment Technologies

5.5.1 Preliminary Treatment Technologies

Pre-Treatment

Pre-treatment of the incoming wastewater is required to address the issue of septicity of the wastewater.

The two principle methods used for septicity control are the addition of chemicals or the aeration of the wastewater. The chemicals most widely used are nitrate compounds (used extensively by Thames Water) or ferric sulphate. Nitrate compounds are generally dosed into the wastewater at the pumping stations feeding the wastewater treatment plant to reduce the formation of hydrogen sulphide in the delivery pipework.

Ferric sulphate is generally dosed upstream of the primary settlement stage at the wastewater treatment plant, and has the effect of precipitating the dissolved hydrogen sulphide from the raw wastewater into the sludge. However, if dosing is not accurately controlled it can have the effect of reducing the nutrient phosphate concentration upstream of the biological treatment stage.

Aeration for septicity control usually takes the form of injection of high pressure air into the rising mains or sewers feeding the wastewater treatment plant, or else the addition of air into the raw wastewater at a lower pressure in a designated chamber.

Therefore, pre-aeration of the wastewater on arrival at the wastewater treatment plant would serve to relieve the septicity problems.

Such a pre-aeration system is designed to provide a retention time of approximately 10 minutes for the wastewater at peak flows to the plant. Longer retention times will result at lower flowrates. This is essential since it is at the lower flowrates that the residence time in the sewers and consequent septicity generation are greatest. These lower flowrates can be expected during the initial operating phases of the wastewater treatment plant as the flows and loads gradually increase to their future design levels (year 2035), and also during dry weather conditions.

The aeration system is usually designed on the basis of adding air at a 30 % volume ratio of the raw wastewater peak flow. In this case the air requirement would be 1057 Nm^3/hr (at atmospheric pressure and 20°C).

To reduce the potential for solids deposition on the tank floor and floating matter at the wastewater surface in the tank, this pre-aeration system should be provided downstream of the screening and grit removal systems.

Due to the odour nuisance associated with septicity and the long residence times of raw wastewater in the convevance systems, it is essential that the inlet channels and chambers be covered, vented and connected to an odour control system.

Screening

Screening to 6 mm is to be provided for all of the wastewater to be treated at the wastewater treatment plant. The maximum size of the solids which will be contained in the wastewater flow from Cobh, Passage West and Monkstown will be 100 mm. This is because coarse screening, in the form of Rotating Bar Interceptors (RBIs), is to be provided at the main pump stations in these areas. Wastewater from Carrigaline will also contain no solids larger than 10 mm since the solids contained in this flow will be macerated using the existing comminutors at the main Carrigaline pump station. The solids size in the wastewater flows from Ringaskiddy, Coolmore and Shanbally will be restricted by the solids passage of their wastewater pumping systems, and is likely to be no bigger than 100 mm.

There are numerous different types of screen available on the market for this application. In general the advantages and disadvantages of the different types of screens are more dependent on the bar spacing or aperture size of the screen than on the specific make. A basic requirement of the screen is that the screen be automatically cleaned using a mechanised rake or brush. A bypass channel fitted with a manually raked screen should be provided to facilitate maintenance or isolation of the mechanical screen.

It is inevitable that some organic and faecal matter will be removed in the screened material. It is therefore essential to provide screenings treatment in the form of washing to improve the aesthetics of the screenings, to reduce the odour potential and to render it less objectionable for disposal. The wash-water containing the organic matter should gravitate back into the main flow for treatment with the wastewater. The screenings should also be de-watered and compacted to minimise the volume of screenings for disposal.

In the past, disintegrators were widely used in the preliminary treatment of wastewater. This type of system is no longer recommended because the sludge produced on site is rendered unsuitable for re-use, and the chopped screenings can cause downstream operational problems such as at weirs, de-watering presses, etc.,

Grit Removal

The optimum grit/grease removal system for a particular situation generally depends on the size of the sewerage scheme and the quantity of wastewater to be treated. The two principal types of system used for wastewater treatment plants of this scale are the aerated grit channels (as used in Clonmel WWTP) and the vortex type grit separator. Both systems are equally effective at removing grit particles down to 0.2 mm in size. The aerated grit channel does have the advantage of facilitating the removal of fats, oils and greases from the wastewater. However, it does have a greater plant footprint. The vortex type of grit trap has a smaller footprint and is more widely used.

As for the screenings, it is inevitable that some faecal matter will be removed from the wastewater in the grit. It is therefore necessary to provide grit treatment and washing, with the resultant washwater returning the organic matter to the main flow for treatment. This reduces the odour potential and makes the grit less objectionable for storage and disposal.

The screenings and grit removed from the wastewater should be stored in either covered skips or else automatically bagged. This is necessary to reduce the risk of materials being blown around by the wind, as well as nuisance from birds and vermin at the screenings area.

Due to the odour potential of the raw wastewater, the screening and grit removal systems should be enclosed and connected to an air extraction system. The vented air should be passed through a high efficiency odour control unit.

Storm Water Handling and Disposal System

The peak flow reaching the wastewater treatment plant will be 1,600 l/s at the design year 2035 loadings, and will be experienced when all of the duty pumps at Carrigaline, Raffeen and Shanbally are operating simultaneously at full capacity. There will be periods when not all of the pumps are operating simultaneously and much lower flows can be expected for periods each day.

The variation in flows reaching the wastewater treatment plant can be dealt with in one of two ways. The simplest option is to design the entire wastewater treatment plant to accommodate flows of 6DWF. However, as outlined above this results in operational difficulties and much larger tankage.

Alternatively, the main treatment stages could be designed to accommodate only flows up to 3DWF, with flows in excess of this being overflowed upstream to a storage tank where it would be allowed to settle. As the incoming flowrate would decrease to say 2DWF, the contents of this storage tank would be returned to the main wastewater stream for treatment. This would result in smaller settlement tanks and downstream pipework and channels.

The storm water settlement tanks used are either circular radial flow tanks and fitted with rotating scraper mechanisms similar to conventional settlement tanks, or else rectangular tanks, without sludge scrapers. In both cases the settled storm water would overflow a weir and gravitate to the treated effluent discharge line.

The radial flow tank system would optimise the settlement of any suspended solids, with the scraper moving these towards a central collection hopper on a continuous basis. When the settled storm water is being returned for treatment the tank is emptied from the bottom, with the settled sludge being returned first. The solids concentration would gradually decrease finishing with a dilute settled storm water. This would result in an initial shock loading of the main treatment system (in terms of solids and BOD) with associated odour, followed by a dilution with a weak wastewater flow.

The rectangular settlement tank would be fitted with a mixing device, which would be activated when settled stormwater is being returned to the main process stream for treatment. This would avoid shock loadings on the treatment system by providing a consistent quality in the stormwater being returned. A tipping bucket is usually installed at high level along one end of the tank. This is filled with water and used to flush any settled solids or deposits to a collection sump at the end of the tank. This happens at the end of every tank emptying cycle and ensures that the tank is kept clean and minimises the risk of associated odour.

The radial flow tanks tend to be slightly more expensive to construct, but would have lower operating costs. Both options are comparable and either could be used at the Cork Harbour Wastewater Treatment Plant.

5.5.2 Primary Treatment Technology

Primary Settlement for wastewater treatment plants of this scale is generally provided in rectangular horizontal flow tanks or in circular radial flow tanks. Both types of system would incorporate continuous sludge scraper mechanisms and overflow weirs. Because of the variation in incoming wastewater flow to the treatment plant and the potential for septic conditions in the raw wastewater, it is essential that the settled primary sludge is removed regularly from the bottom of the tank. This is particularly important at this site since advanced sludge treatment is to be provided, with the resultant sludge liquors returned for treatment to the primary stage of the process. The presence of such liquors coupled with prolonged residence time for the sludge in the bottom of the primary settlement tanks could quickly give rise to septic conditions, floating sludge and poor settlement in the tank. The residence time in the primary settlement tanks should not exceed 2 hours at peak flow. Upward flow or surface loading rates are generally less than 1.5 $m^3/m^2.hr$.

Rectangular horizontal flow tanks are fitted with sludge scrapers fitted to reciprocating bridges or else floor scrapers driven by continuous chain mechanisms. Overflow weirs are provided along one end of the tank. There is greater risk of septic conditions arising in the settled sludge due to the longer residence time for sludge in these tanks. Provision of adequate overflow weir length can result in uneven quality of flow in the settled wastewater.

Circular radial flow tanks are more suitable to this application because the continuous rotating scraper mechanism keeps the settled sludge moving toward the collection hopper and minimises the residence time of the sludge in the tank. Regular withdrawal (by pumping) of the primary sludge from this hopper is essential. The circular tanks also provide the maximum weir length for a more even flow of the settled wastewater.

The use of lamella plates or tubes in primary settlement tanks treating municipal wastewater is not recommended due to

- potential problems associated with clogging due to accumulation on the plates/tubes,
- retention of sludge on the surface of the plates/tubes resulting in septic conditions,
- growth of biofilms or plants on the surface of the lamellae.

Because of the potential for septic conditions in the sludge, and the odour potential associated with these tanks (primarily at the overflow weirs) the design of these primary tanks should incorporate adequate odour control measures. By locating these tanks away from the site boundary it would then be possible to minimise the associated odour level detected at the site boundary to less than 5 ou/m^3. At odour concentrations up to this level, no complaints of odour nuisance from outside the site would be expected.

De-sludging of the primary settlement tanks is usually undertaken on an automatic timed basis. While it would be best to control the de-sludging process in accordance with the level of solids in the settlement tank, no satisfactory sludge control sensor/controller has been developed. There are a number of ultrasonic sludge sensors on the market which have been used to monitor sludge density and the level of the sludge blanket in the primary settlement tanks. However, the submersible sensors have been very difficult to keep clean, and often have required cleaning more than once per day. The non-contact type have not proved reliable in detecting the solids/liquid interface level or the sludge blanket level. Other infra-red and radar types of sensor have been developed and installed, but have not yet been proven as reliable on a long-term basis.

Because the primary settled sludge can have a concentration up to 2 % dry solids, the types of pumps which are suitable are peristaltic, positive displacement, diaphragm or slow speed submersible centrifugal pumps with a solids passage capacity of at least 100mm. Archimedean screw pumps are not suitable due to the cost and the difficulty in controlling the associated odour.

5.5.3 Secondary Treatment

The main objective of the secondary or biological treatment stage is the removal of carbon measured as BOD or COD. In the Cork Harbour Wastewater Treatment Plant it is not necessary to provide for nutrient removal.

This wastewater treatment plant will be constructed using the Design/Build/Operate method with the type of treatment technology and process to be selected by the successful contractor. The type of treatment process to be used can therefore not be specified in this Preliminary report. However, the various treatment systems, which would be suitable for use at this plant, are evaluated below in engineering, economic and environmental terms, in addition to their compatibility with the ultimate sludge treatment system to be employed.

The processes that are most commonly and effectively used for medium to large sized municipal wastewater treatment plants are suspended growth (such as activated sludge), and fixed film (such as biofiltration) systems. In recent years, a number of hybrid systems have also been developed which incorporate elements of both suspended growth and fixed film systems.

5.5.3.1 Activated Sludge Processes and Variations Thereof

The activated sludge process has been used extensively for the treatment of both urban wastewater and industrial wastewater or a combination of both. The process is a continuous system in which aerobic biological growths (suspended cultures) are mixed and aerated with wastewater, and then separated in a gravity settlement system. A large portion of the concentrated sludge is recycled, and mixed with the incoming wastewater to increase the available biomass in the aeration tank, and thereby speed up the treatment reactions.

Operation of the system at a sludge loading rate of greater than 0.15 kg BOD/kg MLVSS/day (typically approximately 0.2 kg BOD/kg MLVSS/day) will achieve the required BOD/COD removal without nitrification of the wastewater. This process is often referred to as a conventional activated sludge system.

There are many variations of the actual configuration of the activated sludge process, including completely mixed, extended aeration, plug flow, tapered feed, tapered aeration, sequencing batch reactors (SBR) and cyclic activated sludge systems (CASS). Some of the process variations involve subtle differences, such as rates and points of air or wastewater application, detention times, reactor shapes and methods of introducing air.

The **completely mixed** conventional aeration system is the simplest form of activated sludge system and is most widely used. The contents of the tank are continuously mixed to eliminate any concentration gradients in terms of BOD, oxygen and MLSS. This has the effect of rapidly dispersing and diluting any shock loads to the system. This system is generally operated at loading rates in excess of 0.2 kg BOD/kg MLSS.day without nitrification being achieved. Depending on the loading, sludge production rates of up to 1.0 kg dry solids per kg BOD removed can be expected. This sludge is amenable to treatment by energy

recovery systems such as anaerobic digestion, with improved digestion when combined with primary sludges.

Extended aeration is an activated sludge system which operates at very low loading rates with F/M ratios typically in the range of 0.05 to 0.10 kg BOD/kg MLSS.day. Nitrification is usually achieved in such a system. Extended aeration is not usually preceded by primary settlement. At the low loading rates and resultant long residence times, overall sludge production is reduced due to the consumption of the dead cells by endogenous respiration. Typical production rates of 0.5 to 0.6 kg dry solids/kg BOD removed apply. The sludge produced is well stabilised with a low concentration of residual organic matter and is therefore not amenable to treatment using energy recovery treatment processes such as anaerobic digestion. Extended aeration sludges are also difficult to dewater. To accommodate the necessary low loading rates, the oxidation ditch volume is considerably larger than that required for a conventional activated sludge which does not provide for nitrification. This increased volume results also in increased mixing power requirements.

High rate activated sludge systems which operate at F/M ratios in excess of 1.0 kg BOD/kg MLSS/day are generally used only as a first stage in a treatment process since they achieve only 60 – 70 % BOD removal. Such a system would therefore require a further stage of treatment to produce a treated effluent of the necessary standard.

In **plug flow systems** the tank is long and narrow with flow entering at one end of the tank and leaving at the other end with negligible longitudinal mixing. This results in various gradients being set up in the tank. There is a high loading rate in terms of F/M ratio at the inlet end of the tank, with this gradually decreasing with progress of flow through the tank. As the substrate is used up along the length of the tank, the sludge production increases. The oxygen demand is greatest at the tank inlet end and reduces towards the tank outlet. This system has the advantage of discouraging the development of filamentous growth and associated bulking problems. The other main advantage of the plug flow system is that by varying the oxygen input it is possible to set up contact and anoxic zones to achieve nitrification and de-nitrification. This feature is not required in the Cork Harbour Wastewater Treatment Plant. A principle disadvantage of the plug flow system is its inability to cope with shock loads to the system.

As the substrate is consumed along the length of the plug flow tank, and its oxygen demand decreases, **tapered aeration** will match the oxygen supply to the demand. This is achieved in a diffused air aeration system by providing a greater density of diffusers towards the inlet end of the tank, and with the density decreasing towards the tank outlet. The air input to these zones would be varied using automated valves on the air supply lines controlled in response to the dissolved oxygen concentration in different parts of the tank. **Step feeding** of the wastewater at a number of points along the length of the aeration tank achieves a similar effect and eliminates the need for tapered aeration by matching oxygen demand with the oxygen supplied. However, this system is rarely used.

SBR (Sequencing Batch Reactor) is a variable volume activated sludge system which operates within a single reactor tank. It does not require pre-settlement of the raw wastewater and is not usually preceded by primary settlement. The sequenced aeration cycles provide process conditions, which achieve biological degradation, biological nutrient reduction and solids-liquid separation. The system operates in a time controlled cyclic mode, which would generally include the following stages of operation.

1. Fill
2. Aerate
3. Settle
4. Decant

5 De-sludge
6 Idle

The duration of these phases of operation depends on the number of SBR tanks being operated and on the treatment objectives for the process. Some of these phases such as "fill" and "aerate" can occur simultaneously. Hydraulic and organic loading rates can be varied to achieve a range of treatment objectives. In any case nutrient reduction is not required at the Cork Harbour Wastewater Treatment Plant. SBR systems traditionally had been operated as "fill and draw" systems on small schemes, but are now increasing in popularity on larger schemes. The principle advantages of this system are the elimination of the separate secondary settlement tanks, sludge return pumps and the resultant smaller footprint of the plant. The SBR also has the ability to tolerate organic and hydraulic shock loads. The footprint of the SBR reaction chamber is similar in size to that of the aeration tanks which would be required for a conventional aeration activated sludge system.

The SBR system requires the use of multiple chambers or tanks with different tanks at different stages in the operating cycle, and at least one tank always available to accept the feed. The flow to and from these tanks is controlled using a system of actuated valves or penstocks, and requires a more complicated control system than a conventional system. A floating decanting weir is used to draw down the settled wastewater at the end of the "settle" phase of the cycle. This is held above top water level until the "decant" phase commences.

The **Cyclic Activated Sludge System (CASS)** is a trademark version of the SBR technology with its own particular control system and type of decanting weir. Such a system has been installed and is operating on a similar sized wastewater treatment plant at Osberstown (80,000 p.e.).

Deep Shaft Activated Sludge systems operate with an aeration chamber up to 150 m deep to increase the oxygen transfer efficiency. However, the sludge produced has poor settling characteristics. The capital costs of such a system are significantly higher than any other form of activated sludge system.

Pure Oxygen systems are not widely used due to the higher cost of transferring oxygen to the mixed liquor, and the safety issues associated with the use of pure oxygen.

The alternative **aeration systems** available for use with activated sludge systems include:
- Surface Aeration Systems (Vertical Shaft or Horizontal Shaft)
- Fine Bubble Diffused Air (FBDA) systems
- Jet Aeration/Venturi type systems
- Hybrid systems combining surface aeration and diffused air aeration systems.

While surface aeration was used extensively in the past due to its robustness, it is now proving less attractive. This is due to its lower oxygen transfer efficiency than diffused air systems, and its tendency to produce aerosols.

Fine Bubble Diffused Air (FBDA) Systems offer high oxygen transfer efficiency with associated reduced running costs. With the development of the flexible membrane type diffusers, and the automated cleaning system (acid rinsing) for the ceramic diffusers, the historical maintenance problems have been alleviated. These new systems produce less aerosol emissions compared to other aeration systems, and provide maximum flexibility in varying the oxygen input to the aeration basin. The FBDA system is now one of the most frequently used aeration methods for the activated sludge process on a global basis in urban

wastewater treatment plants. Acoustic insulation or housing of the blowers significantly reduces any noise emissions.

Jet aeration systems have very high oxygen transfer efficiency, and provide efficient mixing. However, it is not a viable option for a plant of this scale due to the high capital costs. Venturi aeration is a low cost option, but its low oxygen transfer efficiency makes it unsuitable for this plant.

For the Cork Harbour Wastewater Treatment Plant the completely mixed conventional aeration or the SBR would be the most suitable activated sludge system capable of achieving the treatment objectives. Fine Bubble Diffused Air aeration would be the optimum aeration system for either option.

To reduce the potential for filamentous bulking in the sludge, a biological selector zone is usually incorporated at the inlet to the aeration/activated sludge chamber. The incoming wastewater is contacted with recirculated liquor from the aeration chamber in this zone to control the development of the organisms which can lead to sludge bulking, and also to ensure the rapid removal of the readily biodegradable portion.

5.5.3.2 Bio Filtration and Variations Thereof

Biological Filtration is suitable as a complete secondary treatment process for wastewater from a medium sized urban area. Due to recent developments in media type, and changed system configuration, they have been gaining in popularity. The principle types of biofilter in common use are the conventional trickling or percolating filter, the biotower, and the rotating biological contactor (RBC).

While **Conventional Trickling Filters** have been employed on a widespread basis they are no longer considered suitable. This is due to problems of clogging of the media, poor liquid distribution, poor control of the growth of the biofilm, strong potential for nuisance due to odours and flies and difficulties of controlling essential process parameters.

The **Biotower** is similar to the trickling filter system, except for the fact that it uses plastic media which has a higher specific surface area and can therefore operate at much higher loading rates. The plastic media can also be packed to a much greater height, resulting in a smaller plant footprint. The system is however, very prone to odour emissions, and would therefore require roofing with provision of air extraction and an odour control system. A low loaded single stage biotower can be designed to achieve the specified effluent standard of less than 25 mg/l BOD and 35 mg/l suspended solids. This requires continuous re-circulation of effluent over the biotower to maintain the irrigation of the media. This type of biotower also produces greater quantities of sludge than an activated sludge processes.

The biotower system has high construction costs due to its height requirements and also high operating costs due to the energy required for pumping the wastewater and recirculating the effluent. Space requirements for biotowers are small. However, the height of the biotower above ground level makes this type of plant difficult to screen from view. The odour potential and the difficulty of camouflaging such a high structure make this unsuitable for adoption for the Cork Harbour Wastewater Treatment Plant.

The **Rotating Biological Contactor (RBC)** also utilises the biofiltration principal. It consists of rotating plates or discs of light-weight plastic media, onto which the biofilm grows and is attached. These rotate continuously and are partially immersed in the wastewater. These are generally preceded by a primary settlement stage and followed by a secondary settlement stage, with the secondary sludge returned to the primary tank for co-settlement. The sludge produced in these units does not settle as readily or easily as activated sludge, so that the quality of the treated effluent being discharged is not as consistent. These

RBCs are suitable for use only on smaller wastewater treatment plants with a population equivalent loading of less than 3,000 p.e., and would require the installation of multiple units even at that size of plant. RBCs are not considered suitable for use in the Cork Harbour Wastewater Treatment Plant.

5.5.3.3 Hybrid Systems

The **Submerged Filter** system, the most common of which is the **Biological Aerated Filter (BAF)**, was developed in the 1980s and comprises a submerged bed of granular media, or as in later developments of the system, fixed modular type plastic media. A biofilm is attached to and grows on the submerged medium which may be under aeration (as in the BAF). Since there is very little natural erosion of the biofilm the filter requires regular and frequent backwashing.

Submerged filters can operate in either the upflow or down flow mode, but most recent developments have been in the upflow mode. These now exhibit more efficient transfer of oxygen and substrate, as well as being less sensitive to surface clogging.

The BAF process is similar to conventional rapid sand filtration, except that air is sparged into the lower portion of the filter bed, and that a coarser filter medium is used. Loading rates on a submerged filter are similar to those for conventional activated sludge systems, with carbonaceous oxidation being achieved at rates of 0.25 kg BOD/m^3.day (expressed in terms of m^3 total empty bed contact volume). The **Biocarbone** and **Biofor** Systems are the best established of all the BAF processes, with approximately 100 active plants of each type in operation throughout the world.

Most submerged filters require a separate solids removal stage such as gravity sand filtration.

Land area requirements for BAF systems are low, corresponding to approximately one third of the area required for a similar sized conventional activated sludge plant. They are generally used in Ireland for small schemes, but have been constructed in Europe on very large schemes where there was limited land area available for construction. The main BAF systems tend to be in a similar cost range to the biotower process and have specific applications where space restrictions exist. These units are more cost competitive at a smaller scale, where the complete units can be pre-fabricated at the manufacturer's works, with significantly reduced installation or on-site costs.

BAF is therefore considered not to be a viable technology for use in Cork Harbour Wastewater Treatment Plant.

Constructed Wetlands as a treatment option for urban wastewater is more suited to small scale applications, due to the large land requirements needed for this process. Current design standards require an area of 1.5 - 5 hectares per 1000 m^3/day of wastewater throughput, with a BOD loading rate of 80 kg/ha/day. A minimum site area of approximately 60 ha. would be required for the wetlands alone for the Cork Harbour Scheme. When used for secondary treatment, there is a strong potential for odour nuisance from constructed wetlands. Also wetlands, either natural or constructed, are complex, dynamic systems whereby the technology is not readily proven. It is also difficult to control the performance of the system. For these reasons, it is considered unsuitable as a principal secondary treatment process for the Cork Harbour Wastewater Treatment Plant.

An interesting recent development of considerable promise is the use of **Membrane Bioreactors**, which replace the secondary settlement tank with a membrane separation unit. The membrane system is generally installed in the aeration tank which operates at very high MLSS concentrations of up to 10,000

mg/l. It does not require a sludge return system. The membrane bioreactor utilises either ultra-filtration or micro-filtration membranes to provide superior effluent quality in a compact plant. Because of the high associated costs, the municipal applications have generally been only on a small scale. This type of system is used mainly in the production of high quality effluent, treatment of high strength industrial wastewater, and also in the treatment of landfill leachate. Other advantages of the membrane bioreactor are the low plant footprint, low sludge generation and the ability of the system to tolerate shock loads.

The **Kubota** system is one of the few available systems that have been commercially applied to municipal wastewater treatment. It is based upon submerging a membrane filtration process within an activated sludge aeration tank. The Kubota system employs a low-pressure membrane separation process requiring a hydraulic head of approximately 1 to 1.5 m to drive the wastewater through the membrane, making gravity flows through the treatment plant possible.

These units have become more cost attractive in capital and operating terms than in the past due to the reduction in the cost of the membranes and the doubling of the membrane life span. The treated effluent quality produced is extremely good, with concentrations of BOD averaging at less than 4 mg/l, suspended solids at 1 mg/l and faecal coliforms of less than 20 FC/100 ml in the treated effluent.

The main disadvantage of the membrane bioreactor technology is that the costs associated with it are still significantly higher than those associated with conventional technologies. The process requires screening of the raw wastewater to 3 mm, compared with the 5 mm screening for conventional treatment systems. It is generally economical only where the effluent is to be treated to a standard of < 10 mg/l BOD and where disinfection of the treated effluent is required. It is therefore not considered a suitable technology for the Cork Harbour Wastewater Treatment Plant.

The **Integrated Fixed-Film Activated Sludge Process (IFAS)** system, which is an innovative technology that has been developed in recent years, is the integration of fixed film media into the activated sludge reactors to improve performance. It is usually employed to facilitate the increase of existing treatment capacity while minimising construction costs and land requirements. Its main advantage is that it enhances both nitrification and de-nitrification. Different plant arrangements have been used, with the media installed either upstream of the activated sludge zone, in the aerobic zone of the activated sludge reactor, or in an aerated tank as the last stage of the process.

This system is used principally to increase the treatment capacity of existing treatment plants where space for expansion is restricted. As a stand-alone system on a green-field site it would not be an economically suitable treatment option for the Cork Harbour Wastewater Treatment Plant.

The **Moving Bed Bioreactor (MBBR)** is not an activated sludge system because it does not the incorporate return of activated sludge, but it is similar to the floating sponge IFAS techniques, and return activated sludge could be used with the system if desired. Without return activated sludge the treatment process relies almost entirely upon the biofilm, which grows on the floating media. The reactor (containing the media) can be aerated like an activated sludge system if an aerobic zone is required, or it can be mixed with a side mounted mixer if an anoxic zone is desired.

The most widely used MBBR system is the **Kaldnes** moving-bed bioreactor process which is a continuously operating, aerated, non-clogging biofilm reactor with low head-loss and a high specific biofilm surface. It does not require back-washing or return sludge flows, and the head-loss through the reactor is insignificant. The treatment capacity of a reactor of a given volume can be changed, by simply changing the amount of media used. A separate solids removal system is required. In economic terms these would

not be considered as economically suitable treatment options for the Cork Harbour Wastewater Treatment Plant.

5.5.3.4 Evaluation of Secondary Treatment Systems

Of the above secondary treatment systems, the activated sludge systems represent the most economical systems in terms of capital costs, and also when the net present value of the associated Operating and Maintenance costs are taken into account. These O & M costs are comparable with standard biological aerated filter options and biological tower systems.

The main disadvantage of the conventional activated sludge system when compared to the BAF or Biofiltration Systems is that it has the highest land area requirement. But it can be accommodated within the site area available. The SBR version does have a smaller footprint, due to the elimination of the secondary settlement tanks. It is also possible to eliminate the primary settlement tanks and associated primary sludge handling system to reduce the footprint further.

The membrane bioreactors produce the best quality effluent with BOD concentrations consistently less than 4 mg/l, and suspended solids less than 1 mg/l. However, such a high quality of treated effluent is not necessary for the Cork Harbour Wastewater Treatment Plant, and the capital costs of such a treatment process could not be justified.

The most appropriate type of secondary treatment systems for this plant are the conventional completely mixed activated sludge system and the SBR variation of the activated sludge process. The principle reasons for this are set out below:

They are well documented treatment systems which are suitable for wastewater treatment plants of this scale. The activated sludge system has been adopted universally for this purpose, particularly when starting with a "green-field" site.

The structures can be built partially below ground to reduce the visual impact of the plant and to reduce the level of screening from view that will be required.

Either system can operate with or without primary settlement of the raw wastewater.

The sludge produced is reasonably stable and amenable to short term storage on site, and further treatment by most sludge treatment processes including anaerobic digestion.

By constructing in a modular configuration, its design can accommodate the gradual increase from current wastewater loads to those estimated for the year 2030, as well as facilitating future plant expansions.

It minimises odour emissions - the Aerobic Suspended Biomass System is less prone to odour emission compared to Bio Filtration (Attached-Growth/Fixed-Film) Systems.

Both of these activated sludge options provide a reliable and economical system that would consistently achieve the required treatment function. It is also acknowledged that further development of the above technologies and new innovative technologies may be produced which could compare well in engineering, economic and environmental terms with the activated sludge systems. These new systems should also receive consideration if offered by a prospective contractor.

5.5.4 Evaluation of Sludge Treatment Technologies

This wastewater treatment plant will be constructed using the Design/Build/Operate procurement method with the type of treatment technology and process to be selected by the successful contractor. The type of sludge treatment process to be used can therefore not be specified in this Preliminary Report. However, the various sludge treatment systems, which would achieve the sludge treatment requirements set out in 5.4.2 above, are evaluated below.

To maximise the number of options available for the end use of the biosolids product from the sludge treatment process technology capable of producing a biosolids product for use in agriculture and sludge destruction technology are both evaluated.

5.5.4.1 Technology to Produce Biosolids for Use in Agriculture

The list of acceptable technologies which could produce a biosolids product suitable for use in agriculture are set out below:

- Mesophilic anaerobic digestion with pre- or post- pasteurisation
- Thermophilic anaerobic digestion
- Thermophilic aerobic digestion
- Composting (windrows or aerated piles)
- Alkaline Stabilisation
- Thermal Drying

Mesophilic Anaerobic Digestion is a very suitable technology for a plant of this scale, particularly if primary settlement of the raw wastewater is provided. It operates at a temperature of approximately 35 °C with the sludge having a hydraulic retention time of approximately 15 days in the digester.

The principle advantages of this process are the production of biogas which can be used as an energy source to generate electric power and heat, and also the fact that anaerobic digestion will provide destruction of approximately 30% of the total dry solids content of a municipal wastewater sludge.

Incorporation of a pasteurisation stage either before or after digestion of the sludge will result in a biosolids product suitable for application on agricultural land. This pasteurisation stage must achieve a retention period of at least 1 hour at a temperature of ≥ 70°C or 2 hours at a temperature ≥ 55°C. The digested sludge is be in liquid form with a solids concentration of approximately 4 % dry solids. In this state it is suitable for landspreading on agricultural land. By dewatering the digested sludge, the volume of sludge can be reduced to produce a cake with a dry solids content of up to approximately 23 %.

At 23 % dry solids, this biosolids product is still very bulky, and would result in high transportation and disposal costs. Mesophilic anaerobic digestion on its own is therefore not considered as an economically viable means of producing a biosolids product for disposal/re-use. However, the digested and dewatered sludge product can be used as a feed to a thermal drying system which will further reduce the volume of the sludge and convert it to an easily used granular form suitable for beneficial reuse in agriculture. This would significantly reduce the transportation and disposal costs.

Mesophilic anaerobic sludge digestion is not suitable for use with sludges produced by extended aeration, since these sludges are already well stabilised. Since extended aeration is unlikely to be the secondary treatment process employed on site, this is not relevant.

By incorporating a thermal hydrolysis process stage prior to digestion, the temperature of the sludge would be raised to a much higher temperature of 160°C. This high temperature stage in effect provides the pre-pasteurisation stage required for the production of a biosolids suitable for use in agriculture. This results in the breakdown of a greater proportion of the volatile solids in the digester, and consequently produces greater volumes of biogas. This in turn means greater energy recovery both in terms of gas fuel for the provision of heat, but if the biogas is burned in a CHP unit there will be increased electric power generation. The sludge product dewaters to a higher cake solids concentration than that produced by standard anaerobic digestion. The greater solids reduction provided due to the incorporation of the hydrolysis treatment stage will reduce the quantity of biosolids for dewatering and ultimate disposal.

Thermophilic Anaerobic Digestion is similar to mesophilic digestion, except that it operates with a shorter sludge retention time (48 – 72 hours) but at a higher temperature (50 – 55°C), and consequently requires a greater energy input.

Thermophilic Aerobic Digestion operates in the temperature range of 55 to 65 °C, with all of the sludge being subjected to a temperature in excess of 55°C for at least 4 hours. A minimum hydraulic retention time of 7 days in the digester is required. A reduction in volatile solids concentration of ≥ 38 % must be achieved.

The thermophilic digester is aerated and initially heated to raise the temperature to the desired range. However, the sludge digestion process is exothermic, and needs no external heat source once the process is established. Significant energy is required in aerating the sludge, resulting in high operating costs. The sludge aeration also generates significant quantities of odourous air for treatment.

A separate pasteurisation stage is not required to produce a biosolids product in compliance with the requirements for reuse in agriculture. As a sludge treatment process it is ideally suited to the treatment of extended aeration sludges and will achieve up to 30 % total solids destruction in a typical municipal wastewater sludge. However, since extended aeration is unlikely to be the secondary treatment process employed on this site, this advantage can be considered irrelevant.

Disadvantages of this process include the fact that the aerobically digested sludge is difficult to dewater. Therefore if used as a pre-treatment step for advanced sludge treatment such as thermal drying, the volume of sludge for subsequent treatment would be greater than that of an anaerobically digested sludge, and would result in larger sludge drying equipment. As a stand alone process it is not considered economically viable for biosolids production, and would need to be followed by a further volume reduction process for it to become commercially viable.

Composting in windrows to be held at 55°C for at least 15 days, during which time a temperature of ≥ 55°C must be maintained over 5 turnings of the windrow would produce a biosolids product suitable for use in agriculture. Alternatively, static pile or in-vessel composting in which a temperature of ≥ 55°C is achieved and maintained for at least 3 days would produce a biosolids product suitable for use in agriculture. Windrow composting is not ideally suited to the Irish climate due to levels of rainfall experienced here, and is more suitable for dryer and warmer climates. The most appropriate type of composting in the Irish context and for the size of system required at the Cork Harbour Wastewater Treatment Plant is the containerised or "in-vessel" system.

For composting, it is necessary to add a bulking agent such as straw, woodchip, sawdust, bark or other biodegradable waste to the sludge. To minimise the quantity of bulking agent required and the time taken for the excess water to evaporate, the sludge should first be dewatered to at least 25 % dry solids prior to

composting. Once the composting process is complete, more than 70 % of this bulking agent can be removed for re-use.

The biosolids product from the composting process is best suited for soil improvement or land remediation, and also for agriculture. However, it generally has a moisture content of approximately 40 %, and its volume would be approximately 4 times greater than that of a thermally dried biosolids product. It would therefore require larger storage areas, and would result in higher transportation and disposal costs. Due to the abundance of good quality topsoil in the area, it is unlikely that a sufficient market would be available for the compost product from a plant of this scale.

Composting is therefore not considered to be a viable sludge treatment option for the Cork Harbour Wastewater Treatment Plant.

There are two forms of **Alkaline Stabilisation** process which would convert municipal wastewater sludge into a biosolids product suitable for use in agriculture. The first requires the addition of lime to raise the pH of the sludge to greater than 12 with an accompanying rise in temperature to 70°C for 30 minutes. Alternatively, it is necessary to add lime to raise the pH to greater than 12, to maintain the pH above 12 for 72 hours, to achieve a temperature of ≥ 52°C for at least 12 hours, and at the end of the 72 hour period to air dry the product to a dry solids content of ≥ 50% to produce a suitable biosolids product.

Ideally the sludge should first be dewatered to at least 25% dry solids before alkaline stabilisation to limit the volume of lime required. At lower feed solids concentrations it is necessary to increase the amount of lime added to evaporate the water content. This leads to increased volume in the biosolids product and results in higher transportation and disposal costs. Typically the biosolids would have a dry solids content of approximately 50%. The amount of lime required ranges from 0.7 to 2.0 kgs of quicklime to each 1.0 kgs sludge dry solids.

The biosolids product from the alkaline stabilisation process is best suited for use in agricultural areas which are deficient in lime. However, this is not the case in the Cork Harbour area, or in the general Mid Cork area, while agricultural land in the North Cork area does have a lime deficiency. The distance from the biosolids market, coupled with the bulky nature of the product (when compared with a thermally dried product) makes this an unsuitable sludge treatment option for the Cork Harbour Wastewater Treatment Plant.

Thermal Drying of the sludge either by direct or indirect contact with gases to produce a dried biosolids with a moisture content of ≤ 10% would be acceptable provided that either the temperature of the biosolids > 80°C or the wet bulb temperature of the gas in contact with the biosolids as the biosolids leaves the dryer > 80°C.

The size of the dryer is based on the mass of water to be evaporated, and is therefore dependent on the dry solids content of the feed sludge. It is therefore necessary to dewater the sludge prior to drying (typically 25%). Emphasis is usually placed on improving the energy efficiency of the system by use of heat recovery from the process. When coupled to an anaerobic digestion system, some of the surplus biogas produced by digestion can be used as an energy source for the drying process. Similarly if the biogas from the digestion process is burned in a CHP (Combined Heat & Power) unit, some of the surplus electric power generated can be used by the dryer. Alternatively, heat generated in the condensation and sludge cooling processes in the drying system can be recovered and used for other heating purposes such as pre-heating the feed sludge, heating a digestor or for general building heating.

For this scheme the amount of biosolids product produced for re-use/disposal would be 5.0 tonnes/day (7.2m^3) based on the future design year loadings (2030). The dryer size required for the Cork Harbour Wastewater Treatment Plant is within the size range for commercially viable units. The product would be a granular material with a water content of less than 10% which could be easily transported and spread on agricultural land. It is easily applied using standard agricultural machinery, and requires much less storage capacity than other biosolids products. It is generally necessary to shut down the dryer for approximately 2 weeks per annum to carry out routine maintenance work. During that period it is therefore necessary to have available sufficient storage capacity available on site for the un-dried sludge (approximately 360m^3). If this is primary and/or secondary activated sludge which has not undergone any other form of treatment (other than dewatering) this will result in significant odour generation, and loading on the odour control system.

While thermal drying of the sludge does not require any form of pre-treatment (other than de-watering) of the sludge there are advantages in providing anaerobic digestion of the sludge before drying it. The principle advantages are set out as follows:

Anaerobic digestion provides a standby means of producing a compliant biosolids product during periods when the dryer is shut down for annual maintenance and during other unscheduled shut downs. It is acknowledged that this un-dried biosolids product will have a lower solids content and a greater volume as a result. However, this could be acceptable on a short-term basis.

By providing approximately 30% total solids destruction in the digestion stage, and subsequent dewatering to the higher solids content of 25%, the volume of sludge to be dried and consequently the size of the dryer can be reduced significantly.

The biogas generated in the digestion process is a valuable energy source which can reduce the operating costs of the dryer, while heat energy can be recovered from the dryer for use by the digestion process.

The biosolids product which has been pre-treated by anaerobic digestion is more stable and less prone to absorbing water than dried biosolids which have not been pre-digested.

Therefore, it is considered advantageous to provide mesophilic anaerobic digestion in addition to the thermal drying process. Thermal drying of the sludge is therefore considered as a viable sludge treatment process for the Cork Harbour Wastewater Treatment Scheme, either with or without anaerobic digestion as a pre-treatment stage.

5.5.4.2 Sludge Destruction Technologies

Sludge destruction technologies considered for this scheme include

- Advance Fluidised Composting (AFC)
- Reed Beds
- Vermicomposting
- Thermal Degradation (Incineration)
- Pyrolysis and Gasification

Advanced Fluidised Composting is the sludge treatment process recommended for the Cork Harbour Wastewater Treatment Plant. This is a proprietary patented process which is based on thermophilic aerobic sludge digestion process, and incorporates a chemical treatment stage. While the main process vessel is aerated, a portion of the sludge is continuously withdrawn, passed through a solids separation stage

(membrane filtration) with the sludge then chemically treated prior to return to the aerobic digester. The manufacturer of this process claims extremely high rates of organic destruction and has used the process on industrial high strength wastewater applications. However, the system or its performance has not been proven for the treatment of municipal wastewater sludge.

Reed Beds are a sludge destruction technology which results in up to 98 % destruction of the sludge. The reed beds comprise of several layers of graded material in which the common reed is planted. A drainage gallery is provided underneath the bed to collect the effluent. Sludge is then applied regularly in liquid form. After approximately 8 to 10 years the stable material is removed from the base of the bed in small quantities. However, this process requires up to 1 m^2 per p.e of bed area, and is therefore more suitable for small schemes. For the Cork Harbour Wastewater Treatment Plant, this corresponds to a bed area of approximately 80,000 m^2 (8 hectares). Because of the large land area requirements it is not considered suitable for this scheme.

Similarly **Vermicomposting** is also oriented towards the smaller schemes. It takes place in a closed container which is maintained at a temperature of approximately 18°C. Worms are introduced into the woodchip beds at a high density, and sludge is drip fed onto the beds regularly. It is drawn down into the woodchip bed by the worms, and by natural turning and aerating action of the worms, the sludge is degraded. This process is not suitable for a plant of the scale of the Cork Harbour Wastewater Treatment Plant.

Thermal Degradation (Incineration) is an established technology for disposing of large quantities of wastewater sludge. However, because of its complexity and cost and gas treatment requirements it is not considered suitable for use on this scheme. Also based on the current objections to incineration of waste in the Ringaskiddy area, very strong opposition to such a treatment process at this site can be expected. If, however, the waste incinerator project is successful and operational at the time of commissioning of the Cork Harbour Wastewater Treatment Plant, then the operating contractor may make a commercial decision to use this as the treatment and disposal route for the sludge produced on site. It is the contractor who will have to bear this risk.

A promising approach for efficient utilisation of biomass energy is the thermal conversion of the organic material to liquid or gas fuels. **Gasification and Pyrolysis** are two such sludge treatment technologies which utilise the dried biosolids as a feedstock to produce a fuel which could be used as an energy source. The key to the thermal efficiency of these systems is that the remaining solid residue is combusted to provide heat for the drying process.

The pyrolysis process operates at a temperature in the range of 400 to 800 °C at ambient pressure to break down the organic material into a mixture of liquid hydrocarbons, combustible gases and char. This fuel product is similar in composition and properties to diesel oil. An extension of the pyrolysis system is the "Oil from Sludge" process which optimises the oil production. This process operates under pressure, and results in the recovery of 95 – 98 % of the energy in the dried sludge product.

The gasification process operates at much higher temperatures (900 to 1200°C) and break down the organic material into combustible gases. The gas product is suitable for use in the drying process which precedes the gasification process. However, use of the gasification process may require IPC licensing.

Neither of the these processes have yet been proven as commercially viable for a plant of this scale and are therefore not considered suitable technologies for use on the Cork Harbour Wastewater Treatment Plant.

On the basis of the above evaluation, none of the sludge destruction technologies is ideally suited to this plant. The most attractive option would be for the treatment only of municipal wastewater sludge at this plant and to produce a biosolids product for use in agriculture. The treatment process most likely to be adopted is thermal drying (either with or without anaerobic digestion of the sludge prior to drying). However, the successful plant contractor may have innovative developments to offer, and these should be considered at that stage if commercially and environmentally viable.

5.6 Proposed Wastewater Treatment Plant

The Cork Harbour Wastewater Treatment Plant will be constructed using the Design/Build/Operate procurement method, with the type of treatment process and associated technology to be selected by the successful contractor. The type of wastewater and sludge treatment processes to be used cannot therefore be specified in this Preliminary Report. However, for the purpose of providing an indication of the type of plant, site layout and budget costing an indication is provided below of the treatment processes considered most likely to be employed. This is based on experience of other plants of this scale and on current developments in technology. The treatment process is shown schematically on Fig. Nr. 5.6.1.

5.6.1 Wastewater Treatment Process

The indicative treatment process described below is based on a conventional activated sludge process preceded by primary settlement, with the resultant sludge produced being treated by anaerobic digestion and thermal drying. This represents a conservative type of system with a large footprint, within which adequate scope is available for the successful contractor to incorporate innovative technologies with smaller footprints without difficulty. An indicative layout of the proposed wastewater treatment plant is provided in Fig. Nr. 5.6.2.

It is acknowledged that not all of these unit processes are essential to produce a treated effluent and sludge of the required standards, but their exclusion will impact on the sizes and treatment capacity requirements of the remaining process units. The unit sizes below are therefore, based on the inclusion of each of these treatment stages.

The preliminary treatment processes which can be expected to be employed at the Cork Harbour Wastewater Treatment Plant are:

Preliminary Treatment System

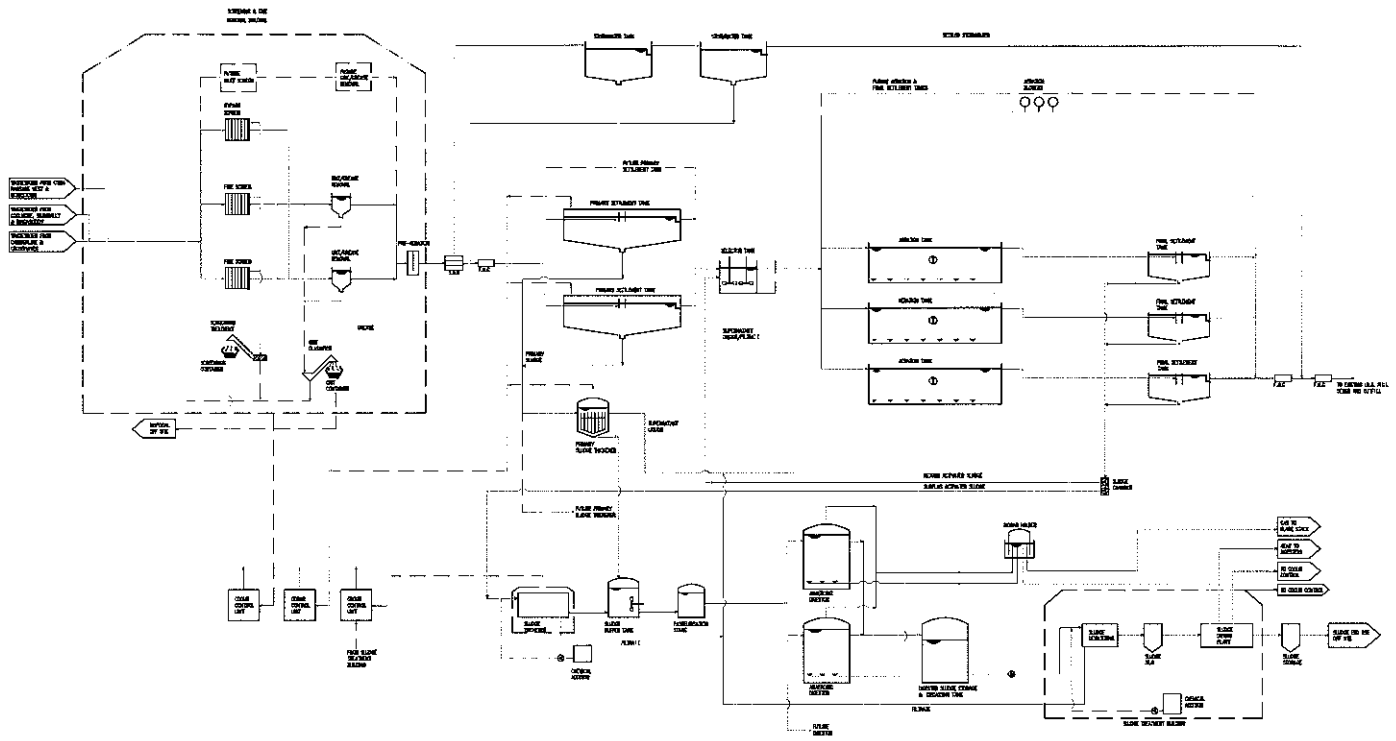
A complete preliminary treatment system with the following elements located within the Preliminary Treatment Building

- 2 Nr (duty/duty) Mechanically cleaned fine screens (with 6 mm spacing), in parallel channels each approximately 2 m wide. These will be capable of passing the maximum flow of 1,600 l/s.
- 1 Nr Manually raked bypass screen to facilitate maintenance on the fine screens.
- 2 Nr (duty/assist) Screenings washing, de-watering and bagging facilities.
- 2 Nr (duty/duty) Vortex type grit traps complete with air lift grit removal system with a diameter of approximately 5.0 m and each capable of passing 800 l/s.
- 2 Nr. (duty/assist) Grit classifiers.
- 2 Nr (duty/standby) air blowers rated at 1,057 Nm^3/hr to aerate the contents of this tank.

The Primary Treatment System will also include:-

- 1 Nr Covered pre-aeration tank with an operational capacity of 960 m^3.

The quantity of screenings removed on site for disposal (note that screening systems employed at Cobh retain the screenings in the flow) is estimated at 1.7 m^3/day based on 85 $m^3/10^6$ m^3 of wastewater at average flow. This will be taken off site for disposal at the Cork County Council landfill site.

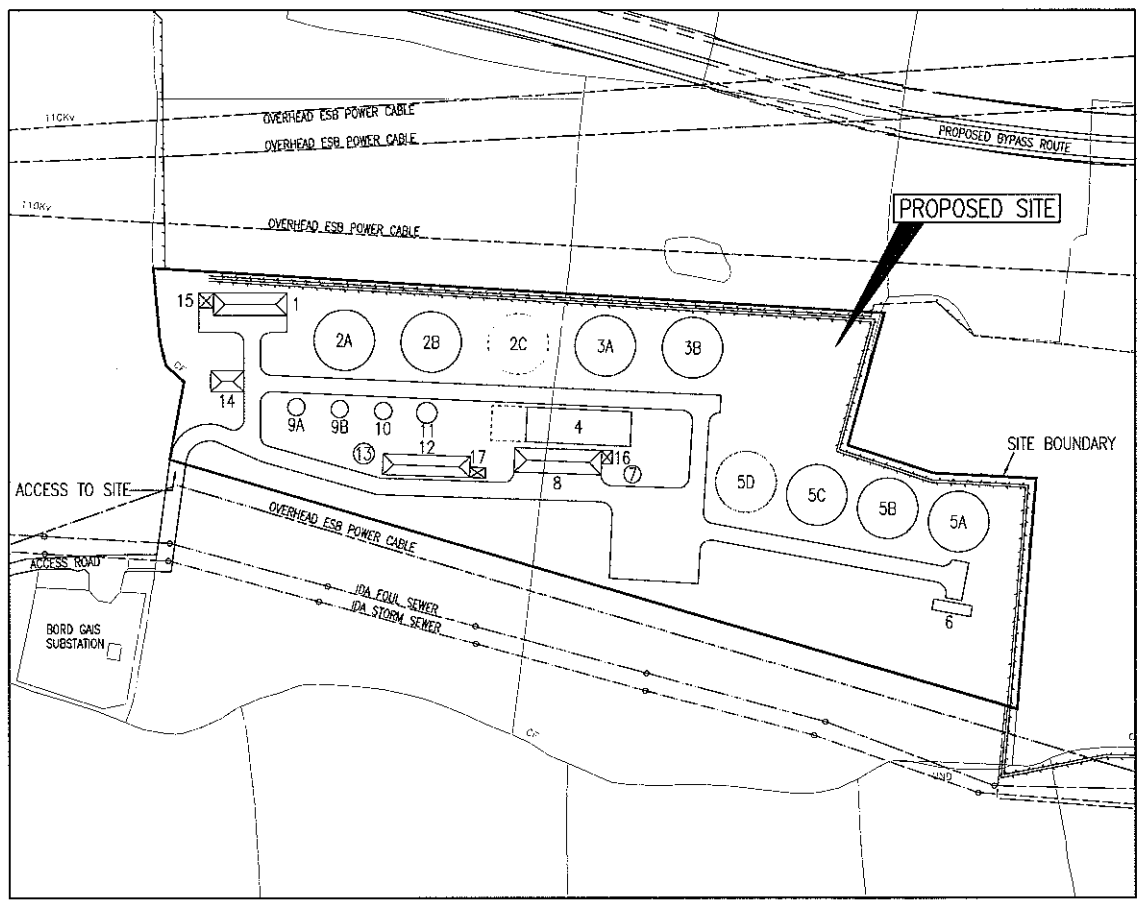


WASTEWATER
TREATED EFFLUENT/ SETTLED STORMWATER
SLUDGE
SCREENINGS/GRIT/GREASE
FILTRATE/SUPERNATANT LIQOUR
REJECT WASHWATER
AIR
BIOGAS
CHEMICAL
FLOW MONITORING CHAMBER F M C
STORMWATER OVERFLOW CHAMBER S O C
PUMP STATION
AIR DIFFUSER
MIXER
SUBMERSIBLE FLOW BOOSTER

Mott MacDonald

FIGURE 5 6 1 PROPOSED WWTP SCHEMATIC FLOW PROFILE FOR CONVENTIONAL ACTIVATED SLUDGE SYSTEM (INDICATIVE DESIGN Nr 1)

CORK HARBOUR MAIN DRAINAGE SCHEME
JOB NR. 234541
DRG NR. 5670FG75



NOTES

1. PRELIMINARY TREATMENT (SCREENING, GRIT REMOVAL & PRE-AERATION)
2. PRIMARY SETTLEMENT TANKS
3. STORMWATER SETTLEMENT TANKS
4. AERATION TANKS
5. SECONDARY SETTLEMENT TANKS
6. TREATED EFFLUENT MONITORING CHAMBER
7. PRIMARY SLUDGE THICKENER TANK
8. ACTIVATED SLUDGE BUILDING (CONTAINING WASTE ACTIVATED SLUDGE BELT THICKENER)
9. ANEROBIC SLUDGE DIGESTERS
10. DIGESTED SLUDGE STORAGE TANK
11. BIOGAS HOLDER
12. SLUDGE TREATMENT BUILDING (HOUSING THE DIGESTED SLUDGE DEWATERING SYSTEM AND THE SLUDGE DRYING PLANT)
13. DRIED SLUDGE STORAGE SILO
14. ADMINISTRATION / CONTROL BUILDING
15. PRELIMINARY TREATMENT ODOUR CONTROL UNIT
16. PRIMARY SLUDGE ODOUR CONTROL TREATMENT UNIT
17. SECONDARY SLUDGE ODOUR TREATMENT UNIT

LEGEND

PROPOSED SITE
RISING MAIN
FOUL SEWER
STORM SEWER
PROPOSED BYPASS
ESB CABLE
INDICATES SPACE AVAILABLE FOR FUTURE EXPANSION

Mott MacDonald

FIGURE 5 6 2 INDICATIVE SITE LAYOUT NR 1 SCALE 1:2 000

EXTRACT FROM O.S. MAPS CORK 5471-D & 5510-B
CORK HARBOUR MAIN DRAINAGE SCHEME
JOB NR. 234541
DRG NR. 5670FG52

The quantity of grit produced on site for disposal off site is estimated at 0.39 m^3/day (with 0.21 m^3/day grit already removed in Cobh) based on a typical grit removal rate of 30 m^3 per 10^6 m^3 of wastewater.

All of the wastewater channels and chambers within this building will be covered, with the air in the enclosed headspaces extracted and vented through an odour control unit. This unit is likely to be outside of the building, and will discharge the treated air to atmosphere.

Because of the risk of the presence of flammable gases such as methane in this building, it will be zoned as a hazardous area, with all electrical equipment including motors and instruments suitable for such an environment. The associated control panels should be installed in a separate non-hazardous room within the building. Also the presence of hydrogen sulphide and other gases in the raw wastewater require that the building itself is also vented, with the extracted air passed through an odour control system.

Storm Water Treatment

The storm water management and treatment system on site is likely to restrict the flows to primary settlement and secondary treatment to 3 DWF, and to allow flows in excess of this to overflow to a storm water treatment system. This system may comprise of;

- 1 Nr Storm water overflow weir in a designated chamber
- 4 Nr Radial flow settlement tanks constructed in reinforced concrete, and fitted with a rotating sludge scraper mechanism and a peripheral overflow weir system. These are sized to provide the equivalent residence time of 2 hours for the flows in excess of 3 DWF, i.e. with a combined operational capacity of 7,810 m^3. When full, these tanks will overflow to the treated effluent discharge pipeline. Based on a typical average water depth of 3.5 m in these tanks, these would each have a diameter of 26.7 m.
- 1 Nr Storm water return sump common to all tanks, and fitted with 2 Nr submersible pumps to operate on a duty/assist basis to return the contents of the tank to the main wastewater flow upstream of the primary settlement tanks. This flow will be returned when the main flow for treatment reduces to 2 DWF or less.

Primary Settlement

The provision of primary settlement tanks operated at an upward flow rate of 1.2 m^3/m^2.hr will remove at least 50 % of the suspended solids from the raw wastewater, and provide a reduction in BOD reduction of at least 30 %. With careful operation and management of these tanks higher removal efficiencies are possible, but the figures quoted here are conservative and allow for flexibility in the systems offered.

- 2 Nr. Radial flow settlement tanks each with an internal diameter of 31.4 m and a sidewall height of 2.5 m, of which only the top 1.0 m will be above ground level. Each tank will be constructed in reinforced concrete and will be fitted with a rotating scraper sludge system and an access bridge. The depth of the overflow weirs will be kept to a minimum to reduce turbulence at the weirs and to reduce odour. It is also most likely that each of the primary settlement tanks will be covered with their head space vented through an odour control system. On the basis of an odour dispersion model prepared for this site it is considered necessary to completely cover the primary settlement tanks to ensure that the odour concentration perceived at the nearest sensitive receptor (cumulatively for all site sources) will be no greater than 1.5$Ou_e m^{-3}/m^3$ (98%^{ile}) and 3$Ou_e m^{-3}/m^3$ (99.5%^{ile}).
- 1 Nr. Primary sludge sump fitted with 2 Nr sludge pumps will be provided to serve both primary settlement tanks. This chamber will also be covered with the headspace vented through an odour control system. These will be pumping the primary sludge at a sludge thickness of 2 % dry solids to the primary sludge thickener.

Secondary Treatment

To achieve the treated effluent standard required a completely mixed activated sludge system is likely to be provided. This would comprise of the following

- 3 Nr. Selector Tanks constructed in reinforced concrete and each with an operational capacity of 417 m^3 would be provided upstream of the aeration tanks. These would be aerated and fitted with a fine bubble diffused air aeration system
- 3 Nr. Aeration tanks constructed in reinforced concrete, and each with an operational capacity of 1,866 m^3. These would be operated at a top water level of 4.5 m and would be fitted with a fine bubble diffused air aeration system, and flow directional mixing system.
- 3 Nr. Positive displacement air blowers to operate on a duty/assist/standby basis would be installed within acoustic enclosures in a designated blower building near the aeration tanks. These would each be rated at 3,112 Nm^3/hr, and would supply the entire air requirements of the selector and aeration tanks.
- 1 Nr Dissolved oxygen control system, which would control the output of the aeration blowers to match the demand of the loading and mixed liquors.

Secondary Settlement

Each of the above aeration tanks would have a designated secondary settlement tank (with interchange possible) which would be constructed in reinforced concrete.

- 3 Nr. Radial flow secondary settlement tanks each fitted with a rotating bridge and scraper system and a peripheral overflow weir. Each of these will have a plan area for settlement of 619 m^2 and a corresponding internal diameter of 28.1 m.
- 3 Nr Pairs of duty/standby sludge return pumps will be provided, with each returning the activated sludge to its designated selector/aeration tank.
- 2 Nr. Sludge wastage pumps to pump the surplus activated sludge to the activated sludge thickening system.

Sludge Thickening

Because of the different thickening characteristics of primary and surplus activated sludge, separate thickening systems will be provided.

- 1 Nr. Gravity sludge thickener installed in a glass reinforced steel tank and fitted with a rotating picket fence assembly will be provided to increase the thickness of the primary sludge from 2 % to 6 % dry solids. This tank will have an operational capacity of 206 m^3 and an internal diameter of 8.1 m. Due to the odourous nature of primary sludge this tank will be roofed, with the air extracted from the headspace and vented through an odour control system.
- 1 Nr. Gravity belt thickener with an odour enclosure fitted will be installed in the Sludge Treatment Building to increase the thickness of the surplus activated sludge from 0.5 % to 6 % dry solids. To achieve this sludge thickness the sludge will be dosed with a polyelectrolyte solution. This unit will be required to thicken approximately 95kg dry solids per hour. This thickener will also be connected to an air extract system and odour treatment unit.
- 2 Nr Thickened sludge pumps (duty/standby) will be provided for each of these thickeners to pump the sludges to a common sludge buffer tank.

Sludge Treatment

To provide maximum flexibility in the use of the biosolids produced, the sludge treatment system to be installed here may include an anaerobic digestion process, preceded by a pasteurisation stage and followed by dewatering and subsequent sludge drying. This system will produce 4.97 tonnes of biosolids per day (at 90% dry solids) for which a market and end use must be sought.

- 1 Nr Sludge buffer tank constructed in glass enamelled steel and into which the thickened primary and secondary sludges would be pumped. This tank would be fitted with a mixer, and would have an operational capacity of 320 m^3 corresponding to three days sludge production.
- 1 Nr sludge pasteurisation tank constructed in steel and thermally insulated would be provided with an operational capacity of 6 m^3. This would be maintained at a temperature of 57 °C.
- 2 Nr. Anaerobic digesters constructed in glass enamelled steel and thermally insulated to maintain the temperature of the contents at 37 °C. Each tank will be fitted with an internal gas mixing system. The operating volume of each of these will be 798 m^3, with a tank diameter of 10.5 m and a sidewall height of 10 m.
- 1 Nr. Digester heating system comprising of a CHP system and standby boiler capable of operating with either natural gas or biogas. These will be used to heat the digester contents by the use of heat exchangers. This heating system will be installed within the Sludge Treatment Building.
- 1 Nr. Biogas holder constructed in glass enamelled steel will be erected near the digesters. This will have an operating capacity of 431 m^3, and will have a diameter of 12 m and a maximum height of 10 m based on a bell-over-water type with the bell at its maximum lift.
- 1 Nr. Flare stack
- 1 Nr. Digested sludge storage tank constructed in glass enamelled steel will be provided adjacent to the digesters. This will be identical in size to the digesters and will be roofed. This will have an operational capacity of 798 m^3, corresponding to 7 days sludge processing capacity. The contents of this tank will be mixed continuously.
- 1 Nr. High pressure sludge dewatering belt press capable of dewatering up to 200 kg dry solids/hour. This press will be enclosed and housed in the sludge Treatment Building. A polymer dosing system will be provided to enhance the dewatering process.
- 1 Nr. Dewatered sludge silo constructed in either GRP or steel will be provided with a capacity equivalent to one day's production of dewatered sludge, i.e. 22.5 m^3.
- 1 Nr. Sludge dryer capable of drying 4,469 kg dry solids/day. This will be operated with an evaporation rate of approximately 0.70 m^3/hr of water taking into account the necessary 125 % peaking factor. The dryer will incorporate all necessary feed and discharge screws, heat generation system, heat exchangers, condenser and air scrubbing system. The dryer will be installed within the Sludge Treatment Building.
- 1 Nr. Sludge silo constructed in either GRP or steel will be provided with a capacity equivalent to 4 day's production of dried sludge, i.e. 20 m^3.
- 1 Nr. Bagging system will be provided for the dried sludge.

Odour Control System

All of those unit processes with odour potential must be connected to a negative air extraction and odour treatment system. Less offensive sources (the aeration tankage, secondary settlement tankage and storm water tankage) are considered low risk in terms of odour and do not require odour control units (OCU).

Based on the preliminary site layout prepared, (Figure 5.6.2) this may comprise three separate odour treatment units with one in each of the locations shown. The units are likely to be installed at the Preliminary Treatment Building, at the Activated Sludge Building and adjacent to the Sludge Treatment Building.

OCU 1 Inlet works, preliminary treatment (screening, grit removal and pre aeration) and primary settlement tanks.

OCU 2 Primary sludge thickener tank and activated sludge building.

OCU 3 Anaerobic sludge digesters, digested sludge storage tank, sludge treatment building (containing the digested sludge dewatering system and sludge drying plant) and the dried sludge storage silo.

The types of odour control unit most commonly used for this application are biofilter units with a shell based media. The number of odour control units and numbers of stages in the odour control system will be selected by the contractor; however the contractor will be required to meet the overall maximum allowable emission rates specified in the Environmental Impact Statement. An odour limit of less than 1.5 Ou_e m^{-3} for the 98th percentile and 3.0 Ou_e m^{-3} for the 99.5th percentile is recommended for the nearest sensitive locations and areas of amenity. These limits are considered sufficiently conservative to provide protection to the community at large taking into account the latest suggested odour impact criteria by environmental agencies in Ireland, the UK and the Netherlands.

Noise Attenuation

The treatment of the wastewater required the use of several elements of rotating machinery, such as pumps, air blowers, compressors, centrifuges, aerators, etc. The noise levels associated with these items can be quite significant and attenuation is required if nuisance levels are to be avoided. Section 3.7 Noise and Vibration addresses the potential noise impacts and the required mitigation measures.

A design noise criterion of 45 dB9A) at 20m from the boundary of the WWTP and a design criterion of 45 dB(A) at 5m from the pumping stations is specified. This represents the noise emissions from continuous plant and process.

In addition, for the WWTP site, a daytime design noise criterion of less than 55 dB(A) at 20m from the boundary is proposed to ensure negligible noise impact due to daytime work activities and vehicles operating within the site.

Plant Control

To optimise the operation and performance of this plant a SCADA system will be necessary. This will significantly reduce the level of manual intervention required for plant operation, and will also enable continuous plant operation without continuous manning of the site. It will incorporate an automatic dial-out system to alert personnel to any critical plant failures when the plant is not manned. Critical information will be made available and transmitted to the relevant Cork County Council office.

Provision of continuous monitoring and sampling of wastewater flow entering and leaving the site will be provided. This will also include monitoring and measuring of the storm water content. This wastewater

monitoring is critical not only in terms of controlling plant operation and complying with the Urban Waste Water Regulations 2001 and 2004, but also for the purposes of charging for wastewater treatment.

5.6.2 Alternative Treatment System

A schematic flow profile of an alternative wastewater treatment system which may be employed on site is shown in Fig. Nr. 5.6.3, with an indicative layout provided in Fig Nr. 5.6.4. The principle differences between this system and the system described previously are the omission of the primary settlement stage and associated sludge treatment system, replacement of aeration and secondary settlement tanks with sequencing batch reactors, and the exclusion of anaerobic sludge digestion. In addition rectangular storm water settlement tanks fitted with mixers are included instead of the radial flow tanks. It is described in brief below.

Preliminary Treatment System

- As per system described previously.

Storm Water Treatment System

- 2 Nr. Rectangular settlement tanks fitted with submersible mixers, tipping bucket flushing systems and an overflow weir along the outlet end of each tank. The tipping bucket is normally at rest above top water level, while the mixer is normally switched off. When it is intended to return the settled water to the main wastewater stream for treatment the mixer is activated to ensure that the return flow is of a consistent nature. When all of the tank contents have been emptied and returned for treatment, the tipping bucket is lowered to empty its contents and flush the floor and side walls of the tank. The operational capacity of these tanks will be exactly the same as for the radial flow circular tanks.
- 1 Nr. storm water sump complete with 2 Nr pumps as per main treatment option.

Primary Settlement

The provision of primary settlement tanks is not included in this option.

Secondary Treatment

To achieve the treated effluent standard required a Sequencing Batch Reactor (SBR) activated sludge system is likely to be provided as an alternative treatment option. This would comprise of the following

- 4 Nr. SBR reactor tanks constructed in reinforced concrete, and each with an operational capacity of 2,000 m^3 (larger capacity than required for conventional system). These would be operated with a top water level of 5.5 m and a bottom water level of 3.85m. Each tank would be fitted with an automated feed system, desludging system and decanting weir. Aeration would be provided by a fine bubble diffused air aeration system. Each of the SBR tanks would incorporate a Selector compartment with an operational capacity of 313 m^3 at the SBR inlet. These compartments would also be aerated and fitted with a fine bubble diffused air aeration system
- 3 Nr. Positive displacement air blowers to operate on a duty/assist/standby basis would be installed within acoustic enclosures in a designated blower building near the aeration tanks. These would each be rated at 4,000 Nm^3/hr, (larger than requirement for conventional system) and would supply the entire air requirements of the selector and aeration tanks.
- 4 Nr Pairs of duty/standby sludge recycle pumps will be provided, with each returning the sludge from the SBR to its selector zone.
- 1 Nr Dissolved oxygen control system, which would control the output of the aeration blowers to match the demand of the loading and mixed liquors.

Secondary Settlement

Separate secondary settlement tanks are not required for the SBR.

- 2 Nr. Sludge wastage pumps to pump the surplus sludge to the sludge thickening system.

Sludge Thickening

Because there will be no primary sludge produced on site by this treatment option only surplus activated sludge thickening system will be provided.

- 2 Nr. Gravity belt thickeners with an odour enclosure fitted will be installed in the Sludge Treatment Building to increase the thickness of the surplus activated sludge from 0.5 % to 6 % dry solids. To achieve this sludge thickness the sludge will be dosed with a polymer solution. These units will each be required to thicken approximately 95kg dry solids per hour. These thickeners will also be connected to an air extract system and odour treatment unit.
- 2 Nr Thickened sludge pumps (duty/standby) will be provided for each of these thickeners to pump the sludges to a common sludge buffer tank.

Sludge Treatment

The sludge treatment system to be installed here might not include an anaerobic digestion stage, but just dewatering followed by sludge drying. This system will result in the production of approximately 7.0 tonnes per day of biosolids product (90% dry solids)for which a market an end use must be sought. This is approximately 41 % more than that produced by the other treatment option.

- 1 Nr Sludge buffer tank constructed in glass enamelled steel and into which the thickened primary and secondary sludges would be pumped. This tank would be fitted with a mixer, and would have an operational capacity of 320 m^3 corresponding to three days sludge production.
- 1 Nr. high pressure sludge dewatering belt press capable of dewatering up to 280 kg dry solids/hour. This press will be enclosed and housed in the sludge Treatment Building. A polymer dosing system will be provided to enhance the dewatering process.
- 1 Nr. Dewatered sludge silo constructed in either GRP or steel will be provided with a capacity equivalent to one day's production of dewatered sludge, i.e. 32 m^3.
- 1 Nr. Sludge dryer capable of drying 6,300 kg dry solids/day. This will be operated with an evaporation rate of approximately 1.0 m^3/hr of water taking into account the necessary 125 % peaking factor. This is approximately 40 % higher than the capacity of the drying system required for the conventional activated sludge system with primary settlement and anaerobic digestion. The dryer will incorporate all necessary feed and discharge screws, heat generation system, heat exchangers, condenser and air scrubbing system. The dryer will be installed within the Sludge Treatment Building. The dryer will use natural gas from the national grid as the fuel source for the heating system.
- 1 Nr. Sludge silo constructed in either GRP or steel will be provided with a capacity equivalent to 4 day's production of dried sludge, i.e. 28.2 m^3.
- 1 Nr. Bagging system will be provided for the dried sludge.

5.6.3 Proposed Site Layout

An indicative site layout for the proposed wastewater treatment plant based on the conventional activated sludge process, as described above and shown schematically in Fig. Nr. 5.6.1 is provided in Fig. Nr. 5.6.2. To optimize the use of the sloping nature of the site, the preliminary treatment and primary settlement stages would be located at the higher elevations on site. Since these would be constructed for the most

part below ground level only the tops of the chamber walls would be visible. These would be screened from view by local vegetative screening.

Similarly, the storm water settlement tanks, aeration tanks and secondary settlement tanks would be constructed in part below ground level, with only the top one meter of the side walls emerging above the finished ground levels.

Access to the WWTP site will be from the existing access road to the Bord Gais substation bordering the south western perimeter of the proposed site. This access road is connected to a minor road (locally known as Cogan's Road) to the west, which currently connects to the National Primary Route to Ringaskiddy (N28). Upgrading of the existing site access road will be required in order to cater effectively with vehicles/traffic associated with the proposed development.

There are proposals to upgrade the N28 from Cork to Ringaskiddy. The Cork to Ringaskiddy Realignment Scheme currently has two proposed interchanges at Shannonpark and Shanbally. The proposed N28 route passes immediately north of the WWTP site and runs approximately parallel to and south of the existing N28 National Primary route.

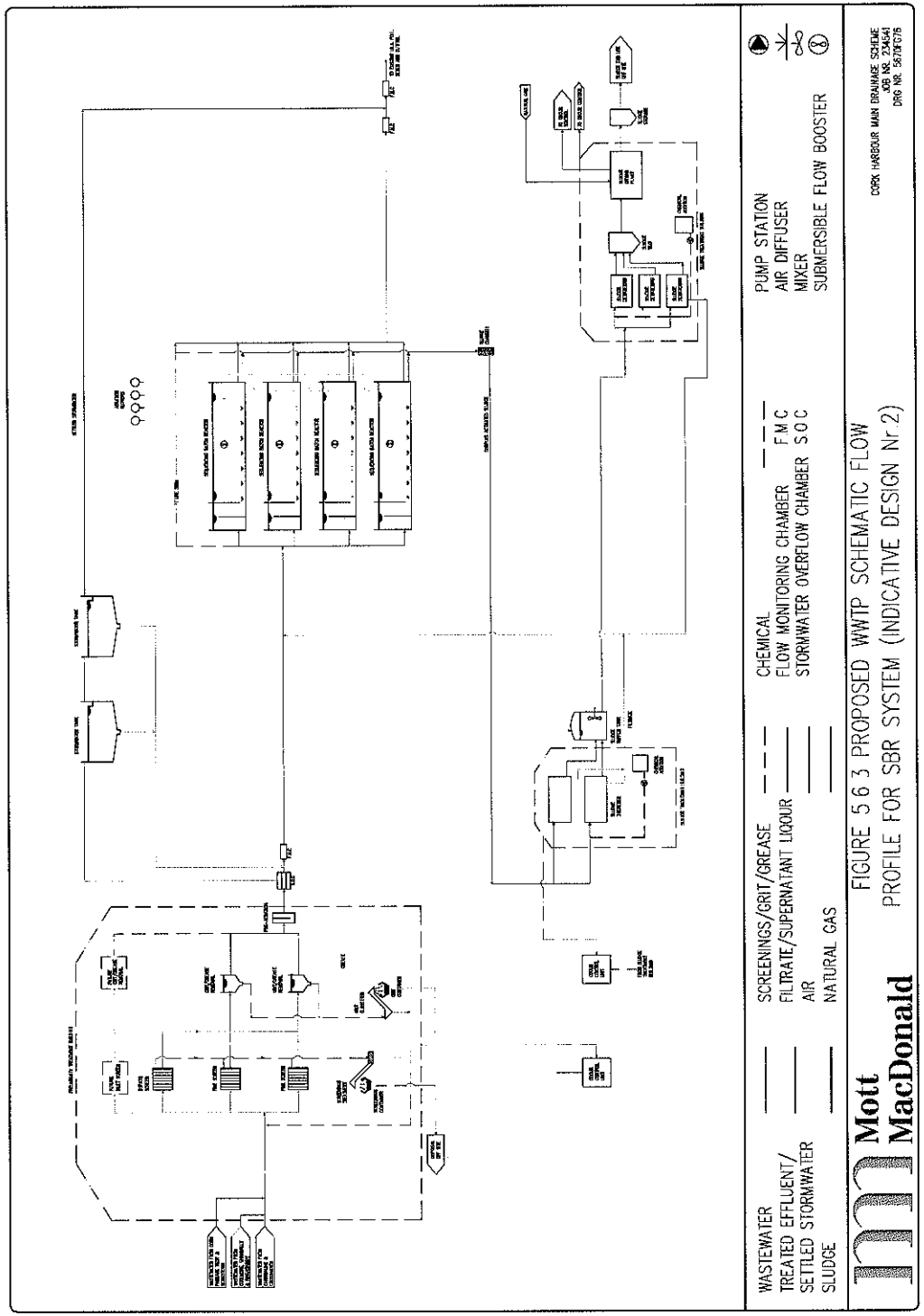
However, the plans for the road scheme show that once constructed it will no longer be possible to access the N28 from the LS427 (Cogan's Road). Communications with the relevant road authorities (the NRA) indicate that it is not envisaged to provide direct access from the WWTP to the N28.

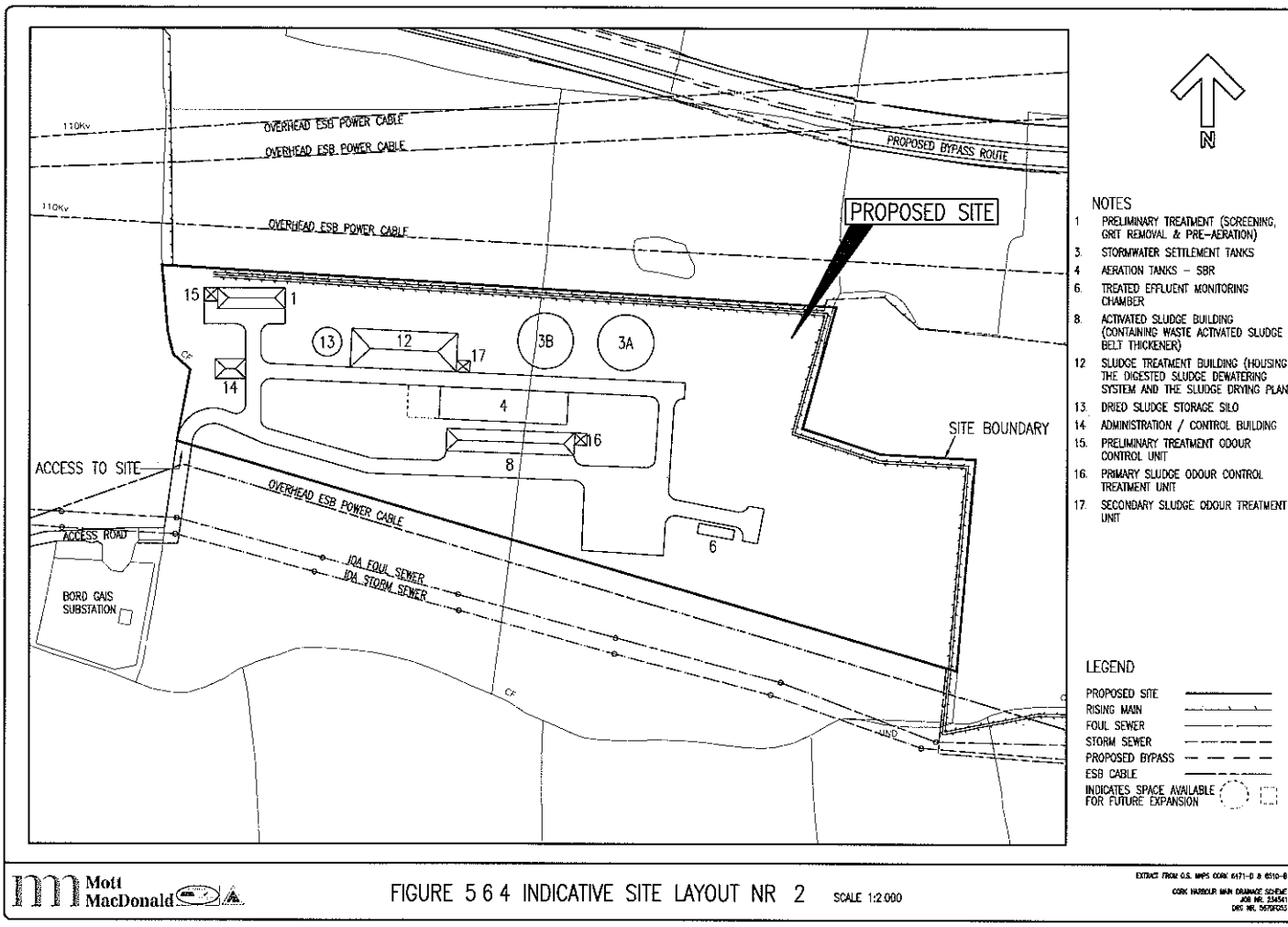
In the event that the road is constructed proper to the completion of the WWTP, access to the WWTP site will be from the N28 to the L2490 (Fernhill Road) and along the LS427 (Cogan's Road) for both the construction and operation phases of the project. Upgrades along this route will be carried out by the NRA as part of the proposed upgrade to the N28 Cork to Ringaskiddy Realignment.

5.6.4 Plant Flexibility and Future Expansion

Assuming the wastewater treatment plant is operational in 2015, the wastewater loads will be approximately 65% of the loads predicted for the year 2035. As such, the proposed wastewater treatment plant should be capable of effective operation while the loading is gradually increasing to the design loading. The modular nature of the activated sludge system described above would facilitate this requirement by operating at lower loading rates or at increasing loading rates with one of the three aeration tanks and its secondary settlement tank out of service in the initial stages of operation.

Sufficient space is also provided at the treatment plant site to facilitate further future expansion to accommodate ultimate loadings due to further development in the scheme's catchment area beyond that date.





Mott MacDonald

FIGURE 5 6 4 INDICATIVE SITE LAYOUT NR 2 SCALE 1:2 000

EXTRACT FROM O.S. MAPS CORK 6171-D & 6510-B
CORK HARBOUR MAIN DRAINAGE SCHEME
JOB NR. 234541
DRG NR. 5670R251

ATTACHMENT 2

CORK LOWER HARBOUR SEWERAGE SCHEME - PROJECT PROGRAMME

Task Name	Duration (months)	2010		2011				2012				2013				2014				2015			
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
DEHLG Approval of PR		★																					
Procurment of Consultants	7																						
Prequalifiaction Period	2																						
Assesment of Submissions	1																						
Invite Tenders	2																						
Tender Assessment	2																						
Appoint Consultants	0				★																		
Detailed Design & Contract Documents	12																						
DEHLG Approval of Contract Documents	6																						
Collection System Contracts	30																						
Tender Period	2																						
Tender Assessment	4																						
Contract Award	0												★										
Construction	24																						
WWTP DBO Contact	39																						
Shortlisting Procedure	6																						
Tender Period	3																						
Tender Assessment	6																						
Contract Award	0															★							
Construction	23																						
Costruction Complete	0																						★

ATTACHMENT 3

Comhairle Contae Chorcai
Cork County Council

WSIP Project Office,
Model Business Park,
Model Farm Road,
Cork.
Tel No: (021) 4819400
Fax No: (021) 4819433
Web: http://www.corkcoco.ie

Colm Brennan

Mr Robert O'Farrell,
Senior Engineer,
Area Operations South,
Cork County Council,
County Hall,
Cork

AREA OPERATIONS SOUTH
0 4 NOV 2010
CORK COUNTY COUNCIL
COUNTY HALL - CORK

2nd November 2010

Re: Cork Lower Harbour Sewerage Scheme

The Environmental Impact Statement for the Scheme was certified by An Bord Pleanála on 24th June 2009.

The Department of the Environment, Heritage and Local Government issued comments on the Preliminary Report for the Scheme in 2009. A revised Report incorporating the comments received was submitted to DEHLG in March 2010 The Department has recently asked for additional documentation to accompany the submission. This is currently being prepared

Cork County Council issued a Consultants Brief to DEHLG for the Detailed Design & Construction stages in September 2010. Comments have been received and the document is currently being revised

The estimated total capital cost of the scheme is €90,899,963 Of this €85,527,042 would be incurred in the initial phase of the project, with €5,372,921 to be expended in later phases

The programme which we are proposing to the DEHLG comprises of 4 contracts:

Contract 1	Cobh Collection System	€17,300,024
Contract 2	Carrigaline Collection System	€4,765,827
Contract 3	Passage West / Monkstown and Ringaskiddy Collection Systems	€9,692,938
Contract 4	Waste Water Treatment Plant DBO	€25,707,600

The Crosshaven Sewerage Scheme was completed under a separate contract Flows from Crosshaven already collected and pumped to Carrigaline from where the sewage is pumped forward with the Carrigaline sewage into the IDA outfall

This outfall will also serve the new treatment plant at Shanbally The treatment plant proposes will have a capacity of 80,000 population equivalent and can be expected to open with a load of approx 50,000 p e which allows a margin of 30,000 p e for future growth

Regards,

Tim O'Herlihy
Executive Engineer
Cork County Council

CORK COUNTY COUNCIL
4 NOV 2010
Maintenance
AREA OPERATIONS SOUTH

ATTACHMENT 4

REGULATION 18 3(b) RESPONSE

CLARIFICATION ON POINTS OF INFORMATION RAISED BY THE ENVIRONMENTAL PROTECTION AGENCY & NATIONAL PARKS & WILDLIFE SERVICE

WASTE WATER DISCHARGE LICENCE APPLICATION

D0057-01

RINGASKIDDY

SUBMITTED TO:
LICENSING UNIT,
ENVIRONMENTAL PROTECTION AGENCY,
WEXFORD

DATE RESPONSE PROVIDED : FEBRUARY 20TH 2009

TABLE OF CONTENTS

TABLE OF CONTENTS CONT'D:

APPENDICES

RESPONSE PART A – FURTHER INFORMATION SUBMITTED TO AN BORD PLEANÁLA

A1 – FURTHER INFORMATION SUBMITTED TO AN BORD PLEANÁLA

An requested further information on 25th August 2008 and again on 19th January 2009. Copies of the information supplied are included in Appendix 1 of this document.

RESPONSE PART B – THE EIS APPROVAL NOTICE & PERMISSION ETC

B1 – EIS APPROVAL

The Environment Impact Statement for the project was lodged with An Bord Pleanála on 10th March 2008. The reference for the EIS for the Proposed Waste water Treatment Plant at Shanbally, County Cork, is case ref PL04 .YA0005. The case is currently listed as "Proposed decision date not available at this time".

ABP requested a copy of the Preliminary Report for the Cork Lower harbour Sewerage Scheme in order to assist the Inspector in making his decision. A copy of the Preliminary Report was issued by Cork County Council on 22nd January 2009, with confirmation of receipt issued by An Bord on 26th January 2009.

It is the policy of the Department of the Environment, Heritage and Local Government, that a Preliminary Report cannot be approved prior to the approval of the EIS, as to do so would be pre-empting the decision on the EIS.

Based on the original programme, the likely timelines, (assuming the Department of the Environment, Heritage and Local Government approve the Preliminary Report without a number of requests for clarification) are now:
DEHLG Approval: June 2009
Appoint Consultants: Dec 2009/Jan 2010
Appoint Contractors: Jan 2012
Construction of Collection System Completion: Dec 2014
Construction of WWTP Completion: May 2015

RESPONSE PART C – COMPLETED TABLES FOR THE PROPOSED DISCHARGES

C1 – BACKGROUND

C1.1 – EXISTING IPPC LICENCES

A number of IPPC licensed industries currently discharge to the existing outfall at the Dognose Bank. The relevant licence holders are listed in Table C1 below. The licence limits are included as mg/l in Table C6, as kg/d in Table C7 and as a worst case combined discharge in Table C8.

Table C1 – IPPC Licence Holders discharging to Dognose Bank

Reg No.	Name	Address
P0006-03	Novartis Ringaskiddy Limited	Ringaskiddy
P0010-04	Pfizer Overseas Pharmaceuticals and C.P. Pharmaceuticals International C.V.	Loughbeg, Ringaskiddy
P0013-04	Pfizer Overseas Pharmaceuticals and C.P. Pharmaceuticals International C.V.	Ballintaggart, Ringaskiddy
P0476-02	Recordati Ireland Limited	Ringaskiddy
P0778-01	Centocor Biologics (Ireland) Limited	Ringaskiddy

C1.2 – CORK COUNTY COUNCIL MONITORING

Cork County Council carries out sampling of the discharges through the Dognose Bank outfall at the terminal pump station. The average results from the available data for the period 2006-2008 inclusive are included in Table C2 below.

Table C2 – Existing Dognose Bank Discharge

BOD	COD	SS	Volume
mg/l			m^3
83	239	118	8,896
kg/d			
738	2,126	1,050	8,896

The existing discharge in Table C2 above shows the average combined discharge from the IPPC licenced industries discharging to the IDA sewer and the combined flows from Carrigaline & Crosshaven which are currently pumped to the IDA sewer.

The application for the discharge license included tables of sample data for the pumping station in Carrigaline and the terminal pumping station on the outfall for 24th October 2007. The data from these tables has been combined in Table C9 and the loading from the IPPC licenced industries has been estimated.

C2 – FUTURE DISCHARGES – POST COMPLETION OF WWTP

In order to quantify the effects of the treated waste water discharge from the proposed WWTP, the design loading for the Base Year (BY 2001) and the Design Year (DY 2030) are included in Table C10. The receiving waters of Outer Cork Harbour are not designated as a sensitive area under the Urban Waste Water Treatment Regulations 2001 and as amended in 2004. Nutrient removal or reduction is not required. The treated discharge for both loadings is given in Table C3 below.

Table C3 – WWTP Treated Discharge

			2001 kg/d	2030 kg/d
Biochemical Oxygen Demand (BOD)	25	mg/l	288	371
Chemical Oxygen Demand (COD)	125	mg/l	1,440	1,855
Total Suspended Solids (SS)	35	mg/l	403	519
Ammonia	12.5	mg/l	144	189
Total Nitrogen	28.5	mg/l	328	423

The figures in Table C3 above when combined with the worst case scenario of all industries discharging at the full IPPC licence limits at the same time (see Table C7) gives the following discharge at the Dognose Bank outfall.

Table C4 – Combined IPPC (Maximum) & WWTP (2030) Treated Discharge

BOD kg/d	COD kg/d	SS kg/d	Total N kg/d	Volume m^3
4,274	12,125	1,219	2,010	21,341

As discussed in Section C1.2 above, the existing discharge at the Dognose Bank includes the combined flows from Carrigaline & Crosshaven. The estimated actual IPPC discharges combined with the WWTP treated discharge are shown in Table C5.

Table C5 – Combined IPPC (Typical based on 24/10/07) & WWTP (2030) Treated Discharge

BOD kg/d	COD kg/d	SS kg/d
885	3,171	1,149

Table C6 – Relevant IPPC Licence Limits (mg/l) (Volume m^3)

Reg No.	Name	pH	Toxicity	BOD	COD	SS	Total N	Ammonia	Total P	Heavy Metals	Sulphates	FOG	VOC	Anionic Detergents	Detergents	Manganese	Copper	Zinc	Volume	Max Vol./Hr
P0006-03	Novartis	6-9	10	250	700	500	70	10	22								0.5	1	900	48
P0010-04	Pfizer	6-9	10	2000	3000	250	100	50	200	1	700	10			5			1	1800	135
P0013-04	Pfizer	6-9	10		5500	500	500	75	60							60	0.5	0.5	2900	
P0476-02	Recordati	6 5-9	10	300	1000	100	100		200	1	1000	10	1	5					100	10
P0778-01	Centocor Biologics	6-9	10	60	300	50	80		20		200	20								

Table C7 – Relevant IPPC Licence Limits kg/d

Reg No.	Name	BOD	COD	SS	Total N	Ammonia	Total P	Manganese
P0006-03	Novartis			225	32	5	10	
P0010-04	Pfizer							
P0013-04	Pfizer		3900	1333	1333	200	160	160
P0476-02	Recordati	30	100	10				
P0778-01	Centocor Biologics	48	240	40				

Table C8 – Total IPPC Discharge to Harbour with all IPPC Operating at Licence Limits (kg/d) (Volume m^3)

pH	Toxicity	BOD	COD	SS	Total N	Ammonia	Total P	Heavy Metals	Sulphates	FOG	VOC	Anionic Detergents	Detergents	Manganese	Copper	Zinc	Volume
6-9	10	3,903	10,270	700	1,587	1 423	556	1 9	1 520	35	0.1	0.5	9	160	1 9	4 15	6 500

Table C9 – Carrigaline Loading (Carrigaline PS) – Carrigaline & IPPC Loading (Outfall PS Ringaskiddy) and IPPC Loading Estimate

Location	pH	BOD	COD	SS	TP	TN	NH3	SO4	O-PO4-P	Flow	Cond 20C	Cadmium	Chromium	Copper	Lead	Nickle	Zinc	Barium	Bomon	Flouride	N03 as N
Ringaskiddy mg/l	7.6	106.0	311.0	112.0	2.2	21.0	14.2	160.0	6.4	8248	2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.7	3.9
Ringaskiddy kg/d		874.3	2565.1	923.8	18.2	173.2	117.1	1319.7	52.5			0.1	0.1	0.1	0.1	0.1	0.1	0.1	42.1	5.4	32.3
Carrigaline mg/l	8.2	103.0	357.0	84.0	6.4	54.0	36.4	108.0	11.2	3500	1679	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1		8.0
Carrigaline kg/d		360.5	1249.5	294.0	22.3	189.0	127.4	378.0	39.2			0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	28.0
IPPC Loading Kg/d		513.8	1315.6	629.8	-4.1	-15.8	-10.3	941.7	13.3			0.0	0.0	0.0	0.0	0.0	-0.1	0.0	41.9	5.4	4.4

Some of the results in the above table have negative values as water quality sampling can only reflect an instant in time

Table C10 – WWTP Loading

LOADING Note1		Cobh		Passage West & Monkstown		Ringaskiddy Shanbally & Coolmore		Carrigaline		Crosshaven		Total	
Category	Parameter	BY	DY	BY	DY	BY	DY	BY	DY	BY	DY	BY	DY
Domestic	Flow	1,608	3,076	760	1437	179	202	1,917	3,496	300	485	4,764	8,696
	BOD	643	1230	304	575	71	81	767	1398	120	194	1,905	3,478
	SS	750	1,435	355	671	83	94	895	1,631	140	226	2,223	4,057
Infiltration	Flow	> 697	1025	> 1,000	479	60	67	3,130	1165	100	162	> 4,987	2,898
Commercial	Flow	293	492	122	230	29	32	342	559	48	78	834	1,391
	BOD	117	197	49	92	11	13	139	224	19	31	335	557
	SS	136	230	57	107	13	15	162	261	22	36	390	649
Institutional	Flow	178	146	37	43	5	28	114	120	Incl.	36	334	374
	BOD	72	56	19	22	3	14	57	60	Incl.	18	151	170
	SS	84	65	22	25	3	16	66	70	Incl.	21	175	197
Industrial	Flow	0	344	0	0	0	0	607	1,138	0	0	607	1,482
	BOD	0	138	0	0	0	0	16	456	0	0	16	594
	SS	0	2300	0	0	0	0	22	531	0	0	22	2,831
Total	Flow	> 2,776	5,083	> 1,919	2,189	273	329	6,105	6,478	448	761	>11,521	14,841
	BOD	832	1,621	371	689	86	108	978	2,138	139	243	2,406	4,799
	SS	971	4,030	433	803	100	125	1,145	2,493	162	283	2,811	7,734
	Pop. Equiv.	13,865	27,020	6,189	11,478	1,426	1,798	16,305	35,636	2,317	4,050	40,102	79,982

Flow (m^3/day) BOD (kg/day) SS (kg/day)

Note 1 Loadings are based on figures calculated in Cork Harbour Main Drainage Preliminary Report (Mott MacDonald Pettit 2007)
Base Year (BY) = 2001 Design Year (DY) = 2030

Note 2 The effluent loadings relating to Institutional sources is not quantified separately from that of the other categories from sources of effluent loadings in Crosshaven.

Note 3 Design treatment capacity is taken as 80 000 P.E.

RESPONSE PART D – IMPACT ASSESSMENT OF THE PROPOSED DISCHARGES – TROPHIC STATUS, SHELLFISH & BATHING WATERS

D1 – BACKGROUND

An assessment of the impacts of the proposed discharges on the receiving waters has been included in Volume 1 of the Environmental Impact Statement (EIS) as Section 3 - Receiving Environment, Sub Section 3.3 Water Quality.

A computer model of the receiving waters was developed for the scheme and the results are included in Volume 2 of the EIS as Appendix 3A. The model estimates the relative changes to the quality of the receiving waters of the provision of the treatment plant, relative to the existing untreated discharges, excluding background concentrations of the modelled substances. Hence the model demonstrates the positive impact of the provision of the treatment plant on the receiving waters.

As part of the correspondence with statutory bodies, the following issues were raised, and included in the EIS.

- South Western Regional Fisheries Board
  - physical impacts of waters containing fisheries
  - effects of sediment disturbance, and impact on commercial/amenity fisheries from the marine crossing
  - Impact on shellfisheries
  - Impacts on fish habitats & water quality (chemical & microbiological)
  - Assessment of the potential for untreated effluent to discharge to harbour waters and Monkstown Creek.
  - Nutrient loading effects on Cork Lower Harbour which is periodically affected by phytoplankton blooms.
  - Measures to avoid and prevent pumping station overflow discharges during operation.

These items are addressed in Chapter 2 - Section 2.11 and Chapter 3 - Section 3.1, 3.2 and 3.3.

- Department of Communications, Marine and Natural Resources
  - noise and vibration details should be noted and limited in accordance with relevant legislation
  - specify in the EIS if dredging for the marine crossing is required
  - details to be provided on proposed pipelines in the foreshore incl. timing/duration
  - refer to the designation of Shellfish Waters
  - potential impacts on navigational safety and passage of migratory fish.

These items are addressed in Chapter 3 - Section 3.1, 3.2, 3.3, 3.4 and 3.7.

The Environmental Protection Agency have asked that additional information be provided in relation to:

"The impact assessment of the proposed discharges having regard to the trophic status of the receiving water and the current uses (shellfish, bathing)"

These impacts were addressed in the EIS, as outlined above, and have been summaries in Section D2 of this response.

D2 – BATHING & SHELLFISH WATERS

D2.1 – EXISTING BATHING WATERS & STANDARDS

The EIS states that "there are no designated bathing areas within the study area, however, Fountainstown beach is a designated bathing area and is located 5.25km from the existing IDA outfall, which is proposed as the sole outfall for discharges from the WWTP."

Cork Lower Harbour is not designated a sensitive water under the *Bathing Water Regulations* of 1992 however, it is a used for recreational purposes. A map showing the locations of bathing waters used for recreational purposes, but not designated as such, is included in this response.

The Bathing Water Regulations (S.I. No. 155 of 1992) a limit is set of:

- ≤ 1000 faecal coliforms/100mls in ≥ 80% of samples
- ≤ 2000 faecal coliforms/100mls in ≥ 95% of samples.

Currently the waters of the Lower Harbour are below these limits. The new Bathing Water Directive 2006/7/EC specifies a standard, in a 95-percentile evaluation for excellent quality coastal waters, of:

- ≤ 100 intestinal enterococci (cfu/100ml)
- ≤ 250 Escherichia coli (cfu/100ml).

D2.2 – EXISTING SHELLFISH WATERS & STANDARDS

Cork Lower Harbour is not designated as sensitive water under Statutory Instruments S.I. No. 268 of 2006 – European Communities (Quality of Shellfish Waters) Regulations 2006. The regulations specifies a limit in the shellfish flesh and intervalvular liquid of:

- ≤ 300 Faecal coliforms

Cork Harbour is a shellfish production area (Code CK-CH). This area lies north of a point from Roberts Head to Roches Point up to and including the mean high water mark. In Ireland the main bivalve species are mussels, native and pacific oysters, razorfish, scallops, clams and cockles. Shellfish areas are classified by the microbiological quality of the water. Areas are assigned a classification of A, B or C by the DAFF based on microbiological monitoring.

Table 3.2.5 Designated Bivalve Mollusc Production Areas in Ireland (October, 2005) included in Volume 2 of the EIS lists the shellfish production areas in Cork Harbour based on information contained on the FSAI (Food Safety Authority of Ireland) website. A map showing the locations of these is included as Figure 3.2.5 of the EIS.

D 2.3 – MODEL OF BACTERIA CONCENTRATIONS

The computer model of the receiving waters developed as part of the EIS included consideration of Faecal coliforms and Intestinal Enterococci and Escherichia coli in the modelling. The results of the faecal colifrom modelling were used to estimate the Intestinal Enterococci and Escherichia coli concentrations. The improvement in conditions due to the provision of the waste water treatment plant have been modelled, not actual concentrations of bacteria as background concentrations were not considered.

The model considered 15 no. specific locations, some but not all of which, coincide with the locations identified as bathing waters within the Lower Harbour Area. The model locations are tabulated below and included in Chapter 4 - Figure 4.13 of Appendix 3A of the EIS.

Table D1 – List of locations used to model bacteria concentrations

Fountainstown	Shoreline closest to Outfall	Oyster Farm – Outer Harbour
Myrtleville	Spike Island	Marlogue Point
Roches Point	Ringaskiddy Ferry	Oyster Farm – North Channel
Crosshaven	Monkstown Creek	West Passage
200m upstream of Outfall*	Cobh	Lough Mahon

* This point is just outside the near field mixing zone.

The model concluded that, for both 2010 & 2030 population projections that provision of the treatment plat would lead to a reduction in levels of faecal coliforms by between 80 and 95%, depending on the location within the study area. The points with the lowest concentrations at Fountainstown and the oyster farm in the North Channel.

Concentrations of Intestinal Enterococci were modelled giving a maximum of 27.44 cfu/100ml at a location 200m North of the proposed outfall based on 2030 population estimates. Concentrations of Escherichia coli at this location would be expected to be the same as the concentrations of faecal coliforms.

With the exception of the area immediately surrounding the outfall the maximum concentrations of Escherichia coli are modelled at less than 250 cfu/100ml, the average concentrations at this location were modelled at 76.3 cfu/100ml. Further details of the predicted concentrations are included in Tables 4-9 and 4-10 and Sections 4.5, 4.6 and 4.7 of Chapter 4 of Appendix 3A.

It can be concluded that the provision of the Waste water Treatment Plant at Shanbally will result in a significant improvement in the water quality within the Lower Harbour, improving the potential for use for recreation and shellfish farming.

D3 – TROPHIC STATUS

The computer model was also used to estimate the effects of nitrogen on the receiving waters by modelling organic nitrogen, ammonia and nitrate. The results of the modelling are discussed in detail in Chapter 6 of the Appendix. As with the bacteria modelling, the results have been presented for the 15 locations tabulated in Section D2.3 above.

The reduction in concentrations of the various forms of Nitrogen are included in Tables 6-2 to 6-4 with spatial mapping demonstrating the reduced concentrations included as Figures 6-17 to 6-20 of the Appendix to the EIS.

The provision of the treatment plant shows considerable reductions in the predicted nitrogen levels in the Lough Mahon (designated sensitive waters) and in the North Channel. It also leads to improvement of the waters in the Outer Harbour.

D4 – CONCLUSIONS

The conclusions of the modelling report are included as Chapter 7 of the Appendix, and are summarised below. It should be noted that

1) The concentrations of Faecal Coliforms in the raw sewage were assumed to be 4.5 times greater than those used for a similar study in Galway.
2) The assumed efficiency of bacteria removal for the treatment plant used in the model is 90%, the efficiency of the existing plant in Midleton is in the region of 98%.
3) 98% removal of bacteria would lead to a treated concentration of 5 times less than the concentration assumed for the model purposes.
4) The model is therefore extremely conservative. A less conservative model, based on 98% efficiency would lead to reductions in coliforms concentrations of between 96 and 99% when compared with the untreated discharges.

D4.1 – FAECAL COLIFORMS

The proposed treatment plant will reduce the number of faecal coliforms in Cork Harbour and the waters outside Roches point.

- The untreated discharge has been modelled giving concentrations of between 2 and 1500 cfu/100ml
- The treated discharge has been modelled giving concentrations of between 2 and 400 cfu/100ml
- The average untreated concentration modelled as 140 cfu/100ml is reduced to 40 cfu/100ml
- Areas including Lough Mahon, the Inner Harbour, East & West Passages and Ringaskiddy show a 95% reduction in coliform levels. Elsewhere the reduction is modelled as 80%.

D4.2 – ESCHERICHIA COLI

The proposed treatment plant would lead to reductions in concentrations of Escherichia coli of the same magnitude as those outlined in 4.1 above for Faecal Coliforms.

D4.3 – INTESTINAL ENTEROCOCCI

The proposed treatment plant, at the conservative model, would lead to reductions in concentrations of Intestinal Enterococci to levels several orders of magnitude lower than those required by Bathing Water Directive 2006/7/EC. The levels of Intestinal Enterococci associated with a less conservative model have not been predicted, but would be, as with the results for Faecal Coliforms and Escherichia coli, significantly less than those predicted by the model.

D4.4 – TROPHIC STATUS

The model shows a marked reduction in the levels of Nitrogen as organic nitrogen, ammonia and nitrate within the study area, particularly in the predicted nitrogen levels in the Lough Mahon (designated sensitive waters) and in the North Channel. The provision of the proposed treatment plant will have a significant positive influence on the trophic status of the receiving waters.

RESPONSE PART E – THE APPROPRIATE ASSESSMENT REQUESTED BY NPWS

Response is in 2 separate parts:

- **E(1) – Proposed Waste Water discharge effects on Cork Harbour PSPA (4030)**
- **E(2) – Appropriate Assessment of Proposed Waste Water Discharge and it's effect on Cork Harbour PSPA (4030) in accordance with Articles 6 & 7 of EC Directive 92/43/EEC**

RESPONSE PART E(1) – PROPOSED WASTE WATER DISCHARGE EFFECTS ON CORK HARBOUR pSPA (4030)

E(1) 1 – BACKGROUND

The National Parks & Wildlife Service have suggested that "the proposed Waste water discharge is considered likely to have significant adverse effects on a European site" due to uncertainty associated with the:

> *"Ability of WWTP to accommodate extra projected population equivalent loading, taking into account potential effects in combination with other WWTP discharges into the Inner Harbour including the Cork City WWTP"*

An assessment of the impacts of the proposed Waste water Treatment Plant (WWTP), including discharges to the receiving waters, has been included in Environmental Impact Statement (EIS) for the Cork Lower Harbour Sewerage Scheme. Relevant information has been extracted and included in the sections below to demonstrate the positive effects of the proposed waste water treatment plant.

E(1) 2 – EXISTING AND PROPOSED WASTE WATER DISCHARGES

A report was completed for Cork County Council in November 2007 relating to modelling Norovirus contamination in Cork Harbour. The report compiled a list of the treated and untreated discharges to the harbour. These are tabulated below and included indicatively on a drawing overleaf.

Table E(1)1 – List of Discharges to Cork Harbour

Location	Treatment	Location	Treatment
Cork City – Carrigrennan	Secondary	Passage West/ Glenbrook/ Monkstown	None
Midleton	Secondary	Whitegate/ Aghda	None
Carrigtohill	Secondary	Ringaskiddy	None
Cloyne	Secondary	Saleen	None
Carrigaline/ Crosshaven	None	Rostellan/ Farsid	None
Cobh	None	Houses -North Channel	None

The modelling completed for the EIS for the Cork Lower Harbour Sewerage Scheme did not consider the background concentrations of coliforms, nitrogen, etc but modelled the improvement in water quality due to the provision of the waste water treatment plant on the existing untreated discharges at Carrigaline/Crosshaven, Cobh, Passage West/ Glenbrook/ Monkstown and Ringaskiddy.

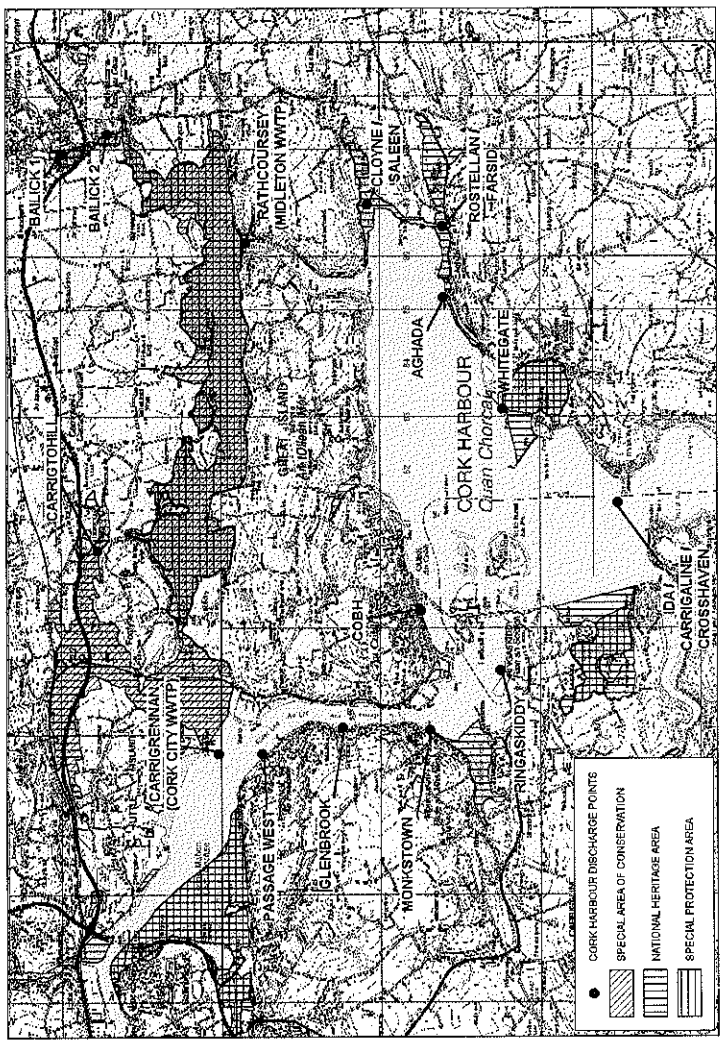


Figure E(1)/1 – Existing Treated and Untreated Discharges to Cork Harbour.

The proposed WWTP will initially be sized for a population equivalent (P.E.) of 50,000. The plant will allow for further expansion to 80,000 P.E., the estimated loading for the year 2030. The discharge standards for the treatment plant are:

- < 25 mg/l BOD
- < 125 mg/l COD
- < 35 mg/l SS

The 2001 loading on the harbour from the untreated discharges of the agglomerations of Carrigaline/Crosshaven, Cobh, Passage West/ Glenbrook/ Monkstown and Ringaskiddy has been estimated as:

Table E(1)2 – Estimated Untreated Discharge Loadings (2001)

Parameter	Cobh	Passage West & Monkstown	Ringaskiddy Shanbally & Coolmore	Carrigaline	Crosshaven	Total
Flow (m^3/day)	> 2,776	> 1,919	273	6,105	448	> 11,521
BOD (kg/day)	832	371	86	978	139	2,406
Ss (kg/day)	971	433	100	1,145	162	2,811
Pop. Equiv.	13,865	6,189	1,426	16,305	2,317	40,102

The estimated loading on the treatment plant by the year 2030 has been estimated as:

Table E(1)3 – Estimated Loading on WWTP – Year 2030

Parameter	Cobh	Passage West & Monkstown	Ringaskiddy Shanbally & Coolmore	Carrigaline	Crosshaven	Total
Flow (m^3/day)	5,083	2,189	329	6,478	761	14,841
BOD (kg/day)	1,621	689	108	2,138	243	4,799
Ss (kg/day)	4,030	803	125	2,493	283	7,734
Pop. Equiv.	27,020	11,478	1,798	35,636	4,050	79,982

The predicted 2030 flow rate of 14,841 m3/day equates to a treated discharge of 371 kg/day BOD. Untreated sewage is estimated to average 60g BOD per person per day. Therefore the treated discharge at the 2030 population estimate is equivalent to an untreated discharge of 6,180 P.E. (BOD). By comparison, the 2006 Census records the population of Passage West as 5,203.

The current untreated discharge from Crosshaven and Carrigaline to the existing IDA outfall discharging at the Dognose Bank (i.e. the proposed outfall for the Cork Lower Harbour Waste water Treatment Plant) was estimated, based on 2001 figures, at 26,449 P.E.

E(1) 3 – TERRESTRIAL AND MARINE ECOLOGY

A terrestrial and marine ecology assessment and report was prepared by Ecofact Environmental
Consultants Ltd. to address the potential impacts of the proposed WWTP and upgraded collection system on the ecology of the receiving environment. The terrestrial and marine ecology report is presented in full in Volume 2, Appendix 2A, and has been summarised as Section 3 - Receiving Environment, Sub Section 3.2 Terrestrial and Marine Ecology, of Volume 1 of the EIS.

Section 3.2.4 of the terrestrial and marine ecology assessment dealt with the impacts of the proposed scheme, and concluded that with correct mitigation measures the construction impacts would be minimal. The report further concluded, in relation to the operational phase impacts:

> *"Current nutrient inputs by foul water outfalls into the affected aquatic areas would be significantly reduced during the operation of the proposed scheme. Such inputs result in increased primary production and turbidity, indirectly suppressing filter feeder activity. Phytoplankton blooms are expected to be less frequent with the expected reduction in nutrient loading due to the proposed development and restrictions on the edibility of shellfish would ease considerably due to the reduction in associated biotoxins. Water quality around the shorelines within the Harbour and along the Owenboy Estuary is expected to improve, encouraging an increase in diversity of infauna (polychaete worms, bivalves, etc.) and epifauna (crabs, crustaceans, snails, etc.)."*

> *"The reduction of nutrients into the affected aquatic areas would improve water quality, habitats and diversity, and consequently add to the conservation status of Cork Harbour SPA, Owenboy River pNHA and Monkstown Creek pNHA."*

E(1) 4 – WATER QUALITY

A computer model of the receiving waters was also developed for the scheme and the results are included in Volume 2 of the EIS as Appendix 3A. The model estimates the relative changes to the quality of the receiving waters of the provision of the treatment plant, relative to the existing untreated discharges, excluding background concentrations of the modelled substances. Hence the model demonstrates the positive impact of the provision of the treatment plant on the receiving waters.

The model concluded that, for both 2010 & 2030 population projections that provision of the treatment plat would lead to a reduction in levels of faecal coliforms by between 80 and 95%, depending on the location within the study area.

The computer model was also used to estimate the effects of nitrogen on the receiving waters by modelling organic nitrogen, ammonia and nitrate. The results of the modelling are discussed in detail in Chapter 6 of the Appendix.

The provision of the treatment plant shows considerable reductions in the predicted nitrogen levels in the Lough Mahon (designated sensitive waters) and in the North Channel. It also leads to improvement of the waters in the Outer Harbour.

E(1) 5 – CONCLUSIONS

E(1) 5.1 – TERRESTRIAL AND MARINE ECOLOGY

The terrestrial and marine ecology assessment and report prepared by Ecofact Environmental Consultants Ltd concluded that the provision of the waste water treatment plant would improve water quality, habitats and diversity, and consequently add to the conservation status of Cork Harbour SPA, Owenboy River pNHA and Monkstown Creek pNHA.

E(1)5.2 – WATER QUALITY

The conclusions of the modelling report are included as Chapter 7 of the Appendix. The model used was extremely conservative, yet showed a significant decrease in coliform levels when compared with the untreated discharges. Areas including Lough Mahon, the Inner Harbour, East & West Passages and Ringaskiddy show a 95% reduction in coliform levels. Elsewhere the reduction is modelled as 80%.

A less conservative model, based on 98% efficiency of the treatment plant (the efficiency currently achieved by the Midleton plant) would lead to reductions in coliforms concentrations of between 96 and 99% when compared with the untreated discharges.

The model also showed a marked reduction in the levels of Nitrogen as organic nitrogen, ammonia and nitrate within the study area, particularly in the predicted nitrogen levels in the Lough Mahon (designated sensitive waters) and in the North Channel. The provision of the proposed treatment plant will have a significant positive influence on the trophic status of the receiving waters.

The loading on the receiving waters from the treated waste water discharged to the harbour at the 2030 population prediction of 80,000 P.E. will be similar to that from the untreated discharge from Passage West in 2006.

E(1) 5.3 – SUMMARY

The proposal for the plant has adequate capacity to cater for future population increases. The provision of the plant will not have an adverse impact on the Cork Harbour SPA. The provision of the Waste water Treatment Plant at Shanbally, combined with the elimination of other untreated discharges through the provision of additional waste water treatment plants in the East of the Harbour, will result in a significant improvement in the water quality within the Lower Harbour, and add to the conservation status of Cork Harbour SPA, Owenboy River pNHA and Monkstown Creek pNHA.

RESPONSE PART E(2) – APPROPRIATE ASSESSMENT

Proposed Waste Water Discharge and its effect on Cork Harbour pSPA (4030) in accordance with Articles 6 & 7 of EC Directive 92/43/EEC

E(2) 1 – BACKGROUND

The National Parks & Wildlife Service have suggested that "the proposed Waste water discharge is considered likely to have significant adverse effects on a European site" because of uncertainty associated with the discharge due to:

> *"Industrial and other discharges potentially leading to elevated concentrations of heavy metals and persistent organic compounds, which can bioaccumulate and have ecotoxicological effects of bird populations; on the following qualifying habitats and species:*
> *Black-tailed godwit (overwintering);*
> *Redshank (overwintering);*
> *Curlew (overwintering);*
> *Regularly occurring migratory bird wintering assemblage;"*

An assessment of the impacts of the proposed Waste water Treatment Plant (WWTP), including discharges to the receiving waters, has been included in Environmental Impact Statement (EIS) for the Cork Lower Harbour Sewerage Scheme. Relevant information has been extracted and included in the sections below to demonstrate the positive effects of the proposed WWTP.

The assessment included reference to the Department of the Marine Shellfish monitoring programme in relation to heavy metal concentrations but did not address the effect of the treatment plant on the concentrations of heavy metals in the harbour, or the bioaccumulation of persistent organic compounds. These are considered in the sections below.

E(2) 2 – PROPOSED WASTE WATER DISCHARGES

As highlighted in a previous response, the proposed WWTP will initially be sized for a population equivalent (P.E.) of 50,000. The plant will allow for further expansion to 80,000 P.E., the estimated loading for the year 2030. The discharge standards for the treatment plant are:

- < 25 mg/l BOD
- < 125 mg/l COD
- < 35 mg/l SS

The predicted 2030 flow rate of 14,841 m3/day equates to a treated discharge 6,180 P.E. (BOD). By comparison, the 2006 Census records the population of Passage West as 5,203.

The current untreated discharge from Crosshaven and Carrigaline to the existing IDA outfall discharging at the Dognose Bank (i.e. the proposed outfall for the Cork Lower Harbour WWTP) was estimated, based on 2001 figures, at 26,449 P.E.

E(2) 3 – EXISTING STUDIES

E(2) 3.1 – IRISH MARINE INSTITUTE

The Marine Institute monitors the levels of priority hazardous substances in shellfish from selected sites around the Irish coast on an annual basis. This monitoring programme is undertaken to comply with the requirements of EU legislation and to contribute to the Joint Assessment and Monitoring Programme required by the 1994 OSPAR convention. The following are extracts from Marine Institute publications:

"European Regulation 466/2001/EC came into effect on 5th April 2002. It sets maximum levels for mercury, lead and cadmium in foodstuffs, including bivalve mussles. While the monitoring presented here was carried out prior to the adoption of this regulation, results are compared with the values set in the regulation."

"There are no internationally agreed standards or guidelines for copper, chromium, zinc or chlorinated hydrocarbons in shellfish for human consumption. However there is a compilation of standard and guidance values for contaminants in shellfish, applied by Contracting Parties to OSPAR (Anon 1992). Samples analysed here are compared with these values. None of the countries have set guidance values or standards for chromium in shellfish."

The results of the Marine Institute Studies including Trace Metal and Chlorinated Hydrocarbon Concentrations in Shellfish from Irish Waters 1997 – 2002 and Trace Metal Concentrations in Shellfish from Irish Waters 2003 – 2005 are available from the National Food Residue Data http://nfrd.teagasc.ie/

These studies have included examination of concentrations of pollutants in oysters in Cork Harbour, and are summarised in Table E(2)1 of this report. All samples were below permissible levels. It is worth noting that after 2002 the levels of Chlorinated Hydrocarbons, PCBs and Pesticides which had been tested for in earlier surveys were below the limits of detection. This is coincidental, although not necessarily attributable to, with the provision of the Cork City WWTP.

Table E(2)1 – Trace Metal and Chlorinated Hydrocarbon Concentrations in Shellfish from Irish Waters 1997-2002 & Trace Metal Concentrations in Shellfish from Irish Waters 2003-2005 in Edible Tissue of oysters in Cork Harbour, 25 samples per annum

		1997	1998	1999	2000	2001	2002	2003	2005
Residue	**Units**	**Residue Concentration**							
Cadmium	mg/kg (ppm) wet wt.	0.19	0.26	0.32	0.25	0.23	0.29	0.16	0.12
Chromium	mg/kg (ppm) wet wt.	0.1	0.14	0.31	0.19*	0.23	0.19	0.22	0.14
Copper	mg/kg (ppm) wet wt.	10.9	23.9	22.6	11.4	11.1	24.8	7.37	8.62
Lead	mg/kg (ppm) wet wt.	0.23	0.15	0.08	0.25	0.45	0.12	0.29	0.21
Mercury	mg/kg (ppm) wet wt.	0.03	0.03	0.03	0.03	0.03*	0.03	0.04	0.04
Nickel	mg/kg (ppm) wet wt.					0			0.13*
Silver	mg/kg (ppm) wet wt.					0	1.21	0.3	0.33
Zinc	mg/kg (ppm) wet wt.	157	270	286	169	165	437	202	162
PCB-028	ug/kg (ppb) wet wt.	0.49	0.82	0.51	0.39	0	0.06		
PCB-031	ug/kg (ppb) wet wt.	0.5	0.79	0.09	0.39	0	0.06		
PCB-052	ug/kg (ppb) wet wt.	0.83	1.61	0.74	0.79	0	0.13		
PCB-101	ug/kg (ppb) wet wt.	0.96	1.37	0.85	1.07	1.1	0.53		
PCB-105	ug/kg (ppb) wet wt.	0.22				0.18	0.11		
PCB-118	ug/kg (ppb) wet wt.	0.7	1.24	0.82	0.64	0.63	0.47		
Pcb-138	ug/kg (ppb) wet wt.	0.92	1.34	1.09	0.61	1.17	0.62		
Pcb-153	ug/kg (ppb) wet wt.	1.57	1.9	1.49	1.53	1.18	1.12		

		1997	1998	1999	2000	2001	2002	2003	2005
Residue	Units	Residue Concentration							
Pcb-156	ug/kg (ppb) wet wt.	0.05	0.07	0.05*	0.06*	0.03	0.02*		
Pcb-180	ug/kg (ppb) wet wt.	0.13	0.22	0.15	0.11	0.04	0.01*		
Aldrin	ug/kg (ppb) wet wt.					-			
Cis-Chlordane	ug/kg (ppb) wet wt.	0.06*	0.06*		0.03	0.04	0.01**		
Dieldrin	ug/kg (ppb) wet wt.	0.83	0.97	2.31	0.12	0	0.54		
Endrin	ug/kg (ppb) wet wt.					0.09	0.05*		
Hexachlorobenzene	ug/kg (ppb) wet wt.	0.24	0.05	0.09	0.07	0.03*	0.01*		
Hexachlorohexane-alpha (HCH-alpha)	ug/kg (ppb) wet wt.	0.09	0.07	0.04		0	0.12		
Hexachlorohexane-beta (HCH-beta)	ug/kg (ppb) wet wt.					0	0.17*		
Isodrin	ug/kg (ppb) wet wt.					0.03*			
Lindane (HCH-gamma)	ug/kg (ppb) wet wt.		0.22	0.26	0.43	0.47	0.04		
op' DDT	ug/kg (ppb) wet wt.				0.04	0	0.01*		
pp' DDD	ug/kg (ppb) wet wt.	0.42	0.87	0.48	0.39	0.31	0.21		
pp' DDE	ug/kg (ppb) wet wt.	1.33	2.4	0.91	1.39	1.3	0.76		
pp' DDT	ug/kg (ppb) wet wt.	0.06	0.54	0.24	0.1	0.34	0.11*		
Trans-Chlordane	ug/kg (ppb) wet wt.				0.05	0.04	0.04		
Trans-nonachlor	ug/kg (ppb) wet wt.			0.04	0.07	0.09			

*Residue Concentration is below the Limit of Quantisation

Table E(2)1 – Trace Metal and Chlorinated Hydrocarbon Concentrations in Shellfish from Irish Waters 1997-2002 & Trace Metal Concentrations in Shellfish from Irish Waters 2003-2005 in Edible Tissue of oysters in Cork Harbour, 25 samples per annum

E(2) 3.2 – ENVIRONMENTAL PROTECTION AGENCY

The following are extracts from Water Quality in Ireland 2004-2006 published by the EPA:

"MONITORING OF TOXIC CONTAMINANT LEVELS IN ESTUARINE AND COASTAL WATERS
The Marine Institute monitors the levels of priority hazardous substances in a range of commercial fish species landed at Irish ports and also in shellfish from selected sites around the Irish coast. These are substances, such as mercury, that have been identified as being of particular concern to the marine environment and to consumers of seafood. Levels of such substances in fish and shellfish are a good indicator of contamination in the marine environment as a whole. Inter alia, the monitoring is part of Ireland's contribution to the Joint Assessment and Monitoring Programme (JAMP) of the OSPAR Convention."

"Environmental Contaminants in Shellfish
Concentrations of environmental contaminants such as metals, hydrocarbons and persistent organic pollutants in bivalve molluscs are very good indicators of ambient water quality with respect to these parameters. The Marine Institute monitors contaminants in mussels and oysters from shellfish growing waters but supplements this with additional samples from areas where shellfish are not harvested to give a more representative picture of the status of waters along the Irish coast."

"Seawater samples were collected from the 14 designated shellfish areas twice annually and analysed for trace metals and organochlorines. All organohalogens (PCBs and pesticides) results were below limits of detection (Marine Institute, 2007). The metal results varied

substantially as would be expected for seawater samples, and a number of samples exceeded current Irish standards (Water Quality (Dangerous Substances) Regulations (S.I. No. 12 of 2001)). Individual results do not in themselves imply a breach as these standards apply as annual average concentrations. However, no samples exceed the imperative values (maximum allowable concentrations) for shellfish waters as set out in SI 268 of 2006."

E(2) 3.3 – ENVIRONMENTAL RESEARCH INSTITUTE, UNIVERSITY COLLEGE CORK

University College Cork completed a number of studies as part of the VITOX/BIOMASSTOX projects. These included "An assessment of the pollutant status of surficial sediment in Cork Harbour in the South East of Ireland with particular reference to polycyclic aromatic hydrocarbons"

The assessment, http://zae.ucc.ie/biomasstox/Kilemade%20et%20al%20(2004).pdf, examined the pollution concentrations of heavy metals, PHAs, PCBs, OCPs, BFRs and organotins in surficial, inter-tidal sediments at 3 points within Cork Harbour with the results for the sites compared to a "clean" site at Ballymacoda outside the harbour. Figure 1 of the report which shows the test sites is included overleaf.

The assessment together with additional studies completed by UCC (available at http://zae.ucc.ie/biomasstox/) on the effects of the toxic compound discovered in the sediment on clams and turbot concluded that Cork Harbour is polluted principally with PHAs on a scale comparable to levels determined previously for both western and eastern Irish Sea sediments, and that "levels of PCBs, OCPs, BFRs and organotins were on the whole quite low, with the majority of the individual compounds being on or below the detection limit of the method."

Of the 3 sites within Cork Harbour, Whitegate, Aghada and Douglas, the site a Douglas was significantly more polluted that the other sites. The sum of PHAs in Douglas was 3 times that of the other sites and > 5 times that Ballymacoda. By comparison the sum of PHAs in Whitegate and Aghada was less than twice that of the Ballymacoda.

The Douglas site also showed moderately elevated levels of heavy metals.

The reports note:

> *"Many sources may contribute to sediment PAHs. The relatively constant abundance of most of the PAHs at all sites, together with the special PAH compound ratios, has demonstrated that the sediments owed their PAH loading to a predominantly single mode of origin, i.e. anthropogenic combustion or pyrolysis processes via run-off, industrial and sewage discharges, and atmospheric input rather than petrogenic sources such as oil spills. However, evidence for the input of PAHs from petroleum appeared at one site within Cork Harbour, Whitegate, the site of an oil refinery, which exhibited the highest P/A and Chry/BaA ratios. These indices indicated slight over-impositions of petrogenic inputs into Cork Harbour at the Whitegate site."*

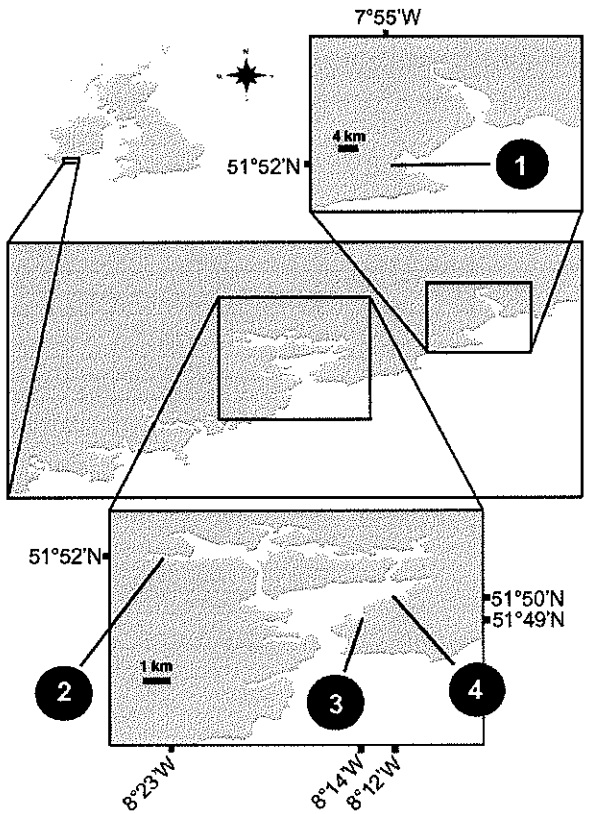


Fig. 1. Map of the sediment sampling sites: (1) Reference site, Ballymacoda and the contaminated sites in Cork Harbour (2) Douglas, (3) Whitegate and (4) Aghada.

E(2) 4 – CONVENTIONAL SEWERAGE TREATMENT & REMOVAL OF HEAVY METALS

"Sewage sludge composition – a multifunctional information" by Vienna University of Technology; Inst. for Water Quality, Resources and Waste Management and available in full at http://www.bvsde.paho.org/bvsaar/cdlodos/pdf/sewagesludge1003.pdf examined the reduction in heavy metals for the Vienna WWTP. "The treatment process in the period of the sampling campaign consists of conventional mechanical treatment with primary settling and a secondary treatment with 80% BOD removal only. P-precipitation was conducted by pre-precipitation in the primary settling and simultaneous precipitation in the secondary treatment." The plant has a daily loading of approximately 550 000 m³ waste water.

The assessment showed, while the removal efficiency decreased with increasing flow, the following were the removal rates for heavy metals:

> *"The removal efficiency of the WWTP is lowest for Zn (58%), followed by Cu (73%) and Cd (67%). 80 to 90% of the Ag-, Hg- and Cr-load are retained in the sludge. The highest removal efficiency was found for Pb (92%) and for Al (> 97%)."*

A similar study, http://www.springerlink.com/content/a512424m3k328562/fulltext.pdf, in Brazil showed the percentages of removal efficiency (RE) as:

> *"Hg 61.5%, Cd 60.0%, Zn 44.9%, Cu 44.2%, Pb 39.7%, Cr 16,5% and Mn 10.4%"*

A study http://www.geo.sc.chula.ac.th/Geology/Thai/News/Technique/GREAT_2008/PDF/142.pdf of the activated sludge WWTP for Bangkok concluded that the removal of metals was directly proportional to initial metal concentration in the influent. The study gave the order and range of percentage removal efficiency as:

> *"Ni (3.6-27.6) < As (6.8-31.7) < Mo (24.0-43.9) < Mn (31.3-66.6) < Zn (36.1-66.0) <Hg (24.9-79.0) < Cd (0.4-87.3) ≤ Cr (3.2-79.5) < Cu (37.3-74.5) < Pb (54.2-78.9) < Fe (80.5-88.3)"*

Health Risk and Environmental Pollution In Relation To Removal Of Heavy Metals By Waste Water Treatment http://www.isah-soc.org/documents/2005/sections/77_vol_2.pdf considered the removal of heavy metals in two WWTPs, the second treating urban waste waters from a conglomeration of approx. 100 000 inhabitants with very little proportion of industrial pre-treated waste waters (WWTP-2). Both treatment systems include mechanical and aerobic biological stages. The study concluded that *"Approximately 70-75% of Zn, Cu, Cd, Cr, Hg and other metals in raw sewage is removed and transformed to the sludge"*

Table E(2)2 shows the transfer coefficients for two small treatment plants in Austria, which have been investigated in detail over one year (Zessner 1999).

TP	A ,2-stage ASP ("ts" ~25 d)				B, 1stage ASP (ts ~ 8d)			
	Influent + chemicals for Pprec.		sludge	effluent	influent		sludge	effluent
	g/PE/d	g/Inh/d	%	%	g/PE/d	g/Inh/d	%	%
CSB	110	224	28	7	110	92	43	12
N	8,2	16,7	17	18	1,5	1,3	15	67
P	1,05	2,1	86	14	12,5	10,5	26	74
	mg/PE/d	mg/Inh/d	%	%	mg/PE/d	mg/Inh/d	%	%
Zn	59	120	51	46	127	106	45	53
Cu	17	34	77	19	15	12,6	56	42
Pb	2,5	5	72	16	3,9	3,2	79	16
Cd	0,13	0,27	53	44	0,19	0,16	38	59
Cr	3	6,1	80	18	3,4	2,9	49	46
Ni	2,5	5,1	68	30	2,9	2,4	34	62
Hg	0,03	0,06	> 46	< 52	0,14	0,11	(55)	(45)

Table E(2)2 – Specific loads in the influent and their distribution to the different end products based on a mass balance over one year

E(2) 5 – CONVENTIONAL SEWERAGE TREATMENT & REMOVAL OF PERSISTENT ORGANIC POLLUTANTS/COMPOUNDS

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. They can persist in the environment, are capable of long-range transport, and can bioaccumulate in human and animal tissue.

In May 1995, the United Nations Environment Programme Governing Council began investigating POPs, initially beginning with a short list of aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, and toxaphene.

A number of studies have investigated the removal of persistent organic pollutants/compounds through conventional sewerage treatment.

One study, http://www.springerlink.com/content/b61512402715w265/fulltext.pdf, "The Fate of Dissolved Organic Carbon (DOC) in the Waste water Treatment Process and its Importance in the Removal of Waste water Contaminants" showed the reductions in pollutant levels, following secondary treatment (SSE) compared with the raw water (RW) entering the treatment plant in Table E(2)3 overleaf.

Table E(2)3 – Reductions in pollutant levels, following secondary treatment (SSE) compared with the raw water (RW)

POPs	RW	PSE	SSE
Hexachlorobutadine	ND (4.7)	ND (2.4)	ND (1.2)
Dichlobenil	ND (11)	ND (5.7)	ND (2.8)
Quintozene	20 (4.2)	18 (2.1)	12 (1.1)
Hexachlorobenzene	6.7 (4.7)	3.8 (2.4)	12 (1.2)
α-HCH	23 (6.0)	13 (3.0)	5.8 (1.5)
β-HCH	19 (6.5)	4.1 (3.2)	6.1 (1.6)
γ-HCH	ND (3.6)	ND (1.8)	ND (0.9)
Isobenzan	ND (10)	ND (5.0)	ND (2.5)
α-Endosulfan	39 (6.0)	17 (3.0)	2.7 (1.5)
Aldrin	ND (6.5)	ND (3.2)	ND (1.6)
Isodrin	ND (4.0)	ND (2.0)	ND (1.0)
Dieldrin	15 (5.5)	12 (2.7)	5.7 (1.4)
Endrin	ND (4.0)	ND (2.0)	2.9 (1.0)
Heptachlor	25 (3.7)	4.3 (1.7)	2.3 (0.9)
Heptachlor-exo-epoxide	110 (5.5)	79 (2.7)	18 (1.4)
Heptachlor-endo-epoxide	ND (5.0)	ND (2.5)	ND (1.2)
p-p'-DDE	2.4 (4.5)	1.8 (2.2)	0.73 (1.1)
p-p'-DDD	9.8 (4.7)	7.8 (2.4)	4.7 (1.2)
p-p'-DDT	ND (7.0)	ND (3.5)	ND (1.7)
PCB-28	2.5 (6.0)	3.6 (3.0)	2.7 (1.5)
PCB-52	210 (4.7)	110 (2.4)	88 (1.2)
PCB-101	140 (10)	72 (5.0)	37 (2.6)
PCB-118	8.6 (6.0)	6.3 (3.0)	4.6 (1.5)
PCB-153	5.7 (4.0)	4.6 (2.0)	0.7 (0.4)
PCB-138	2.7 (4.5)	1.8 (2.2)	1.5 (1.1)
PCB-180	160 (5.5)	140 (2.7)	41 (1.4)

ND: Not detected. The detection limits for individual POPs in wastewater (ng l^{-1}), calculated as signal-to-noise ratio of three, are given in parentheses (Katsoyiannis and Samara 2002)

E(2) 6 – CONCLUSIONS

The Environmental Protection Agency have confirmed that "*Concentrations of environmental contaminants such as metals, hydrocarbons and persistent organic pollutants in bivalve molluscs are very good indicators of ambient water quality with respect to these parameters.*" It is appropriate to take surveys shown existing lack of contamination in Oysters in Cork Harbour into consideration in the assessment of the impact of the proposed WWTP. These surveys do not show elevated pollution levels within the harbour.

E(2) 6.1 – HEAVY METAL CONCENTRATIONS IN CORK HARBOUR

Cork Lower Harbour is regularly tested for concentrations of heavy metals and it has been concluded by the Department of the Marine, the Environmental Protection Agency and University College Cork that there is not an issue with heavy metals pollution in the harbour. Section E(2)4 above clearly shows that the provision of primary and secondary treatment with a conventional activated sludge process, as with the proposed WWTP at Shanbally, leads to significant reductions in the levels of heavy metals in the treated waste water. This is as a coincidental part of the process as the metal ions, being heavier than water, tend to settle out into the sludge as part of the treatment process.

The provision of the treatment plant will significantly decrease the levels of heavy metals released to the harbour when compared with the current release of untreated sewage. The provision of the WWTP will not have an adverse effect on the Cork Harbour SPA as it will lead to reduced discharge of heavy metals, not the elevated discharge suggested by the NPWS.

E(2) 6.2 – PERSISTENT ORGANIC COMPOUNDS

As with the concentrations of heavy metals, Cork Lower Harbour is regularly tested for persistent organic pollutants. It has been demonstrated by the Department of the Marine, the Environmental Protection Agency and University College Cork that there is no longer an issue with persistent organic pollutants in the water in the harbour. Since 2002, coincidental with the provision of the Cork City WWTP, the levels of all organohalogens (PCBs and pesticides) were below limits of detection in the water samples. The study completed in 2004 by UCC of inter-tidal sediments concluded that levels of PCBs, OCPs, BFRs and organotins were on the whole quite low, with the majority of the individual compounds being on or below the detection limit of the method.

The UCC study did however confirm that the harbour does have a pollution issue with the levels of PAHs in the sediment of the harbour on a scale comparable to levels determined previously for both western and eastern Irish Sea sediments. The study also concluded that, with the exception of Whitegate where some PAH concentrations were clearly associated with the oil refinery, the "relatively constant abundance of most of the PAHs at all sites, together with the special PAH compound ratios, has demonstrated that the sediments owed their PAH loading to a predominantly single mode of origin" i.e. the PAHs at the clean site came from the same source as the PAH within the harbour. The actual source could not however be defined.

As Section E(2)5 above demonstrates, the provision of the treatment plant will significantly decrease the levels of for persistent organic pollutants released to the harbour when compared with the release of untreated sewage. The provision of the WWTP will not have an adverse effect on the Cork Harbour SPA as it will lead to reduced discharge of for persistent organic pollutants, not the elevated discharge suggested by the NPWS.

Response Part E(2) - Appropriate Assessment of Proposed Waste Water Discharge and it's effect on Cork Harbour pSPA (4030) in accordance with Articles 6 & 7 of EC Directive 92/43/EEC

E(2) 6.3 – SUMMARY

The provision of the proposed WWTP at Shanbally will not have a significant adverse effect on the Cork Harbour SPA. It will in fact have a positive effect on the SPA through the reduction in the levels of heavy metals and persistent organic pollutants/compounds released to the harbour.

The harbour does not currently have an issue with the accumulation of heavy metals or persistent organic compounds (other than PHAs) in the sediment of the harbour. There is no evidence of accumulations of either metals or persistent organic pollutants/compounds in the flesh of shellfish with are tested in the harbour every year.

As it has been demonstrated that the provision of the treatment plant will have a positive effect on the SPA no further investigation is required.

RESPONSE PART F – HANDLING OF TREATED TRADE EFFLUENT AND UNTREATED WASTE WATER

F1 – HANDLING OF TREATED & UNTREATED WASTE WATER

Following completion of the proposed Waste Water Treatment Plant at Shanbally only effluent discharging directly to the IDA sewer from IPPC Licenced Industry will be discharged without treatment in the WWTP. The quality of this effluent is dictated by the IPPC licence limits. All waste water collected from the agglomerations of Cobh, Passage West/Glenbrook/Monkstown, Ringaskiddy, Carrigaline & Crosshaven, from domestic and non-domestic sources will be treated in the proposed WWTP.

APPENDIX A – FURTHER INFORMATION SUBMITTED TO AN BORD PLEANÁLA

2 ***Information on likely residence time for sewage from Cobh to be in transit to the proposed treatment works. Confirm if sewage from Cobh would be transferred through four pumping stations in series. Comment on likely capacity of storm tanks in Cobh in relation to the expected storm flows.***

The residence time for flow from West Beach pumping station in Cobh to the inlet works of the wastewater treatment plant has been calculated at 9 hours and 44 minutes (Ref Table 2.1 attached).

It is confirmed almost 30% of the flows from Cobh would be transferred through four pumping stations in series.

The storm tanks at West Beach in Cobh have been sized based on holding the 'first foul flush' in the storm tanks. The effective volume of the storm tanks is 640m³. The estimated overflow volume in a 2 year 30 minute storm is 757m³.

Indicate size of proposed Rafeen Pumping station, together with capacity, design year flows and volume of stormwater storage. Indicate route and discharge point of overflow pipe.

The wet well of the pump station will have a plan area of 53m² (10.6m x 5.0m). The difference between the pump cut-in level and the pump cut-out level will be 1.0m, giving an effective volume of 53m³. The proposed pump rate from the pump station is 569 l/s. The design year flow is 569 l/s, comprising of 557 l/s pumped onwards from Monkstown pumping station and 12 l/s from local foul sewers. The height between the pump cut-in level and the emergency overflow is 2.778m, giving an effective storage volume of 147m³.

The route and discharge point of the overflow pipe are as indicated on Figure 3.1 attached.

3 ***Comment on impact of disproportionate rise in energy costs since preparation of the EIS and particularly confirm the preference for the chosen solution, given that it involves additional pumping over and above that for the second short- listed option.***

The detailed evaluation of ten options for the scheme described in Section 2.3.1 of the EIS included a spreadsheet which allowed the costs for the various options to be compared. This spreadsheet allowed a sensitivity analysis to be carried out to examine the impact of an increase in, for example, civil, M&E, power or transport costs. This sensitivity analysis was used to assess the impact of the disproportionate rise in energy costs since the preparation of the EIS, with published indices used to determine the percentage increase in the various costs since the initial option selection was carried out in 2001. The output from this sensitivity analysis is included as Figure 4.1 and indicates that Option 2 (the currently proposed option) is still the most cost effective option.

To assess the impact of possible further increases in energy costs, the cost for energy was increased by a further 20%, with all other costs left at current prices. In this case Option 2 is still the preferred option (Ref. Figure 4.2).

4 ***Indicate location and approximate size of other outfalls to Cork Harbour and indicate the location of the outfall to the Cork City WWTP.***

Figure 5.1 illustrates the location and volume of the following known discharges to Cork Harbour :

- 10 nr. existing wastewater outfalls in Cork Lower Harbour as part of the Cork Harbour Drainage Scheme;
- Discharges from Midleton, Carrigtwohill and Carrigrennan WWTPs;
- Discharges from Cloyne, Saleen, Rostellan and Farsid;
- IPPC discharges; and
- Section 4 discharges.

The location of Cork City WWTP (Carrigrennan) and the location of the proposed primary outfall for Cork Lower Harbour are indicated in red on Figure 5.1.

Available information on the discharge volumes and outfall pipe sizes are indicated in Table 5.1 attached.

5 *Give details of consultations with the South Western River Basin District group (or their successors if the project is completed) in relation to compliance of the proposal with the objectives of the Water Framework Directive as it relates to Cork Harbour.*

The Consultants engaged to prepare the EIS for the Cork Harbour Main Drainage Scheme on behalf of Cork County Council are the lead consultants working on the South Western River Basin District. The Consultants considered the objectives of the Water Framework Directive but could not comment on same in the EIS because the work on the River Basin project was not sufficiently advanced at that time to determine the implications, if any, for the objectives of the Water Framework Directive as a result of the proposed development.

The objectives of the Water Framework Directive are to achieve Good Status in all bodies of water by 2015. The proposed wastewater treatment plant will discharge through an existing outfall pipeline to Cork Harbour. The water body which receives the discharges from the outfall pipeline has been designated 'at risk' of not achieving the objectives of the Water Framework Directive. One of the criteria which has put the water body at risk is the lack of a wastewater treatment plant. At present, wastewater from Carrigaline and Crosshaven is untreated prior to discharge through the existing outfall.

Water bodies which are 'at risk' must be subject to measures. The Water Framework Directive requires that the 'Basic Measures' are implemented and where necessary 'Supplementary Measures'. The Basic Measure in respect of the proposed development includes the Urban Waste Water Treatment

Directive which requires urban wastewater to be treated prior to discharge. The proposed development is consistent with the requirements of the Urban Waste Water Treatment Directive and is a positive step in achieving the objectives of Water Framework Directive at this location. It is not known at this time if any supplementary measures need to be implemented which would have implications for the proposed development.

If it transpires that supplementary measures are required, possible measures in respect of the wastewater treatment plant could include the incorporation of a higher level of treatment than is required under the Urban Waste Water Treatment Directive. In the EIS it is stated that the plant will be designed such that nutrient removal can be provided in an upgrade if required (page 145 of the EIS). An area within the site has been allocated to allow sufficient space for same should the future requirement be realised.

6 *Baseline information on water quality in Lower Cork Harbour to put in context comments regarding Health and Safety on page 79 and regarding Tourism and Recreation on page 85 of Volume 2 of the EIS with respect to impacts from the current discharges on the environment. Clarify, in relation to Appendix 3A, Volume III of EIS if faecal coliform, norovirus and nitrogen results are related to measured values in the Lower Harbour.*

Baseline Information on water quality in Cork Harbour was received from Cork City Council and is enclosed for your information. The extracted data for faecal coliforms in Cork Harbour from 2005-2007 is also enclosed.

The comments made on Health and Safety and Tourism and Recreation on pages 79 and 85 of the EIS were made with regard to the existing situation whereby untreated waste water is currently being discharged via 10 nr. outfalls into Cork Harbour. The outfalls do not discharge into designated bathing areas, however, some of these locations are used for recreational purposes. For example the outfall at Monkstown is adjacent to Monkstown Pier which is used frequently by locals for recreational activities. Water quality data in the vicinity of the current discharge outfalls is not available, however, it can be expected that mircobiological and nutrient levels are higher in the vicinity of the discharge locations near the shore compared with the deeper waters further from the shoreline following dispersion and dilution. The proposed WWTP and upgrade of the collection system will involve the decommissioning of 9 nr. discharge outfalls around Cork Harbour. Emergency and stormwater overflows will remain at some of these locations but will be designed in accordance with the DoEHLG guidelines "Procedures and Criteria in relation to Storm Water Overflows".

A computer model was developed for Cork Harbour to simulate the release, transport and decay of faecal coliforms, norovirus and nitrogen from the Lower Harbour catchment. Four cases were simulated:

Case 1: No treatment (flows for 2001)

Case 2: No treatment (flows for 2010)

Case 3: With treatment (flows for 2010)

Case 4: With treatment (flows for 2030)

A comprehensive model does not exist in relation to the overall nutrient and microbiological contribution to Cork Harbour and the overall water quality in the Harbour and as such, the most practical approach was to identify the inputs into the harbour which will be addressed as part of the proposed development.

Inputs into the harbour from the collection system and its current discharges were modelled and compared with the future scenario to demonstrate the relative change in water quality expected to arise following the proposed development. As a consequence the data presented provides an accurate representation of the relative improvement in water quality which will be addressed as part of the proposed scheme.

Claire Foley,

Senior Staff Officer.

Encl.

Table 2 1 - Calculation of Residence Time from Cobh (West Beach PStn) to Wastewater Treatment Plant

West Beach Pumping Station		
Wet well width (m)	7 m	
Wet well length (m)	3.5 m	
Wet well effective depth (m)	1 m	
Wet Well effective volume	24.5 m3	
Incoming flow rate (1 DWF)	17.5 l/s	Design Year, 1 DWF
Pump Rate	35 l/s	D/A/A pumps at 105 l/s, assume duty pumps at 1/3 of this
Time to fill wet well	1400 sec	
Time to empty wet well	1400 sec	
Total Residence Time	2800 sec	

West Beach Rising Main		
Length of Rising Main	540 m	
Internal Diameter of Rising Main	250 mm	
Total volume of Rising Main	26.5 m3	
Pumped velocity	0.71 m/s	
Total volume pumped per cycle	49 m3	Rising main empties in one pump cycle
Nr of pump cycles	0.54	
0 full pump cycles take	0 sec	
Time to start of next pump cycle	1400 sec	
Time of pumping	756 sec	
Total time in rising main	756 sec	

Gravity Sewer to Carrigaloe Pump Station		
Length of gravity sewer	3160 m	
Average Velocity	0.75 m/s	assumed average velocity
Time of Flow	4213 s	

Carrigaloe Pumping Station		
Wet well width (m)	4 m	
Wet well length (m)	9.6 m	
Wet well effective depth (m)	1 m	
Wet Well effective volume	38.4 m3	
Incoming flow rate (1 DWF)	61.5 l/s	Design Year, 1 DWF
Pump Rate	185 l/s	D/A pumps at 370 l/s, assume duty pumps at 1/2 of this
Time to fill wet well	624 sec	
Time to empty wet well	311 sec	
Total Residence Time	935 sec	

Carrigaloe Rising Main		
Length of Rising Main	1091 m	
Internal Diameter of Rising Mains	500 2x (mm)	
Total volume of Rising Main	428.2 m3	
Pumped velocity	0.94 m/s	per rising main
Total volume pumped per cycle	57.5 m3	
Nr of pump cycles	7.45	
7 full pump cycles take	6545 sec	
Time to start of next pump cycle	624 sec	duty/assist rising mains
Time of pumping	7309 sec	
Total time in rising main	7309 sec	

Gravity Sewer to Monkstown Pump Station		
Length of gravity sewer	850 m	
Average Velocity	0.75 m/s	assumed average velocity
Time of Flow	1133.6	

Monkstown Pumping Station		
Wet well width (m)	5 m	
Wet well length (m)	10.6 m	
Wet well effective depth (m)	1 m	
Wet Well effective volume	53 m3	
Incoming flow rate (1 DWF)	92.6 l/s	Design Year, 1 DWF
Pump Rate	278.5 l/s	D/A pumps at 557 l/s, assume duty pumps at 1/2 of this
Time to fill wet well	571 sec	
Time to empty wet well	285 sec	
Total Residence Time	856 sec	

Monkstown Rising Main		
Length of Rising Main	1187 m	
Internal Diameter of Rising Main	700 mm	
Total volume of Rising Main	456.6 m3	
Pumped velocity	0.72 m/s	
Total volume pumped per cycle	79.4 m3	
Nr of pump cycles	5.75	
5 full pump cycles take	4280 sec	
Time to start of next pump cycle	571 sec	
Time of pumping	5064.8 sec	
Total time in rising main	5064.8 sec	

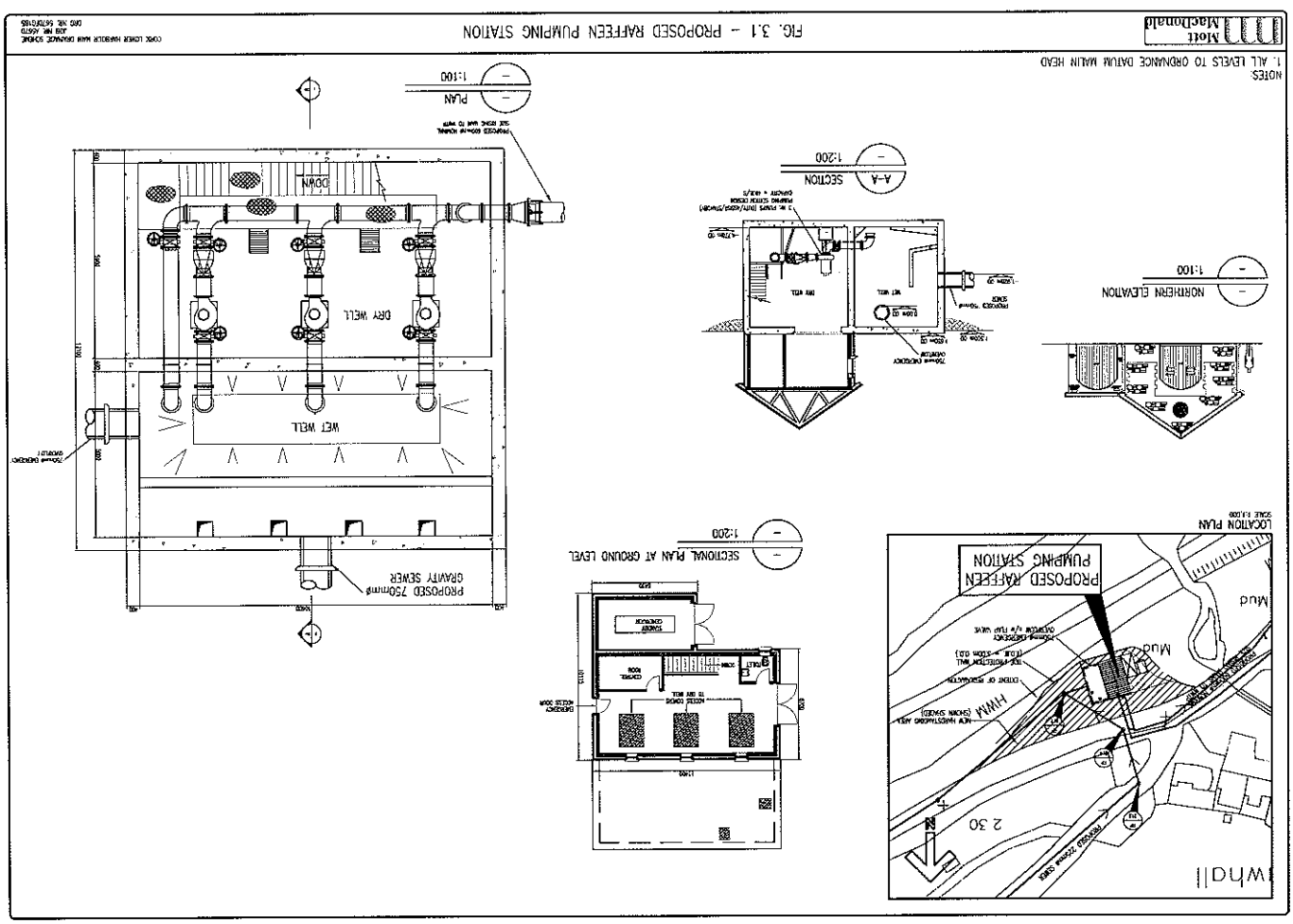
Gravity Sewer to Raffeen Pump Station		
Length of gravity sewer	1030 m	
Average Velocity	0.75 m/s	assumed average velocity
Time of Flow	1373 s	

Raffeen Pumping Station		
Wet well width (m)	5 m	
Wet well length (m)	10.6 m	
Wet well effective depth (m)	1 m	
Wet Well effective volume	53 m3	
Incoming flow rate (1 DWF)	94.8 l/s	Design Year, 1 DWF
Pump Rate	284.5 l/s	D/A pumps at 569 l/s assume duty pumps at 1/2 of this
Time to fill wet well	559 sec	
Time to empty wet well	279 sec	
Total Residence Time	838 sec	

Raffeen Rising Main		
Length of Rising Main	2278 m	
Internal Diameter of Rising Main	700 mm	
Total volume of Rising Main	876.2 m3	
Pumped velocity	0.74 m/s	
Total volume pumped per cycle	79.4 m3	
Nr of pump cycles	11.04	
11 full pump cycles take	9218 sec	
Time to start of next pump cycle	569 sec	
Time of pumping	9788.2 sec	
Total time in rising main	9788.2 sec	

Total Time from West Beach Pumping Station to Wastewater Treatment Plant

35066 sec
9:44 hours:mins



Sensitivity analysis

Figure 4.1 Inflation to June 2008

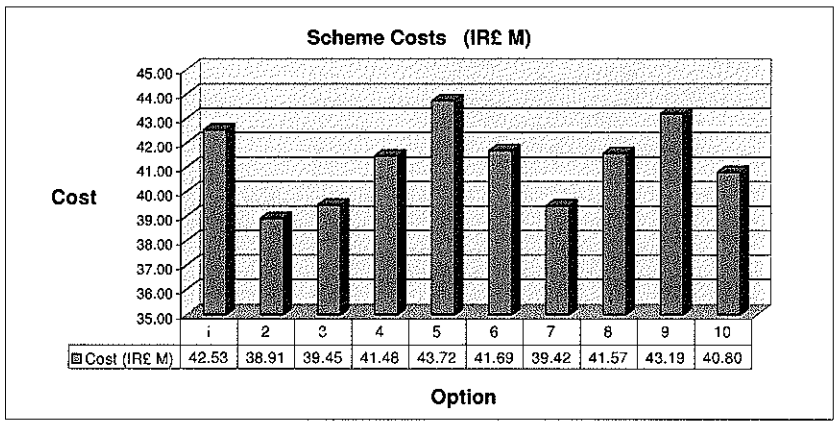
Base case

Option	1	2	3	4	5	6	7	8	9	10
Base Case Cost (IR£ M)	30.01	27.59	27.81	29.24	30.70	29.48	28.54	30.27	30.30	28.70
Base Rank	7	1	2	5	10	6	3	8	9	4

Option	1	2	3	4	5	6	7	8	9	10
Cost (IR£ M)	42.53	38.91	39.45	41.48	43.72	41.69	39.42	41.57	43.19	40.80

Current Rank	8	1	3	5	10	7	2	6	9	4
Change in Rank	-1	0	-1	0	0	-1	1	2	0	0

Cost Diferential	12.52	11.32	11.64	12.24	13.02	12.21	10.88	11.30	12.88	12.10
Cost Diferential Rank	8	3	4	7	10	6	1	2	9	5



M&E %	143
Civil - Terrestrial %	143
Civil - Marine %	143
WwTW %	100
Pumping Stations %	100
Chemicals (RM) %	88
Pipework %	100
Power %	165
Labour %	164
Transport %	131
Telemetry & Control %	143

Sensitivity analysis

Figure 4.2 Inflation to June 2008, Additional 20% increase in Power Costs

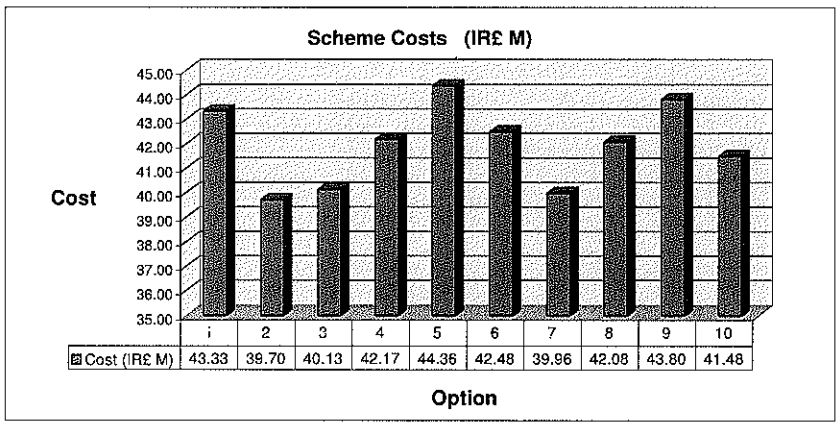
Base case

Option	1	2	3	4	5	6	7	8	9	10
Base Case Cost (IR£ M)	30.01	27.59	27.81	29.24	30.70	29.48	28.54	30.27	30.30	28.70
Base Rank	7	1	2	5	10	6	3	8	9	4

Option	1	2	3	4	5	6	7	8	9	10
Cost (IR£ M)	43.33	39.70	40.13	42.17	44.36	42.48	39.96	42.08	43.80	41.48

Current Rank	8	1	3	6	10	7	2	5	9	4
Change in Rank	-1	0	-1	-1	0	-1	1	3	0	0

Cost Diferential	13.32	12.12	12.32	12.93	13.66	13.00	11.42	11.80	13.50	12.78
Cost Diferential Rank	8	3	4	6	10	7	1	2	9	5



M&E %	143
Civil - Terrestrial %	143
Civil - Marine %	143
WwTW %	100
Pumping Stations %	100
Chemicals (RM) %	88
Pipework %	100
Power %	200
Labour %	164
Transport %	131
Telemetry & Control %	143

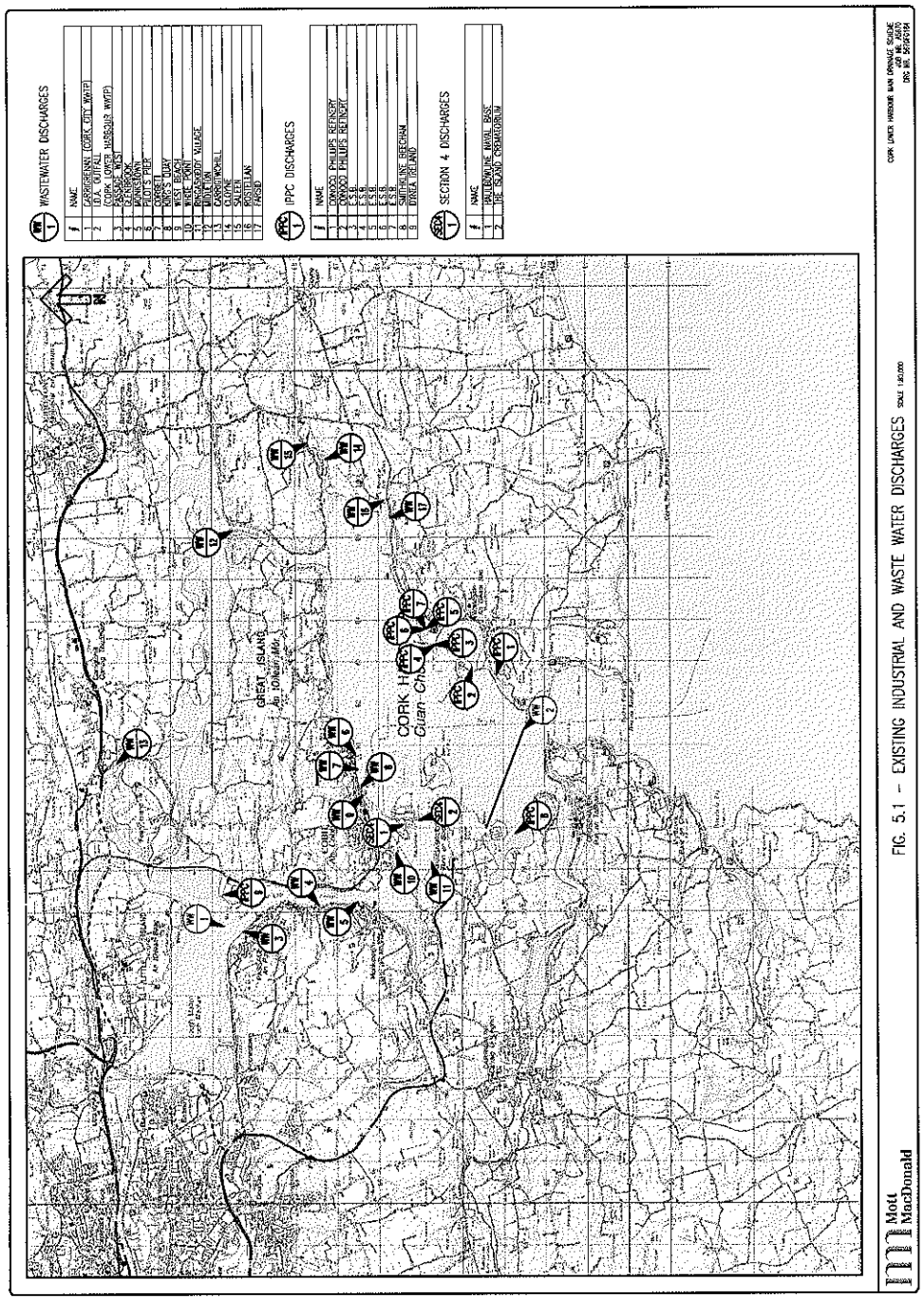


Table 5.1 Discharges to Cork Harbour

WW No.	Waste Water Discharges	Available Information	Information Source
1	Carrigrennan (Cork City WWTP)	94000 m3/day; outfall pipe diameter of 1600 mm	WWDLA
2	I.D.A. Outfall	4075 m3/day	Preliminary Report
3	Passage West	547 m3/day; outfall pipe diameter of 450 mm	Preliminary Report
4	Glenbrook	327 m3/day; outfall pipe diameter of 1400 mm	Preliminary Report
5	Monkstown	185 m3/day	Preliminary Report
6	Pilot's Pier	353 m3/day; outfall pipe diameter of 450 mm	Preliminary Report
7	Corbett	178 m3/day; outfall pipe diameter of 300 mm	Preliminary Report
8	King's Quay	444 m3/day	Preliminary Report
9	West Beach	668 m3/day; outfall pipe diameter of 600 mm	Preliminary Report
10	White Point	634 m3/day; outfall pipe diameter of 600 mm	Preliminary Report
11	Ringaskiddy Village	101 m3/day	Preliminary Report
12	Midleton	11994 m3/day; tidal holding tank	WWDLA
13	Carrigtwohill	2226 m3/day; outfall pipe diameter of 1200 mm	WWDLA
14	Clovne	225 m3/day (PE-1000 Average flow of 225 l/person/day)	Cork County Council
15	Saleen	68 m3/day (PE-300 Average flow of 225 l/person/day)	Cork County Council
16	Rostellan	7 m3/day (PE-30 Average flow of 225 l/person/day)	Cork County Council
17	Farsid	5 m3/day (PE-200 Average flow of 225 l/person/day)	Cork County Council
IPPC No.	**IPPC Discharges**	**Available Information**	**Information Source**
1	Conoco Philips Whitegate Refinery Ltd.	Maximum discharge per day - 1200 m3/day	IPPC Licence
2	Conoco Philips Whitegate Refinery Ltd.	No information available	IPPC Licence
3	Electricity Supply Board (Aghada)	Maximum discharge per day - 76,8000 m3/day	IPPC Licence
4	Electricity Supply Board (Aghada)	Maximum discharge per day - 79,2000 m3/day	IPPC Licence
5	Electricity Supply Board (Aghada)	Maximum discharge per day - 500 m3/dav	IPPC Licence
6	Electricity Supply Board (Aghada)	Maximum discharge per day - 400 m3/day	IPPC Licence
7	Electricity Supply Board (Aghada)	No information available	IPPC Licence
8	SmithKline Beecham (Manufacturing) Ltd.	Maximum discharge per day - 1300 m3/day	IPPC Licence
9	Dynea Ireland Ltd.	Maximum discharge per dav - 720 m3/day	IPPC Licence
Section 4 No.	**Section 4 Discharges**	**Available Information**	**Information Source**
1	Department of Defence - Haulbowline Naval Base	160 m3/day	Cork County Council
2	The Island Crematorium Ltd.	Maximum discharge per day - 4 m3/day	Cork County Council

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (W)	GPS(N)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity (mS/cm @25°C)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
8719K1	C16	Anglers Rest	Top	High	16-May-05	[redacted]		10.20	[redacted]	12.0	11.7	11.7	1.000	270 µS/cm	[redacted]	8.0	34	20	<2	15	31669	30	770
8719K2	C14	Waterworks	Top	High	16-May-05	[redacted]		10.35	[redacted]	12.0	9.9	9.9	1.000	213 µS/cm	[redacted]	7.5	45	24	<2	26	17232	30	387
8719K3		Field Control	[redacted]					10.15	[redacted]					49.4	32.5	8.0	32	26	<2	131	1953	210	<1
8719K4	C9	Tivoli	Bottom	High	16-May-05	70174	72203	10.30	8	16.5	9.6	8.1	0.841	43.9	28.4	8.3	77	<5	4	99	2117	39	20
8719K5	C9	Tivoli	Top	High	16-May-05	70174	72203	10.30	Total 8	16.4	9.3	9.0	0.972	8.5	4.8	7.8	61	29	<2	117	18182	53	6440
8719K6	C7	Blackrock Castle	Bottom	High	16-May-05	72655	72101	10.15	7.5	15.5	10.7	9.0	0.844	43.0	28.7	8.3	81	<5	4	9	2250	39	47
8719K7	C7	Blackrock Castle	Middle	High	16-May-05	72655	72101	10.15	5.5	14.3	11.6	9.5	0.847	41.9	27.0	8.3	77	<5	5	9	2995	49	76
8719K8	C7	Blackrock Castle	Top	High	16-May-05	72655	72101	10.15	Total 8	14.0	10.2	9.8	0.961	10.9	6.2	7.9	70	37	<2	140	16093	59	3300
8719K9	C8	Mid L. Mahon	Bottom	High	16-May-05	74336	70846	9.45	9	15.0	11.5	9.7	0.844	43.2	27.9	8.4	74	<5	5	15	2073	39	45
8719K10	C8	Mid L. Mahon	Middle	High	16-May-05	74336	70846	9.45	4.5	14.3	11.5	9.9	0.862	38.3	24.3	8.5	72	<5	5	5	4318	49	221
8719K11	C8	Mid L. Mahon	Top	High	16-May-05	74336	70846	9.45	Total 10	13.4	14.0	12.3	0.880	33.1	20.8	8.5	31	<5	4	5	8390	56	250
8719K12	C6	End L. Mahon	Bottom	High	16-May-05	76742	67407	9.30	12	13.5	11.3	9.3	0.827	47.0	30.6	8.3	14	<5	4	12	1205	23	14
8719K13	C6	End L. Mahon	Middle	High	16-May-05	76742	67407	9.30	6	13.2	11.4	9.5	0.830	46.0	29.8	8.3	52	<5	4	9	1798	30	31
8719K14	C6	End L. Mahon	Top	High	16-May-05	76742	67407	9.30	Total 18.5	13.0	13.0	10.9	0.842	42.8	27.6	8.4	52	<5	4	4	2588	39	41
8719K15	C5	Haulbowline	Bottom	High	16-May-05	78050	65301	9.00	13	15.4	10.6	8.9	0.824	46.7	30.5	8.3	45	<5	4	5	1395	23	14
8719K16	C5	Haulbowline	Middle	High	16-May-05	78050	65301	9.00	6.5	15.5	10.8	9.1	0.844	43.2	27.9	8.4	58	<5	6	5	2254	36	38
8719K17	C5	Haulbowline	Top	High	16-May-05	78050	65301	9.00	Total 15	15.4	11.4	9.9	0.870	36.4	23.1	8.5	61	<5	4	6	5204	49	146
8719K18	C4	Lower Harbour	Bottom	High	16-May-05	81736	58062	8.30	12	14.1	11.4	9.3	0.820	49.2	32.5	8.3	27	<5	4	5	354	13	2
8719K19	C4	Lower Harbour	Middle	High	16-May-05	81736	58052	8.30	6	13.8	12.2	10.0	0.820	48.8	31.8	8.3	36	<5	3	13	380	15	4
8719K20	C4	Lower Harbour	Top	High	16-May-05	81736	58062	8.30	Total 12	14.6	12.2	10.0	0.820	47.0	30.6	8.4	36	<5	5	9	1054	23	8
8719K21	C3	End Cork Harbour	Bottom	High	16-May-05	81242	62182	8.00	22	13.1	11.1	9.1	0.819	50.1	33.0	8.2	18	<5	3	9	246	10	<1
8719K22	C3	End Cork Harbour	Middle	High	16-May-05	81242	62182	8.00	12	13.1	11.1	9.1	0.819	49.9	32.8	8.2	18	<5	3	6	177	10	1
8719K23	C3	End Cork Harbour	Top	High	16-May-05	81242	62182	8.00	Total 23	13.3	11.4	9.3	0.819	48.5	31.6	8.3	32	<5	5	9	686	20	4
8719K24		Field Blank	[redacted]											48.3	31.6	8.1	1231	1215	<2	1243	6089	214	<1
sample 24-3		Field Control-Field B	[redacted]														1199	1189	0	1112	4136	4	0
Min									3.5	12.0	9.3	0.0	0.8	8.5	4.8	7.5	14.0	<5	<2	4.0	177.0	10.0	<1
Max									22.0	16.5	14.0	12.3	1.0	50.1	33.0	8.5	81.0	37.0	6.0	140.0	31669.0	210.0	6440.0
Mean									9.4	14.1	11.3	9.3	0.9	41.3	26.6	8.2	48.0	8.0	3.4	29.0	6238.6	40.6	515.0

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS(N)	GPS (W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
8718K1	C16	Anglers Res	Top	Low	24-May-05	[redacted]				Not Determined	10.8	10.8	1.000	195µS/cm	Not App	7.9	Not Determined	19	3	12	10815	26	770
8718K2	C14	Waterworks	Top	Low	24-May-05	[redacted]				Not Determined	9.3	9.3	1.000	216µS/cm	Not App	7.6	Not Determined	53	2	15	15921	49	1733
8718K3		Field Contro	[redacted]											49.5	32.5	8.0	Not Determined	27	<2	<6	1949	460	<1
8718K4	C9	Tivoli	Bottom	Low	24-May-05	5154101N	0826028W	11.48	6	14.0	7.8	6.6	0.847	42.4	27.4	8.1	Not Determined	43	2	345	2548	49	488
8718K5	C9	Tivoli	Top	Low	24-May-05	5154095N	0826978W	11.49	Total 6	15.0	7.9	7.5	0.947	15.4	9.0	7.9	Not Determined	57	2	201	11607	62	12740
8718K6	C7	Blackrock C	Bottom	Low	24-May-05	[illegible]	[illegible]	11.31	6	14.2	8.4	7.1	0.847	42.5	27.4	8.1	Not Determined	28	2	178	3042	43	167
8718K7	C7	Blackrock C	Middle	Low	24-May-05	[illegible]	[illegible]	11.31	3	14.0	9.4	8.1	0.858	39.7	25.3	8.1	Not Determined	29	3	174	3702	46	436
8718K8	C7	Blackrock C	Top	Low	24-May-05	[illegible]	[illegible]	11.31	Total 7.5	14.2	8.8	7.9	0.892	29.9	18.6	8.1	Not Determined	38	2	202	6996	53	2840
8718K9	C8	Mid L. Maho	Bottom	Low	24-May-05	5153169N	0822114W	11.08	7	14.4	9.5	7.9	0.836	45.0	29.2	8.2	Not Determined	22	2	105	2143	39	67
8718K10	C8	Mid L. Maho	Middle	Low	24-May-05	5153183N	0822137W	11.08	3.5	15.0	9.5	8.0	0.840	44.0	28.4	8.2	Not Determined	28	2	113	2600	43	73
8718K11	C8	Mid L. Maho	Top	Low	24-May-06	5153180N	0822145W	11.12	Total 9.3	14.8	9.4	8.0	0.848	42.5	27.4	8.2	Not Determined	27	2	125	2724	49	167
8718K12	C6	End L. Maho	Bottom	Low	24-May-05	[illegible]	[illegible]	10.23	11	14.0	9.4	7.9	0.839	43.8	28.4	8.2	Not Determined	27	<2	105	2422	43	142
8718K13	C6	End L. Maho	Middle	Low	24-May-05	[illegible]	[illegible]	10.23	5.5	14.0	9.7	8.2	0.846	42.5	27.5	8.2	Not Determined	19	2	130	2900	46	344
8718K14	C6	End L. Maho	Top	Low	24-May-05	[illegible]	[illegible]	10.23	Total 18.2	14.0	9.4	7.9	0.846	42.7	27.5	8.1	Not Determined	29	2	122	2954	43	344
8718K15	C5	Haulbowline	Bottom	Low	24-May-05	5150517N	0818588W	9.48	21	13.0	10.4	8.5	0.819	48.7	31.9	8.2	Not Determined	6	2	42	898	20	7
8718K16	C5	Haulbowline	Middle	Low	24-May-05	5150514N	0818628W	9.52	10.5	13.0	10.3	8.4	0.819	49.1	32.0	8.2	Not Determined	6	<2	42	983	20	7
8718K17	C5	Haulbowline	Top	Low	24-May-05	5150551N	0818528W	10	Total 22.9	13.0	10.1	8.3	0.819	48.8	31.9	8.2	Not Determined	8	3	55	1014	20	7
8718K18	C4	Lower Harb	Bottom	Low	24-May-05	[illegible]	[illegible]	9.21	10	13.9	10.1	8.2	0.811	51.1	33.7	8.1	Not Determined	<5	2	24	447	10	2
8718K19	C4	Lower Harb	Middle	Low	24-May-05	[illegible]	[illegible]	9.25	6	13.7	9.9	7.9	0.811	50.7	33.5	8.1	Not Determined	<5	3	30	500	10	<1
8718K20	C4	Lower Harb	Top	Low	24-May-05	[illegible]	[illegible]	9.25	Total 15.[illegible]	12.6	[illegible]	8.8	0.811	50.5	33.2	8.1	Not Determined	<5	3	24	574	10	2
8718K21	C3	End Cork H	Bottom	Low	24-May-05	5146694N	0816089W	9	26	13.7*	10.2	8.2	0.807	52.4	34.6	8.1	Not Determined	5	<2	33	255	7	<1
8718K22	C3	End Cork H	Middle	Low	24-May-05	5146797N	0816133W	9.03	13	Not Determined	10.5	8.5	0.807	51.9	34.2	8.1	Not Determined	<5	<2	27	261	7	3
8718K23	C3	End Cork H	Top	Low	24-May-05	5146694N	0816051W	9.05	Total 27	Not Determined	10.5	8.5	0.807	51.8	34.2	8.3	Not Determined	<5	2	26	306	7	<1
8718K24		Field Blank	[redacted]											49.4	32.4	8.1	Not Determined	63	<2	222	2648	269	<1
sample 24-3		Field Contro	[redacted]														Not Determined	56	0	222	659	-191	0
Min									3.0	13.0	7.8	6.6	0.8	15.4	9.0	7.5	Not Determined	<5	<2	12.0	255.0	7.0	<1
Max									26.0	15.0	11.0	10.8	1.0	52.4	34.6	8.2	Not Determined	57.0	3.0	345.0	15925.0	460.0	12740.0
Mean									9.9	14.0	9.5	8.2	0.9	44.5	28.9	8.1	Not Determined	24.0	1.7	93.0	3370.6	50.5	319.0

Sample Registration 1471
Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
1455L1	C16	Anglers Res	Top	High	21-Jun-05	[redacted]				not measured on site	10.3	10.3	1.000	184.0	n/a	8.1	37	33	<2	15	8676	53	236
1455L2	C14	Waterworks	Top	High	21-Jun-05	[redacted]				not measured on site	10.8	10.8	1.000	204.0	n/a	7.8	39	37	<2	24	12298	76	687
1455L3		Field Contro	[redacted]																				
1455L4	C9	Tivoli	Bottom	High	21-Jun-05			17	8	17.1	8.8	8.0	0.898	45.2	29.4	8.1	72	34	<2	156	1861	43	12
1455L5	C9	Tivoli	Top	High	21-Jun-05			17.09	Total 9.1	18.0	8.2	7.8	0.952	22.3	13.5	7.9	241	171	<2	1952	11877	92	6170
1455L6	C7	Blackrock C	Bottom	High	21-Jun-05			16.32	10	17.0	8.5	7.6	[illegible]	46.3	30.2	8.1	[illegible]	11	<2	98	1470	43	18
1455L7	C7	Blackrock C	Middle	High	21-Jun-05			16.36	5	17.2	8.5	7.9	0.890	44.2	29.8	8.2	66	19	<2	108	2652	46	18
1455L8	C7	Blackrock C	Top	High	21-Jun-05			16.4	Total 10.6	18.2	8.3	7.6	0.917	37.0	25.5	8.1	75	36	<2	180	3175	68	25
1455L9	C8	Mid L. Mahon	Bottom	High	21-Jun-05			16.11	10	16.5	9.3	8.3	0.891	47.8	31.2	8.1	50	19	<2	54	1098	30	6
1455L10	C8	Mid L. Mahon	Middle	High	21-Jun-05			16.15	5	16.7	9.2	8.2	0.891	47.1	30.6	8.2	52	21	<2	54	1236	38	14
1455L11	C8	Mid L. Mahon	Top	High	21-Jun-05			16.18	Total 10.6	16.7	9.5	8.5	0.894	46.6	30.4	8.2	58	22	<2	51	1860	39	6
1455L12	C6	End L. Mahon	Bottom	High	21-Jun-05			15.54	14	16.1	9.1	8.1	0.886	49.2	32.3	8.2	44	11	<2	21	782	20	1
1455L13	C6	End L. Mahon	Middle	High	21-Jun-05			15.59	7	16.1	9.6	8.5	0.886	49.3	32.2	8.1	39	11	<2	19	802	20	9
1455L14	C6	End L. Mahon	Top	High	21-Jun-05			16.03	Total 14.3	16.1	9.4	8.3	0.886	48.6	31.8	8.2	30	14	<2	30	970	36	6
1455L15	C5	Haubowline	Bottom	High	21-Jun-05			15.21	11	15.9	9.8	8.6	0.882	50.7	33.3	8.1	30	<5	<2	<6	310	<16	1
1455L16	C5	Haubowline	Middle	High	21-Jun-05			15.36	6.5	15.8	9.8	8.6	0.882	50.5	33.2	8.2	27	<5	<2	<6	337	<16	2
1455L17	C5	Haubowline	Top	High	21-Jun-05			15.39	Total 11.6	16.3	9.9	8.8	0.896	48.5	31.8	8.2	37	10	<2	6	926	23	2
1455L18	C4	Lower Harbo	Bottom	High	21-Jun-05			15.09	13	14.8	9.2	8.0	0.874	52.7	34.5	8.1	18	<5	<2	<6	102	<16	5
1455L19	C4	Lower Harbo	Middle	High	21-Jun-05			15.13	6.5	14.8	9.3	8.2	0.876	52.0	34.1	8.1	17	<5	<2	<6	97	<16	4
1455L20	C4	Lower Harbo	Top	High	21-Jun-05			15.15	Total 14	15.2	9.4	8.3	0.876	51.8	34.0	8.1	19	<5	<2	<6	109	<16	<1
1455L21	C3	End Cork H	Bottom	High	21-Jun-05			14.48	24	13.9	8.9	7.8	0.873	52.9	34.9	8.0	20	<5	<2	<6	47	<16	1
1455L22	C3	End Cork H	Middle	High	21-Jun-05			14.52	12	13	9.1	7.9	0.872	53.0	34.9	8.0	16	<5	<2	<6	<22	<16	1
1455L23	C3	End Cork H	Top	High	21-Jun-05			14.55	Total 25	13	9.5	8.3	0.872	52.9	34.9	8.1	18	<5	<2	<6	<22	<16	<1
1455L24		Field Blank	[redacted]																				
sample 24-3		Field Contro																					
Min									6.0	13.2	8.2	7.6	0.9	22.3	13.5	7.8	16.0	<5	<2	6.0	47.0	20.0	<1
Max									24.0	18.2	10.8	10.8	1.0	53.0	34.9	8.2	241.0	171.0	2.0	1952.0	12298.0	92.0	6170.0
Mean									10.2	15.9	9.3	8.4	0.9	47.4	31.0	8.1	55.9	22.0	<2	167.6	2502.4	43.9	516.0

Sample Registration 1471
Client Reference

Lab #	Station	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100 mls)
1439L1	C16	Anglers Re	Top	Low	21-Jun-05	[redacted]				not measured on site	8.9	8.9	1.000	183µS/cm	Not App	7.7	21	13	<2	22	9099	51	179
1439L2	C14	Waterwork	Top	Low	21-Jun-05	[redacted]				not measured on site	8.9	8.9	1.000	202µS/cm	Not App	7.8	47	46	<2	31	12852	92	517
1439L3		Field Cont	[redacted]											49.5	32.3	7.9	82	83	<2	233	2879	<16	<1
1439L4	C9	Tivoli	Bottom	Low	21-Jun-05			12.5	5	17.7	8.0	7.2	0.899	44.6	28.9	8.1	78	37	<2	260	1792	46	30
1439L5	C9	Tivoli	Top	Low	21-Jun-05			12.6	Total 6	17.7	7.7	7.2	0.931	31.8	19.9	7.9	92	55	2	336	4685	72	1733
1439L6	C7	Blackrock	Bottom	Low	21-Jun-05			12.3	7	17.6	8.9	8.0	0.902	43.7	28.3	8.1	69	34	<2	168	1964	46	39
1439L7	C7	Blackrock	Middle	Low	21-Jun-05			12.4	3.5	18.1	8.9	8.1	0.909	40.1	25.6	8.1	67	37	<2	203	2408	53	64
1439L8	C7	Blackrock	Top	Low	21-Jun-05			12.4	Total 7.5	18.6	8.4	7.8	0.928	32.7	20.5	8.1	73	45	<2	283	4212	62	756
1439L9	C8	Mid L. Mal	Bottom	Low	21-Jun-05			12.1	6	18.1	8.9	8.0	0.902	42.9	27.6	8.2	58	31	<2	103	1638	49	37
1439L10	C8	Mid L. Mal	Middle	Low	21-Jun-05			12.2	2.5	17.9	9.2	8.3	0.902	43.0	27.7	8.2	66	31	<2	65	2166	49	40
1439L11	C8	Mid L. Mal	Top	Low	21-Jun-05			12.2	Total 5.8	17.7	9.2	8.4	0.913	39.7	25.3	8.2	69	35	<2	139	2586	53	61
1439L12	C6	End L. Mal	Bottom	Low	21-Jun-05			11.5	10	17.7	9.2	8.2	0.895	46.1	29.9	8.2	64	27	<2	75	1351	43	24
1439L13	C6	End L. Mal	Middle	Low	21-Jun-05			11.6	5	17.7	9.2	8.2	0.895	45.4	29.5	8.2	67	27	<2	75	1260	43	16
1439L14	C6	End L. Mal	Top	Low	21-Jun-05			12	Total 11	17.6	9.3	8.4	0.899	44.9	29.1	8.2	61	27	<2	71	1457	46	27
1439L15	C5	Haubowlin	Bottom	Low	21-Jun-05			11.2	10	16.2	9.7	8.6	0.890	47.3	31.0	8.2	46	16	<2	46	824	30	21
1439L16	C5	Haubowlin	Middle	Low	21-Jun-05			11.3	5	16.1	9.8	8.7	0.890	47.3	30.8	8.2	45	17	<2	41	1174	30	11
1439L17	C5	Haubowlin	Top	Low	21-Jun-05			11.3	Total 11.4	16.1	9.8	8.7	0.890	47.0	30.7	8.2	48	17	<2	39	1360	33	15
1439L18	C4	Lower Har	Bottom	Low	21-Jun-05			10.8	10	15.5	9.6	8.5	0.882	50.3	32.9	8.2	33	6	<2	6	478	<16	1
1439L19	C4	Lower Har	Middle	Low	21-Jun-05			11	5	15.3	9.7	8.6	0.882	50.0	32.8	8.2	33	9	<2	12	496	16	2
1439L20	C4	Lower Har	Top	Low	21-Jun-05			11.1	Total 11.6	15.5	9.7	8.6	0.888	49.7	32.2	8.2	37	10	<2	14	633	20	3
1439L21	C3	End Cork I	Bottom	Low	21-Jun-05			10.2	26	14.7	9.8	8.6	0.876	51.7	34.0	8.1	25	7	<2	<6	217	<16	6
1439L22	C3	End Cork I	Middle	Low	21-Jun-05			10.30	13	15.1	9.9	8.7	0.878	51.2	33.7	8.2	27	6	2	8	289	<16	1
1439L23	C3	End Cork I	Top	Low	21-Jun-05			10.4	Total 27.5	14.9	10.0	8.8	0.882	50.7	33.4	8.2	23	5	<2	<6	292	<16	<1
1439L24		Field Cont	[redacted]											49.9	32.7	8.1	31	29	<2	<6	1993	<16	<1
sample 24-3		Field B-A															51	54	<2	233	886	<16	<1
Min									2.5	14.7	7.7	7.2	0.8	31.8	19.9	7.7	21.0	5.0	<2	<6	217.0	16.0	<1
Max									26.0	18.6	10.0	8.9	1.0	51.7	34.0	8.2	92.0	83.0	2.0	336.0	12852.0	92.0	1733.0
Mean									8.2	16.8	9.2	8.3	0.9	45.4	29.5	8.1	52.3	27.1	<2	91.0	2453.7	44.7	516.0

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
2930L1	C16	Anglers Rest	Top	Low	19-Jul-05					19.9	8.3	8.3	1.000	170.0		7.6	18	15	<2	25	6329	36	172
2930L2	C14	Waterworks	Top	Low	19-Jul-05					19.9	7.8	7.8	1.000	169.0		7.7	42	56	<2	23	9898	49	160
2930L3		Field Control A												50.0	32.5	8.2	69	77	<2	32	2391	<16	<1
2930L4	C9	Tivoli	Bottom	Low	19-Jul-05			11:50	5.2	19.6	6.6	5.6	0.849	43.4	28.0	8.0	120	58	3	890	1550	39	11
2930L5	C9	Tivoli	Top	Low	19-Jul-05			11:50	Total 6.2	19.6	6.5	5.6	0.864	38.8	24.6	8.0	97	54	3	903	2502	49	28
2930L6	C7	Blackrock Castle	Bottom	Low	19-Jul-05			11:30	6.0	18.1	7.2	6.0	0.837	45.8	29.5	8.2	[illegible]	42	3	404	965	26	13
2930L7	C7	Blackrock Castle	Middle	Low	19-Jul-05			11:30	3.5	18.6	7.6	6.4	0.844	43.8	28.2	8.1	[illegible]	43	3	477	1448	33	16
2930L8	C7	Blackrock Castle	Top	Low	19-Jul-05			11:30	Total 7.2	18.1	7.4	6.3	0.856	41.0	26.8	8.1	109	47	3	557	2154	39	35
2930L9	C8	Mid L. Mahon	Bottom	Low	19-Jul-05			11:09	5.5	18.5	7.6	6.5	0.833	47.4	30.9	8.2	79	27	3	154	523	30	10
2930L10	C8	Mid L. Mahon	Middle	Low	19-Jul-05			11:09	3.5	18.4	8.0	6.7	0.832	46.5	30.4	8.3	81	28	3	171	735	33	19
2930L11	C8	Mid L. Mahon	Top	Low	19-Jul-05			11:09	Total 7.5	18.4	7.9	6.6	0.836	46.3	30.2	8.3	73	28	4	170	757	36	23
2930L12	C6	End L. Mahon	Bottom	Low	19-Jul-05			10:50	11	18.2	8.4	7.0	0.829	48.0	31.4	8.3	[illegible]	32	3	[illegible]	[illegible]	26	8
2930L13	C6	End L. Mahon	Middle	Low	19-Jul-05			10:50	6	18.3	8.3	6.9	0.832	47.4	31.0	8.3	[illegible]	24	4	122	497	30	5
2930L14	C6	End L. Mahon	Top	Low	19-Jul-05			10:50	Total 12.0	18.4	8.2	6.8	0.832	47.2	30.8	8.3	74	23	4	121	536	30	14
2930L15	C5	Haulbowline	Bottom	Low	19-Jul-05			10:22	13.1	17.7	8.9	7.3	0.821	49.5	32.5	8.3	51	8	<2	50	213	<16	7
2930L16	C5	Haulbowline	Middle	Low	19-Jul-05			10:22	7	17.9	8.6	7.1	0.825	49.0	32.0	8.3	42	10	2	69	261	16	6
2930L17	C5	Haulbowline	Top	Low	19-Jul-05			10:22	Total 14.1	18.0	8.5	7.0	0.825	48.8	32.0	8.3	43	10	2	69	275	16	20
2930L18	C4	Lower Harbour	Bottom	Low	19-Jul-05			09:59	7.5	17.1	8.7	7.1	0.816	50.7	33.4	8.2	[illegible]	<5	<2	<6	[illegible]	<16	3
2930L19	C4	Lower Harbour	Middle	Low	19-Jul-05			09:59	4.5	17.1	8.5	6.9	0.816	50.7	33.3	8.2	[illegible]	<5	<2	<6	[illegible]	<16	1
2930L20	C4	Lower Harbour	Top	Low	19-Jul-05			09:57	Total 8.5	17.0	9.2	7.5	0.816	50.7	33.3	8.2	[illegible]	<5	<2	<6	58	<16	4
2930L21	C3	End Cork Harbour	Bottom	Low	19-Jul-05			09:25	25	16.3	8.9	7.2	0.811	51.8	34.1	8.1	15	<5	<2	<6	31	<16	3
2930L22	C3	End Cork Harbour	Middle	Low	19-Jul-05			09:25	13	16.1	9.3	7.6	0.815	51.2	33.9	8.2	18	<5	<2	<6	27	<16	5
2930L23	C3	End Cork Harbour	Top	Low	19-Jul-05			09:24	Total 26	15.8	8.7	7.1	0.815	51.3	33.8	8.2	25	<5	<2	<6	27	<16	28
2930L24		Field Control B												48.2	31.7	8.2	121	131	<2	228	2533	<16	<1
sample 24-3		Field B-A															52	54	0	196	142	0	0
Min									3.5	15.8	6.5	5.6	0.8	38.8	24.6	7.7	15.0	8.0	2.0	23.0	27.0	16.0	1.0
Max									25.0	19.9	9.3	8.3	1.0	51.8	34.1	8.3	120.0	77.0	4.0	903.0	9898.0	49.0	172.0
Mean									6.9	18.2	8.2	6.9	0.8	47.9	31.1	8.2	61.9	30.0	3.1	252.9	1422.8	32.5	26.9

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
2977L1	C16	Anglers Rest	Top	High	19-Jul-05					22.0	8.3	8.3	1.000	169.0		7.8	26	26	<2	22	6900	40	150
2977L2	C14	Waterworks	Top	High	19-Jul-05					22.0	8.3	8.3	1.000	188.0		7.7	43	53	<2	27	8525	49	162
2977L3		Field Control A																					
2977L4	C9	Tivoli	Bottom	High	19-Jul-05			15:52	9	19.1	8.1	6.8	0.841	45.4	29.3	8.2	104	46	3	504	996	26	8
2977L5	C9	Tivoli	Top	High	19-Jul-05			15:52	Total 9.0	19.5	7.7	6.6	0.850	40.4	26.0	8.0	125	53	3	886	2644	43	25
2977L6	C7	Blackrock Castle	Bottom	High	19-Jul-05			15:34	8.7	19.0	8.2	7.2	0.837	45.1	29.5	8.3	75	31	3	[illegible]	[illegible]	38	10
2977L7	C7	Blackrock Castle	Middle	High	19-Jul-05			15:34	6	18.9	8.3	6.9	0.837	45.1	29.6	8.3	[illegible]	31	3	240	786	36	11
2977L8	C7	Blackrock Castle	Top	High	19-Jul-05			15:34	Total 8.7	18.5	8.4	7.0	0.841	45.0	29.4	8.3	[illegible]	30	4	301	1019	36	15
2977L9	C8	Mid L. Mahon	Bottom	High	19-Jul-05			15:15	8.8	18.4	8.3	6.8	0.825	49.1	32.2	8.3	50	13	2	85	282	18	1
2977L10	C8	Mid L. Mahon	Middle	High	19-Jul-05			15:15	5	18.5	8.5	7.1	0.830	48.2	31.8	8.3	61	15	3	84	310	23	4
2977L11	C8	Mid L. Mahon	Top	High	19-Jul-05			15:15	Total 8.8	18.6	8.6	7.1	0.830	48.3	31.5	8.3	64	14	4	82	323	23	7
2977L12	C6	End L. Mahon	Bottom	High	19-Jul-05			14:54	13.3	18.0	8.6	7.1	0.821	50.1	32.9	8.2	47	7	2	26	151	<16	4
2977L13	C6	End L. Mahon	Middle	High	19-Jul-05			14:53	7.2	18.2	8.7	7.1	0.821	49.8	32.4	8.3	[illegible]	8	2	26	190	<16	5
2977L14	C6	End L. Mahon	Top	High	19-Jul-05			14:53	Total 14.3	18.0	8.8	7.3	0.825	49.1	32.5	8.3	46	6	3	26	204	<16	10
2977L15	C5	Haulbowline	Bottom	High	19-Jul-05			14:37	11.2	17.3	8.8	7.3	0.816	51.3	33.4	8.2	25	<5	2	<6	<22	<16	<1
2977L16	C5	Haulbowline	Middle	High	19-Jul-05			14:37	6.1	17.5	9.0	7.4	0.817	50.8	33.6	8.3	25	<5	2	<6	<22	<16	3
2977L17	C5	Haulbowline	Top	High	19-Jul-05			14:37	Total 12.2	17.6	8.9	7.3	0.817	51.0	33.4	8.3	27	<5	2	<6	<22	<16	3
2977L18	C4	Lower Harbour	Bottom	High	19-Jul-05			14:15	9.4	15.9	9.1	7.4	0.811	51.7	34.2	8.1	20	<5	<2	<6	<22	<16	<1
2977L19	C4	Lower Harbour	Middle	High	19-Jul-05			14:15	5.2	15.8	9.0	7.3	0.811	51.8	34.0	8.2	[illegible]	<5	<2	<6	<22	<16	2
2977L20	C4	Lower Harbour	Top	High	19-Jul-05			14:15	Total 10.4	15.5	9.0	7.3	0.811	51.8	34.0	8.2	11	<5	<2	<6	<22	<16	1
2977L21	C3	End Cork Harbour	Bottom	High	19-Jul-05			13:30	27.5	14.2	8.8	7.1	0.809	52.3	34.5	8.1	11	<5	<2	<6	<22	<16	1
2977L22	C3	End Cork Harbour	Middle	High	19-Jul-05			13:30	14	14.2	8.9	7.2	0.809	52.1	34.5	8.1	11	<5	<2	<6	<22	<16	<1
2977L23	C3	End Cork Harbour	Top	High	19-Jul-05			13:30	Total 28.5	14.0	9.1	7.4	0.809	52.1	34.5	8.1	10	<5	<2	<6	<22	<16	1
2977L24		Field Control B																					
sample 24-3		Field B-A																					
Min									5.0	14.0	7.7	6.6	0.8	40.4	26.0	7.7	10.0	<5	<2	<6	<22	<16	<1
Max									27.5	22.0	9.3	9.3	1.0	188.0	34.5	8.3	125.0	53.0	4.0	886.0	8525.0	49.0	162.0
Mean									10.0	17.8	8.7	7.3	0.8	60.9	32.2	8.2	46.4	25.6	2.7	186.2	1789.5	32.8	22.4

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
4478L1	C16	Anglers Rest	Top	Low	17-Aug-05	[redacted]				18.0	8.2	8.2	1.000	198.0	[redacted]	7.8	20	10	<2	12	6041	36	109
4478L2	C14	Waterworks	Top	Low	17-Aug-05	[redacted]				18.0	8.2	8.2	1.000	193.0	[redacted]	7.6	30	28	<2	31	8620	39	214
4478L3		Field Control A	[redacted]											48.9	32.3	7.9	22	27	<2	14	2657	<16	<1
4478L4	C9	Tivoli	Bottom	Low	17-Aug-05	51.54.030	8.25.380	11.45	6	18.4	9.8	8.8	0.895	46.1	29.9	8.1	51	15	3	109	1045	53	10
4478L5	C9	Tivoli	Top	Low	17-Aug-05	51.54.030	8.25.380	11.47	Total 6.7	18.8	8.9	8.5	0.958	13.2	7.8	7.9	52	38	<2	139	7765	62	14210
4478L6	C7	Blackrock Castle	Bottom	Low	17-Aug-05	[illegible]	8.24.140	[illegible]	7.5	18.0	[illegible]	8.1	[illegible]	46.4	30.3	8.1	[illegible]	26	3	124	[illegible]	53	7
4478L7	C7	Blackrock Castle	Middle	Low	17-Aug-05	[illegible]	8.24.140	[illegible]	4	18.1	[illegible]	8.2	[illegible]	46.6	29.5	8.1	[illegible]	14	[illegible]	105	[illegible]	53	22
4478L8	C7	Blackrock Castle	Top	Low	17-Aug-05	[illegible]	8.24.140	[illegible]	Total 9.7	[illegible]	[illegible]	8.1	0.945	[illegible]	[illegible]	7.9	45	[illegible]	<2	117	7400	[illegible]	[illegible]
4478L9	C8	Mid L. Mahon	Bottom	Low	17-Aug-05	51.53.170	8.22.100	11.02	7.5	17.9	10.3	8.8	0.833	47.3	30.8	8.1	72	15	2	104	837	56	7
4478L10	C8	Mid L. Mahon	Middle	Low	17-Aug-05	51.53.170	8.22.100	11.06	4	18.0	10.2	8.5	0.832	47.1	30.7	8.1	69	15	3	80	828	56	19
4478L11	C8	Mid L. Mahon	Top	Low	17-Aug-05	51.53.170	8.22.100	11.08	Total 8.6	18.1	10.2	8.6	0.840	45.2	29.3	8.2	68	13	3	24	1377	62	29
4478L12	C6	End L. Mahon	Bottom	Low	17-Aug-05	[illegible]	[illegible]	[illegible]	[illegible]	17.7	10.4	8.8	[illegible]	[illegible]	31.2	8.1	74	26	<2	127	[illegible]	65	[illegible]
4478L13	C6	End L. Mahon	Middle	Low	17-Aug-05	[illegible]	[illegible]	[illegible]	6	17.7	10.3	[illegible]	[illegible]	[illegible]	30.3	8.1	[illegible]	25	2	106	[illegible]	58	[illegible]
4478L14	C6	End L. Mahon	Top	Low	17-Aug-05	[illegible]	[illegible]	10.44	Total 15.2	17.8	10.6	8.2	[illegible]	37.2	23.8	8.1	[illegible]	22	7	84	[illegible]	62	[illegible]
4478L15	C5	Haulbowline	Bottom	Low	17-Aug-05	51.50.470	8.18.700	10.07	21	17.0	10.7	8.8	0.820	48.9	32.7	8.1	35	15	<2	64	328	30	10
4478L16	C5	Haulbowline	Middle	Low	17-Aug-05	51.50.470	8.18.700	10.11	11	17.1	10.7	8.8	0.820	48.5	32.4	8.1	35	16	<2	81	548	36	12
4478L17	C5	Haulbowline	Top	Low	17-Aug-05	51.50.470	8.18.700	10.16	Total 22	17.1	10.9	9.0	0.824	49.1	32.1	8.1	39	14	<2	59	1160	38	10
4478L18	C4	Lower Harbour	Bottom	Low	17-Aug-05	[illegible]	[illegible]	[illegible]	12	16.5	[illegible]	[illegible]	0.815	[illegible]	[illegible]	8.1	20	[illegible]	<2	13	[illegible]	<16	2
4478L19	C4	Lower Harbour	Middle	Low	17-Aug-05	51.50.900	[illegible]	[illegible]	6.5	16.5	[illegible]	[illegible]	0.815	51.0	[illegible]	8.1	[illegible]	<5	<2	12	142	<16	2
4478L20	C4	Lower Harbour	Top	Low	17-Aug-05	[illegible]	[illegible]	9.47	Total 13	16.5	11.0	[illegible]	0.815	51.0	33.5	8.1	21	[illegible]	<2	12	140	<16	1
4478L21	C3	End Cork Harbour	Bottom	Low	17-Aug-05	51.49.179	8.18.182	9.10	31	16.2	10.4	8.4	0.811	51.5	34.0	8.1	17	6	<2	17	<22	<16	2
4478L22	C3	End Cork Harbour	Middle	Low	17-Aug-05	51.49.179	8.18.182	9.15	16	16.1	10.6	8.6	0.815	51.4	33.8	8.1	18	<5	<2	<6	89	<16	<1
4478L23	C3	End Cork Harbour	Top	Low	17-Aug-05	51.49.179	8.18.182	9.19	Total 32	16.1	11.3	9.2	0.815	51.2	33.7	8.1	18	<5	<2	14	89	<16	1
4478L24		Field Control B	[redacted]											48.7	31.6	7.9	107	123	<2	383	3410	<16	<1
sample 24-3		Field B-A	[redacted]														-85	-96	<2	14	-753	<16	<1
Min									4.0	16.1	8.2	8.1	0.8	13.2	7.8	7.8	17.0	6.0			89.0	30.0	
Max									31.0	18.6	11.3	9.2	1.0	51.5	34.0	8.2	74.0	39.0	3.0	174.0	8620.0	62.0	14210.0
Mean									11.1	17.4	10.2	8.7	0.9	45.1	29.4	8.0	45.1	25.3			2260.5	50.3	

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
4510L1	C16	Anglers Rest	Top	High	17-Aug-05	[redacted]				19.0	11.3	11.3	1.000	175.0	[redacted]	8.5	35	34	<2	9	6244	30	131
4510L2	C14	Waterworks	Top	High	17-Aug-05	[redacted]				19.0	9.4	9.4	1.000	191.0	[redacted]	7.9	32	25	<2	23	9854	35	176
4510L3		Field Control A	[redacted]																				
4510L4	C9	Tivoli	Bottom	High	17-Aug-05	51.51.100	8.26.020	16.05	9	18.2	9.0	7.5	0.836	46.3	30.1	8.0	182	6	<4	224	1019	46	16
4510L5	C9	Tivoli	Top	High	17-Aug-05	51.54.100	8.26.020	16.10	Total 10	18.7	8.2	7.9	0.855	40.9	26.2	8.1	75	21	4	72	2073	49	1300
4510L6	C7	Blackrock Castle	Bottom	High	17-Aug-05	51.54.070	8.24.160	15.42	10	18.2	9.6	8.1	[illegible]	40.7	30.6	8.1	[illegible]	7	2	152	[illegible]	59	12
4510L7	C7	Blackrock Castle	Middle	High	17-Aug-05	51.54.070	8.24.160	15.48	5.5	18.3	9.9	8.3	0.836	46.4	[illegible]	8.2	81	<5	3	[illegible]	806	56	22
4510L8	C7	Blackrock Castle	Top	High	17-Aug-05	51.54.070	8.24.160	15.51	Total 11.3	19.0	[illegible]	[illegible]	0.879	37.0	[illegible]	8.2	74	23	4	24	[illegible]	50	[illegible]
4510L9	C8	Mid L. Mahon	Bottom	High	17-Aug-05	51.53.180	8.22.100	15.21	10	18.2	9.8	8.1	0.825	46.6	31.8	8.1	67	17	2	105	847	43	20
4510L10	C8	Mid L. Mahon	Middle	High	17-Aug-05	51.53.180	8.22.100	15.26	6.6	18.3	9.9	8.2	0.829	48.0	31.3	8.2	71	9	4	73	717	46	46
4510L11	C8	Mid L. Mahon	Top	High	17-Aug-05	51.53.180	8.22.100	15.30	Total 11.1	18.7	9.7	8.1	0.837	45.7	29.6	8.2	63	10	3	30	1058	53	11
4510L12	C6	End L. Mahon	Bottom	High	17-Aug-05	51.52.510	8.19.970	15.04	16.5	17.5	10.1	8.3	0.821	48.8	[illegible]	8.1	45	10	<2	54	390	26	5
4510L13	C6	End L. Mahon	Middle	High	17-Aug-05	51.52.510	8.19.970	15.08	7	17.5	9.1	8.1	0.821	49.0	32.4	8.1	45	9	2	54	372	30	9
4510L14	C6	End L. Mahon	Top	High	17-Aug-05	51.52.510	8.19.970	15.10	Total 15.5	17.6	[illegible]	[illegible]	0.821	[illegible]	32.5	8.1	41	<5	2	54	[illegible]	30	6
4510L15	C5	Haulbowline	Bottom	High	17-Aug-05	51.50.490	8.16.680	14.35	24	17.2	10.3	8.4	0.816	51.0	33.4	8.1	29	<5	3	26	97	<16	<1
4510L16	C5	Haulbowline	Middle	High	17-Aug-05	51.50.490	8.16.680	14.39	12.5	16.9	10.1	8.2	0.816	51.0	33.5	8.1	24	<5	2	21	115	<16	2
4510L17	C5	Haulbowline	Top	High	17-Aug-05	51.50.490	8.16.680	14.42	Total 25.4	17.0	10.0	8.2	0.816	51.1	33.5	8.1	24	<5	2	35	109	<16	1
4510L18	C4	Lower Harbour	Bottom	High	17-Aug-05	51.50.900	8.15.920	[illegible]	14	16.3	10.3	8.4	0.811	51.8	33.9	8.1	19	<5	<2	31	75	<16	6
4510L19	C4	Lower Harbour	Middle	High	17-Aug-05	51.50.900	8.15.920	[illegible]	8	16.2	10.2	8.5	0.811	51.7	34.0	8.1	18	<5	3	27	62	<16	7
4510L20	C4	Lower Harbour	Top	High	17-Aug-05	51.50.900	8.15.920	14.22	[illegible]	16.2	[illegible]	8.1	0.811	[illegible]	34.0	8.1	20	<5	<2	29	42	<16	2
4510L21	C3	End Cork Harbour	Bottom	High	17-Aug-05	51.49.000	8.16.350	13.52	32	16.3	9.9	8.0	0.811	52.1	34.2	8.1	128	<5	<2	24	<22	<16	7
4510L22	C3	End Cork Harbour	Middle	High	17-Aug-05	51.49.000	8.16.350	13.57	16	15.9	10.3	8.4	0.811	52.0	34.3	8.1	13	<5	<2	26	31	<16	1
4510L23	C3	End Cork Harbour	Top	High	17-Aug-05	51.49.000	8.16.350	14.00	Total 33.3	15.6	10.4	8.4	0.811	52.1	34.3	8.1	16	<5	<2	26	<22	<16	3
4510L24		Field Control B	[redacted]																				
sample 24-3		Field B-A																					
Min									5.5	15.6	9.0	7.5	0.8	37.0	23.4	7.9	13.0	8.0			31.0	26.0	
Max									32.0	19.0	11.3	11.3	1.0	52.1	34.3	8.5	182.0	34.0	4.0	224.0	9854.0	58.0	1300.0
Mean									12.9	17.5	10.0	8.4	0.8	46.4	31.8	8.1	52.7	16.5			1439.4	43.0	

Sample Registration 1471

	Client Reference																						
Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	*E. Coliforms* (MPN/100mls)
6000L1	C16	Anglers Rest	Top	Low	14-Sep-05	[redacted]				18.0	10.0	10.0	1.000	182.0	[redacted]	7.8	35	34	<2	13	7298	12	486
6000L2	C14	Waterworks	Top	Low	14-Sep-05	[redacted]				18.0	9.6	9.6	1.000	190.0	[redacted]	7.8	43	41	<2	26	9553	14	238
6000L3		Field Control A	[redacted]																				
6000L4	C9	Tivoli	Bottom	Low	14-Sep-05	51.54.10	8.26.010	13.25	7.0	18.0	7.7	6.4	0.836	45.9	29.8	7.8	74	44	<2	228	350	21	15
6000L5	C9	Tivoli	Top	Low	14-Sep-05	51.54.10	8.26.010	13.30	Total 8.3	19.0	7.9	7.6	0.956	12.8	7.4	7.6	62	53	<2	189	8016	20	15290
6000L6	C7	Blackrock Castle	Bottom	Low	14-Sep-05	51.54.06	8.23.960	13.40	9.0	18.4	8.1	6.8	0.836	46.9	30.1	8.0	70	36	<2	154	394	23	21
6000L7	C7	Blackrock Castle	Middle	Low	14-Sep-05	51.54.06	8.23.960	13.44	5.0	18.6	8.2	6.9	0.841	44.5	28.7	8.0	77	32	8	127	855	23	22
6000L8	C7	Blackrock Castle	Top	Low	14-Sep-05	51.54.06	8.23.960	13.45	Total 10.2	19.7	8.2	7.4	0.900	29.2	18.1	7.8	70	46	<2	194	5138	21	1120
6000L9	C8	Mid L. Mahon	Bottom	Low	14-Sep-05	51.53.35	8.22.380	14.00	9.5	18.1	8.6	7.2	0.832	47.3	30.8	8.0	65	33	<2	144	266	20	27
6000L10	C8	Mid L. Mahon	Middle	Low	14-Sep-05	51.53.35	8.22.380	14.03	5.5	18.4	8.8	7.4	0.836	46.1	29.9	8.0	70	31	2	130	910	23	45
6000L11	C8	Mid L. Mahon	Top	Low	14-Sep-05	51.53.35	8.22.380	14.07	Total 10.6	19.0	8.9	7.5	0.844	43.8	28.3	8.0	71	29	2	85	979	26	12
6000L12	C6	End L. Mahon	Bottom	Low	14-Sep-05	51.52.67	8.20.120	14.15	12.5	18.0	8.4	6.9	0.826	49.1	32.1	8.0	37	21	<2	90	62	12	12
6000L13	C6	End L. Mahon	Middle	Low	14-Sep-05	51.52.67	8.20.120	14.17	7.0	18.0	8.4	7.0	0.829	48.4	31.7	8.0	43	21	<2	94	<22	14	8
6000L14	C6	End L. Mahon	Top	Low	14-Sep-05	51.52.67	8.20.120	14.20	Total 13.5	18.3	8.7	7.2	0.832	46.5	30.3	8.0	46	25	<2	82	399	19	9
6000L15	C5	Haulbowline	Bottom	Low	14-Sep-05	51.50.40	8.19.030	14.41	14.5	17.8	8.4	6.9	0.821	50.0	32.7	8.0	35	12	<2	48	<22	8	6
6000L16	C5	Haulbowline	Middle	Low	14-Sep-05	51.50.40	8.19.030	14.43	8.0	18.1	8.5	7.0	0.825	49.0	32.1	8.0	40	14	<2	44	<22	11	3
6000L17	C5	Haulbowline	Top	Low	14-Sep-05	51.50.40	8.19.030	14.47	Total 15.8	18.6	8.6	7.2	0.833	46.6	30.4	8.0	51	18	2	51	523	17	6
6000L18	C4	Lower Harbour	Bottom	Low	14-Sep-05	51.50.93	8.16.120	15.00	15.0	17.5	9.0	7.4	0.817	51.2	33.6	8.0	24	9	<2	32	<22	<5	<1
6000L19	C4	Lower Harbour	Middle	Low	14-Sep-05	51.50.93	8.16.120	15.03	8.0	17.7	8.7	7.1	0.817	51.1	33.6	8.0	27	24	<2	58	<22	<5	1
6000L20	C4	Lower Harbour	Top	Low	14-Sep-05	51.50.93	8.16.120	15.05	Total 16.0	17.4	8.5	7.3	0.816	51.1	33.6	8.0	32	7	<2	20	<22	<5	1
6000L21	C3	End Cork Harbour	Bottom	Low	14-Sep-05	51.48.75	8.16.340	15.18	27.5	16.9	9.0	7.3	0.812	51.7	34.1	8.0	21	9	<2	19	<22	<5	13
6000L22	C3	End Cork Harbour	Middle	Low	14-Sep-05	51.48.75	8.16.340	15.22	14.5	17.0	8.7	7.1	0.812	51.5	33.9	8.0	27	6	<2	19	<22	5	23
6000L23	C3	End Cork Harbour	Top	Low	14-Sep-05	51.48.75	8.16.340	15.25	Total 28.5	17.4	8.5	6.9	0.816	51.4	33.8	8.0	32	5	<2	22	115	<5	1
6000L24		Field Control B	[redacted]																				
sample 24-3		Field B-A	[redacted]																				
Min									5.0	16.9	7.7	6.4	0.8	12.8	7.4	7.6	21.0	5.0	<2	13.0	<22	<5	<1
Max									27.5	19.7	10.0	10.0	1.0	51.7	34.1	8.0	77.0	53.0	3.0	228.0	9553.0	26.0	15290.0
Mean									11.9	18.1	8.6	7.4	0.9	45.7	29.8	7.9	47.8	25.0	2.3	85.0	2432.4	17.0	826.7

Sample Registration 1471

	Client Reference																						
Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	*E. Coliforms* (MPN/100mls)
6000L1	C16	Anglers Rest	Top	Low	14-Sep-05	[redacted]				18.0	10.0	10.0	1.000	182.0	[redacted]	7.8	35	34	<2	13	7298	12	486
6000L2	C14	Waterworks	Top	Low	14-Sep-05	[redacted]				18.0	9.6	9.6	1.000	190.0	[redacted]	7.8	43	41	<2	26	9553	14	238
6000L3		Field Control A	[redacted]																				
6000L4	C9	Tivoli	Bottom	Low	14-Sep-05	51.54.100	8.26.010	13.25	7.0	18.0	7.7	6.4	0.836	45.9	29.8	7.8	74	44	<2	228	350	21	15
6000L5	C9	Tivoli	Top	Low	14-Sep-05	51.54.100	8.26.010	13.30	Total 8.3	19.0	7.9	7.6	0.956	12.8	7.4	7.6	62	53	<2	189	8016	20	15290
6000L6	C7	Blackrock Castle	Bottom	Low	14-Sep-05	51.54.060	8.23.960	13.40	9.0	18.4	8.1	6.8	0.836	46.9	30.1	8.0	70	36	<2	154	394	23	21
6000L7	C7	Blackrock Castle	Middle	Low	14-Sep-05	51.54.060	8.23.960	13.44	5.0	18.6	8.2	6.9	0.841	44.5	28.7	8.0	77	32	8	127	855	23	22
6000L8	C7	Blackrock Castle	Top	Low	14-Sep-05	51.54.060	8.23.960	13.49	Total 10.2	19.7	8.2	7.4	0.900	29.2	18.1	7.8	70	46	<2	194	5138	21	1120
6000L9	C8	Mid L. Mahon	Bottom	Low	14-Sep-05	51.53.350	8.22.380	14.00	9.5	18.1	8.6	7.2	0.832	47.3	30.8	8.0	65	33	<2	144	266	20	27
6000L10	C8	Mid L. Mahon	Middle	Low	14-Sep-05	51.53.350	8.22.380	14.03	5.5	18.4	8.8	7.4	0.836	46.1	29.9	8.0	70	31	2	130	310	23	45
6000L11	C8	Mid L. Mahon	Top	Low	14-Sep-05	51.53.350	8.22.380	14.07	Total 10.6	19.0	8.9	7.5	0.844	43.8	28.3	8.0	71	29	2	85	979	26	12
6000L12	C6	End L. Mahon	Bottom	Low	14-Sep-05	51.52.670	8.20.120	14.15	12.5	18.0	8.4	6.9	0.826	49.1	32.1	8.0	37	21	<2	90	62	12	12
6000L13	C6	End L. Mahon	Middle	Low	14-Sep-05	51.52.670	8.20.120	14.17	7.0	18.0	8.4	7.0	0.829	48.4	31.7	8.0	43	21	<2	94	<22	14	8
6000L14	C6	End L. Mahon	Top	Low	14-Sep-05	51.52.670	8.20.120	14.20	Total 13.5	18.3	8.7	7.2	0.832	46.5	30.3	8.0	46	25	<2	82	399	19	9
6000L15	C5	Haulbowline	Bottom	Low	14-Sep-05	51.50.400	8.19.030	14.41	14.5	17.8	8.4	6.9	0.821	50.0	32.7	8.0	35	12	<2	48	<22	8	6
6000L16	C5	Haulbowline	Middle	Low	14-Sep-05	51.50.400	8.19.030	14.43	8.0	18.1	8.5	7.0	0.825	49.0	32.1	8.0	40	14	<2	44	<22	11	3
6000L17	C5	Haulbowline	Top	Low	14-Sep-05	51.50.400	8.19.030	14.47	Total 15.8	18.6	8.6	7.2	0.833	46.6	30.4	8.0	51	18	2	51	523	17	6
6000L18	C4	Lower Harbour	Bottom	Low	14-Sep-05	51.50.930	8.16.120	15.00	15.0	17.5	9.0	7.4	0.817	51.2	33.6	8.0	24	9	<2	32	<22	<5	<1
6000L19	C4	Lower Harbour	Middle	Low	14-Sep-05	51.50.930	8.16.120	15.03	8.0	17.7	8.7	7.1	0.817	51.1	33.6	8.0	27	24	<2	58	<22	<5	1
6000L20	C4	Lower Harbour	Top	Low	14-Sep-05	51.50.930	8.16.120	15.05	Total 16.0	17.4	8.5	7.3	0.816	51.1	33.6	8.0	32	7	<2	20	<22	<5	1
6000L21	C3	End Cork Harbour	Bottom	Low	14-Sep-05	51.48.750	8.16.340	15.18	27.5	16.9	9.0	7.3	0.812	51.7	34.1	8.0	21	9	<2	19	<22	<5	13
6000L22	C3	End Cork Harbour	Middle	Low	14-Sep-05	51.48.750	8.16.340	15.22	14.5	17.0	8.7	7.1	0.812	51.5	33.9	8.0	27	6	<2	19	<22	5	23
6000L23	C3	End Cork Harbour	Top	Low	14-Sep-05	51.48.750	8.16.340	15.25	Total 28.5	17.4	8.5	6.9	0.816	51.4	33.8	8.0	32	5	<2	22	115	<5	1
6000L24		Field Control B	[redacted]																				
sample 24-3		Field B-A	[redacted]																				
Min									5.0	16.9	7.7	6.4	0.8	12.8	7.4	7.6	21.0	5.0	<2	13.0	<22	<5	<1
Max									27.5	19.7	10.0	10.0	1.0	51.7	34.1	8.0	77.0	53.0	3.0	228.0	9553.0	26.0	15290.0
Mean									11.9	18.1	8.6	7.4	0.9	45.7	29.8	7.9	47.8	25.0	2.3	85.0	2432.4	17.0	826.7

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	*E. Coliforms* (MPN/100mls)
7400L1	C16	Anglers Rest	Top	Low	12-Oct-05					13.3	9.9	9.9	1.000	189.0		7.8	24	24	<2	24	8125	51	378
7400L2	C14	Waterworks	Top	Low	12-Oct-05					13.2	9.2	9.2	1.000	176.0		7.6	21	28	2	31	8299	53	173
7400L3		Field Control A												48.8	31.8	8.0	184	181	<2	534	3543	<16	<1
7400L4	C9	Tivoli	Bottom	Low	12-Oct-05	N/A	N/A	08:29	8	12.7	9.5	8.1	0.853	40.0	25.7	7.9	47	44	<2	230	2166	69	156
7400L5	C9	Tivoli	Top	Low	12-Oct-05	N/A	N/A	08:29	Total 7	12.5	9.6	9.4	0.983	5.0	2.7	7.7	25	30	<2	114	6594	69	3790
7400L6	C7	Blackrock Castle	Bottom	Low	12-Oct-05	51°20'	08°22'	08:50	8	12.7	9.2	7.8	0.839	46.4	30.3	7.9	46	47	<2	217	1719	62	15
7400L7	C7	Blackrock Castle	Middle	Low	12-Oct-05	51°20'	08°22'	08:50	4	12.9	9.2	7.7	0.834	45.0	29.1	7.9	51	45	<2	207	1983	66	41
7400L8	C7	Blackrock Castle	Top	Low	12-Oct-05	51°20'	08°22'	08:50	Total 9	12.5	9.3	9.0	0.966	6.5	4.6	7.7	28	31	<2	190	5279	82	3450
7400L9	C8	Mid L. Mahon	Bottom	Low	12-Oct-05	51°25'	08°03'	09:10	8	12.4	8.6	7.4	0.856	39.2	24.9	7.8	50	46	<2	207	2422	76	122
7400L10	C8	Mid L. Mahon	Middle	Low	12-Oct-05	51°25'	08°03'	09:10	4	12.5	8.4	7.1	0.850	41.4	26.7	7.8	52	51	<2	238	2106	79	160
7400L11	C8	Mid L. Mahon	Top	Low	12-Oct-05	51°25'	08°03'	09:10	Total 9	12.0	8.5	7.5	0.887	30.8	19.2	7.8	46	43	<2	215	3246	89	1414
7400L12	C6	End L. Mahon	Bottom	Low	12-Oct-05	N/A	N/A	09:30	13	12.8	8.9	7.2	0.823	48.8	31.4	7.9	40	36	<2	158	1383	62	25
7400L13	C6	End L. Mahon	Middle	Low	12-Oct-05	N/A	N/A	09:30	7	12.6	8.6	7.1	0.832	46.8	29.8	7.9	51	45	<2	231	1602	69	42
7400L14	C6	End L. Mahon	Top	Low	12-Oct-05	N/A	N/A	09:30	Total 14	11.6	9.1	8.0	0.883	32.0	20.3	7.8	47	43	<2	204	3287	76	270
7400L15	C5	Haulbowline	Bottom	Low	12-Oct-05	51°50'	08°18'	09:55	15	12.5	10.0	8.2	0.815	49.7	32.5	7.9	30	24	<2	72	992	39	11
7400L16	C5	Haulbowline	Middle	Low	12-Oct-05	51°50'	08°18'	09:55	8	12.6	9.5	7.9	0.827	47.0	30.7	7.9	34	31	<2	104	1528	56	28
7400L17	C5	Haulbowline	Top	Low	12-Oct-05	51°50'	08°18'	09:55	Total 17	12.0	9.2	7.9	0.860	37.7	24.0	7.8	46	43	<2	201	2821	76	403
7400L18	C4	Lower Harbour	Bottom	Low	12-Oct-05	N/A	N/A	10:20	14	12.8	9.9	8.1	0.815	50.0	33.1	7.9	22	22	<2	54	872	38	6
7400L19	C4	Lower Harbour	Middle	Low	12-Oct-05	N/A	N/A	10:20	7	12.8	9.7	7.9	0.819	48.0	32.2	7.9	28	28	<2	84	1262	43	6
7400L20	C4	Lower Harbour	Top	Low	12-Oct-05	N/A	N/A	10:20	Total 15	12.3	9.7	8.0	0.822	47.0	31.3	7.9	29	29	<2	107	1458	46	13
7400L21	C3	End Cork Harbour	Bottom	Low	12-Oct-05	51°48'	08°15'	10:50	28	13.0	9.9	8.0	0.807	52.0	34.2	8.0	14	13	<2	<6	419	48	1
7400L22	C3	End Cork Harbour	Middle	Low	12-Oct-05	51°48'	08°16'	10:50	14	13.0	9.7	7.8	0.807	51.8	34.3	8.0	19	15	<2	21	487	30	5
7400L23	C3	End Cork Harbour	Top	Low	12-Oct-05	51°48'	08°18'	10:50	Total 29	12.7	9.5	7.7	0.811	51.2	33.6	8.0	18	17	<2	28	731	36	8
7400L24		Field Control B												49.2	32.5	8.0	16	23	<2	<6	2347	<16	<1
sample 24-3		Field B-A															188	156	<2	534	1196	<16	<1
Min									4.0	11.6	8.4	7.1	0.8	0.0	2.7	7.6	14.0	13.0	<2	<6	416.0	30.0	1.0
Max									28.0	13.3	10.0	9.9	1.0	52.0	34.3	8.0	184.0	181.0	2.0	534.0	8299.0	89.0	3790.0
Mean									10.5	12.5	9.3	8.0	0.9	40.8	26.8	7.9	41.3	40.1	2.0	158.4	2745.1	59.7	500.9

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	*E. Coliforms* (MPN/100mls)
7438L1	C16	Anglers Rest	Top	Low	12-Oct-05					14.0	10.1	10.1	1.000	149.0		7.7	15	13	<2	27	5226	66	61
7438L2	C14	Waterworks	Top	Low	12-Oct-05					13.9	10.1	10.1	1.000	153.0		7.7	18	17	<2	26	5491	66	93
7438L3		Field Control A																					
7438L4	C9	Tivoli	Bottom	Low	12-Oct-05	51°54'	08°26'	12:40	8	13.9	8.9	7.4	0.828	46.8	30.5	7.9	54	49	<2	243	1559	66	23
7438L5	C9	Tivoli	Top	Low	12-Oct-05	51°54'	08°26'	12:40	Total 9	13.6	9.0	8.7	0.972	8.2	4.5	7.7	36	41	<2	118	5310	69	4500
7438L6	C7	Blackrock Castle	Bottom	Low	12-Oct-05	51°54'	08°24'	12:50	9	13.5	8.8	7.3	0.835	44.7	29.0	7.9	53	48	<2	225	1818	66	24
7438L7	C7	Blackrock Castle	Middle	Low	12-Oct-05	51°54'	08°24'	12:50	5	13.5	8.8	7.2	0.839	44.2	28.5	7.9	58	51	<2	249	1840	70	28
7438L8	C7	Blackrock Castle	Top	Low	12-Oct-05	51°54'	08°24'	12:50	Total 11	13.6	8.7	8.3	0.958	12.4	7.1	7.8	34	36	<2	174	5489	72	2310
7438L9	C8	Mid L. Mahon	Bottom	Low	12-Oct-05	51°53'	08°22'	13:10	9	13.5	8.8	7.4	0.843	43.9	28.0	7.9	48	44	<2	194	2241	59	27
7438L10	C8	Mid L. Mahon	Middle	Low	12-Oct-05	51°53'	08°22'	13:10	5	13.3	8.8	7.4	0.842	42.6	27.4	7.9	49	46	<2	224	1771	66	26
7438L11	C8	Mid L. Mahon	Top	Low	12-Oct-05	51°53'	08°22'	13:10	Total 10	12.9	8.7	7.5	0.865	36.7	23.3	7.9	56	48	<2	222	2848	72	122
7438L12	C6	End L. Mahon	Bottom	Low	12-Oct-05	51°52'	08°20'	13:30	14	13.5	8.9	7.3	0.824	48.2	31.4	7.9	[illegible]	28	<2	106	1284	45	18
7438L13	C6	End L. Mahon	Middle	Low	12-Oct-05	51°52'	08°20'	13:30	7	13.3	8.8	7.3	0.834	45.1	29.1	7.9	41	34	<2	149	1926	59	26
7438L14	C6	End L. Mahon	Top	Low	12-Oct-05	51°52'	08°20'	13:30	Total 15	12.8	9.1	8.0	0.880	32.9	20.6	7.9	57	44	<2	229	3040	76	280
7438L15	C5	Haulbowline	Bottom	Low	12-Oct-05	51°50'	08°18'	13:50	15	13.3	9.1	7.4	0.815	50.2	33.1	7.9	37	24	<2	73	859	39	8
7438L16	C5	Haulbowline	Middle	Low	12-Oct-05	51°50'	08°19'	13:50	8	13.1	8.9	7.3	0.819	49.1	32.1	7.9	40	27	<2	96	1129	43	7
7438L17	C5	Haulbowline	Top	Low	12-Oct-05	51°50'	08°19'	13:50	Total 16	13.1	8.8	7.3	0.834	44.8	29.0	7.9	49	36	<2	158	1909	59	15
7438L18	C4	Lower Harbour	Bottom	Low	12-Oct-05	51°50'	08°16'	14:10	13	13.0	8.9	7.2	0.809	51.8	34.0	8.0	67	18	<2	32	496	30	1
7438L19	C4	Lower Harbour	Middle	Low	12-Oct-05	51°50'	08°16'	14:10	7	13.3	8.5	6.9	0.812	51.0	33.6	8.0	34	20	<2	50	684	39	2
7438L20	C4	Lower Harbour	Top	Low	12-Oct-05	51°50'	08°16'	14:10	Total 14	13.6	8.9	7.1	0.812	50.6	33.3	7.9	74	22	<2	53	859	29	3
7438L21	C3	End Cork Harbour	Bottom	Low	12-Oct-05	51°48'	08°16'	14:35	24	13.3	9.3	7.5	0.811	51.3	33.9	8.0	20	18	<2	37	585	36	1
7438L22	C3	End Cork Harbour	Middle	Low	12-Oct-05	51°48'	08°16'	14:35	13	13.1	8.9	7.1	0.811	51.2	33.6	8.0	29	18	<2	49	684	30	2
7438L23	C3	End Cork Harbour	Top	Low	12-Oct-05	51°48'	08°16'	14:35	Total 25	12.8	8.8	7.2	0.819	48.5	31.8	7.9	39	27	<2	99	1275	43	5
7438L24		Field Control B																					
sample 24-3		Field B-A																					
Min									5.0	12.6	8.5	6.9	0.8	8.2	4.5	7.7	15.0	13.0	<2	26.0	496.0	30.0	1.0
Max									24.0	14.0	10.1	10.1	1.0	51.8	34.0	8.0	67.0	51.0	<2	249.0	5491.0	76.0	4500.0
Mean									10.5	13.4	9.0	7.7	0.9	42.7	27.7	7.9	41.3	32.3	<2	129.2	2194.5	54.6	342.2

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
8754L1	C16	Anglers Rest	Top	High	7-Nov-05	[redacted]					10.5	10.5	1.000	148.0	[redacted]	7.2	Not Tested	36	<2	68	12652	43	96
8754L2	C14	Waterworks	Top	High	7-Nov-05	[redacted]					9.9	9.9	1.000	167.0	[redacted]	7.3	Not Tested	40	<2	64	16319	49	152
8754L3		Field Control A	[redacted]											50.4	33.2	8.0	Not Tested	24	<2	6	2834	<16	N/A
8754L4	C9	Tivoli	Bottom	High	7-Nov-05	51.54.107	8.25.98	9.2	8.5	11.7	12.9	12.1	0.939	16.5	9.8	7.9	Not Tested	41	<2	105	13184	59	980
8754L5	C9	Tivoli	Top	High	7-Nov-05	51.54.107	8.25.98	9.2	Total 9.3	11.2	13.2	12.8	0.971	7.8	4.3	7.5	Not Tested	44	<2	94	15465	59	687
8754L6	C7	Blackrock Castle	Bottom	High	7-Nov-05	51.54.069	8.24.01	9.36	9.5	12.6	12.9	11.0	0.850	40.5	26.1	7.9	Not Tested	37	<2	136	5290	62	76
8754L7	C7	Blackrock Castle	Middle	High	7-Nov-05	51.54.069	8.24.01	9.36	5	12.5	12.4	11.2	0.902	27.4	16.9	7.8	Not Tested	42	<2	136	9783	65	816
8754L8	C7	Blackrock Castle	Top	High	7-Nov-05	51.54.069	8.24.01	9.36	Total 10.3	11.5	12.1	11.7	0.969	8.4	5.3	7.5	Not Tested	44	<2	100	15181	66	1300
8754L9	C8	Mid L. Mahon	Bottom	High	7-Nov-05	51.53.34	8.22.41	9.5	10	12.5	12.6	10.6	0.838	49.8	28.3	7.9	Not Tested	28	<2	90	4136	53	46
8754L10	C8	Mid L. Mahon	Middle	High	7-Nov-05	51.53.34	8.22.41	9.5	5	12.0	12.4	11.0	0.890	30.4	18.9	7.9	Not Tested	41	<2	143	9158	72	517
8754L11	C8	Mid L. Mahon	Top	High	7-Nov-05	51.53.34	8.22.41	9.5	Total 10.6	11.5	12.0	11.3	0.939	16.9	10.0	7.7	Not Tested	45	<2	135	13179	79	921
8754L12	C6	End L. Mahon	Bottom	High	7-Nov-05	51.52.69	8.20.13	10.09	13	12.5	12.5	10.5	0.842	42.5	27.4	7.9	Not Tested	34	<2	122	4615	58	59
8754L13	C6	End L. Mahon	Middle	High	7-Nov-05	51.52.69	8.20.13	10.09	6.5	12.2	12.2	10.7	0.868	36.2	23.0	7.9	Not Tested	34	<2	111	7002	62	178
8754L14	C6	End L. Mahon	Top	High	7-Nov-05	51.52.69	8.20.13	10.09	Total 13.5	11.1	12.5	10.9	0.946	14.5	8.5	7.7	Not Tested	47	<2	129	14479	72	1733
8754L15	C5	Haulbowline	Bottom	High	7-Nov-05	51.50.39	9.19.03	10.32	14.5	13.1	12.4	10.1	0.815	50.2	33.0	8.0	Not Tested	17	<2	33	1552	36	14
8754L16	C5	Haulbowline	Middle	High	7-Nov-05	51.50.39	8.19.03	10.32	7.5	13.0	12.3	10.1	0.823	48.0	31.4	8.0	Not Tested	20	<2	46	2600	43	17
8754L17	C5	Haulbowline	Top	High	7-Nov-05	51.50.39	8.19.03	10.32	Total 15.4	12.4	11.4	9.8	0.860	38.1	24.3	7.9	Not Tested	31	<2	95	6430	59	55
8754L18	C4	Lower Harbour	Bottom	High	7-Nov-05	51.50.95	8.18.02	10.5	13.5	13.1	11.9	9.7	0.811	50.9	33.5	8.0	Not Tested	16	<2	27	1419	53	5
8754L19	C4	Lower Harbour	Middle	High	7-Nov-05	51.50.95	8.18.02	10.5	7	12.7	12.1	10.1	0.824	44.6	28.7	8.0	Not Tested	23	<2	60	3679	46	22
8754L20	C4	Lower Harbour	Top	High	7-Nov-05	51.50.95	8.18.02	10.5	Total 14.3	12.5	11.8	9.8	0.842	43.4	28.1	8.0	Not Tested	25	<2	75	4406	49	46
8754L21	C3	End Cork Harbour	Bottom	High	7-Nov-05	51.48.77	8.16.32	11.19	29	12.6	12.4	10.2	0.823	47.5	31.0	8.0	Not Tested	20	<2	49	2890	41	17
8754L22	C3	End Cork Harbour	Middle	High	7-Nov-05	51.48.77	8.16.32	11.19	14	12.5	12.3	10.3	0.838	44.0	28.5	8.0	Not Tested	25	<2	71	4269	53	36
8754L23	C3	End Cork Harbour	Top	High	7-Nov-05	51.48.77	8.16.32	11.19	Total 29.7	12.5	11.8	9.9	0.898	43.8	28.3	8.0	Not Tested	24	<2	68	4274	49	33
8754L24		Field Control B	[redacted]											49.7	32.6	8.1	Not Tested	178	<2	531	4340	<16	N/A
sample 24-3		Field B-A	[redacted]														#VALUE!	154	0	525	1506	0	
Min									5.0	11.1	9.9	9.6	0.8	7.8	4.3	7.2	0.0	16.0	<2	6.0	1419.0	33.0	5.0
Max									29.0	13.1	13.2	12.8	1.0	50.9	33.5	8.0	0.0	47.0	<2	143.0	16319.0	79.0	1733.0
Mean									11.0	12.3	12.1	10.6	0.9	34.4	22.8	7.8	#DIV/0!	32.2	<2	85.5	7606.3	55.1	355.2

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
9588L1	C16	Anglers Rest	Top	Low	23-Nov-05	[redacted]					10.6	10.6	1.000	218.0	[redacted]	7.6	Not Tested	53	<2	20	18729	38	397
9588L2	C14	Waterworks	Top	Low	23-Nov-05	[redacted]					10.8	10.8	1.000	237.0		7.5	Not Tested	34	<2	22	24127	39	308
9588L3		Field Control A	[redacted]											49.6	32.6	8.1	Not Tested	52	<2	8	2879	16	<1
9588L4	C9	Tivoli	Bottom	Low	23-Nov-05	51°54'107	08°26'020	13:52	6	10.2	11.2	9.6	0.854	39.4	25.2	7.6	Not Tested	52	<2	280	6727	59	476
9588L5	C9	Tivoli	Top	Low	23-Nov-05	51°54'107	08°26'020	13:52	Total 7	9.4	9.6	9.3	0.949	13.9	8.1	7.6	Not Tested	55	<2	259	18162	62	2420
9588L6	C7	Blackrock Castle	Bottom	Low	23-Nov-05	51°54'069	08°24'002	13:34	7	10.0	10.7	8.8	0.835	43.5	28.9	7.8	Not Tested	60	<2	312	4876	62	42
9588L7	C7	Blackrock Castle	Middle	Low	23-Nov-05	51°54'069	08°24'002	13:34	4	10.1	10.7	9.5	0.890	42.8	27.8	7.8	Not Tested	63	<2	216	5319	62	52
9588L8	C7	Blackrock Castle	Top	Low	23-Nov-05	51°54'069	08°24'002	13:34	Total 8	9.2	10.3	10.0	0.967	8.8	4.8	7.5	Not Tested	61	<2	158	17350	56	1733
9588L9	C8	Mid L. Mahon	Bottom	Low	23-Nov-05	51°53'140	08°22'012	13:11	7	10.0	9.7	8.2	0.846	41.9	26.5	7.9	Not Tested	65	<2	226	8067	66	58
9588L10	C8	Mid L. Mahon	Middle	Low	23-Nov-05	51°53'140	08°22'012	13:11	4	9.8	10.5	9.0	0.854	38.7	24.6	7.8	Not Tested	68	<2	230	7296	72	208
9588L11	C8	Mid L. Mahon	Top	Low	23-Nov-05	51°53'140	08°22'012	13:11	Total 8	9.6	10.0	9.0	0.897	27.7	17.1	7.6	Not Tested	58	<2	202	11417	72	1733
9588L12	C6	End L. Mahon	Bottom	Low	23-Nov-05	51°52'870	08°20'108	12:51	11	10.1	10.9	9.3	0.843	41.9	27.0	7.9	Not Tested	61	<2	226	5762	62	44
9588L13	C6	End L. Mahon	Middle	Low	23-Nov-05	51°52'870	08°20'108	12:51	8	9.8	10.5	9.1	0.870	35.1	22.4	7.8	Not Tested	61	<2	195	8769	55	177
9588L14	C6	End L. Mahon	Top	Low	23-Nov-05	51°52'870	08°20'108	12:51	Total 12	9.4	10.4	9.3	0.896	27.4	17.2	7.4	Not Tested	63	<2	222	11972	72	1120
9588L15	C5	Haulbowline	Bottom	Low	23-Nov-05	51°50'420	08°19'046	12:23	14	10.6	10.9	8.9	0.813	49.8	32.7	7.9	Not Tested	41	<2	49	2294	39	4
9588L16	C5	Haulbowline	Middle	Low	23-Nov-05	51°50'420	08°19'046	12:23	7	10.5	11.0	9.0	0.817	48.6	31.8	7.9	Not Tested	46	<2	53	2777	43	3
9588L17	C5	Haulbowline	Top	Low	23-Nov-05	51°50'420	08°19'046	12:23	Total 16	10.3	10.8	8.9	0.827	45.7	29.7	7.9	Not Tested	50	<2	103	4096	49	39
9588L18	C4	Lower Harbour	Bottom	Low	23-Nov-05	51°50'890	08°18'050	11:56	12	10.8	10.7	8.7	0.814	50.8	33.1	7.9	Not Tested	41	<2	36	<22	43	3
9588L19	C4	Lower Harbour	Middle	Low	23-Nov-05	51°50'890	08°18'050	11:56	8	10.8	10.7	8.7	0.817	48.6	31.2	7.9	Not Tested	46	<2	58	2692	39	4
9588L20	C4	Lower Harbour	Top	Low	23-Nov-05	51°50'890	08°18'050	11:56	Total 14	10.8	10.6	8.8	0.820	47.8	31.2	7.9	Not Tested	48	<2	68	3087	48	23
9588L21	C3	End Cork Harbour	Bottom	Low	23-Nov-05	51°48'790	08°16'035	11:33	27	10.8	10.7	8.7	0.809	50.7	33.4	7.9	Not Tested	48	<2	27	<22	36	3
9588L22	C3	End Cork Harbour	Middle	Low	23-Nov-05	51°48'790	08°16'035	11:33	14	10.5	11.0	8.9	0.813	50.0	32.9	7.9	Not Tested	46	<2	40	<22	36	1
9588L23	C3	End Cork Harbour	Top	Low	23-Nov-05	51°48'790	08°16'035	11:33	Total 28	10.1	10.4	8.6	0.831	45.4	29.5	7.9	Not Tested	51	<2	96	4229	49	12
9588L24		Field Control B	[redacted]											48.5	31.8	8.0	Not Tested	145	<2	1050	4783	<15	<1
sample 24-3		Field B-A	[redacted]														#VALUE!	93	0	1042	2104	15	0
Min									4.0	9.2	9.7	8.2	0.8	8.8	4.8	7.5	0.0	34.0	<2	8.0	2294.0	16.0	1.0
Max									27.0	10.8	11.2	10.8	1.0	50.7	33.4	8.1	0.0	68.0	<2	260.0	24127.0	72.0	2420.0
Mean									9.7	10.1	10.8	9.1	0.9	40.3	26.1	7.8	#DIV/0!	53.4	<2	129.3	8416.6	51.8	407.2

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
1448M1	C16	Anglers Rest	Top	High	12-Dec-05					13.8	11.4	11.4	1.000	228.0		7.5	Not Tested	35	<2	29	18481	24	128
1448M2	C14	Waterworks	Top	High	12-Dec-05					14.0	11.2	11.2	1.000	245.0		7.5	Not Tested	34	<2	27	24428	30	148
1448M3		Field Control A												47.5	31.0	7.9	Not Tested	2192	<2	>500 (~2000)	4446	<16	*
1448M4	C9	Tivoli	Bottom	High	12-Dec-05	51°54'	08°25'	13:40	7.5	Not Tested	11.7	9.9	0.849	39.6	25.3	7.8	Not Tested	44	<2	222	5846	50	34
1448M5	C9	Tivoli	Top	High	12-Dec-05	51°54'	08°25'	13:40	Total 8.5	Not Tested	12.0	11.7	0.976	5.5	3.0	7.6	Not Tested	48	<2	133	16826	46	5370
1448M6	C7	Blackrock Castle	Bottom	High	12-Dec-05	51°54'	08°23'	13:20	[illegible]	Not Tested	[illegible]	9.4	[illegible]	43.4	[illegible]	7.8	Not Tested	[illegible]	<2	225	[illegible]	45	40
1448M7	C7	Blackrock Castle	Middle	High	12-Dec-05	51°54'	08°23'	13:20	3	Not Tested	[illegible]	9.2	[illegible]	40.2	25.7	7.9	Not Tested	[illegible]	<2	234	[illegible]	51	64
1448M8	C7	Blackrock Castle	Top	High	12-Dec-05	51°54'	08°23'	13:20	Total [illegible]	Not Tested	[illegible]	11.0	[illegible]	10.7	6.1	7.7	Not Tested	[illegible]	<2	135	14709	46	1559
1448M9	C8	Mid L. Mahon	Bottom	High	12-Dec-05	51°53'	08°22'	13:00	6.5	Not Tested	10.6	8.8	0.827	45.5	29.5	7.9	Not Tested	43	<2	195	3246	40	65
1448M10	C8	Mid L. Mahon	Middle	High	12-Dec-05	51°53'	08°22'	13:00	5	Not Tested	10.9	9.1	0.838	43.3	28.0	7.9	Not Tested	44	<2	207	4437	44	52
1448M11	C8	Mid L. Mahon	Top	High	12-Dec-05	51°53'	08°22'	13:00	Total 9.5	Not Tested	11.6	10.5	0.903	25.7	115.8	7.8	Not Tested	42	<2	169	11674	64	530
1448M12	C6	End L. Mahon	Bottom	High	12-Dec-05	51°52'	08°20'	12:15	11.5	Not Tested	10.0	8.2	[illegible]	42.2	30.7	7.9	Not Tested	[illegible]	<2	103	2901	32	17
1448M13	C6	End L. Mahon	Middle	High	12-Dec-05	51°52'	08°20'	12:15	6	Not Tested	10.5	8.6	[illegible]	46.6	32.4	7.9	Not Tested	31	<2	112	3182	37	33
1448M14	C6	End L. Mahon	Top	High	12-Dec-05	51°52'	08°20'	12:15	Total 12.5	Not Tested	10.8	9.2	0.885	35.6	22.4	7.8	Not Tested	39	<2	176	7825	58	186
1448M15	C5	Haulbowline	Bottom	High	12-Dec-05	51°50'	08°19'	11:50	12.9	Not Tested	10.8	8.8	0.815	48.5	31.7	7.9	Not Tested	28	<2	88	2378	25	6
1448M16	C5	Haulbowline	Middle	High	12-Dec-05	51°50'	08°19'	11:50	7	Not Tested	11.0	9.2	0.834	43.7	28.2	7.9	Not Tested	32	<2	121	4442	39	20
1448M17	C5	Haulbowline	Top	High	12-Dec-05	51°50'	08°19'	11:50	Total 13.9	Not Tested	11.2	9.8	0.871	35.4	22.4	7.8	Not Tested	40	<2	171	7794	49	195
1448M18	C4	Lower Harbour	Bottom	High	12-Dec-05	51°50'	08°16'	11:30	12.9	Not Tested	10.5	8.1	0.807	50.7	[illegible]	7.9	Not Tested	20	<2	50	728	22	3
1448M19	C4	Lower Harbour	Middle	High	12-Dec-05	51°50'	08°16'	11:30	7	Not Tested	10.2	8.3	0.811	49.5	32.5	7.9	Not Tested	23	<2	60	2138	[illegible]	5
1448M20	C4	Lower Harbour	Top	High	12-Dec-05	51°50'	08°16'	11:30	Total 13.9	Not Tested	10.4	8.8	0.825	46.3	30.4	7.8	Not Tested	29	<2	93	3127	30	7
1448M21	C3	End Cork Harbour	Bottom	High	12-Dec-05	51°48'	08°16'	10:55	26	Not Tested	11.0	8.9	0.805	52.2	34.4	7.9	Not Tested	20	<2	24	<22	19	2
1448M22	C3	End Cork Harbour	Middle	High	12-Dec-05	51°48'	08°16'	10:55	13	Not Tested	10.7	8.8	0.805	51.5	33.8	7.8	Not Tested	21	<2	35	1205	20	1
1448M23	C3	End Cork Harbour	Top	High	12-Dec-05	51°48'	08°15'	10:55	Total 30	Not Tested	10.5	8.8	0.815	49.0	32.1	7.9	Not Tested	25	<2	84	2290	26	3
1448M24		Field Control B												50.5	33.1	8.1	Not Tested	25	<2	28	2670	<16	*
sample 24-3		Field B-A															#VALUE!	2167	<2	#VALUE!	1776	<16	*
Min									5.0	13.8	10.0	8.1	0.8	5.5	3.0	7.5	0.0	20.0			728.0	19.0	
Max									29.0	14.0	12.0	11.7	1.0	52.2	115.8	8.1	0.0	2192.0	0.0	229.0	24428.0	64.0	5370.0
Mean									10.1	13.9	10.9	9.4	0.9	41.3	31.3	7.8	#DIV/0!	124.1			7026.2	37.5	

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temperature (°C)	DO (mg/lO2) Direct	DO (mg/lO2) Corrected	Salinity Factor	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
1530M1	C16	Anglers Rest	Top	Low	13-Dec-05					15.8	11.7	11.7	1.000	218.0		7.6	Not Tested	34	<2	38	18299	33	308
1530M2	C14	Waterworks	Top	Low	13-Dec-05					17.8	11.4	11.4	1.000	226.0		7.5	Not Tested	35	<2	37	22922	32	276
1530M3		Field Control A																					
1530M4	C9	Tivoli	Bottom	Low	13-Dec-05	51.54.105	08.26.017	10:30	6.5	Not Tested	Not Tested	Not Tested	0.849	39.8	25.5	7.8	Not Tested	47	<2	266	4632	51	154
1530M5	C9	Tivoli	Top	Low	13-Dec-05	51.54.105	08.26.017	10:35	Total 6	Not Tested	Not Tested	Not Tested	0.974	6.6	3.6	7.6	Not Tested	65	<2	122	17927	61	7280
1530M6	C7	Blackrock Castle	Bottom	Low	13-Dec-05	51.54.080	08.23.957	10:50	7	Not Tested	Not Tested	Not Tested	0.844	40.7	26.1	7.9	Not Tested	42	<2	209	4852	57	218
1530M7	C7	Blackrock Castle	Middle	Low	13-Dec-05	51.54.080	08.23.957	10:52	3.5	Not Tested	Not Tested	Not Tested	0.872	34.0	21.4	7.8	Not Tested	48	<2	197	7572	54	361
1530M8	C7	Blackrock Castle	Top	Low	13-Dec-05	51.54.080	08.23.957	10:55	Total 7.7	Not Tested	Not Tested	Not Tested	0.987	8.7	4.9	7.7	Not Tested	58	<2	117	15947	62	1414
1530M9	C6	Mid L. Mahon	Bottom	Low	13-Dec-05	51.53.134	08.22.054	11:05	7.5	Not Tested	Not Tested	Not Tested	0.837	43.0	27.7	7.9	Not Tested	45	<2	204	4260	50	178
1530M10	C6	Mid L. Mahon	Middle	Low	13-Dec-05	51.53.134	08.22.054	11:08	3.5	Not Tested	Not Tested	Not Tested	0.852	39.1	25.0	7.9	Not Tested	47	<2	218	6151	59	268
1530M11	C6	Mid L. Mahon	Top	Low	13-Dec-05	51.53.134	08.22.054	11:10	Total 8.1	Not Tested	Not Tested	Not Tested	0.871	33.7	21.3	7.8	Not Tested	49	<2	227	8658	72	1986
1530M12	C6	End L. Mahon	Bottom	Low	13-Dec-05	51.52.675	08.20.101	11:25	10.5	Not Tested	Not Tested	Not Tested	0.833	43.9	28.6	7.9	Not Tested	49	<2	187	3915	42	179
1530M13	C6	End L. Mahon	Middle	Low	13-Dec-05	51.52.675	08.20.101	11:27	5.5	Not Tested	Not Tested	Not Tested	0.844	41.4	26.8	7.9	Not Tested	50	<2	207	5274	51	189
1530M14	C6	End L. Mahon	Top	Low	13-Dec-05	51.52.675	08.20.101	11:30	Total [illegible]	Not Tested	Not Tested	Not Tested	0.875	32.6	20.5	7.9	Not Tested	42	<2	179	8517	57	1203
1530M15	C5	Haulbowline	Bottom	Low	13-Dec-05	51.50.420	08.19.029	12:30	13	Not Tested	Not Tested	Not Tested	0.822	47.1	30.8	8.0	Not Tested	28	<2	67	2515	28	10
1530M16	C5	Haulbowline	Middle	Low	13-Dec-05	51.50.420	08.19.029	12:33	6.5	Not Tested	Not Tested	Not Tested	0.830	44.9	28.9	8.0	Not Tested	25	<2	85	3742	37	26
1530M17	C5	Haulbowline	Top	Low	13-Dec-05	51.50.420	08.19.029	12:35	Total 13.8	Not Tested	Not Tested	Not Tested	0.860	37.3	23.7	7.9	Not Tested	37	<2	140	7267	50	188
1530M18	C4	Lower Harbour	Bottom	Low	13-Dec-05	51.50.925	08.18.073	12:50	13	Not Tested	Not Tested	Not Tested	0.911	50.1	32.9	8.0	Not Tested	20	<2	33	797	20	3
1530M19	C4	Lower Harbour	Middle	Low	13-Dec-05	51.50.925	08.18.073	12:54	6.5	Not Tested	Not Tested	Not Tested	0.915	49.1	32.1	8.0	Not Tested	27	<2	44	1820	24	8
1530M20	C4	Lower Harbour	Top	Low	13-Dec-05	51.50.925	08.18.073	12:57	Total 13.7	Not Tested	Not Tested	Not Tested	0.822	46.6	30.4	8.0	Not Tested	25	<2	65	2625	30	15
1530M21	C3	End Cork Harbour	Bottom	Low	13-Dec-05	51.48.768	08.16.323	13:15	29	Not Tested	Not Tested	Not Tested	0.804	51.8	34.1	8.0	Not Tested	24	<2	<8	500	<16	<1
1530M22	C3	End Cork Harbour	Middle	Low	13-Dec-05	51.48.768	08.16.323	13:17	16	Not Tested	Not Tested	Not Tested	0.804	57.9	34.3	8.0	Not Tested	25	<2	9	487	<16	<1
1530M23	C3	End Cork Harbour	Top	Low	13-Dec-05	51.48.768	08.16.323	13:20	Total 29.5	Not Tested	Not Tested	Not Tested	0.807	51.4	33.8	8.0	Not Tested	22	<2	<5	695	<16	4
1530M24		Field Control B																					
sample 24-3		Field B-A																					
Min									3.5	15.8	11.4	11.4	0.8	8.6	3.6	7.5	0.0	20.0	0.0	9.0	487.0	20.0	3.0
Max									29.0	17.8	11.7	11.7	1.0	226.0	34.3	8.0	0.0	65.0	0.0	268.0	22922.0	72.0	7280.0
Mean									9.8	16.8	11.6	11.6	0.9	58.3	25.8	7.9	#DIV/0!	38.2	#DIV/0!	132.4	8852.5	45.3	713.0

Sample Registration 1471

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temp (°C)	DO (mg/lO2)	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	Coliforms (MPN/100	Chlorophyll a (µg/l)
	Client Reference																					
3421M1	C16	Anglers Rest	Top	Low	2-Feb-06	[redacted]				8.0	10.9	0.2	[redacted]	7.6	70	58	<2	37	18362	43	649	1.0
3421M2	C14	Waterworks	Top	Low	2-Feb-06					8.0	10.8	0.2		7.5	42	27	<2	33	2466	49	697	0.9
3421M3		A										49.7	32.6	8.1	38	25	<2	17	2368	26	*	*
3421M4	C9	Tivoli	Bottom	Low	2-Feb-06	51.54.10	08.26.01	14.00	5	7.8	7.7	23.4	14.6	7.7	103	71	<2	356	11951	66	4040	0.6
3421M5	C9	Tivoli	Top	Low	2-Feb-06	51.54.10	08.26.01	14.09	5.6	8.5	9.7	7.7	4.3	7.5	113	81	<2	270	19513	72	4870	0.9
3421M6	C7	Blackrock Castle	Bottom	Low	2-Feb-06	51.54.07	08.23.90	13.27	7	7.5	8.9	39.1	25.0	7.8	77	52	<2	309	6371	66	228	0.9
3421M7	C7	Blackrock Castle	Middle	Low	2-Feb-06	51.54.07	08.23.90	13.3	3.5	7.1	8.5	34.5	21.8	7.8	75	55	<2	356	8431	66	1986	0.6
3421M8	C7	Blackrock Castle	Top	Low	2-Feb-06	51.54.07	08.23.90	13.45	7.7	8.0	10.9	9.3	5.5	7.5	83	63	<2	418	17231	66	2420	1.2
3421M9	C8	Mid L. Mahon	Bottom	Low	2-Feb-06	51.53.15	08.22.10	13.14	7	7.6	8.9	42.1	27.1	7.9	71	47	<2	257	5066	62	127	0.8
3421M10	C8	Mid L. Mahon	Middle	Low	2-Feb-06	51.53.15	08.22.10	13.18	3.5	7.5	8.9	36.8	23.3	7.8	73	50	<2	285	7491	66	292	0.7
3421M11	C8	Mid L. Mahon	Top	Low	2-Feb-06	51.53.15	08.22.10	13.22	7.9	7.9	9.6	30.3	18.9	7.8	71	53	<2	266	10171	66	2420	1.0
3421M12	C6	End L. Mahon	Bottom	Low	2-Feb-06	51.52.66	08.20.10	12.51	10.5	7.6	8.9	41.1	26.4	7.9	78	48	<2	288	5846	62	317	0.8
3421M13	C6	End L. Mahon	Middle	Low	2-Feb-06	51.52.66	08.20.10	12.55	5.5	7.7	9.2	38.3	24.5	7.8	72	46	<2	251	7118	62	770	0.9
3421M14	C6	End L. Mahon	Top	Low	2-Feb-06	51.52.66	08.20.10	12.58	10.2	7.8	9.6	32.6	20.3	7.8	79	50	<2	285	9781	66	1300	1.2
3421M15	C5	Haulbowline	Bottom	Low	2-Feb-06	51.50.39	08.19.03	12.16	12.5	8.1	9.2	46.0	29.9	7.8	61	35	<2	165	3524	49	38	0.8
3421M16	C5	Haulbowline	Middle	Low	2-Feb-06	51.50.39	08.19.03	12.14	6.5	8.3	9.0	45.9	29.9	7.8	66	37	<2	170	3672	43	63	0.8
3421M17	C5	Haulbowline	Top	Low	2-Feb-06	51.50.39	08.19.03	12.1	13	8.1	6.9	45.4	29.4	7.9	60	38	<2	185	3892	43	53	No Result
3421M18	C4	Lower Harbour	Bottom	Low	2-Feb-06	51.15.91	08.16.07	11.2	12	8.4	9.2	49.9	32.7	7.8	40	22	<2	40	1821	33	2	0.9
3421M19	C4	Lower Harbour	Middle	Low	2-Feb-06	51.15.91	08.16.07	11.34	6.5	8.8	9.4	49.7	32.5	7.9	38	17	<2	38	1843	36	2	0.8
3421M20	C4	Lower Harbour	Top	Low	2-Feb-06	51.15.91	08.16.07	11.3	13.5	8.9	9.1	48.9	32.0	7.8	42	25	<2	67	2166	39	5	0.9
3421M21	C3	End Cork Harbour	Bottom	Low	2-Feb-06	51.48.78	08.16.32	11.04	28	8.9	9.1	51.2	33.7	7.9	31	18	<2	8	1268	30	<1	1.0
3421M22	C3	End Cork Harbour	Middle	Low	2-Feb-06	51.48.78	08.16.32	10.54	14	8.8	9.2	50.8	33.5	7.9	32	19	<2	<6	1424	33	6	1.0
3421M23	C3	End Cork Harbour	Top	Low	2-Feb-06	51.48.78	08.16.32	10.43	28.7	8.3	9.2	50.2	33.1	7.9	40	24	<2	68	1680	36	4	1.1
3421M24		B	[redacted]									49.3	32.3	8.0	229	221	<2	544	3373	20	<1	*
sample 24-3		Control B-A										0	0	0	191	196	0	527	1005	-6	<1	*
Min									3.5	7.5	6.9	7.7	4.3	7.5	31.0	17.0	<2	<6	1268.0	26.0	<1	0.6
Max									28.7	8.9	10.9	51.2	33.7	8.1	113.0	81.0	<2	418.0	19513.0	72.0	4870.0	1.2
Mean									10.4	8.0	9.2	38.6	25.6	7.8	70.2	49.7	<2	188.6	6671.9	51.3	966.1	0.8

Sample Registration 1471

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Time (24Hr)	Depth (m)	Temp (°C)	DO (mg/lO2)	Conductivity @25°C (mS/cm)	Salinity (ppt)	pH	Total Phosphate (µg/l P)	o-phosphate (µg/l P)	BOD (mg/l)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	Coliforms (MPN/100	Chlorophyll a (µg/l)
	Client Reference																					
3494M1	C16	Anglers Rest	Top	High	3-Feb-06	[redacted]				11.5	10.7	0.2	0.1	7.3	38	27	<2	41	15404	51	387	1.1
3494M2	C14	Waterworks	Top	High	3-Feb-06					10.8	11.0	0.2	0.1	7.5	48	35	<2	30	22609	53	308	1.0
3494M3		Field Control A	[redacted]																			
3494M4	C9	Tivoli	Bottom	High	3-Feb-06	51.54.09	08.26.02	9.35	9.0	7.6	No Result	29.8	18.4	7.5	74	58	<2	366	5817	69	15	<0.1
3494M5	C9	Tivoli	Top	High	3-Feb-06	51.54.09	08.26.02	9.47	9.7	8.0	8.8	30.5	18.9	7.7	60	37	<2	122	16171	66	20	1.3
3494M6	C7	Blackrock Castle	Bottom	High	3-Feb-06	51.54.07	08.23.93	10.02	10.0	7.7	8.8	43.4	28.0	7.8	78	62	<2	232	6020	68	62	0.2
3494M7	C7	Blackrock Castle	Middle	High	3-Feb-06	51.54.07	08.23.93	10.07	5.0	7.7	8.9	42.6	27.3	7.8	80	55	<2	253	6451	66	228	0.8
3494M8	C7	Blackrock Castle	Top	High	3-Feb-06	51.54.07	08.23.93	10.10	11.0	7.7	9.0	38.2	24.8	7.8	77	55	<2	255	9404	76	548	0.8
3494M9	C8	Mid L. Mahon	Bottom	High	3-Feb-06	51.53.10	08.22.01	10.27	9.0	7.8	8.9	46.1	30.0	7.9	61	43	<2	240	4305	56	29	0.7
3494M10	C8	Mid L. Mahon	Middle	High	3-Feb-06	51.53.10	08.22.01	10.31	5.0	7.8	9.0	44.2	28.6	7.9	62	45	<2	270	4826	62	48	0.7
3494M11	C8	Mid L. Mahon	Top	High	3-Feb-06	51.53.10	08.22.01	10.35	10.8	7.7	9.1	41.8	26.9	7.9	71	53	<2	297	7348	76	457	0.9
3494M12	C6	End L. Mahon	Bottom	High	3-Feb-06	51.52.69	08.20.12	11.08	12.2	7.8	8.9	45.3	29.4	7.9	55	37	<2	185	3738	53	11	0.7
3494M13	C6	End L. Mahon	Middle	High	3-Feb-06	51.52.69	08.20.12	11.13	6.0	7.8	9.0	44.8	29.0	7.8	55	39	<2	202	4994	49	35	0.8
3494M14	C6	End L. Mahon	Top	High	3-Feb-06	51.52.69	08.20.12	11.18	13.0	7.7	9.1	43.2	27.8	7.9	61	48	<2	228	5080	56	59	1.0
3494M15	C5	Haulbowline	Bottom	High	3-Feb-06	51.50.42	08.19.08	13.02	12.0	7.8	8.9	46.7	30.5	8.0	57	36	<2	180	3404	49	21	0.8
3494M16	C5	Haulbowline	Middle	High	3-Feb-06	51.50.42	08.19.08	13.06	6.0	7.8	9.0	45.2	29.3	8.0	56	36	<2	206	3659	59	21	0.9
3494M17	C5	Haulbowline	Top	High	3-Feb-06	51.50.42	08.19.08	13.10	13.5	7.8	9.1	44.8	29.0	8.0	57	40	<2	222	4079	53	40	0.9
3494M18	C4	Lower Harbour	Bottom	High	3-Feb-06	51.50.92	08.18.09	12.29	12.0	8.1	9.0	50.6	33.3	8.0	35	22	<2	50	1567	36	2	0.8
3494M19	C4	Lower Harbour	Middle	High	3-Feb-06	51.50.92	08.18.09	12.34	6.0	8.0	9.1	49.7	32.8	8.0	38	24	<2	84	1848	39	4	0.8
3494M20	C4	Lower Harbour	Top	High	3-Feb-06	51.50.92	08.18.09	12.38	13.8	7.9	9.1	48.5	31.7	8.0	60	29	<2	116	2479	60	4	0.8
3494M21	C3	End Cork Harbour	Bottom	High	3-Feb-06	51.48.79	08.16.30	11.53	28.0	8.2	8.8	51.1	33.6	8.0	27	19	<2	33	1194	43	11	0.9
3494M22	C3	End Cork Harbour	Middle	High	3-Feb-06	51.48.79	08.16.30	11.57	16.0	8.2	9.0	51.1	33.6	8.0	31	21	<2	39	1266	35	1	1.1
3494M23	C3	End Cork Harbour	Top	High	3-Feb-06	51.48.79	08.16.30	12.01	30.2	8.1	9.1	49.9	32.8	8.0	32	22	<2	40	1422	39	1	0.9
3494M24		Field Control B	[redacted]																			
sample 24-3		Field B-A																				
Min									6.0	7.6	8.8	29.8	0.1	7.3	27.0	18.0	<2	30.0	1194.0	35.0	1.0	0.7
Max									30.2	11.5	11.0	51.1	33.6	8.0	80.0	58.0	<2	366.0	22609.0	76.0	548.0	1.3
Mean									11.8	8.0	9.2	44.4	28.1	7.9	54.4	37.7	<2	175.8	5911.8	54.2	104.0	0.9

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/O2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
5422M1	C18	Anglers Rest	Top	High	21-Mar-06	[redacted]				12.6	7.7	195.0	0.1	11.5		<2	35	12	17	15755	25	160
5422M2	C14	Waterworks	Top	High	21-Mar-06					12.3	7.8	196.0	0.1	11.1		<2	36	17	18	13684	33	165
5422M3		Field Control A	[redacted]													<2	33.0	25.0	<5	2790.0	<16	*
5422M4	C9	Tivoli	Bottom	High	21-Mar-06	51.54.09	08.25.99	8.5	9.30	7.2	8.0	42.9	27.7	9.4		<2	50	43	269	5133	36	104
5422M5	C9	Tivoli	Top	High	22-Mar-06	51.54.09	08.25.99	Total 7.9	9.34	7.5	7.9	37.2	19.4	9.5		<2	43	14	77	13459	36	1986
5422M6	C7	Blackrock Castle	Bottom	High	21-Mar-06	51.54.09	08.22.98	10.7	9.06	7.5	8.0	44.5	29.1	9.5		<2	51	46	278	5880	36	131
5422M7	C7	Blackrock Castle	Middle	High	22-Mar-06	51.54.09	08.22.98	5.5	9.13	7.2	8.1	44.0	28.2	9.6		<2	60	41	248	8762	40	488
5422M8	C7	Blackrock Castle	Top	High	23-Mar-06	51.54.09	08.22.98	Total 11.5	9.19	7.4	8.0	34.1	21.6	9.9		<2	56	26	138	13096	43	2420
5422M9	C8	Mid L. Mahon	Bottom	High	21-Mar-06	51.53.12	08.21.98	9.4	8.35	7.2	8.0	46.5	30.3	9.3		<2	34	37	192	3680	30	46
5422M10	C8	Mid L. Mahon	Middle	High	22-Mar-06	51.53.12	08.21.98	4.7	8.41	7.1	8.1	43.9	28.3	9.8		<2	34	38	180	4384	33	26
5422M11	C8	Mid L. Mahon	Top	High	23-Mar-06	51.53.12	08.21.98	Total 10.7	8.46	7.0	8.1	42.3	27.2	10.1		<2	37	35	176	4433	30	24
5422M12	C6	End L. Mahon	Bottom	High	21-Mar-06	51.52.69	08.20.14	11.5	8.06	7.2	8.1	49.4	32.4	9.6		<2	29	26	112	2709	20	6
5422M13	C6	End L. Mahon	Middle	High	22-Mar-06	51.52.69	08.20.14	6.4	8.13	7.2	8.1	47.9	31.3	9.7		<2	27	29	126	2922	30	10
5422M14	C6	End L. Mahon	Top	High	23-Mar-06	51.52.69	08.20.14	Total 12.7	8.18	7.0	8.1	42.7	27.5	10.1		<2	38	35	185	4433	30	38
5422M15	C5	Haulbowline	Bottom	High	21-Mar-06	51.50.40	08.19.01	13.1	10.23	7.2	8.1	50.6	33.3	9.5		<2	35	22	63	1639	20	12
5422M16	C5	Haulbowline	Middle	High	22-Mar-06	51.50.40	08.19.01	7.2	10.27	7.2	8.1	49.9	32.7	9.6		3	34	25	62	2272	56	11
5422M17	C5	Haulbowline	Top	High	23-Mar-06	51.50.40	08.19.01	Total 13.9	10.32	8.9	8.1	45.4	29.4	9.9		<2	27	30	120	3242	28	11
5422M18	C4	Lower Harbour	Bottom	High	21-Mar-06	51.50.99	08.16.08	11.2	10.56	7.2	8.1	51.9	34.2	9.4		<2	25	13	33	860	23	1
5422M19	C4	Lower Harbour	Middle	High	22-Mar-06	51.50.99	08.16.08	6.1	11.06	7.2	8.1	51.5	33.8	9.5		<2	18	19	32	1027	<16	2
5422M20	C4	Lower Harbour	Top	High	23-Mar-06	51.50.99	08.16.08	Total 12.1	11.06	7.0	8.1	46.7	31.0	9.8		<2	20	21	48	1315	<16	4
5422M21	C3	End Cork Harbour	Bottom	High	21-Mar-06	51.48.79	08.16.29	27.9	11.25	7.2	8.1	51.9	34.2	9.3		<2	25	20	35	1143	<16	2
5422M22	C3	End Cork Harbour	Middle	High	22-Mar-06	51.48.79	08.16.29	15.6	11.29	7.2	8.1	51.3	33.8	9.5		<2	31	20	45	1222	<16	1
5422M23	C3	End Cork Harbour	Top	High	23-Mar-06	51.48.79	08.16.29	Total 29.1	11.34	7.1	8.1	50.1	32.9	9.7		<2	32	24	48	1488	20	1
5422M24		Field Control B	[redacted]													<2	143.0	132.0	113.0	2834.0	<16	*
sample 24-3		Field B-A														<2	110.0	107.0	113.0	44.0	<16	*
Min								4.7		6.9	7.7	31.2	19.4	9.3	0.0		25.0	12.0		44.0	20.0	1.0
Max								27.9		12.6	8.1	51.9	34.2	11.5	0.0	3.0	60.0	46.0	278.0	15684.0	56.0	2420.0
Mean								10.4		7.7	8.0	46.1	30.0	9.8	#DIV/0!		45.3	31.4		4850.4	32.4	257.5

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C	Salinity (ppt)	DO (mg/O2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
5753M1	C16	Anglers Rest	Top	Low	21-Mar-06	[redacted]				14.0	7.6	176.6	0.1	11.2		<2	41	6	20	12077	26	166
5753M2	C14	Waterworks	Top	Low	21-Mar-06					14.0	7.5	168.2	0.1	10.7		<2	40	13	22	14087	30	196
5753M3		Field Control A	[redacted]																			
5753M4	C9	Tivoli	Bottom	Low	21-Mar-06	51.54.10	08.26.02	4.3	12.12	7.7	7.8	44.8	28.9	8.6		<2	78	43	243	6855	38	1300
5753M5	C9	Tivoli	Top	Low	22-Mar-06	51.54.10	08.26.02	Total 5.5	12.16	7.9	7.7	6.3	3.5	11.4		<2	54	24	83	14123	38	5460
5753M6	C7	Blackrock Castle	Bottom	Low	21-Mar-06	51.54.06	08.23.92	8.6	11.46	7.6	7.8	45.8	28.6	8.3		<2	79	46	264	5398	36	649
5753M7	C7	Blackrock Castle	Middle	Low	22-Mar-06	51.54.06	08.23.92	3.1	11.51	8.0	7.8	41.4	28.6	9.1		<2	70	37	183	6881	36	1300
5753M8	C7	Blackrock Castle	Top	Low	23-Mar-06	51.54.06	08.23.92	Total 7.2	11.55	7.9	7.7	11.4	6.5	11.0		<2	82	33	135	12794	38	2420
5753M9	C8	Mid L. Mahon	Bottom	Low	21-Mar-06	51.53.14	08.22.09	6.6	11.20	7.5	7.8	45.2	29.3	9.0		<2	81	42	220	6142	43	233
5753M10	C8	Mid L. Mahon	Middle	Low	22-Mar-06	51.53.14	08.22.09	3.0	11.24	8.3	7.8	37.2	23.8	9.4		<2	22	41	206	7737	43	613
5753M11	C8	Mid L. Mahon	Top	Low	23-Mar-06	51.53.14	08.22.09	Total 7.2	11.26	8.2	7.8	31.9	19.8	9.8		<2	85	38	165	10050	43	980
5753M12	C6	End L. Mahon	Bottom	Low	21-Mar-06	51.52.54	08.20.09	5.8	11.00	8.2	7.8	44.4	28.1	9.3		<2	75	44	215	5695	46	231
5753M13	C6	End L. Mahon	Middle	Low	22-Mar-06	51.52.54	08.20.09	5.8	10.56	8.2	7.8	40.2	26.1	9.5		<2	65	40	187	5931	46	344
5753M14	C6	End L. Mahon	Top	Low	23-Mar-06	51.52.54	08.20.09	Total 11.0	11.06	8.2	7.8	35.2	20.7	9.5		<2	55	40	206	7772	49	179
5753M15	C5	Haulbowline	Bottom	Low	21-Mar-06	51.50.41	08.19.04	6.5	13.06	8.1	7.9	47.7	31.1	9.3		<2	90	35	149	4956	38	146
5753M16	C5	Haulbowline	Middle	Low	22-Mar-06	51.50.41	08.19.04	4.5	13.13	8.2	7.9	38.7	24.6	9.6		<2	59	38	172	6280	39	517
5753M17	C5	Haulbowline	Top	Low	23-Mar-06	51.50.41	08.19.04	Total 11.0	13.17	8.3	7.9	36.4	23.0	9.7		<2	83	38	175	6576	49	411
5753M18	C4	Lower Harbour	Bottom	Low	21-Mar-06	51.50.93	08.16.10	13.6	12.33	8.0	8.0	53.8	33.9	9.1		<2	46	28	62	3204	23	44
5753M19	C4	Lower Harbour	Middle	Low	22-Mar-06	51.50.93	08.16.10	8.7	13.37	8.1	7.9	48.4	31.7	9.2		<2	44	28	90	4617	28	29
5753M20	C4	Lower Harbour	Top	Low	23-Mar-06	51.50.93	08.16.10	Total 13.6	13.42	8.3	7.9	42.5	27.2	9.5		<2	57	34	145	5095	39	179
5753M21	C3	End Cork Harbour	Bottom	Low	21-Mar-06	51.48.84	08.16.39	23.9	14.03	7.9	8.0	55.2	36.7	9.0		<2	57	15	20	1103	<16	1
5753M22	C3	End Cork Harbour	Middle	Low	22-Mar-06	51.48.84	08.16.39	13.7	14.07	7.9	8.0	55.1	36.6	9.1		<2	58	19	35	1521	<16	2
5753M23	C3	End Cork Harbour	Top	Low	23-Mar-06	51.48.84	08.16.39	Total 25.4	14.11	8.2	8.0	49.5	32.4	9.3		<2	38	26	71	2848	23	15
M24		Field Control B	[redacted]																			
sample 24-3		Field B-A																				
Min								3.0		7.5	7.5	6.3	0.1	8.3	0.0		22.0	6.0		1103.0	23.0	1.0
Max								23.9		14.0	8.0	55.2	36.7	11.4	0.0	0.0	85.0	48.0	264.0	14123.0	49.0	5460.0
Mean								8.4		8.6	7.8	40.3	23.7	9.6	#DIV/0!		59.3	32.3		7015.4	37.2	700.6

Sample Registration 1471

Client Reference																						
Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
7017M1	C16	Anglers Rest	Top	Low	24-Apr-06						7.5	211.0	0.1	11.8		3	32	11	23	14805	23	179
7017M2	C14	Waterworks	Top	Low	24-Apr-06						7.6	233.0	0.1	10.3		<2	47	25	22	20549	33	548
7017M3		Field Control A														*	*	*	*	*	*	*
7017M4	C9	Tivoli	Bottom	Low	24-Apr-06	51.54.09	08.26.01	5.0	9.50	10.6	7.8	48.2	32.2	8.8		<2	114	55	374	3833	39	166
7017M5	C9	Tivoli	Top	Low	24-Apr-06	51.54.09	08.26.01	Total 6.1	9.55	12.0	7.9	42.9	27.7	8.6		<2	61	32	98	14109	49	3930
7017M6	C7	Blackrock Castle	Bottom	Low	24-Apr-06	51.54.06	08.23.97	5.8	9.27	10.6	8.0	48.8	32.5	9.4		<2	65	20	220	3357	39	31
7017M7	C7	Blackrock Castle	Middle	Low	24-Apr-06	51.54.06	08.23.97	3.2	9.32	10.8	8.0	48.5	31.7	9.7		<2	73	27	165	5811	43	173
7017M8	C7	Blackrock Castle	Top	Low	24-Apr-06	51.54.06	08.23.97	Total 7.0	9.36	11.0	8.0	41.4	26.9	9.8		<2	76	28	128	15256	49	1906
7017M9	C8	Mid L. Mahon	Bottom	Low	24-Apr-06	51.53.18	08.24.14	6.6	8.53	10.7	8.0	50.3	33.1	10.0		<2	72	21	183	2476	35	1733
7017M10	C8	Mid L. Mahon	Middle	Low	24-Apr-06	51.53.18	08.24.14	3.9	8.57	11.1	8.0	48.4	31.6	10.2		<2	77	22	159	3091	39	44
7017M11	C8	Mid L. Mahon	Top	Low	24-Apr-06	51.53.18	08.24.14	Total 7.6	9.02	11.4	8.0	43.0	27.7	10.4		<2	68	26	157	10465	56	36
7017M12	C6	End L. Mahon	Bottom	Low	24-Apr-06	51.52.82	08.20.10	11.0	8.28	10.9	8.0	50.2	33.0	10.4		<2	59	14	128	2564	36	45
7017M13	C6	End L. Mahon	Middle	Low	24-Apr-06	51.52.82	08.20.10	5.8	8.33	11.5	8.0	49.7	31.8	10.4		<2	60	15	125	2814	39	22
7017M14	C6	End L. Mahon	Top	Low	24-Apr-06	51.52.82	08.20.10	Total 12.0	8.37	11.8	8.0	44.2	28.8	10.5		<2	64	16	134	6435	36	12
7017M15	C5	Haulbowline	Bottom	Low	24-Apr-06	51.50.40	08.19.03	12.2	10.49	10.4	8.1	54.0	35.8	10.6		<2	41	5	69	1457	23	<1
7017M16	C5	Haulbowline	Middle	Low	24-Apr-06	51.50.40	08.19.03	6.5	10.53	10.7	8.1	51.9	34.2	10.7		<2	48	9	89	2352	30	4
7017M17	C5	Haulbowline	Top	Low	24-Apr-06	51.50.40	08.19.03	Total 13.1	10.57	11.1	8.1	47.4	30.9	10.7		<2	49	11	96	3086	36	16
7017M18	C4	Lower Harbour	Bottom	Low	24-Apr-06	51.50.86	08.16.11	11.6	11.16	10.6	8.1	52.9	35.0	10.9		<2	[illegible]	25	19	832	16	<1
7017M19	C4	Lower Harbour	Middle	Low	24-Apr-06	51.50.86	08.16.11	5.7	11.20	10.9	8.2	53.0	34.8	11.0		<2	34	<5	37	872	16	<1
7017M20	C4	Lower Harbour	Top	Low	24-Apr-06	51.50.86	08.16.11	Total 13.0	11.24	10.7	8.1	52.0	34.3	11.0		<2	35	<5	41	1054	20	<1
7017M21	C3	End Cork Harbour	Bottom	Low	24-Apr-06	51.48.74	08.16.23	21.7	11.48	10.2	8.1	54.4	36.1	10.5		<2	22	<5	19	345	<16	<1
7017M22	C3	End Cork Harbour	Middle	Low	24-Apr-06	51.48.74	08.16.23	10.7	11.52	10.3	8.1	54.3	36.0	10.7		<2	19	<5	22	332	<16	<1
7017M23	C3	End Cork Harbour	Top	Low	24-Apr-06	51.48.74	08.16.33	Total 22.6	11.56	10.5	8.2	53.6	35.5	11.0		<2	21	<5	22	554	<16	<1
7017M24		Field Control B														*	*	*	*	*	*	*
sample 24-3		Field B-A														n/a	n/a	n/a	n/a	n/a	n/a	n/a
Min								3.2		10.2	7.5	41.0	0.1	8.6			19.0	5.0		332.0	16.0	4.0
Max								21.7		12.0	8.2	54.4	36.1	11.8		3.0	114.0	55.0	374.0	20549.0	56.0	3930.0
Mean								8.5		10.9	8.0	49.4	29.5	10.3			54.3	21.5		5293.6	35.7	595.0

Sample Registration 1471

Client Reference																						
Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
7085M1	C16	Anglers Rest	Top	High	24-Apr-06						7.7	210.0	0.1	11.9		<2	57	38	11	14761	23	238
7085M2	C14	Waterworks	Top	High	24-Apr-06						7.4	234.0	0.1	11.4		8	37	19	15	20115	26	281
7085M3		Field Control A																				
7085M4	C9	Tivoli	Bottom	High	24-Apr-06	51.54.09	08.25.98	6.3	14.41	10.8	8.0	49.4	32.4	9.3		<2	64	30	225	3535	38	40
7085M5	C9	Tivoli	Top	High	24-Apr-06	51.54.09	08.25.98	Total 7.3	14.45	11.4	8.0	38.8	24.7	9.9		3	63	33	182	11266	53	1300
7085M6	C7	Blackrock Castle	Bottom	High	24-Apr-06	51.54.07	08.23.96	9.2	14.11	10.8	8.1	42.7	32.6	9.3		3	60	22	186	3190	38	41
7085M7	C7	Blackrock Castle	Middle	High	24-Apr-06	51.54.07	08.23.96	8.1	14.15	11.0	8.1	43.5	32.0	10.1		2	57	19	130	4228	40	64
7085M8	C7	Blackrock Castle	Top	High	24-Apr-06	51.54.07	08.23.96	Total 10.0	14.19	11.2	8.1	30.5	18.8	10.2		3	42	24	118	10465	43	461
7085M9	C8	Mid L. Mahon	Bottom	High	24-Apr-06	51.53.15	08.22.12	6.9	13.46	11.0	8.1	49.6	32.5	10.4		3	54	18	149	2524	33	20
7085M10	C8	Mid L. Mahon	Middle	High	24-Apr-06	51.53.15	08.22.12	3.8	13.50	11.1	8.1	48.7	31.8	10.5		3	57	18	143	2963	36	81
7085M11	C8	Mid L. Mahon	Top	High	24-Apr-06	51.53.15	08.22.12	Total 8.1	13.55	11.2	8.1	45.3	29.4	10.7		5	55	16	108	3684	43	20
7085M12	C6	End L. Mahon	Bottom	High	24-Apr-06	51.52.81	08.20.04	10.7	13.24	10.8	8.1	50.9	33.3	10.5		3	46	7	69	1863	26	8
7085M13	C6	End L. Mahon	Middle	High	24-Apr-06	51.52.81	08.20.04	5.7	13.28	10.8	8.1	50.7	33.2	10.5		4	45	7	73	1889	26	6
7085M14	C6	End L. Mahon	Top	High	24-Apr-06	51.52.81	08.20.04	Total 11.7	13.32	11.0	8.1	49.5	32.8	10.8		3	45	8	69	2464	30	21
7085M15	C5	Haulbowline	Bottom	High	24-Apr-06	51.50.40	08.19.03	13.5	15.34	10.4	8.1	53.9	35.7	10.7		<2	46	<5	14	651	<16	<1
7085M16	C5	Haulbowline	Middle	High	24-Apr-06	51.50.40	08.19.03	6.2	15.38	10.6	8.2	53.3	35.2	11.0		3	32	<5	21	797	16	<1
7085M17	C5	Haulbowline	Top	High	24-Apr-06	51.50.40	08.19.03	Total 14.7	15.43	10.7	8.2	52.5	34.7	11.1		<2	35	<5	31	1107	16	9
7085M18	C4	Lower Harbour	Bottom	High	24-Apr-06	51.50.80	08.16.11	13.8	15.59	10.2	8.1	55.3	36.4	10.4		<2	15	<5	21	35	<16	<1
7085M19	C4	Lower Harbour	Middle	High	24-Apr-06	51.50.80	08.16.11	7.2	16.03	10.1	8.1	55.3	35.7	10.5		<2	15	<5	13	50	<16	<1
7085M20	C4	Lower Harbour	Top	High	24-Apr-06	51.50.80	08.16.11	Total 15.1	16.07	10.3	8.1	54.6	36.4	10.7		<2	15	<5	14	39	<16	<1
7085M21	C3	End Cork Harbour	Bottom	High	24-Apr-06	51.48.77	08.16.39	20.0	16.29	10.1	8.1	55.3	36.8	10.4		<2	14	<5	15	111	<16	<1
7085M22	C3	End Cork Harbour	Middle	High	24-Apr-06	51.48.77	08.16.39	11.1	16.35	10.3	8.2	55.0	36.5	10.8		<2	16	<5	15	149	<16	<1
7085M23	C3	End Cork Harbour	Top	High	24-Apr-06	51.48.77	08.16.39	Total 21.2	16.39	10.5	8.2	54.4	36.1	10.8		<2	17	<5	15	314	<16	<1
7085M24		Field Control B																				
sample 24-3		Field B-A																				
Min								3.8		10.1	7.4	30.5	0.1	9.3			14.0	7.0		35.0	16.0	3.0
Max								20.0		11.4	8.2	55.3	36.8	11.9		8.0	63.0	38.0	225.0	20115.0	53.0	1300.0
Mean								9.9		10.7	8.1	49.8	29.9	10.6			42.6	20.0		3974.1	33.2	163.1

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
M1	C16	Anglers Rest	Top	Low	7-Jun-06	[redacted]				19.0	7.3	0.2	0.1	9.9	4.1	<2	38	<5	42		91	
M2	C14	Waterworks	Top	Low	7-Jun-06	[redacted]				18.2	7.2	0.2	0.1	9.8	3.3	<2	44	8	39		82	
M3		Field Control A	[redacted]													<2	67.0	31.0	100.0		<16	
M4	C9	Tivoli	Bottom	Low	7-Jun-06	51.54.10	08.26.02	5.0	9.39	12.9	7.6	50.7	33.3	7.7	11.5	<2	78	15	195		46	
M5	C9	Tivoli	Top	Low	7-Jun-06	51.54.10	08.26.02	8.2	9.44	14.5	7.9	48.9	30.8	11.6	33.4	<2	74	33	123		69	
M6	C7	Blackrock Castle	Bottom	Low	7-Jun-06	51.54.08	08.23.97	6.7	9.14	13.5	7.9	51.6	34.2	10.6	13.6	<2	76	12	147		40	
M7	C7	Blackrock Castle	Middle	Low	7-Jun-06	51.54.08	08.23.97	3.3	9.18	13.5	7.8	50.7	33.4	10.3	16.7	4	71	<5	26		49	
M8	C7	Blackrock Castle	Top	Low	7-Jun-06	51.54.08	08.23.97	8.1	9.21	15.2	8.1	43.4	28.0	10.5	32.3	<2	54	48	72		59	
M9	C8	Mid L. Mahon	Bottom	Low	7-Jun-06	51.53.14	08.22.05	5.7	8.5	13.8	7.9	51.9	34.2	10.9	18.0	3	68	<5	71		43	
M10	C8	Mid L. Mahon	Middle	Low	7-Jun-06	51.53.14	08.22.05	3.5	8.54	14.0	7.9	50.2	33.0	11.5	33.6	3	90	<5	14		56	
M11	C8	Mid L. Mahon	Top	Low	7-Jun-06	51.53.14	08.22.05	8.3	8.58	14.9	8.1	47.9	31.2	14.2	37.7	2	82	<5	21		92	
M12	C6	End L. Mahon	Bottom	Low	7-Jun-06	51.52.68	08.20.15	9.3	8.21	14.0	7.8	51.4	33.9	11.4	17.5	3	62	<5	12		58	
M13	C6	End L. Mahon	Middle	Low	7-Jun-06	51.52.68	08.20.15	8.1	8.26	15.4	8.0	48.6	31.9	12.5	38.1	3	66	<5	17		56	
M14	C6	End L. Mahon	Top	Low	7-Jun-06	51.52.68	08.20.15	11.3	8.31	16.0	8.2	34.8	21.9	13.5	19.3	3	64	<5	14		72	
M15	C5	Haulbowline	Bottom	Low	7-Jun-06	51.50.39	08.18.96	14.5	10.41	13.2	8.0	55.5	36.9	11.0	7.3	2	34	<5	22		20	
M16	C5	Haulbowline	Middle	Low	7-Jun-06	51.50.39	08.18.96	7.3	10.45	13.4	8.0	54.0	35.8	11.5	11.2	2	48	<5	17		36	
M17	C5	Haulbowline	Top	Low	7-Jun-06	51.50.39	08.18.96	15.6	10.48	16.3	8.2	44.9	29.1	14.2	26.9	3	49	<5	<6		69	
M18	C4	Lower Harbour	Bottom	Low	7-Jun-06	51.50.92	08.15.97	10.6	11.17	13.4	8.0	55.7	37.0	11.1	5.5	<2	27	<5	12		<16	
M19	C4	Lower Harbour	Middle	Low	7-Jun-06	51.50.92	08.15.97	3.9	11.22	13.7	8.0	54.8	36.2	11.9	0.6	<2	30	<5	<6		<16	
M20	C4	Lower Harbour	Top	Low	7-Jun-06	51.50.92	08.15.97	12.7	11.26	14.9	8.2	52.3	34.4	13.1	8.4	<2	35	<5	38		33	
M21	C3	End Cork Harbour	Bottom	Low	7-Jun-06	51.48.76	08.16.30	23.1	11.57	12.3	8.0	56.9	37.4	11.2	8.4	<2	19	<5	<6		<16	
M22	C3	End Cork Harbour	Middle	Low	7-Jun-06	51.48.76	08.16.30	15.8	12.02	12.3	8.0	56.3	37.5	11.3	4.1	<2	21	<5	<6		<16	
M23	C3	End Cork Harbour	Top	Low	7-Jun-06	51.48.76	08.16.30	29.0	12.06	14.1	8.1	54.8	36.4	12.3	3.5	<2	23	33	127		69	
M24		Field Control B	[redacted]													<2	157.0	144.0	278.0		<16	
sample 24-3		Field B-A	[redacted]																			
Min								3.3		12.3	7.2	34.8	0.1	7.7	3.3		19.0	6.0		0.0	20.0	0.0
Max								29.0		19.0	8.2	58.3	37.5	14.2	38.1	4.0	90.0	48.0	195.0	0.0	92.0	0.0
Mean								10.3		14.5	7.9	50.8	30.9	11.8	18.5		57.2	40.8		#DIV/0!	57.6	#DIV/0!

Sample Registration 1471

Client Reference

Lab #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS(W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
M1	C16	Anglers Rest	Top	High	7-Jun-06	[redacted]				18.6	7.1	0.2	0.1	9.7	3.3	<2	58	26	30		79	
M2	C14	Waterworks	Top	High	7-Jun-06	[redacted]				18.3	7.2	0.2	0.1	9.9	3.6	<2	42	12	31		76	
M3		Field Control A	[redacted]																			
M4	C9	Tivoli	Bottom	High	7-Jun-06	51.54.09	08.26.00	7.8	14.36	13.3	7.8	51.2	33.7	9.5	17.4	3	78	8	103		46	
M5	C9	Tivoli	Top	High	7-Jun-06	51.54.09	08.26.00	8.5	14.4	16.1	8.0	39.4	25.1	11.9	25.5	<2	66	25	104		76	
M6	C7	Blackrock Castle	Bottom	High	7-Jun-06	51.54.07	08.23.94	8.2	14.15	13.6	7.9	51.9	34.2	10.8	19.5	3	71	7	105		39	
M7	C7	Blackrock Castle	Middle	High	7-Jun-06	51.54.07	08.23.94	4.0	14.19	14.1	8.0	50.4	33.1	11.7	34.2	3	76	<5	27		49	
M8	C7	Blackrock Castle	Top	High	7-Jun-06	51.54.07	08.23.94	10.2	14.22	17.4	8.4	36.2	22.9	18.6	22.4	<2	72	26	96		65	
M9	C8	Mid L. Mahon	Bottom	High	7-Jun-06	51.53.14	08.22.03	8.9	13.54	13.6	8.0	52.3	34.5	11.4	12.4	<2	65	6	100		33	
M10	C8	Mid L. Mahon	Middle	High	7-Jun-06	51.53.14	08.22.03	4.0	13.58	14.1	8.0	51.7	34.1	11.8	15.9	2	64	<5	62		39	
M11	C8	Mid L. Mahon	Top	High	7-Jun-06	51.53.14	08.22.03	9.8	14.01	18.6	8.2	46.1	30.0	14.7	26.5	3	72	<5	14		72	
M12	C6	End L. Mahon	Bottom	High	7-Jun-06	51.52.62	08.20.10	12.6	13.33	13.4	8.0	54.0	35.8	11.4	9.7	<2	41	<5	30		20	
M13	C6	End L. Mahon	Middle	High	7-Jun-06	51.52.62	08.20.10	6.1	13.37	13.5	8.0	53.6	35.5	11.6	19.8	<2	55	<5	32		46	
M14	C6	End L. Mahon	Top	High	7-Jun-06	51.52.62	08.20.10	14.5	13.4	14.6	8.1	50.5	33.2	12.7	12.7	4	50	<5	18		49	
M15	C5	Haulbowline	Bottom	High	7-Jun-06	51.50.39	08.19.01	13.9	15.3	13.6	8.0	55.4	36.8	11.5	7.2	<2	26	<5	18		<16	
M16	C5	Haulbowline	Middle	High	7-Jun-06	51.50.39	08.19.01	7.2	15.34	14.1	8.0	54.8	36.4	12.2	8.4	<2	31	<5	21		<16	
M17	C5	Haulbowline	Top	High	7-Jun-06	51.50.39	08.19.01	15.4	15.38	15.4	8.2	51.0	33.6	14.5	15.3	3	45	<5	13		36	
M18	C4	Lower Harbour	Bottom	High	7-Jun-06	51.50.91	08.16.09	13.9	15.56	13.0	8.0	56.1	37.5	11.4	4.3	<2	18	<5	<6		<16	
M19	C4	Lower Harbour	Middle	High	7-Jun-06	51.50.91	08.16.09	7.9	15.59	13.3	8.0	56.0	37.3	11.5	3.8	<2	22	<5	10		<16	
M20	C4	Lower Harbour	Top	High	7-Jun-06	51.50.91	08.16.09	15.8	16.03	14.2	8.1	56.3	36.8	12.2	2.3	<2	19	<5	8		<16	
M21	C3	End Cork Harbour	Bottom	High	7-Jun-06	51.48.77	08.16.33	26.7	16.25	12.1	8.0	56.3	37.5	11.1	9.8	<2	20	<5	8		<16	
M22	C3	End Cork Harbour	Middle	High	7-Jun-06	51.48.77	08.16.33	15.5	16.29	12.9	8.0	56.2	37.4	11.4	5.0	<2	18	<5	11		<16	
M23	C3	End Cork Harbour	Top	High	7-Jun-06	51.48.77	08.16.33	29.5	16.34	15.7	8.1	54.4	36.1	12.7	2.3	<2	12	<5	9		<16	
M24		Field Control B	[redacted]																			
sample 24-3		Field B-A	[redacted]																			
Min								4.0		12.1	7.7	36.2	0.1	9.5	2.3		12.0	6.0		0.0	20.0	0.0
Max								29.5		18.6	8.4	56.3	37.5	18.6	34.2	4.0	78.0	26.0	105.0	0.0	79.0	0.0
Mean								12.0		14.6	8.0	51.6	31.0	11.9	12.2		46.4	15.4		#DIV/0!	51.9	#DIV/0!

Sample Registration 1471

Client Reference

Lab Test #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-Phosphate (µg/l P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
N1	C16	Anglers Rest	Top	High	28-Jun-06	[redacted]				20.3	7.3	67.6	0.0	9.7	3.7	<2	36	16	26	9123	33	236
N2	C14	Waterworks	Top	High	28-Jun-06	[redacted]				19.9	7.4	66.0	0.0	9.6	4.1	<2	44	23	36	12117	46	435
N3		Field Control A	[redacted]													<2	61.0	36.0	13.0	2524.0	66.0	<1
N4	C9	Tivoli	Bottom	High	28-Jun-06	51.54.09	08.26.00	8.2	8.23	15.3	8.0	48.4	31.7	8.1	15.6	<2	67	19	129	1541	49	25
N5	C9	Tivoli	Top	High	28-Jun-06	51.54.09	08.26.00	Total 9.1	8.27	16.4	8.1	46.1	29.9	10.1	27.5	<2	71	40	172	12121	76	11190
N6	C7	Blackrock Castle	Bottom	High	28-Jun-06	51.54.06	08.23.97	8.8	8.02	15.3	8.1	49.9	32.5	8.9	14.6	<2	67	14	83	1231	39	55
N7	C7	Blackrock Castle	Middle	High	28-Jun-06	51.54.06	08.23.97	5.3	8.05	15.5	8.1	49.1	32.2	8.9	15.7	<2	76	15	96	1537	43	99
N8	C7	Blackrock Castle	Top	High	28-Jun-06	51.54.06	08.23.97	Total 10.6	8.09	16.1	8.1	45.4	29.6	9.8	18.9	<2	77	23	119	8816	89	1733
N9	C8	Mid L. Mahon	Bottom	High	28-Jun-06	51.53.14	08.22.26	10.1	7.4	15.0	8.1	50.6	33.2	9.6	12.9	<2	52	7	14	793	30	10
N10	C8	Mid L. Mahon	Middle	High	28-Jun-06	51.53.14	08.22.26	5.5	7.43	15.0	8.1	50.3	33.1	9.6	12.2	<2	53	8	18	921	33	20
N11	C8	Mid L. Mahon	Top	High	28-Jun-06	51.53.14	08.22.26	Total 11.0	7.47	15.5	8.1	49.0	32.1	9.8	13.3	<2	59	12	30	1616	43	30
N12	C6	End L. Mahon	Bottom	High	28-Jun-06	51.52.66	08.20.09	12.1	7.18	14.5	8.0	51.9	34.2	9.6	8.5	<2	42	<5	<6	483	20	10
N13	C6	End L. Mahon	Middle	High	28-Jun-06	51.52.66	08.20.09	5.8	7.22	14.9	8.1	51.4	33.9	9.5	10.6	<2	46	5	17	510	23	6
N14	C6	End L. Mahon	Top	High	28-Jun-06	51.52.66	08.20.09	Total 13.9	7.26	15.0	8.1	50.5	33.2	9.8	10.6	<2	39	6	9	512	26	11
N15	C5	Haulbowline	Bottom	High	28-Jun-06	51.58.40	08.19.02	15.1	9.13	14.4	8.1	53.6	35.5	8.9	6.1	<2	27	<5	<6	230	<16	3
N16	C5	Haulbowline	Middle	High	28-Jun-06	51.58.40	08.19.02	7.4	9.17	14.4	8.1	52.7	34.8	9.4	9.1	<2	27	<5	<6	434	<16	2
N17	C5	Haulbowline	Top	High	28-Jun-06	51.58.40	08.19.02	Total 15.8	9.21	14.6	8.1	52.2	34.4	9.7	8.5	<2	38	<5	8	381	20	5
N18	C4	Lower Harbour	Bottom	High	28-Jun-06	51.50.90	08.16.10	14.2	9.37	14.5	8.1	54.3	36.0	8.8	2.8	<2	14	<5	<6	40	<16	<1
N19	C4	Lower Harbour	Middle	High	28-Jun-06	51.50.90	08.16.10	7.4	9.41	14.5	8.1	54.5	36.0	8.7	2.5	<2	13	<5	<6	40	<16	2
N20	C4	Lower Harbour	Top	High	28-Jun-06	51.50.90	08.16.10	Total 15.6	9.44	14.6	8.1	54.2	35.9	8.7	1.4	<2	47	<5	<6	71	<16	4
N21	C3	End Cork Harbour	Bottom	High	28-Jun-06	51.48.74	08.16.38	22.7	10.04	14.5	8.1	53.9	35.7	8.8	5.2	<2	15	<5	6	53	<16	1
N22	C3	End Cork Harbour	Middle	High	28-Jun-06	51.48.74	08.16.38	11.0	10.08	14.5	8.1	53.8	35.6	9.0	4.0	<2	15	<5	6	49	<16	<1
N23	C3	End Cork Harbour	Top	High	28-Jun-06	51.48.74	08.16.38	Total 23.2	10.12	14.6	8.1	53.6	35.5	9.1	2.5	<2	18	<5	<6	66	<16	1
N24		Field Control B	[redacted]													<2	138.0	139.0	129.0	2883.0	62.0	<1
sample 24-3		Field B-A	[redacted]																			
Min								5.3		14.4	7.3	45.4	0.0	8.1	1.4		13.0	5.0		40.0	20.0	11.0
Max								22.7		20.3	8.1	54.3	36.0	10.1	27.5	0.0	77.0	40.0	172.0	12121.0	76.0	3.0
Mean								10.3		15.4	8.0	51.2	30.7	9.3	9.5		46.3	26.1		2354.2	41.1	2.0

Sample Registration 1471

Client Reference

Lab Test #	Station #	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	o-Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E. Coliforms (MPN/100mls)
N1	C16	Anglers Rest	Top	Low	28-Jun-06	[redacted]				21.1	7.6	167.0	0.1	9.8	3.8	<2	45	26	59	9331	43	153
N2	C14	Waterworks	Top	Low	28-Jun-06	[redacted]				20.6	7.4	173.2	0.1	9.2	3.2	<2	43	26	68	12760	38	261
N3		Field Control A	[redacted]																			
N4	C9	Tivoli	Bottom	Low	28-Jun-06	51.54.10	08.26.02	5.4	13.17	15.3	7.6	48.2	31.5	7.6	13.8	<2	83	24	341	1598	49	31
N5	C9	Tivoli	Top	Low	28-Jun-06	51.54.10	08.26.02	Total 6	13.2	16.2	8.1	46.6	30.3	10.4	18.5	<2	82	43	355	10482	76	17820
N6	C7	Blackrock Castle	Bottom	Low	28-Jun-06	51.54.07	08.23.96	6.9	12.53	15.4	8.0	48.9	32.0	8.7	13.4	8	82	11	135	1747	46	10
N7	C7	Blackrock Castle	Middle	Low	28-Jun-06	51.54.07	08.23.96	4.2	12.57	15.5	8.0	48.4	31.6	8.6	18.2	4	86	5	114	2808	57	17
N8	C7	Blackrock Castle	Top	Low	28-Jun-06	51.54.07	08.23.96	Total 7.5	13.01	17.1	8.2	37.4	22.6	11.8	14.4	<2	71	30	307	11969	76	5180
N9	C8	Mid L. Mahon	Bottom	Low	28-Jun-06	51.53.13	08.22.07	8.1	12.31	15.2	8.1	50.0	32.8	9.4	13.0	<2	54	9	87	1174	39	7
N10	C8	Mid L. Mahon	Middle	Low	28-Jun-06	51.53.13	08.22.07	4.1	12.34	15.6	8.1	48.7	31.8	9.4	14.2	3	69	7	100	1351	43	20
N11	C8	Mid L. Mahon	Top	Low	28-Jun-06	51.53.13	08.22.07	Total 8.5	12.39	16.2	8.2	46.3	30.1	10.7	11.9	2	51	<5	89	1426	46	5
N12	C6	End L. Mahon	Bottom	Low	28-Jun-06	51.52.61	08.20.09	11.5	12.09	15.3	8.1	49.7	33.0	9.7	12.9	<2	57	<5	73	1244	43	10
N13	C6	End L. Mahon	Middle	Low	28-Jun-06	51.52.61	08.20.09	8.5	12.13	16.0	8.1	47.7	31.1	10.3	11.7	2	50	<5	72	1320	43	22
N14	C6	End L. Mahon	Top	Low	28-Jun-06	51.52.61	08.20.09	Total 12.1	12.17	16.5	8.1	46.1	29.9	10.0	11.9	2	62	<5	91	1616	46	21
N15	C5	Haulbowline	Bottom	Low	28-Jun-06	51.50.39	08.18.98	12.0	14.1	14.7	8.1	52.0	34.3	9.5	10.7	<2	41	<5	78	695	26	7
N16	C5	Haulbowline	Middle	Low	28-Jun-06	51.50.39	08.18.98	6.0	14.13	15.0	8.1	50.9	33.4	9.9	12.8	<2	39	6	80	713	26	12
N17	C5	Haulbowline	Top	Low	28-Jun-06	51.50.39	08.18.98	Total10.3	14.17	15.7	8.1	49.7	32.6	10.6	8.5	<2	40	<5	71	872	30	4
N18	C4	Lower Harbour	Bottom	Low	28-Jun-06	51.50.91	08.18.08	12.4	14.33	14.6	8.1	53.3	35.2	9.2	8.9	<2	25	<5	57	263	<16	4
N19	C4	Lower Harbour	Middle	Low	28-Jun-06	51.50.91	08.18.08	5.9	14.36	14.8	8.1	52.3	34.5	9.9	10.7	<2	29	<5	62	386	18	5
N20	C4	Lower Harbour	Top	Low	28-Jun-06	51.50.91	08.18.08	Total12.7	14.4	15.1	8.1	51.4	33.8	10.2	6.6	<2	29	<5	65	509	23	4
N21	C3	End Cork Harbour	Bottom	Low	28-Jun-06	51.48.73	08.18.35	22.2	15	14.6	8.1	54.0	35.7	8.8	4.6	<2	15	<5	71	71	<16	1
N22	C3	End Cork Harbour	Middle	Low	28-Jun-06	51.48.73	08.18.35	12.4	15.03	14.6	8.1	53.7	35.6	9.1	6.1	<2	14	<5	54	89	<16	1
N23	C3	End Cork Harbour	Top	Low	28-Jun-06	51.48.73	08.18.35	Total23.5	15.07	14.6	8.1	53.2	35.2	9.8	4.5	<2	18	<5	44	64	<16	4
N24		Field Control B	[redacted]																			
sample 24-3		Field B-A	[redacted]																			
Min								4.1		14.6	7.4	37.4	0.1	7.6	3.3		14.0	5.0		71.0	16.0	1.0
Max								22.2		21.1	8.2	54.0	35.7	11.8	18.5	4.0	83.0	43.0	355.0	12750.0	76.0	17820.0
Mean								9.0		15.9	8.0	49.4	29.5	9.7	10.5		47.4	19.8		2613.5	42.4	1070.0

Sample Registration 1471
Client Reference

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mgXO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			--	--	--	--	--			E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	High	31-Jul-06			2.0		16.0	7.7	158.5	0.1	10.0	3.6	2	28	<5	11	7821	46	272
N2	C14	Waterworks	Top	High	31-Jul-06			2.1		16.4	7.4	187.0	0.1	9.0	3.9	2	32	<5	6	10571	43	649
N3		Field Control A	-	-							8.0					<2	48.0	42.0	<6	1749.0	<16	<1
N4	C9	Tivoli	Bottom	High	31-Jul-06	51.54.090	08.25.943	7.7	11:22	19.0	8.0	48.1	31.4	Note 1	15.4	5	55	17	117	939	39	23
N5	C9	Tivoli	Top	High	31-Jul-06	51.54.090	08.25.943	0.9	11:26	19.7	8.1	45.8	29.8	Note 1	43.2	5	57	21	122	1709	46	71
N6	C7	Blackrock Castle	Bottom	High	31-Jul-06	51.54.077	08.24.106	8.8	10:58	18.6	8.1	48.9	32.1	Note 1	10.2	4	52	19	131	864	39	31
N7	C7	Blackrock Castle	Middle	High	31-Jul-06	51.54.077	08.24.106	5.4	11:02	18.5	8.1	48.1	31.5	Note 1	15.1	4	61	20	138	988	43	47
N8	C7	Blackrock Castle	Top	High	31-Jul-06	51.54.077	08.24.106	1.3	11:05	18.6	8.1	46.5	30.2	Note 1	50.6	2	54	26	202	3645	56	2420
N9	C8	Mid L. Mahon	Bottom	High	31-Jul-06	51.53.167	08.22.120	9.2	10:39	18.0	8.1	49.8	32.7	Note 1	7.9	<2	35	18	89	292	26	26
N10	C8	Mid L. Mahon	Middle	High	31-Jul-06	51.53.167	08.22.120	5.2	10:37	18.0	8.1	49.6	32.5	Note 1	10.4	3	43	23	114	722	33	20
N11	C8	Mid L. Mahon	Top	High	31-Jul-06	51.53.167	08.22.120	0.7	10:41	18.4	8.1	46.6	30.3	Note 1	11.6	3	58	21	127	903	46	12
N12	C6	End L. Mahon	Bottom	High	31-Jul-06	51.52.581	08.22.043	13.9	10:02	17.4	8.1	50.9	33.5	7.9	6.5	<2	36	11	48	164	20	5
N13	C6	End L. Mahon	Middle	High	31-Jul-06	51.52.581	08.22.043	7.8	10:08	17.5	8.1	50.8	33.3	7.2	9.5	<2	35	11	51	221	23	18
N14	C6	End L. Mahon	Top	High	31-Jul-06	51.52.581	08.22.043	1.2	10:11	17.9	8.1	49.9	32.7	8.0	13.6	2	30	13	67	247	30	9
N15	C5	Haulbowline	Bottom	High	31-Jul-06	51.50.364	08.18.899	19.2	09:28	16.6	8.1	52.2	34.5	7.5	5.0	<2	20	7	21	<22	<16	4
N16	C5	Haulbowline	Middle	High	31-Jul-06	51.50.364	08.18.899	10.3	09:32	16.7	8.1	52.1	34.4	7.9	5.1	<2	178	6	17	<22	<16	7
N17	C5	Haulbowline	Top	High	31-Jul-06	51.50.364	08.18.899	1.3	09:36	17.1	8.1	51.7	34.1	7.9	4.8	<2	21	8	19	<22	<16	12
N18	C4	Lower Harbour	Bottom	High	31-Jul-06	51.50.961	08.16.213	15.3	09:01	14.5	8.0	53.2	35.1	8.2	3.1	<2	18	<5	14	<22	<16	8
N19	C4	Lower Harbour	Middle	High	31-Jul-06	51.50.961	08.16.213	8.0	09:05	15.0	8.0	53.0	35.0	8.2	3.4	<2	18	<5	21	<22	<16	10
N20	C4	Lower Harbour	Top	High	31-Jul-06	51.50.961	08.16.213	1.1	09:09	16.5	8.1	52.3	34.5	8.2	3.4	<2	19	<5	12	<22	<16	2
N21	C3	End Cork Harbour	Bottom	High	31-Jul-06	51.52.220	08.19.939	17.6	08:29	13.2	7.8	53.5	35.4	8.2	1.8	<2	19	6	17	<22	<16	<1
N22	C3	End Cork Harbour	Middle	High	31-Jul-06	51.52.220	08.19.939	8.7	08:34	13.6	7.9	53.4	35.3	8.0	2.1	<2	22	<5	13	<22	<16	<1
N23	C3	End Cork Harbour	Top	High	31-Jul-06	51.52.220	08.19.939	1.1	08:38	14.3	8.0	53.2	35.2	8.1	2.4	<2	75	5	19	<22	<16	2

Sample Registration 1471
Client Reference

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/l O2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			--	--	--	--	--	E60	--	E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	Low	31-Jul-06			2.2		15.1	7.9	158.4	0.1	9.7	3.7	2	32	<5	9	6249	46	153
N2	C14	Waterworks	Top	Low	31-Jul-06			1.9		15.9	7.8	172.0	0.1	9.5	4.1	2	49	<5	16	8300	49	649
N3		Field Control A																				
N4	C9	Tivoli	Bottom	Low	31-Jul-06	51.54.101	08.26.044	5.0	16:28	19.1	8.0	47.8	31.2	5.1	15.0	4	66	34	288	2002	53	22
N5	C9	Tivoli	Top	Low	31-Jul-06	51.54.101	08.26.044	2.5	16:33	19.8	8.0	39.3	25.1	6.6	13.3	3	82	70	743	3755	105	770
N6	C7	Blackrock Castle	Bottom	Low	31-Jul-06	51.54.060	08.24.181	6.8	16:01	18.6	8.0	49.8	31.8	7.3	11.9	4	49	20	141	1001	43	21
N7	C7	Blackrock Castle	Middle	Low	31-Jul-06	51.54.060	08.24.181	4.1	16:06	18.9	8.1	48.0	31.3	7.3	21.3	4	56	15	120	1284	49	22
N8	C7	Blackrock Castle	Top	Low	31-Jul-06	51.54.060	08.24.181	1.3	16:10	19.7	8.1	42.0	27.0	7.7	18.9	4	46	21	154	2347	49	130
N9	C8	Mid L. Mahon	Bottom	Low	31-Jul-06	51.53.192	08.22.154	7.2	15:34	18.1	8.1	49.5	32.4	8.8	7.9	4	57	15	105	864	43	13
N10	C8	Mid L. Mahon	Middle	Low	31-Jul-06	51.53.192	08.22.154	3.9	15:37	18.6	8.1	48.3	31.6	7.4	17.2	6	59	10	83	979	62	6
N11	C8	Mid L. Mahon	Top	Low	31-Jul-06	51.53.192	08.22.154	1.0	15:41	19.3	8.2	45.8	29.8	9.7	28.8	8	57	7	35	1159	56	16
N12	C6	End L. Mahon	Bottom	Low	31-Jul-06	51.52.595	08.20.054	11.0	15:09	18.2	8.1	48.6	31.8	7.6	11.9	3	59	18	118	615	56	24
N13	C6	End L. Mahon	Middle	Low	31-Jul-06	51.52.595	08.20.054	5.6	15:13	18.7	8.2	47.3	30.9	9.1	16.3	4	48	13	57	965	46	20
N14	C6	End L. Mahon	Top	Low	31-Jul-06	51.52.595	08.20.054	1.0	15:16	18.8	8.2	46.8	30.5	8.9	21.0	4	46	12	59	1094	46	10
N15	C5	Haulbowline	Bottom	Low	31-Jul-06	51.50.364	08.18.862	13.8	14:35	17.4	8.1	51.0	33.5	9.9	6.6	<2	6	9	44	376	23	17
N16	C5	Haulbowline	Middle	Low	31-Jul-06	51.50.364	08.18.862	7.9	14:39	17.9	8.1	49.8	32.7	8.2	10.3	<2	31	9	44	500	30	18
N17	C5	Haulbowline	Top	Low	31-Jul-06	51.50.364	08.18.862	1.0	14:42	18.1	8.1	49.5	32.5	8.1	9.3	<2	34	9	42	421	30	7
N18	C4	Lower Harbour	Bottom	Low	31-Jul-06	51.50.914	08.16.222	11.2	14:00	15.2	8.0	52.3	34.5	8.3	5.0	<2	20	6	18	<22	<16	4
N19	C4	Lower Harbour	Middle	Low	31-Jul-06	51.50.914	08.16.222	7.1	14:04	15.6	8.0	52.0	34.3	7.8	5.4	<2	20	5	14	<22	<16	8
N20	C4	Lower Harbour	Top	Low	31-Jul-06	51.50.914	08.16.222	1.3	14:08	16.8	8.1	51.9	34.2	8.8	3.7	<2	20	5	21	<22	<16	6
N21	C3	End Cork Harbour	Bottom	Low	31-Jul-06	51.48.749	08.16.379	18.4	13:24	15.4	8.0	52.8	34.9	8.9	3.8	<2	16	<5	<6	<22	<16	2
N22	C3	End Cork Harbour	Middle	Low	31-Jul-06	51.48.749	08.16.379	8.9	13:28	15.7	8.0	52.8	34.9	8.3	4.2	<2	14	<5	8	<22	<16	1
N23	C3	End Cork Harbour	Top	Low	31-Jul-06	51.48.749	08.16.379	1.3	13:32	16.1	8.0	52.6	34.7	7.9	4.0	<2	16	<5	10	<22	<16	6
N24		Field Control B																				
Sample 24-3		Field B-A																				

Lab Test Nr.	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			---	---	---	---	---			E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 161	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	High	#REF!			2.0		16.6	7.7	169.5	0.1	11.0	3.9	0	18	<5	17	8136	41	130
N2	C14	Waterworks	Top	High	30-08-06			2.1		16.9	7.8	169.7	0.1	11.5	2.8	<2	31	25	24	9557	39	102
N3		Field Control A	-	-												<2	31.0	37.0	522.0	2613.0	<16	<1
N4	C9	Tivoli	Bottom	High	30-08-06	51.54.10	08.26.00	5.8	11:39	16.8	8.0	49.5	32.5	7.9	7.0	2	46	34	182	1065	53	378
N5	C9	Tivoli	Top	High	30-08-06	51.54.10	08.26.00	1.1	11:44	17.6	8.0	48.1	31.5	8.1	7.3	<2	69	69	219	5536	66	34480
N6	C7	Blackrock Castle	Bottom	High	30-08-06	51.54.09	08.23.94	9.2	11:14	16.6	8.0	50.2	33.0	9.2	8.2	<2	40	30	127	846	53	101
N7	C7	Blackrock Castle	Middle	High	30-08-06	51.54.09	08.23.94	5.6	11:18	16.5	8.0	49.8	32.6	9.1	8.1	<2	44	31	131	930	66	148
N8	C7	Blackrock Castle	Top	High	30-08-06	51.54.09	08.23.94	1.0	11:24	16.8	8.0	47.8	31.2	9.2	10.9	<2	50	41	242	2350	66	1986
N9	C8	Mid L. Mahon	Bottom	High	30-08-06	51.53.13	08.22.01	8.4	10:43	16.2	8.0	51.1	33.6	9.0	6.9	<2	55	24	100	593	43	1
N10	C8	Mid L. Mahon	Middle	High	30-08-06	51.53.13	08.22.01	4.6	10:49	16.2	8.0	50.7	33.3	8.7	7.5	<2	56	24	98	620	43	8
N11	C8	Mid L. Mahon	Top	High	30-08-06	51.53.13	08.22.01	1	10:59	16.4	8.0	49.8	32.7	9.3	9.4	2	36	23	90	704	53	7
N12	C6	End L. Mahon	Bottom	High	30-08-06	51.52.59	08.20.11	12.6	10:17	15.8	8.0	52.3	34.6	8.7	5.0	<2	26	16	59	372	30	4
N13	C6	End L. Mahon	Middle	High	30-08-06	51.52.59	08.20.11	6.8	10:23	16.0	8.0	51.8	34.2	9.6	6.0	<2	33	19	62	416	30	9
N14	C6	End L. Mahon	Top	High	30-08-06	51.52.59	08.20.11	1.0	10:29	16.2	8.0	50.9	33.5	9.6	10.9	<2	35	20	71	527	39	5
N15	C5	Haubowline	Bottom	High	30-08-06	51.50.42	08.19.05	14.1	09:35	15.4	8.0	53.3	35.3	8.5	4.0	<2	19	10	21	190	<16	4
N16	C5	Haubowline	Middle	High	30-08-06	51.50.42	08.19.05	7.1	09:41	15.7	8.0	52.9	34.9	9.1	5.3	<2	19	10	21	190	<16	23
N17	C5	Haubowline	Top	High	30-08-06	51.50.42	08.19.05	1.1	09:47	15.8	8.0	52.6	34.7	9.1	5.1	<2	20	12	23	199	<16	1
N18	C4	Lower Harbour	Bottom	High	30-08-06	51.50.92	08.16.12	14.4	09:05	14.6	8.0	54.0	35.8	8.4	3.8	<2	15	6	<6	84	<16	2
N19	C4	Lower Harbour	Middle	High	30-08-06	51.50.92	08.16.12	7.3	09:11	14.8	8.0	53.9	35.7	7.7	3.9	<2	15	7	<6	89	<16	1
N20	C4	Lower Harbour	Top	High	30-08-06	51.50.92	08.16.12	1.1	09:16	14.9	8.0	53.8	35.7	8.2	4.2	<2	14	9	<6	89	<16	<1
N21	C3	End Cork Harbour	Bottom	High	30-08-06	51.48.79	08.16.32	26.9	08:33	14.4	7.9	54.1	35.9	105.4	3.9	<2	12	6	12	140	<16	<1
N22	C3	End Cork Harbour	Middle	High	30-08-06	51.48.79	08.16.32	14.2	08:40	14.4	7.9	54.1	35.9	8.8	4.2	<2	11	6	13	106	<16	1
N23	C3	End Cork Harbour	Top	High	30-08-06	51.48.79	08.16.32	1.3	08:45	14.4	7.9	54.1	35.9	8.9	3.6	<2	13	6	15	89	<16	1
N24		Field Control B			30-08-06											<2	105.0	151.0	104.0	2480.0	<16	<1

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			---	---	---	---	---	E60	---	E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	Low	#REF!			2.2		15.1	7.7	171.5	0.1	11.6	3.7	<2	37	25	36	7560	43	613
N2	C14	Waterworks	Top	Low	30-08-06			1.9		15.5	7.7	166.9	0.1	10.8	3.1	<2	34	28	33	9167	33	172
N3		Field Control A																				
N4	C9	Tivoli	Bottom	Low	30-08-06	51.54.10	08.26.03	4.4	16:26	17.0	8.0	49.3	32.3	7.5	6.0	<2	65	63	366	2405	56	27230
N5	C9	Tivoli	Top	Low	30-08-06	51.54.10	08.26.03	1.1	16:31	16.8	7.9	47.5	31.0	6.9	6.2	<2	60	54	411	7236	53	687
N6	C7	Blackrock Castle	Bottom	Low	30-08-06	51.54.09	08.24.00	6.1	16:00	16.8	8.0	49.7	32.6	7.3	7.7	<2	<5	32	166	1076	49	112
N7	C7	Blackrock Castle	Middle	Low	30-08-06	51.54.09	08.24.00	3.3	16:04	17.0	8.0	48.9	32.0	8.4	8.4	<2	47	34	185	1929	53	265
N8	C7	Blackrock Castle	Top	Low	30-08-06	51.54.09	08.24.00	1.1	16:09	18.0	8.0	46.7	30.4	9.5	8.6	<2	55	43	225	2892	56	921
N9	C8	Mid L. Mahon	Bottom	Low	30-08-06	51.53.12	08.22.05	8.2	15:28	16.6	8.0	50.4	33.1	8.2	6.7	<2	45	28	109	850	53	34
N10	C8	Mid L. Mahon	Middle	Low	30-08-06	51.53.12	08.22.05	4.2	15:31	16.8	8.0	49.4	32.4	8.8	7.7	2	45	26	78	996	53	115
N11	C8	Mid L. Mahon	Top	Low	30-08-06	51.53.12	08.22.05	0.8	15:37	16.8	8.0	48.6	31.8	9.5	11.3	3	53	26	86	1081	49	198
N12	C6	End L. Mahon	Bottom	Low	30-08-06	51.52.60	08.20.13	10.9	15:00	15.3	8.0	50.2	33.0	9.5	7.4	<2	45	28	130	744	49	16
N13	C6	End L. Mahon	Middle	Low	30-08-06	51.52.60	08.20.13	5.9	15:04	16.3	8.0	49.9	32.8	8.6	7.0	<2	42	30	131	757	56	11
N14	C6	End L. Mahon	Top	Low	30-08-06	51.52.60	08.20.13	1.1	15:09	16.5	8.1	49.0	32.1	9.6	12.9	<2	45	27	122	957	53	72
N15	C5	Haubowline	Bottom	Low	30-08-06	51.50.41	08.19.04	12.2	14:26	15.7	8.0	52.7	34.8	8.7	4.7	<2	26	16	62	354	26	3
N16	C5	Haubowline	Middle	Low	30-08-06	51.50.41	08.19.04	7.2	14:31	15.9	8.0	52.0	34.3	8.8	5.9	<2	30	17	59	381	26	2
N17	C5	Haubowline	Top	Low	30-08-06	51.50.41	08.19.04	1.0	14:36	16.1	8.0	51.6	34.0	9.3	7.6	<2	31	17	55	456	33	8
N18	C4	Lower Harbour	Bottom	Low	30-08-06	51.50.89	08.16.12	11.0	13:55	14.9	8.0	53.7	35.6	9.0	4.2	<2	18	9	22	164	<16	<1
N19	C4	Lower Harbour	Middle	Low	30-08-06	51.50.89	08.16.12	6.1	14:02	15.4	8.0	53.2	35.2	9.5	4.8	<2	25	9	23	190	<16	1
N20	C4	Lower Harbour	Top	Low	30-08-06	51.50.89	08.16.12	1.0	14:05	15.6	8.0	52.9	35.0	9.2	4.7	<2	23	11	26	230	<16	<1
N21	C3	End Cork Harbour	Bottom	Low	30-08-06	51.48.80	08.16.32	25.2	13:25	14.6	8.0	54.0	35.8	9.1	3.7	<2	12	5	<6	58	<16	<1
N22	C3	End Cork Harbour	Middle	Low	30-08-06	51.48.80	08.16.32	15.2	13:30	14.7	8.0	54.0	35.7	10.0	4.5	<2	9	<5	<6	38	<16	<1
N23	C3	End Cork Harbour	Top	Low	30-08-06	51.48.80	08.16.32	3.0	13:35	14.9	8.0	53.8	35.6	9.1	5.0	<2	15	5	<6	35	<16	3

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			---	---	---	---	---			E59	E56	E57	E15 ETE 151	E58	E61	E 19 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colifert
N1	C16	Anglers Rest	Top	High	4-Oct-06						7.3	168.7	0.1	18.2	2.4	<2	42	14	46	8128	81	155
N2	C14	Waterworks	Top	High	4-Oct-06						7.2	146.7	0.1	12.3	5.4	<2	41	17	39	9730	76	91
N3		Field Control A														<2						
N4	C9	Tivoli	Bottom	High	4-Oct-06	51.54.10	08.25.97	6.7	16.19	15.1	7.8	47.4	27.0	7.5	1.5	<2	56	45	176	2843	92	16
N5	C9	Tivoli	Top	High	4-Oct-06	51.54.10	08.25.97	1.4	16.22	15.4	7.8	35.2	7.6	8.6	2.8	<2	64	28	100	10350	76	1120
N6	C7	Blackrock Castle	Bottom	High	4-Oct-06	51.54.10	08.23.95	6.3	15.52	15.9	7.9	47.4	27.3	8.0	1.7	<2	85	48	172	2883	95	16
N7	C7	Blackrock Castle	Middle	High	4-Oct-06	51.54.10	08.23.95	3.5	15.56	14.9	7.9	46.3	19.4	8.1	1.7	<2	64	42	154	6470	95	387
N8	C7	Blackrock Castle	Top	High	4-Oct-06	51.54.10	08.23.95	1.4	15.59	14.7	7.8	34.9	8.9	8.1	3.1	<2	56	35	114	12121	76	2420
N9	C8	Mid L. Mahon	Bottom	High	4-Oct-06	51.53.14	08.22.11	6.4	15.29	14.8	7.9	47.7	27.3	8.3	1.6	<2	62	39	145	2684	79	11
N10	C8	Mid L. Mahon	Middle	High	4-Oct-06	51.53.14	08.22.11	3.4	15.33	14.8	7.9	45.5	25.2	8.6	1.9	<2	60	39	150	3468	89	18
N11	C8	Mid L. Mahon	Top	High	4-Oct-06	51.53.14	08.22.11	1.3	15.36	14.9	7.9	38.3	22.3	9.4	3.0	<2	69	41	183	4522	95	29
N12	C6	End L. Mahon	Bottom	High	4-Oct-06	51.52.60	08.19.07	12.6	15.08	14.7	7.9	50.4	31.1	8.6	1.8	<2	45	25	78	1382	56	12
N13	C6	End L. Mahon	Middle	High	4-Oct-06	51.52.60	08.19.07	7.2	15.11	14.7	7.9	49.8	29.3	8.7	1.9	<2	48	29	102	2090	62	13
N14	C6	End L. Mahon	Top	High	4-Oct-06	51.52.60	08.19.07	1.3	15.14	14.8	7.9	43.2	26.4	9.2	2.9	<2	53	34	134	2945	82	21
N15	C5	Haubowline	Bottom	High	4-Oct-06	51.50.42	08.15.98	12.5	14.42	14.7	7.9	51.3	32.3	8.9	1.9	<2	28	21	57	963	53	10
N16	C5	Haubowline	Middle	High	4-Oct-06	51.50.42	08.15.98	7.3	14.46	14.7	7.9	50.7	30.8	8.8	1.9	<2	37	24	73	1560	56	8
N17	C5	Haubowline	Top	High	4-Oct-06	51.50.42	08.15.98	1.3	14.49	14.8	7.9	47.0	29.0	9.3	3.3	<2	42	29	98	2117	72	4
N18	C4	Lower Harbour	Bottom	High	4-Oct-06	51.50.90	08.16.32	14.3	14.18	14.6	7.9	52.3	33.4	8.9	1.6	<2	30	17	32	478	43	4
N19	C4	Lower Harbour	Middle	High	4-Oct-06	51.50.90	08.16.32	7.4	14.21	14.7	8.0	52.2	32.4	8.9	1.7	<2	31	19	46	930	46	9
N20	C4	Lower Harbour	Top	High	4-Oct-06	51.50.90	08.16.32	1.4	14.25	15.0	7.9	47.9	31.2	9.3	2.8	<2	33	24	69	1426	53	3
N21	C3	End Cork Harbour	Bottom	High	4-Oct-06	51.48.19	08.16.30	25.3	13.52	14.6	8.0	53.1	34.5	8.9	1.6	<2	19	13	6	259	36	1
N22	C3	End Cork Harbour	Middle	High	4-Oct-06	51.48.19	08.16.30	19.5	13.57	14.6	8.0	52.9	34.3	8.9	1.8	<2	28	13	13	164	44	4
N23	C3	End Cork Harbour	Top	High	4-Oct-06	51.48.19	08.16.30	1.4	14.01	14.6	8.0	52.5	34.1	9.1	1.8	<2	21	14	17	341	39	2
N24		Field Control B																				

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			---	---	---	---	---	E60	---	E59	E56	E57	E15 ETE 151	E58	E61	E 19 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colifert
N1	C16	Anglers Rest	Top	Low	4-Oct-06					13.2	7.3	168.7	0.1	18.2	2.4	<2	70	28	34	13740	58	365
N2	C14	Waterworks	Top	Low	4-Oct-06					13.3	7.3	184.2	0.1	18.3	2.7	<2	54	26	31	16909	66	411
N3		Field Control A														<2	61.0	48.0	<6	2436.0	<16	<1
N4	C9	Tivoli	Bottom	Low	4-Oct-06	51.54.10	08.25.99	5.6	11.37	15.1	7.8	49.2	28.8	6.9	1.3	<2	72	45	195	2095	85	50
N5	C9	Tivoli	Top	Low	4-Oct-06	51.54.10	08.25.99	1.1	11.40	15.8	7.8	41.4	7.5	8.1	3.6	<2	60	39	154	9898	82	8090
N6	C7	Blackrock Castle	Bottom	Low	4-Oct-06	51.54.09	08.23.95	6.2	11.14	15.0	7.8	48.4	24.1	7.7	1.4	<2	71	41	168	3375	92	101
N7	C7	Blackrock Castle	Middle	Low	4-Oct-06	51.54.09	08.23.95	3.5	11.19	15.1	7.9	47.5	25.2	7.8	1.5	<2	74	42	163	2580	89	35
N8	C7	Blackrock Castle	Top	Low	4-Oct-06	51.54.09	08.23.95	1.4	11.23	15.2	7.8	43.4	5.9	7.9	3.1	<2	68	32	127	8915	89	3230
N9	C8	Mid L. Mahon	Bottom	Low	4-Oct-06	51.53.14	08.22.06	6.5	10.54	15.0	7.9	48.3	27.8	7.9	1.6	<2	95	47	170	2445	92	25
N10	C8	Mid L. Mahon	Middle	Low	4-Oct-06	51.53.14	08.22.06	3.0	10.57	15.1	7.9	45.1	23.8	8.0	2.0	<2	91	47	198	4070	102	45
N11	C8	Mid L. Mahon	Top	Low	4-Oct-06	51.53.14	08.22.06	1.2	11.00	15.0	7.9	41.4	15.2	8.2	2.4	<2	78	43	189	7577	128	579
N12	C6	End L. Mahon	Bottom	Low	4-Oct-06	51.52.61	08.20.15	10.3	10.33	15.0	7.9	47.4	27.6	8.0	1.9	<2	83	44	162	2493	89	20
N13	C6	End L. Mahon	Middle	Low	4-Oct-06	51.52.61	08.20.15	6.3	10.36	14.9	7.8	43.3	23.1	8.3	2.1	<2	74	43	181	4163	99	411
N14	C6	End L. Mahon	Top	Low	4-Oct-06	51.52.61	08.20.15	1.3	10.40	14.1	7.8	32.8	15.6	9.1	3.1	<2	67	38	159	6514	96	1120
N15	C5	Haubowline	Bottom	Low	4-Oct-06	51.50.40	08.18.96	10.5	10.03	14.8	7.9	50.5	29.4	8.5	0.0	<2	50	32	109	2077	86	24
N16	C5	Haubowline	Middle	Low	4-Oct-06	51.50.40	08.18.96	5.6	10.07	14.7	7.9	45.7	27.3	8.6	0.0	<2	54	35	132	2580	72	22
N17	C5	Haubowline	Top	Low	4-Oct-06	51.50.40	08.18.96	1.3	10.10	14.4	7.9	38.9	23.0	9.0	0.0	<2	55	33	153	3955	89	56
N18	C4	Lower Harbour	Bottom	Low	4-Oct-06	51.50.19	08.16.08	10.7	9.04	14.7	7.9	52.0	32.3	0.1	2.3	<2	31	20	59	934	43	10
N19	C4	Lower Harbour	Middle	Low	4-Oct-06	51.50.19	08.16.08	5.4	9.14	14.7	7.9	49.7	31.9	5.4	0.1	<2	30	22	65	1083	43	10
N20	C4	Lower Harbour	Top	Low	4-Oct-06	51.50.19	08.16.08	1.4	9.18	14.2	7.9	46.1	29.4	0.0	3.2	<2	33	28	99	1926	59	6
N21	C3	End Cork Harbour	Bottom	Low	4-Oct-06	51.48.19	08.16.30	26.2	8.26	14.6	7.9	52.8	33.1	0.1	0.5	<2	26	17	39	678	44	13
N22	C3	End Cork Harbour	Middle	Low	4-Oct-06	51.48.19	08.16.30	14.8	8.32	14.6	7.9	51.0	32.4	0.1	2.2	<2	38	20	50	864	43	9
N23	C3	End Cork Harbour	Top	Low	4-Oct-06	51.48.19	08.16.30	1.2	8.38	14.4	7.9	48.8	31.2	0.1	2.2	<2	37	24	76	1430	59	9
N24		Field Control B																38.0	<6	2480.0	<16	<1

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/NO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			—	—	—	—	—			E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 161	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	High	24-Oct-06					11.4	7.6	0.2	0.1	12.6	2.0	<2	58	44	18	18038	72	517
N2	C14	Waterworks	Top	High	24-Oct-06					11.8	7.7	0.2	0.1	13.6	2.0	<2	43	35	19	24322	59	308
N3		Field Control A	-	-												<2	52	44	<5	2701	<16	<1
N4	C9	Tivoli	Bottom	High	24-Oct-06	51.54.10	08.26.02	7.1	09:37	14.2	7.6	41.8	28.9	6.5	0.9	<2	60	45	285	5319	95	70
N5	C9	Tivoli	Top	High	24-Oct-06	51.54.10	08.26.02	1.3	09:41	13.8	7.8	36.9	23.4	8.8	1.5	<2	58	45	81	17533	102	1553
N6	C7	Blackrock Castle	Bottom	High	24-Oct-06	51.54.08	08.23.95	8.6	09:12	13.8	7.9	42.0	27.0	9.5	1.3	<2	55	44	231	4225	85	85
N7	C7	Blackrock Castle	Middle	High	24-Oct-06	51.54.08	08.23.95	5.2	09:16	13.7	7.9	41.7	26.7	8.7	1.4	<2	65	45	225	6475	92	343
N8	C7	Blackrock Castle	Top	High	24-Oct-06	51.54.08	08.23.95	1.5	09:20	13.6	7.9	36.9	23.4	9.5	1.6	<2	62	39	145	12954	115	722
N9	C8	Mid L. Mahon	Bottom	High	24-Oct-06	51.53.14	08.22.06	9.4	09:48	13.8	7.9	46.7	30.4	10.0	1.1	<2	51	32	143	9716	69	58
N10	C8	Mid L. Mahon	Middle	High	24-Oct-06	51.53.14	08.22.06	5.3	09:52	13.7	7.9	43.1	27.6	9.8	1.3	<2	58	37	174	5026	82	123
N11	C8	Mid L. Mahon	Top	High	24-Oct-06	51.53.14	08.22.06	1.4	09:55	13.2	7.9	36.8	23.3	10.0	1.4	<2	54	39	139	12785	108	1739
N12	C6	End L. Mahon	Bottom	High	24-Oct-06	51.52.67	08.20.15	13.1	09:23	13.8	7.9	47.3	30.8	10.0	1.1	<2	48	30	127	3543	66	13
N13	C6	End L. Mahon	Middle	High	24-Oct-06	51.52.67	08.20.15	7.2	09:27	13.8	7.9	47.0	30.7	10.3	1.2	<2	53	32	134	4110	72	47
N14	C6	End L. Mahon	Top	High	24-Oct-06	51.52.67	08.20.15	1.2	09:31	12.6	7.8	31.8	19.8	10.6	1.4	<2	60	40	163	9836	95	727
N15	C5	Haubowline	Bottom	High	24-Oct-06	51.50.38	08.19.00	13.6	10:26	13.6	8.0	46.3	30.1	9.8	1.2	<2	46	27	100	2622	59	22
N16	C5	Haubowline	Middle	High	24-Oct-06	51.50.38	08.19.00	8.2	10:30	13.7	8.0	46.0	29.9	9.7	1.2	<2	41	27	103	2887	59	42
N17	C5	Haubowline	Top	High	24-Oct-06	51.50.38	08.19.00	1.4	10:34	13.6	8.0	44.5	28.8	10.0	1.2	<2	56	31	122	4163	66	37
N18	C4	Lower Harbour	Bottom	High	24-Oct-06	50.51.92	08.16.11	13.2	10:49	14.1	8.0	52.0	34.3	9.9	0.9	<2	22	16	40	1134	39	12
N19	C4	Lower Harbour	Middle	High	24-Oct-06	50.51.92	08.16.11	9.2	10:53	13.9	8.0	50.3	33.1	10.0	1.0	<2	25	20	58	1561	46	10
N20	C4	Lower Harbour	Top	High	24-Oct-06	50.51.92	08.16.11	1.3	10:57	13.8	8.0	48.5	31.7	10.0	1.1	<2	30	23	72	1940	49	12
N21	C3	End Cork Harbour	Bottom	High	24-Oct-06	51.48.74	08.16.30	22.1	11:17	13.9	8.0	50.6	33.2	9.9	1.0	<2	43	21	55	1601	43	15
N22	C3	End Cork Harbour	Middle	High	24-Oct-06	51.48.74	08.16.30	15.7	11:21	13.9	8.0	50.2	33.0	10.0	1.0	<2	30	20	58	1758	43	13
N23	C3	End Cork Harbour	Top	High	24-Oct-06	51.48.74	08.16.30	1.4	11:25	13.7	8.0	48.0	31.4	10.2	1.0	<2	30	22	67	2241	46	28
N24		Field Control B														<2	210	205	171	2790	<16	<1

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/NO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			—	—	—	—	—	E60	—	E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 161	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	Low	24-Oct-06					11.5	7.7	0.2	0.1	13.5	2.3	<2	58	40	18	18414	72	387
N2	C14	Waterworks	Top	Low	24-Oct-06					12.0	7.7	0.2	0.1	13.4	1.9	<2	72	39	19	24149	56	326
N3		Field Control A	-	-																		
N4	C9	Tivoli	Bottom	Low	24-Oct-06	51.54.09	08.25.00	4.8	15:42	14.1	7.7	41.6	26.7	7.0	0.9	<2	55	53	359	4796	89	26
N5	C9	Tivoli	Top	Low	24-Oct-06	51.54.09	08.25.00	1.4	15:46	14.8	7.8	37.6	23.9	8.8	1.3	<2	58	46	149	19477	72	9880
N6	C7	Blackrock Castle	Bottom	Low	24-Oct-06	51.54.09	08.23.95	5.5	15:22	13.9	7.9	41.8	26.8	6.2	0.9	<2	68	48	285	4752	89	60
N7	C7	Blackrock Castle	Middle	Low	24-Oct-06	51.54.09	08.23.95	2.2	15:26	13.8	7.9	37.8	24.0	9.0	1.3	<2	65	46	206	9092	95	559
N8	C7	Blackrock Castle	Top	Low	24-Oct-06	51.54.09	08.23.95	1.6	15:29	13.8	7.9	36.2	22.9	9.3	1.3	<2	74	49	163	16169	82	7540
N9	C8	Mid L. Mahon	Bottom	Low	24-Oct-06	51.53.15	08.22.11	6.3	15:00	13.8	7.9	43.4	28.0	9.5	1.1	<2	65	47	228	4539	89	73
N10	C8	Mid L. Mahon	Middle	Low	24-Oct-06	51.53.15	08.22.11	3.0	15:04	13.8	7.9	40.0	25.6	9.8	1.2	<2	67	44	228	5638	95	51
N11	C8	Mid L. Mahon	Top	Low	24-Oct-06	51.53.15	08.22.11	1.3	15:08	13.7	7.9	34.3	21.5	10.3	1.8	<2	70	44	212	7223	82	85
N12	C6	End L. Mahon	Bottom	Low	24-Oct-06	51.52.59	08.20.08	11.2	14:39	13.8	7.9	43.6	28.2	9.5	1.1	<2	68	50	270	4805	92	251
N13	C6	End L. Mahon	Middle	Low	24-Oct-06	51.52.59	08.20.08	6.6	14:44	13.6	7.9	40.6	26.0	10.0	1.2	<2	64	42	208	5987	89	534
N14	C6	End L. Mahon	Top	Low	24-Oct-06	51.52.59	08.20.08	1.4		13.2	7.9	32.0	20.0	10.7	2.3	<2	59	40	183	9313	66	727
N15	C5	Haubowline	Bottom	Low	24-Oct-06	51.50.40	08.19.10	11.4	14:07	14.0	8.0	49.8	32.8	9.8	0.9	<2	54	34	147	3986	76	31
N16	C5	Haubowline	Middle	Low	24-Oct-06	51.50.40	08.19.10	6.4	14:11	13.8	8.0	46.9	30.5	9.8	1.0	<2	53	36	157	4770	76	71
N17	C5	Haubowline	Top	Low	24-Oct-06	51.50.40	08.19.10	1.5	14:15	13.4	7.9	39.0	24.8	10.0	1.7	<2	58	40	177	6769	82	154
N18	C4	Lower Harbour	Bottom	Low	24-Oct-06	51.50.89	08.16.08	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<2	42	27	99	2631	53	16
N19	C4	Lower Harbour	Middle	Low	24-Oct-06	51.50.89	08.16.08	5.8	13:40	13.8	8.0	46.9	30.5	9.9	1.1	<2	44	30	117	3109	59	35
N20	C4	Lower Harbour	Top	Low	24-Oct-06	51.50.89	08.16.08	1.4	13:43	13.6	8.0	42.2	27.1	10.1	1.2	<2	49	34	148	4690	69	56
N21	C3	End Cork Harbour	Bottom	Low	24-Oct-06	51.48.75	08.16.35	21.5	13:08	14.0	8.0	50.4	33.1	10.2	0.9	<2	30	21	55	1479	39	13
N22	C3	End Cork Harbour	Middle	Low	24-Oct-06	51.48.75	08.16.35	13.6	13:13	14.0	8.0	50.0	32.8	9.9	1.0	<2	33	22	68	1827	39	11
N23	C3	End Cork Harbour	Top	Low	24-Oct-06	51.48.75	08.16.35	1.6	13:17	13.8	8.0	47.2	30.8	9.8	1.1	<2	44	25	96	3344	49	19

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/KO2)	Chlorophyll α (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			---	---	---					E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colifert
N1	C16	Anglers Rest	Top	High	15-Nov-06					n/a	7.3	117.0	0.1	8.5	2.0	<2	88	48	32	11853	143	3950
N2	C14	Waterworks	Top	High	15-Nov-06					n/a	7.4	188.2	0.1	9.9	2.1	<2	112	78	40	17723	92	1986
N3		Field Control A	-	-												<2	61.0	46	<6	2524	<16	<1
N4	C9	Tivoli	Bottom	High	15-Nov-06	51.54.10	08.26.04	6.8	15:14	12.6	7.9	47.6	28.8	7.0	0.9	<2	90	51	298	3007	69	302
N5	C9	Tivoli	Top	High	15-Nov-06	51.54.10	08.26.04	1.5	15:18	12.3	7.9	39.7	4.2	7.6	1.5	<2	119	68	163	14977	92	30760
N6	C7	Blackrock Castle	Bottom	High	15-Nov-06	51.54.08	08.23.94	7.0	14:46	12.7	7.9	48.0	29.2	7.4	0.9	<2	86	47	235	2918	69	71
N7	C7	Blackrock Castle	Middle	High	15-Nov-06	51.54.08	08.23.94	4.2	14:50	12.6	7.9	47.5	28.0	7.5	0.9	<2	80	46	235	3755	72	132
N8	C7	Blackrock Castle	Top	High	15-Nov-06	51.54.08	08.23.94	1.4	14:55	12.2	7.9	42.4	5.3	7.6	1.3	<2	116	53	230	12462	53	41050
N9	C8	Mid L. Mahon	Bottom	High	15-Nov-06	51.53.15	08.22.09	7.9	14:19	12.8	7.9	48.8	30.7	7.7	0.9	<2	70	67	233	2400	125	35
N10	C8	Mid L. Mahon	Middle	High	15-Nov-06	51.53.15	08.22.09	5.4	14:22	12.7	7.9	48.0	30.2	7.4	0.9	<2	84	53	225	2759	56	56
N11	C8	Mid L. Mahon	Top	High	15-Nov-06	51.53.15	08.22.09	1.3	14:27	12.0	7.9	41.3	17.1	7.9	1.2	<2	57	37	174	8335	92	980
N12	C6	End L. Mahon	Bottom	High	15-Nov-06	51.52.62	08.70.08	12.2	13:51	12.9	8.0	50.3	31.9	7.4	0.9	<2	38	25	94	1891	43	20
N13	C6	End L. Mahon	Middle	High	15-Nov-06	51.52.62	08.70.08	7.8	13:55	12.9	8.0	49.9	30.4	7.5	0.9	<2	41	26	111	2325	49	17
N14	C6	End L. Mahon	Top	High	15-Nov-06	51.52.62	08.70.08	1.4	13:59	12.1	7.9	44.5	17.3	8.0	1.1	<2	60	37	171	7488	95	1203
N15	C5	Haubowline	Bottom	High	15-Nov-06	51.50.41	08.19.16	12.9	13:15	13.1	8.0	51.6	32.4	7.2	0.8	<2	25	21	64	1749	36	19
N16	C5	Haubowline	Middle	High	15-Nov-06	51.50.41	08.19.16	8.5	13:19	13.0	8.0	51.4	31.3	7.4	0.8	<2	35	24	90	2281	43	23
N17	C5	Haubowline	Top	High	15-Nov-06	51.50.41	08.19.16	1.5	13:23	12.1	7.9	45.0	26.6	8.2	1.2	<2	53	35	171	4291	69	38
N18	C4	Lower Harbour	Bottom	High	15-Nov-06	51.50.89	08.16.12	14.3	12:42	13.1	7.9	52.3	34.2	7.1	0.8	<2	25	16	22	779	23	2
N19	C4	Lower Harbour	Middle	High	15-Nov-06	51.50.89	08.16.12	8.2	12:46	13.1	7.9	52.1	33.8	7.2	0.8	<2	27	18	36	1050	26	7
N20	C4	Lower Harbour	Top	High	15-Nov-06	51.50.89	08.16.12	1.3	12:51	12.6	7.9	49.6	32.5	7.6	1.0	<2	31	20	57	1523	33	7
N21	C3	End Cork Harbour	Bottom	High	15-Nov-06	51.41.86	08.16.38	24.0	12:11	13.0	7.8	52.7	34.6	7.2	0.8	<2	26	14	7	525	<16	3
N22	C3	End Cork Harbour	Middle	High	15-Nov-06	51.41.86	08.16.38	14.6	12:16	13.0	7.9	52.5	34.8	7.3	0.8	<2	28	15	12	556	<16	5
N23	C3	End Cork Harbour	Top	High	15-Nov-06	51.41.86	08.16.38	1.4	12:21	12.9	7.9	51.6	33.3	7.8	0.9	<2	38	17	30	809	23	4
N24		Field Control B														<2	180	157	1090	2657	<16	<1

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/KO2)	Chlorophyll α (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			---	---	---	---	---	E60	---	E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colifert
N1	C16	Anglers Rest	Top	Low	20-Nov-06					9.9	7.9	150.8	0.1	9.4	2.1	<2	44	23	7	12407	143	210
N2	C14	Waterworks	Top	Low	20-Nov-06					9.9	7.5	157.6	0.1	9.6	2.3	<2	57	30	5	14845	125	308
N3		Field Control A	-	-																		
N4	C9	Tivoli	Bottom	Low	20-Nov-06	51.54.08	08.25.98	5.0	12:35	12.0	7.7	43.4	28.0	5.8	0.9	<2	72	47	271	5775	85	1203
N5	C9	Tivoli	Top	Low	20-Nov-06	51.54.08	08.25.98	2.0	12:39	11.4	7.7	22.9	13.8	8.3	1.9	<2	67	37	51	14869	125	2419
N6	C7	Blackrock Castle	Bottom	Low	20-Nov-06	51.54.09	08.23.97	4.5	12:10	11.5	7.8	43.1	27.8	6.5	1.0	<2	81	47	249	5691	82	649
N7	C7	Blackrock Castle	Middle	Low	20-Nov-06	51.54.09	08.23.97	4.2	12:14	11.6	7.8	40.8	26.2	5.6	1.6	<2	75	46	207	7892	92	1414
N8	C7	Blackrock Castle	Top	Low	20-Nov-06	51.54.09	08.23.97	1.9	12:50	10.9	7.8	31.5	19.6	7.6	1.5	<2	78	44	152	11284	105	1986
N9	C8	Mid L. Mahon	Bottom	Low	20-Nov-06	51.53.16	08.22.12	8.3	11:46	11.2	7.9	44.8	28.9	7.3	1.0	<2	82	39	208	3941	66	85
N10	C8	Mid L. Mahon	Middle	Low	20-Nov-06	51.53.16	08.22.12	4.4	11:49	11.0	7.9	42.0	27.0	7.4	1.1	<2	72	41	231	6492	79	629
N11	C8	Mid L. Mahon	Top	Low	20-Nov-06	51.53.16	08.22.12	1.3	11:52	10.0	7.8	31.3	19.5	8.2	1.4	<2	91	45	219	9814	95	1986
N12	C6	End L. Mahon	Bottom	Low	20-Nov-06	51.52.59	08.20.11	11.7	11:18	11.1	7.9	43.5	28.1	7.5	1.1	<2	61	37	207	5088	99	159
N13	C6	End L. Mahon	Middle	Low	20-Nov-06	51.52.59	08.20.11	7.2	11:23	10.6	7.9	40.2	25.7	7.8	1.1	<2	73	38	194	6541	76	409
N14	C6	End L. Mahon	Top	Low	20-Nov-06	51.52.59	08.20.11	1.2	11:27	10.1	7.8	26.9	16.5	8.5	1.7	<2	81	45	159	11027	99	1553
N15	C5	Haubowline	Bottom	Low	20-Nov-06	51.50.41	08.19.09	10.1	10:45	11.0	7.9	44.9	29.1	7.8	1.0	<2	57	31	139	3866	56	69
N16	C5	Haubowline	Middle	Low	20-Nov-06	51.50.41	08.19.09	7.1	10:48	10.8	7.9	42.5	27.3	7.8	1.0	<2	71	34	154	5363	82	105
N17	C5	Haubowline	Top	Low	20-Nov-06	51.50.41	08.19.09	1.2	10:52	10.4	7.9	37.1	23.5	8.2	1.2	<2	62	39	165	8352	79	519
N18	C4	Lower Harbour	Bottom	Low	20-Nov-06	51.50.90	08.16.04	10.2	10:11	11.5	7.9	49.5	32.4	7.7	0.9	<2	173	24	85	2934	43	35
N19	C4	Lower Harbour	Middle	Low	20-Nov-06	51.50.90	08.16.04	7.2	10:15	11.0	7.8	46.7	30.4	7.8	0.9	<2	49	26	85	2511	43	37
N20	C4	Lower Harbour	Top	Low	20-Nov-06	51.50.90	08.16.04	1.1	10:18	10.9	7.9	44.3	28.7	8.0	1.0	<2	49	29	113	3516	33	42
N21	C3	End Cork Harbour	Bottom	Low	20-Nov-06	51.49.83	08.16.34	24.5	09:31	11.9	7.9	50.8	33.4	7.6	0.9	<2	35	19	46	1820	33	21
N22	C3	End Cork Harbour	Middle	Low	20-Nov-06	51.49.83	08.16.34	16.3	09:35	11.7	7.9	50.1	32.9	7.7	0.9	<2	37	20	45	1703	33	29
N23	C3	End Cork Harbour	Top	Low	20-Nov-06	51.49.83	08.16.34	1.5	09:39	11.0	7.9	46.1	30.2	7.9	1.1	<2	56	29	90	5301	43	51

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Lab Test No	Station No	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)		Lab Test No	Station No	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			—	—	—	—	—	E60	—	Test No & Method		E59	E56	E57	E16 ETE 151	E58	E61	E 18 ETE 161		Test No & Method		E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	High						N1	C16									N1	C16						
N2	C14	Waterworks	Top	High						N2	C14									N2	C14						
N3		Field Control A	-	-						N3										N3							
N4	C9	Tivoli	Bottom	High		51.54.19	08.25.00			N4	C9									N4	C9						
N5	C9	Tivoli	Top	High		51.54.19	08.25.00			N5	C9									N5	C9						
N6	C7	Blackrock Castle	Bottom	High		51.54.09	08.24.00			N6	C7									N6	C7						
N7	C7	Blackrock Castle	Middle	High		51.54.09	08.24.00			N7	C7									N7	C7						
N8	C7	Blackrock Castle	Top	High		51.54.09	08.24.00			N8	C7									N8	C7						
N9	C8	Mid L. Mahon	Bottom	High		51.53.12	08.22.05			N9	C8									N9	C8						
N10	C8	Mid L. Mahon	Middle	High		51.53.12	08.22.05			N10	C8									N10	C8						
N11	C8	Mid L. Mahon	Top	High		51.53.12	08.22.05			N11	C8									N11	C8						
N12	C6	End L. Mahon	Bottom	High		51.52.60	08.20.13			N12	C6									N12	C6						
N13	C6	End L. Mahon	Middle	High		51.52.60	08.20.13			N13	C6									N13	C6						
N14	C6	End L. Mahon	Top	High		51.52.60	08.20.13			N14	C6									N14	C6						
N15	C5	Haubowline	Bottom	High		51.50.41	08.19.04			N15	C5									N15	C5						
N16	C5	Haubowline	Middle	High		51.50.41	08.19.04			N16	C5									N16	C5						
N17	C5	Haubowline	Top	High		51.50.41	08.19.04			N17	C5									N17	C5						
N18	C4	Lower Harbour	Bottom	High		51.50.89	08.16.12			N18	C4									N18	C4						
N19	C4	Lower Harbour	Middle	High		51.50.89	08.16.12			N19	C4									N19	C4						
N20	C4	Lower Harbour	Top	High		51.50.89	08.16.12			N20	C4									N20	C4						
N21	C3	End Cork Harbour	Bottom	High		51.48.80	08.16.32			N21	C3									N21	C3						
N22	C3	End Cork Harbour	Middle	High		51.48.80	08.16.32			N22	C3									N22	C3						
N23	C3	End Cork Harbour	Top	High		51.48.80	08.16.32			N23	C3									N23	C3						

Lab Test No	Station No	Station	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			—	—	—	—	—			E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 161	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colilert
N1	C16	Anglers Rest	Top	Low	4-Dec-06					8.9	7.4	0.1	0.1	10.1	2.2	<4	67	22	54	12912	32	326
N2	C14	Waterworks	Top	Low	4-Dec-06					8.9	7.1	0.1	0.1	10.0	2.1	<4	96	35	53	16784	33	488
N3		Field Control A	-	-												<4	55	45	<6	2303	<16	<1
N4	C9	Tivoli	Bottom	Low	4-Dec-06	n/a	n/a	5.7	12:37	9.6	7.8	29.9	18.5	8.9	1.5	<4	76	35	82	15451	36	2410
N5	C9	Tivoli	Top	Low	4-Dec-06	n/a	n/a	1.5	12:40	8.8	7.5	1.4	0.8	10.8	2.2	<4	73	39	89	17705	39	3840
N6	C7	Blackrock Castle	Bottom	Low	4-Dec-06	n/a	n/a	7.6	12:06	10.0	7.8	42.8	27.5	8.2	1.7	<4	75	36	109	11155	36	1986
N7	C7	Blackrock Castle	Middle	Low	4-Dec-06	n/a	n/a	4.7	12:13	9.4	7.8	27.3	16.8	9.3	1.7	<4	79	35	106	14384	39	1553
N8	C7	Blackrock Castle	Top	Low	4-Dec-06	n/a	n/a	1.5	12:17	8.8	7.6	9.7	2.6	10.7	2.3	<4	75	35	114	12077	43	1986
N9	C8	Mid L. Mahon	Bottom	Low	4-Dec-06	n/a	n/a	7.4	11:41	9.9	7.8	43.0	27.7	8.2	1.1	<4	91	41	163	11616	56	1300
N10	C8	Mid L. Mahon	Middle	Low	4-Dec-06	n/a	n/a	4.0	11:45	9.0	7.7	17.3	10.2	9.8	2.0	<4	88	40	132	13215	53	1120
N11	C8	Mid L. Mahon	Top	Low	4-Dec-06	n/a	n/a	1.4	11:48	8.9	7.5	11.7	6.7	10.3	2.1	<4	68	37	87	17484	39	1986
N12	C6	End L. Mahon	Bottom	Low	4-Dec-06	n/a	n/a	11.4	11:18	9.8	7.8	39.8	25.1	8.4	1.3	<4	96	49	210	10190	62	1733
N13	C6	End L. Mahon	Middle	Low	4-Dec-06	n/a	n/a	5.8	11:21	8.6	7.8	22.0	13.2	9.4	1.9	<4	90	38	153	12582	62	1203
N14	C6	End L. Mahon	Top	Low	4-Dec-06	n/a	n/a	1.3	11:25	8.8	7.6	13.5	7.8	10.1	2.0	<4	96	40	149	13919	56	1733
N15	C5	Haubowline	Bottom	Low	4-Dec-06	n/a	n/a	10.9	10:45	10.1	7.9	49.9	32.7	8.1	0.9	<4	72	35	95	5496	30	549
N16	C5	Haubowline	Middle	Low	4-Dec-06	n/a	n/a	7.8	10:48	9.8	7.9	43.9	28.4	8.4	1.1	<4	82	38	123	7918	39	980
N17	C5	Haubowline	Top	Low	4-Dec-06	n/a	n/a	1.4	10:51	8.9	7.8	22.7	13.7	9.5	1.8	<4	80	40	138	11187	46	1414
N18	C4	Lower Harbour	Bottom	Low	4-Dec-06	n/a	n/a	8.1	10:09	9.5	7.9	41.6	26.7	8.5	1.1	<4	67	38	94	5383	30	270
N19	C4	Lower Harbour	Middle	Low	4-Dec-06	n/a	n/a	6.3	10:12	9.5	7.9	37.8	24.0	8.8	1.3	<4	69	37	108	7037	36	403
N20	C4	Lower Harbour	Top	Low	4-Dec-06	n/a	n/a	1.6	10:15	9.1	7.8	28.4	17.4	9.4	1.6	<4	76	39	<6	9597	43	1120
N21	C3	End Cork Harbour	Bottom	Low	4-Dec-06	n/a	n/a	21.6	09:37	10.1	7.8	51.3	33.8	8.0	1.1	<4	64	30	67	3268	23	64
N22	C3	End Cork Harbour	Middle	Low	4-Dec-06	n/a	n/a	14.4	09:41	10.0	7.8	48.8	32.0	8.2	1.0	<2	65	31	67	3906	26	120
N23	C3	End Cork Harbour	Top	Low	4-Dec-06	n/a	n/a	1.7	09:46	9.3	7.8	36.2	22.9	8.9	1.3	<4	69	35	102	6997	33	289
N24		Field Control B														<4	148	109	165	2347	<16	<1

Lab Test No	Station No	Statio	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			—	—	—	—	—			E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colifert
P1	C16	Anglers Rest	Top	High	10-Jan-07					9.0	6.9	0.145	0.1	11.2	1.9	<2	52	28	69	12648	46	365
P2	C14	Waterworks	Top	High	10-Jan-07					8.7	6.4	0.153	0.1	10.8	1.9	2	71	38	72	14805	56	579
P3		Field Control A	-	-												<2	48	48.0	<6	2813	<16	<1
P4	C9	Tivoli	Bottom	High	10-Jan-07	51.54.08	08.25.99	6.6	11:49	9.5	7.7	43.2	27.8	8.6	0.9	<2	51	41	179	5310	36	89
P5	C9	Tivoli	Top	High	10-Jan-07	51.54.08	08.25.99	0.4	11:53	8.2	7.5	3.9	2.1	11.3	2.1	<2	83	45	117	14357	59	980
P6	C7	Blackrock Castle	Bottom	High	10-Jan-07	51.54.08	08.23.98	7.0	11:22	9.8	7.8	45.0	29.2	8.9	1.0	<2	72	40	168	3676	33	72
P7	C7	Blackrock Castle	Middle	High	10-Jan-07	51.54.08	08.23.98	4.9	11:25	9.8	7.8	43.9	28.4	9.0	1.0	<2	66	42	163	4473	33	96
P8	C7	Blackrock Castle	Top	High	10-Jan-07	51.54.08	08.23.98	0.4	11:29	8.5	7.6	12.1	6.9	10.7	2.0	<2	91	48	134	12696	59	1414
P9	C8	Mid L. Mahon	Bottom	High	10-Jan-07	51.53.14	08.22.12	7.3	10:55	9.8	7.8	47.0	30.6	9.0	0.9	<2	45	34	111	3330	26	52
P10	C8	Mid L. Mahon	Middle	High	10-Jan-07	51.53.14	08.22.12	4.5	10:59	9.8	7.8	45.9	29.8	9.0	2.0	<2	43	39	132	7298	39	94
P11	C8	Mid L. Mahon	Top	High	10-Jan-07	51.53.14	08.22.12	0.9	11:03	8.9	7.7	21.3	12.7	10.2	1.6	<2	72	46	181	11306	56	1300
P12	C6	End L. Mahon	Bottom	High	10-Jan-07	51.52.51	08.20.10	14.2	10:22	9.8	7.7	48.8	31.9	7.6	1.5	<2	38	30	76	3069	23	46
P13	C6	End L. Mahon	Middle	High	10-Jan-07	51.52.51	08.20.10	10.6	10:25	9.8	7.8	48.4	31.6	8.9	0.9	<2	48	31	89	4127	26	42
P14	C6	End L. Mahon	Top	High	10-Jan-07	51.52.51	08.20.10	0.4	10:29	8.5	7.8	26.0	15.8	10.1	1.4	<2	60	42	152	11152	59	1553
P15	C5	Haubowline	Bottom	High	10-Jan-07	51.50.41	08.19.09	9.2	09:49	9.9	7.8	50.6	33.3	8.9	0.9	<2	42	29	37	2148	16	5
P16	C5	Haubowline	Middle	High	10-Jan-07	51.50.41	08.19.09	11.5	09:50	9.9	7.8	50.6	33.3	8.9	0.9	<2	37	27	49	2389	16	13
P17	C5	Haubowline	Top	High	10-Jan-07	51.50.41	08.19.09	0.4	09:54	9.4	7.8	38.4	24.4	9.4	1.1	<2	43	35	122	6904	36	106
P18	C4	Lower Harbour	Bottom	High	10-Jan-07	51.50.90	08.16.11	16.1	09:09	9.9	7.8	52.5	34.7	9.0	1.2	<2	48	23	14	1067	<16	1
P19	C4	Lower Harbour	Middle	High	10-Jan-07	51.50.90	08.16.11	10.8	09:13	9.9	7.8	52.5	34.7	8.9	1.0	<2	38	23	22	1430	<16	4
P20	C4	Lower Harbour	Top	High	10-Jan-07	51.50.90	08.16.11	0.3	09:20	9.5	7.8	46.0	29.9	9.1	0.9	<2	34	26	53	3290	23	11
P21	C3	End Cork Harbour	Bottom	High	10-Jan-07	51.48.82	08.16.39	28.4	08:38	9.9	7.7	52.8	34.9	9.1	1.1	<2	80	21	<6	390	<16	<1
P22	C3	End Cork Harbour	Middle	High	10-Jan-07	51.48.82	08.16.39	17.8	08:43	9.9	7.8	52.8	34.9	8.9	1.0	<2	66	21	<6	354	<16	<1
P23	C3	End Cork Harbour	Top	High	10-Jan-07	51.48.82	08.16.39	0.4	08:48	9.8	7.8	51.8	34.2	8.8	0.9	<2	44	22	10	841	<16	<1
P24		Field Control B															586	589	527	2879	<16	<1

Lab Test No	Station No	Statio	Depth	Tide	Date	GPS (N)	GPS (W)	Depth (m)	Time (24Hr)	Temp (°C)	pH	Conductivity @25°C (mS/cm)	Salinity (ppt)	DO (mg/lO2)	Chlorophyll a (µg/l)	BOD (mg/l)	Total Phosphate (µg/l P)	MRP Phosphate (µg/ P)	Ammonium (µg/l NH4)	Nitrate (µg/l NO3)	Nitrite (µg/l NO2)	E Coliforms (MPN/100mls)
Test No & Method			—	—	—	—	—	E60	—	E59	E56	E57	E16 ETE 161	E58	E61	E 18 ETE 181	E 19 E 221	E 22 E 221	E 23 E 221	E24 E 221	E 25 E 221	E 27 Colifert
P1	C16	Anglers Rest	Top	Low	16-Jan-07					8.4	7.6	0.145	0.1	10.4	1.5	<2	22	23	48	11466	36	166
P2	C14	Waterworks	Top	Low	16-Jan-07					8.4	7.6	0.160	0.1	10.4	1.6	<2	26	26	51	14233	53	210
P3		Field Control A	-	-								0.160										
P4	C9	Tivoli	Bottom	Low	16-Jan-07	51.54.09	08.25.96	6.5	11:37	9.8	7.8	47.4	30.9	8.0	0.8	<2	35	40	211	4203	36	127
P5	C9	Tivoli	Top	Low	16-Jan-07	51.54.09	08.25.96	0	11:40	8.5	7.6	4.6	2.4	10.9	1.6	<2	44	35	85	14938	56	2750
P6	C7	Blackrock Castle	Bottom	Low	16-Jan-07	51.54.09	08.23.95	7.9	11:10	9.7	7.8	47.6	31.1	8.3	2.6	<2	38	40	202	6545	39	488
P7	C7	Blackrock Castle	Middle	Low	16-Jan-07	51.54.09	08.23.95	4.7	11:16	9.5	7.9	43.0	27.8	8.5	0.9	<2	38	40	165	9415	46	1046
P8	C7	Blackrock Castle	Top	Low	16-Jan-07	51.54.09	08.23.96	0.2	11:21	8.5	7.7	5.1	2.8	10.9	1.7	<2	55	40	117	14318	56	1986
P9	C8	Mid L. Mahon	Bottom	Low	16-Jan-07	51.53.16	08.22.12	7.5	10:48	9.7	7.7	39.1	25.1	5.4	2.1	<2	38	41	217	5842	49	416
P10	C8	Mid L. Mahon	Middle	Low	16-Jan-07	51.53.16	08.22.12	4.8	10:50	9.4	7.9	40.1	25.6	8.4	0.9	<2	37	39	175	10150	59	1046
P11	C8	Mid L. Mahon	Top	Low	16-Jan-07	51.53.16	08.22.12	0.1	10:53	8.4	7.7	15.0	9.7	10.2	1.4	<2	37	38	145	12803	62	2420
P12	C6	End L. Mahon	Bottom	Low	16-Jan-07	51.52.63	08.20.12	12.7	10:24	9.6	7.9	48.3	31.6	9.5	1.5	<2	50	51	275	4247	36	326
P13	C6	End L. Mahon	Middle	Low	16-Jan-07	51.52.63	08.20.12	7.5	10:28	9.6	7.9	45.3	29.4	8.6	0.9	<2	41	45	225	8255	53	921
P14	C6	End L. Mahon	Top	Low	16-Jan-07	51.52.63	08.20.12	0.0	10:31	8.2	7.8	16.6	9.7	10.2	1.4	<2	38	40	135	12855	56	1414
P15	C5	Haubowline	Bottom	Low	16-Jan-07	51.50.42	08.19.14	12.5	09:49	9.7	7.9	51.3	33.8	8.7	0.8	<2	27	33	96	2715	23	23
P16	C5	Haubowline	Middle	Low	16-Jan-07	51.50.42	08.19.14	7.0	09:53	9.6	7.9	47.3	30.9	8.8	0.8	<2	32	35	135	3946	30	26
P17	C5	Haubowline	Top	Low	16-Jan-07	51.50.42	08.19.14	0.1	09:57	8.7	7.9	27.0	16.6	9.8	1.2	<2	35	39	148	10208	49	1414
P18	C4	Lower Harbour	Bottom	Low	16-Jan-07	51.50.87	08.15.94	12.6	09:18	9.7	7.9	52.3	34.5	8.7	2.7	<2	23	27	58	2980	23	7
P19	C4	Lower Harbour	Middle	Low	16-Jan-07	51.50.87	08.15.94	7.2	09:22	9.5	7.9	47.8	31.2	9.8	0.9	<2	23	28	67	3463	26	3
P20	C4	Lower Harbour	Top	Low	16-Jan-07	51.50.87	08.15.94	0.1	09:26	8.7	7.9	36.5	23.1	9.6	1.0	<2	31	33	122	6833	36	488
P21	C3	End Cork Harbour	Bottom	Low	16-Jan-07	51.48.83	08.16.36	26.6	08:43	9.7	7.8	52.8	34.9	8.6	1.8	<2	20	24	18	1971	<16	1
P22	C3	End Cork Harbour	Middle	Low	16-Jan-07	51.48.83	08.16.36	16.8	08:49	9.7	7.8	52.7	34.8	8.6	0.8	<2	32	25	35	2237	<16	1
P23	C3	End Cork Harbour	Top	Low	16-Jan-07	51.48.83	08.16.36	0.1	08:54	9.0	7.8	42.9	27.6	9.2	0.9	<2	38	26	81	4566	30	1

Sample Registration 1471 Sample Registration 1471

High Tide

Station #	Station	Station #	Depth	Station	GPS (W)	GPS(N)	May-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Feb-06	Mar-06	Apr-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Jan-07
							E. Coliforms (MPN/100mls)																
C16	Anglers Rest	C16	Top	Anglers Rest			770	150	131	488	61	96	128	387	160	238	236	272	130	155	517	3950	365
C14	Waterworks	C14	Top	Waterworks			387	162	178	238	93	152	148	308	186	281	435	649	102	91	308	1986	579
C9	Tivoli	C9	Bottom	Tivoli	70174	72203	20	8	16	15	23	980	34	15	104	40	25	29	378	16	70	302	89
C9	Tivoli	C9	Top	Tivoli	70174	72203	6440	25	1300	15290	4500	687	5970	20	1986	1300	11190	71	34480	1120	1553	30760	980
C7	Blackrock Castle	C7	Bottom	Blackrock Castle	72655	72101	47	10	12	21	24	76	40	60	121	41	65	31	101	16	65	71	72
C7	Blackrock Castle	C7	Middle	Blackrock Castle	72655	72101	75	11	22	22	28	318	64	226	488	84	99	47	148	387	843	132	96
C7	Blackrock Castle	C7	Top	Blackrock Castle	72655	72101	5300	16	687	1120	2310	1300	1553	548	2420	461	1733	2420	1986	2420	722	41060	1414
C8	Mid L. Mahon	C8	Bottom	Mid L. Mahon	74336	70846	45	1	20	27	27	46	55	29	48	20	10	26	1	11	53	35	52
C8	Mid L. Mahon	C8	Middle	Mid L. Mahon	74336	70846	221	4	46	45	26	517	52	48	28	61	20	20	8	18	123	56	94
C8	Mid L. Mahon	C8	Top	Mid L. Mahon	74336	70846	250	7	11	12	122	921	530	457	24	20	30	12	7	29	1733	980	1300
C6	End L. Mahon	C6	Bottom	End L. Mahon	76742	67407	14	4	5	12	16	59	17	11	6	9	10	5	4	12	18	20	36
C6	End L. Mahon	C6	Middle	End L. Mahon	76742	67407	31	5	9	6	25	178	13	35	10	5	6	18	9	13	47	17	42
C6	End L. Mahon	C6	Top	End L. Mahon	76742	67407	41	10	6	9	230	1733	165	36	88	21	11	9	5	21	727	1203	1553
C5	Haulbowline	C5	Bottom	Haulbowline	78050	65301	14	<1	<1	6	8	14	6	21	12	1	3	4	4	10	22	19	5
C5	Haulbowline	C5	Middle	Haulbowline	78050	65301	36	3	2	3	7	17	20	21	11	1	2	7	23	8	42	23	13
C5	Haulbowline	C5	Top	Haulbowline	78050	65301	146	3	1	6	15	55	195	40	11	3	5	12	1	4	37	38	106
C4	Lower Harbour	C4	Bottom	Lower Harbour	81736	66052	2	<1	6	<1	1	26	[illegible]	2	1	1	1	6	2	4	12	2	1
C4	Lower Harbour	C4	Middle	Lower Harbour	81736	66052	4	2	7	1	2	30	6	4	2	1	2	10	1	9	10	7	4
C4	Lower Harbour	C4	Top	Lower Harbour	81736	66052	6	1	2	1	2	44	7	4	4	1	14	2	1	3	12	7	11
C3	End Cork Harbour	C3	Bottom	End Cork Harbour	81242	62182	<1	1	7	13	1	17	2	11	2	1	1	1	1	1	15	3	1
C3	End Cork Harbour	C3	Middle	End Cork Harbour	81242	62182	1	<1	1	23	2	36	1	1	1	1	1	1	1	4	13	5	1
C3	End Cork Harbour	C3	Top	End Cork Harbour	81242	62182	4	1	3	1	5	33	3	1	1	1	1	2	1	2	28	4	1

Sample Registration 1471

Low Tide

Client Reference				GPS (W)	GPS(N)	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Feb-06	Mar-06	Apr-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Jan-07
Station #	Station	Depth	Station			*E. coliforms (MPN/100mls)*																		
C16	Anglers Rest	Top	Anglers Rest			770	179	172	109	249	378	397	308	649	166	179	153	153	613	365	387	210	326	166
C14	Waterworks	Top	Waterworks			1733	517	160	214	299	173	308	276	687	196	548	261	649	172	411	326	308	488	210
C9	Tivoli	Bottom	Tivoli	70174	72203	488	30	11	10	5	156	575	154	4040	1300	166	31	22	27230	50	26	1203	2410	127
C9	Tivoli	Top	Tivoli	70174	72203	12740	1733	28	14210	12010	3790	2420	7280	4870	5480	3930	17820	770	687	6090	9880	2419	3640	2750
C7	Blackrock Castle	Bottom	Blackrock Castle	72655	72101	107	59	13	7	4	19	42	216	228	649	31	10	21	112	101	60	649	1986	488
C7	Blackrock Castle	Middle	Blackrock Castle	72655	72101	436	94	16	22	2	41	52	361	1986	1300	173	47	22	285	35	659	1414	1559	1046
C7	Blackrock Castle	Top	Blackrock Castle	72655	72101	3840	756	35	6580	1733	2450	1733	1414	2420	2420	1986	5120	180	921	3230	7640	1986	1986	1986
C8	Mid L. Mahon	Bottom	Mid L. Mahon	74336	70846	67	37	10	7	7	122	58	178	127	233	1733	7	13	34	25	73	85	1300	416
C8	Mid L. Mahon	Middle	Mid L. Mahon	74336	70846	73	40	19	19	6	160	208	268	292	613	44	20	6	115	45	51	629	1120	1046
C8	Mid L. Mahon	Top	Mid L. Mahon	74336	70846	167	61	23	29	32	1414	1733	1986	2420	980	36	5	16	186	579	85	1986	1986	2420
C6	End L. Mahon	Bottom	End L. Mahon	76742	67407	167	24	9	56	12	23	44	173	317	231	45	10	24	16	20	251	159	1733	326
C6	End L. Mahon	Middle	End L. Mahon	76742	67407	344	16	5	53	23	42	177	189	770	344	22	23	20	11	411	534	403	1203	921
C6	End L. Mahon	Top	End L. Mahon	76742	67407	344	27	14	345	21	770	1120	1203	1300	179	12	21	10	72	1120	727	1553	1733	1414
C5	Haulbowline	Bottom	Haulbowline	78050	65301	7	21	7	10	<1	11	4	10	38	146	1	7	17	3	24	31	89	549	23
C5	Haulbowline	Middle	Haulbowline	78050	65301	7	11	6	12	3	28	3	26	63	517	4	12	18	2	22	71	105	980	28
C5	Haulbowline	Top	Haulbowline	78050	65301	7	15	20	10	19	403	39	188	53	411	16	4	7	8	56	154	510	1414	1414
C4	Lower Harbour	Bottom	Lower Harbour	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	270	[illegible]
C4	Lower Harbour	Middle	Lower Harbour	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C4	Lower Harbour	Top	Lower Harbour	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1120	[illegible]
C3	End Cork Harbour	Bottom	End Cork Harbour	81242	62182	<1	6	3	2	2	1	3	<1	1	1	1	1	2	1	13	13	21	64	1
C3	End Cork Harbour	Middle	End Cork Harbour	81242	62182	3	1	5	<1	2	5	1	<1	6	2	1	1	1	1	9	11	29	120	1
C3	End Cork Harbour	Top	End Cork Harbour	81242	62182	<1	<1	28	1	1	8	12	4	4	15	1	4	6	3	9	19	61	299	1

Our Ref: 04.YA0005

WSIP PROJECT OFFICE
2 JAN 2009
CORK COUNTY COUNCIL

Tim O'Herlihy
Cork County Council
W.S.I.P. Project Office
Model Business Park
Model Farm Road
Cork

19th January 2009

Re: Proposed Wastewater Treatment Plant at Shanbally, County Cork.

Dear Madam,

Further to our email in relation to the preliminary report associated with the above mentioned case, the Board hereby requests that the suggested volumes be forwarded to it within 2 weeks from the date of this letter. i.e. by 2nd February, 2009.

Please quote the above-mentioned An Bord Pleanála reference number in any correspondence or telephone contact with the Board.

Yours faithfully,

Luke Ryan
Executive Officer.

An Bord Pleanála

64 Sráid Maoilbhríde,
Baile Átha Cliath 1.

Tele: (01) 858 8100
LoCall: 1800 275 175
Fax: (01) 872 2684
Website: www.pleanala.ie
email: bord@pleanala.ie

64 Marlborough Street,
Dublin 1.

[redacted]

Cork County Council

Model Business Park,
Model Farm Road,
Cork.
Tel No: (021) 4819400
Fax No: (021) 4819433
Web:http://www.corkcoco.ie

Mr Luke Ryan,
Executive Officer,
An Bord Pleanála,
64 Marlborough Street,
Dublin 1.

22nd January 2009

Re: Proposed Wastewater Treatment Plant at Shanbally, County Cork.
ABP Ref. 04.YA0005

Further to your letter of 19th January and our previous discussions, enclosed please find copies of the following documents from the Preliminary Report for the above project.

- VOLUME i
  - Section 1 – Introduction
  - Section 2 – Existing Infrastructure
  - Section 3 – Future Infrastructure
- VOLUME 2
  - Section 4 – Waste Water Conveyance Treatment and Disposal Schemes
  - Section 5 – Waste Water and Sludge Treatment
- VOLUME 5
  - Appendix G – Appendices to Section 4 & 5
- VOLUME 6 (PDF copies on CD)
  - Drawings

Yours sincerely,

Tim O'Herlihy
Executive Engineer
WSIP Project Office

ATTACHMENT 5

An Bord Pleanála

Inspector's Report

Board Reference:	04.YA0005
Proposed Development:	Proposed Wastewater Treatment Plant at Shanbally, County Cork
Local Authority:	Cork County Council
Inspector:	Daniel O'Connor

PROPOSED WASTEWATER TREATMENT PLANT AT SHANBALLY, CARRIGALINE , COUNTY CORK

CONTENTS

1.0 STATUTORY REQUIREMENTS

Cork County Council, by letter of 7th march 2008, applied to An Bord Pleanála for approval to the proposed Wastewater Treatment Plant in the townland of Shanbally, Co. Cork. The proposed Wastewater Treatment Plant is to cater for Cobh, Passage West, Monkstown, Ringaskiddy, Crosshaven and Carrigaline. The application included 3 copies of the Environmental Impact Statement which is in 3 volumes. The application is stated to be made under Section 175(3) and 226 of the Planning and Development Act 2000 and in accordance with Art 118 in part 10 of the Planning and Development Regulations 2001.

A copy of the notice published in the Irish Examiner on 29th February 2008 was also enclosed. Prescribed bodies were notified and the a copy of the letter of notification is enclosed. This states that the EIS has been issued to the prescribed bodies and was issued on 6th March 2008.

The prescribed bodies notified are given as follows:

- An Chomhairle Ealaíon
- Fáilte Ireland
- An Taisce *The National Trust for Ireland*
- Minister for Environment, Heritage and Local Government
- Heritage Council
- Cobh Town Council
- Passage West Town Council
- South Western Regional Fisheries Board (SWRFB)
- Córas Iompar Éireann
- EPA Headquarters
- HSE Head Office
- Minister for Communications, energy and Natural Resources
- Minister for Agriculture Fisheries and Food
- Railway Safety Commission

The requirements of Article 121 of the Planning and Development Regulations (SI 600 of 2001) appear to have been complied with in relation to the notification of the Prescribed Bodies.

1.1 Responses / Submissions from Prescribed Bodies

The prescribed bodies which responded were The Railway Safety Commission (RSC), the South Western Regional Fisheries Board (SWRFB), HSE-Southern Region, the Development Applications Unit of DEHLG and the Department of Agriculture, Fisheries and Food (Coastal Zone Management Section). Submissions were also received from 3rd parties namely Mr Kevin Loftus and Mr Michael Barry. The submissions are described in Chapter 4 0 below.

1.2 Additional Information

By letter of 25th August 2008 the Board requested additional information form the Local Authority in relation to the following:

- Extent of combined and separate sewerage systems in Cobh
- Residence time of sewage in rising mains

- Robustness of cost comparisons in light of rising energy costs
- Locations of existing outfalls and discharges
- Consultation with River Basin District group
- Water Quality data clarification.

The Local Authority submitted the information by letter dated 12th September 2008 and the responses are dealt with in paragraphs 4.9 to 4.15 below.

1.3 As the provisions of Regulation No 44 of the Wastewater Discharge (Authorisation) Regulations apply in this instance, the views of the EPA were sought by the Board in relation to the development by letter of 11th December 2008. The EPA responded by letter of 17th December 2008 and noted that pursuant to WWDA Regulations 2007, Cork County Council had submitted applications in respect of the following (existing) discharges:

- D0057-01 Ringaskiddy / Carrigaline
- D0129-01 Passsage West / Monkstown
- D0140-01 Cork North
- D0054-01 Cobh

The EPA letter stated that the above applications were being assessed and that no application had been made in respect of the (proposed) Shanbally development.

The views of the EPA in relation to the efficacy of the proposals as far as storm overflows is concerned is therefore not available at this time.

1.4 Cork County Council submitted Volumes 1, 2 and 5 of the Preliminary Report for the Cork Harbour Main Drainage Scheme as additional information as requested by the Board by letter of 19th January 2009. The request for this documentation was to have clarity in relation to the proposals of the Local Authority in relation to stormwater discharges and on separation of foul and storm water within the sewer network. The assessment of this information is under **Section 4.16 below.**

1.5 I carried out a site inspection on 11th August 2008.

2.0 PROPOSED DEVELOPMENT

The proposal is to construct a Wastewater Treatment Plant at Shanbally, approximately 2 kilometres west of Ringaskiddy on locally elevated ground. The proposed design capacity is for a plant of 80,000 p.e. and the proposal is to use an existing IDA outfall off Ringaskiddy towards Carlisle Fort on the east side of the outer harbour mouth.

It is proposed to use the Design / Build / Operate form of procurement.

The proposal also includes 4 No. major pumping stations at West Beach (Cobh) Carrigaloe, Monkstown and Rafeen operating effectively in series together with the diversion of the rising main from the existing Carrigaline (Church Road) pumping station to the proposed WWTW. It also includes construction of a number of new smaller pumping stations and the incorporation of others into the network discharging to the proposed WWTW.

In total there would be over 20 small and 5 large pumping stations in the expanded network. Stormwater tanks would be provided at individual pumping stations and the proposal is to pump forward 6-7 times dry weather flow from each pumping station with excess flows being held in storm tanks during heavy rainfall events. Emergency overflows are planned at pumping stations to allow for power outages etc.

The proposed method of procurement of the project is by DBO and the EIS is not in a position to give details of actual proposed layout or systems. There are two different indicative layouts described in the text and outlined in figures 2.5 – 2.8 of the EIS. The estimation is that construction would take 2 years and there is a commitment that the maximum height of any building would be 12 metres above existing ground level. The location of the high voltage overhead power lines dictate the general layout of the plant and it is noted that there are less buildings and structures involved in the Sequencing Batch Reactor type layout.

Control mechanisms to be provided are a Construction Environmental Management Plan, an Operational Environmental Management Plan and an Energy Management Plan.

The provision of an extensive surface water system which would remove surface water from combined sewers is referred to in the EIS but is not detailed.

3.0 IMPACTS IDENTIFIED

3.1 The EIS describes the impacts under 8 main headings as follows:

- Human Beings
- Terrestrial and Marine Ecology
- Water Quality
- Soils, Geology and Hydrogeology
- Material Assets
- Air Quality, Odour and Climate
- Noise and Vibration
- Cultural Heritage
- Landscape and Visual impacts.

The EIS also describes interactions

3.2 Human Beings

Land uses adjacent to the proposed WWTP site include a site with permission for residential development, the proposed realigned N28 and tourism and recreational uses. The harbour uses also include tourism and recreational uses. Construction activities identified include excavation, pipe-laying construction of the WWTP and pumphouses and a proposed Marine Crossing.

The EIS states that the loss of 7.36 hectares of agricultural land for the WWTP would not be a significant impact. Raffeen and West Beach pumping stations would be built on reclaimed land

The prediction in the EIS is that there would be positive impacts for future development arising from the construction and operation of the WWTP. Traffic impacts are anticipated to be slight in the operational phase.

The 2006 census figures are given as 32,411 for the catchment to be served and the plant design is for 80,000 p.e. The EIS states that the plant would facilitate increased residential and commercial development in the environs of the Lower Harbour.

3.3 Terrestrial and Marine Ecology

Cork harbour is described as being connected to the Atlantic Ocean by a narrow inlet between Roches Point and Crosshaven and that inter-tidal flats are often muddy in character. The proposed Plant is located within 2 kilometres of the Great Island Channel SAC which stretches from Little Island to Middleton.

Habitats are described in the EIS and are mainly rated as of local importance. However the habitat types "Estuaries and sea inlets and bays" , "Infralittoral gravels and sands" , "Mud Shore" and "mixed sediment shore" are rated of international importance It is noted that the location of emergency storm outfalls is not determined

The EIS notes that Cork Harbour is an area of international importance for wintering waterfowl and sections of the harbour are designated SPA, SAC and NHA. Near the proposed WWTP there is reference to a badger sett and mitigation is proposed. The harbour is stated to be an important nursery ground for juvenile fish before they return to sea. Adult mullet are noted grazing on algal films and the impact of the proposed WWTP is stated to be likely to impact on mullet. The EIS describes the impact on mullet arising from the removal of sewage outfalls as neutral. Oyster sites in the harbour currently have a 'B' Classification.

Impacts arising from the Marine Crossing are described as not being particularly invasive and would be less so with tunnelling. It states in the EIS that the construction impacts on mussels and other fauna would be more than compensated by the cleaner conditions following on the development.

During operation, disturbance to mammals are described as minimal. Restrictions on edibility of fish are predicted to ease considerably. The WWTP would be subject to licence from EPA under Wastewater Discharge (Authorisation) Regulations 2007.

The EIS states that excavation work on the foreshore would ensure that the top layer of sediment would be reinstated. The EIS notes permanent loss of habitat at the WWTP site which it does not consider significant.

3.4 Water Quality

Modelling was carried out covering an area including the Old Head of Kinsale and extending to the city waterworks on the river Lee in Cork City. The west passage of the river Lee is noted as being designated "sensitive" but the lower Harbour is not so designated. The status of Lower Cork Harbour is described as being eutrophic in Lough Mahon (2003), north channel at Great Island is now improved to Intermediate; Lee estuary is intermediate, Cork Harbour disimproved to intermediate and the Owenacurra Estuary disimproved to eutrophic.

Faecal coliform concentrations are given for 2005-2007 period in the EIS. These indicate peak values for December 2006 at low tide of over 1,000 coliforms per 100 ml. The peak for high tide is 44 and both peaks are isolated. The EIS predicts faecal coliform levels at 15 points in the Lower Harbour. Tables in the EIS also show the predicted levels of various parameters for treated effluent. The EIS conclusion is that as wastewater from the lower harbour area is only one factor contributing to water quality the positive impact of the proposed WWTP would be moderate.

Table 3.3.7 and 3.3.10 in the EIS compare predicted coliform counts for treated and untreated scenarios. For Cobh at neap tide untreated effluent has a predicted average level of 154 faecal coliforms per 100 ml while for treated the level is 0.05. For the remaining chosen 14 points there is a general significant reduction predicted. The differences between the treated and untreated scenarios are most marked in the case of predicted coliform maximum counts, rather than averages.

The EIS notes that there are no statutory regulations to give effect tot the requirements of the Water Framework Directive and notes the requirement for a River Basin

Management Plan Reference is made to a DEHLG publication from 1995 entitled " Procedures and Criteria in relation to Stormwater Overflows" and notes that the treatment of overflows would be subject to EPA Licence under the Wastewater Discharge (Authorisation) Regulations 2007

Reference to the EPA website indicates that Cork County Council applied in 2007/8 for licence h for the following:

- Cobh direct discharges ref D0054-01
- Passage / Monkstown direct discharge ref D0129-01
- Ringaskidy direct discharge ref D0057-01
- North Cobh WWTP at Ballynoe ref D0140-01

It is noted that the North Cobh treatment plant is not referred to in the EIS. The licence application states that the plant would be decommissioned when the Shanbally plant was put into operation and the flows from Ballynoe would be transferred to the new system Separate foul and surface water systems are stated to be provided in this catchment and there is reference to a p.e. of 4,000 for the plant

EIS prediction is that following mitigation, there would be positive impact on water quality which would also positively impact on ecology, aquaculture, recreation, economic activity and development

3.5 Soils, Geology and Hydrogeology

The depth of overburden at the proposed WWTP site is given as between 8 and 20 metres and therefore blasting of rock is not anticipated. A survey of November 2007 suggests that there is an absence of groundwater up to 15 metres below ground level Karstification of limestone is referred to and a depression on the site is potentially a karst feature. The prediction in the EIS is that with mitigation there would be no significant residual negative impacts on the soils or geological / hydrogeological environment

3.6 Material Assets

Assets of human origin are listed as towns and villages and recreational facilities, public utilities and transport infrastructure. Impacts on roads arise from interference with the road surface in laying of pipelines. The drainage network is described as mainly being a combined sewerage system. The EIS notes that Cork Harbour is the second largest harbour in the world in terms of navigable area. The proposed marine pipeline is predicted to have significant temporary negative impacts on harbour traffic.

Consultation is proposed with the DAFF in relation to foreshore and in-stream works. The prediction is that pipelaying would result in slight temporary negative impacts due to traffic disruption.

Positive impacts are predicted on towns and villages and on recreational facilities arising from the operation of the WWTP. It notes that there are no designated areas adjacent to the WWTP site and no mitigation is required in that regard.

The need for septicity control in the pumping mains is identified as a necessary mitigation measure arising from the long length of rising mains and the consequential long residence time of sewage effluent in the mains.

3.7 Air Quality, Odour and Climate

Air quality is predicted to involve slight negative impacts relating to NO_2 and PM_{10} but would remain well within legislative limit values. Dust deposition is recognised as a construction phase risk and a Construction Environmental Management Plan is proposed to include measures to control dust and regulate traffic.

Odour dispersion modelling indicated that sensitive receptors would have a 98^{th} percentile level of less than 1.5 odour units per cubic metre. It is noted that the odour predictions are based on a specimen design and as such do not relate to any specified process. It is also noted that no predictions are made in respect of pumping stations where odour problems associated with septicity are identified as a potential impact.

The conclusion in the EIS states that no odour impact would be perceived at sensitive receptors following the implementation of good design in terms of odour management.

3.8 Noise and Vibration

Construction phase noise impacts are identified as the most significant. In the case of the WWTP the nearest sensitive receptor is stated to be 134 metres distant. It is predicted that there would be negligible impact on sports activities in the area arising from construction at the WWTP It predicts lower noise and vibration impacts for pumping stations generally but predicts a 70 dBA level at Monkstown and West Beach pumping stations .It predicts that there would not be significant operational noise impacts. The EIS envisages no significant residual noise impacts but notes that the achievement of the design criteria would be the responsibility of the contractor's design team.

3.9 Cultural Heritage

Ringforts in the vicinity of the pipeline route were identified and a total of 27 sites of archaeological of architectural significance are referred to in tables 3.8.4 to 3.8.6 of the EIS. The recommended mitigation measures include monitoring within the relevant zones of archaeological potential (ZAP) and fencing off of areas and creation of buffer zones. The EIS provides for specific archaeological monitoring of the proposed sub-marine pipeline between Carrigaloe and Monkstown

The EIS predicts that with mitigation measures in place there would be no significant residual archaeological or architectural heritage impacts arising from the proposed development.

3.10 Landscape and Visual

The prediction regarding the WWTP is that the greater surrounding area is capable of absorbing the development without changing the character of the urban fringe landscape. The EIS notes that notwithstanding the rural character of the area the tell-tale signs of urban intensity are evident.

The EIS recommends a planting programme using native species for the area of the proposed treatment plant. It states that the plant would not converge with existing or proposed developments but would remain a small singular element within the urban fringe landscape

The impacts of the main pumping stations are described in the EIS and the and note is taken of the architectural treatment proposed in order to minimise visual impacts.

Residual impacts are referred to in the EIS and it recommends an assessment be carried out at the WWTP after 7-10 years when the planting had matured.

4.0 SUBMISSIONS AND ADDITIONAL INFORMATION

4.1 A number of submissions were received from prescribed bodies and from 3rd parties and these are described in paragraphs 4.2 to 4.8. Additional information submitted by the applicants on foot of a request from the Board is given in paragraphs 4.9 to 4.12.

4.2 Submission of RSC.

The Railway Safety Commission submitted that the development impacts on the Cork to Cobh railway line and requests that notification of works should be made to the Divisional Engineer at Limerick Junction Station.

4.3 Submission by SWRFB

The South Western Regional Fisheries Board, by letter of 15h April 2008 submitted that no reference had been made in the EIS to the crossing of freshwater watercourses and requested that it be a condition that the applicants would agree the timing and design of all crossings of watercourses and also of all foreshore and marine crossings

An ongoing monitoring programme was also requested.

4.4 Submission by HSE – Southern Region

By letter of 1st May 2008 the Health Service Executive, South Lee Environmental Health Dept. submitted that mitigation measures were required for residents close to the proposed WWTW in relation to monitoring during construction and information regarding progress of the works. Assignment of a designated person by the Local Authority for support is recommended. Pest control measures are requested as mitigation during construction, continuing into operation. Noise monitoring is recommended as is the monitoring of agricultural use of sewage sludge

4.5 Submission of DEHLG

The Development Applications Unit of the Department of Heritage, Environment and Local Government, by letter of 25th April 2008 made submissions in relation to archaeological monitoring. Specifically the DAU set out the requirements for monitoring for pipeline excavations including the proposed marine crossing. It also recommended that the route of the pipeline be redesigned if possible to avoid direct impact on the disused Victoria Baths in Cobh. The recommendation of the DAU is that if it is not possible to re-design the route the advice of a Conservation Architect should be sought.

4.6 Submission by Coastal Zone Management Division of DAFF

By letter of 7th May, 2008 the Coastal Zone Management Division of the Department of Agriculture, Food and Fisheries notes that the construction of a modern WWTP would result in improved water quality in the lower harbour area. It states that part of Cork Harbour would be officially designated as a Shellfish growing area under the Quality of Shellfish Waters Regulations (SI 268 of 2006).

It also notes the requirement for the County Council to acquire a lease / licence from DAFF in respect of the property aspect of the application.

4.7 Third party submission by Mr Kevin Loftus.

Mr Loftus, of 4 Elm Court, Douglas submitted a drawing indicating his proposals for integrating the works into development at Spike Island. Mr Loftus states the proposed plant is in close proximity to a residential area and he had previously proposed that the plant should be located at Ringabella as an alternative. He notes that the connection for Crosshaven would be more direct to that location. In relation to Spike Island, Mr Loftus states that a sewer corridor could be provided as part of the possible Spike Island Works which include the construction of a marina.

4.8 Submission by Mr Michael Barry.

Mr Barry made a submission dated 7th May 2008 on behalf of himself and his family and has an address of Ringaskiddy / Shanbally. Mr Barry states that he objects on the strongest possible grounds to the development on a number of headings as follows:

- Due to height and scale, the development would be injurious to residential amenities in the area
- Development is contrary to protection of established and zoned residential uses in the area
- Development would adversely impact on family's enjoyment of their farm
- Development would result in a diminution of the value of the farm.

Mr Barry elaborates on the objections as follows:

1. The scale of the development should be taken in conjunction with proposed N28 road. This road is not a priority which indicates prematurity of the WWTW proposal. Construction would cause significant traffic hazard and the development is contrary to the various planning goals, objectives and aims set out by the Local Authority in the Development Plan.
2. Regarding zoning , Mr Barry states that the proposal is contrary to the use of the area by all other users and points out that he has thoroughbred horses who are very susceptible to noise and dust.
3. Regarding enjoyment of the land, Mr Barry submits that full regard be given to his family's fundamental right to expect that the use and enjoyment of their land would be protected.

4. With reference to the diminution of the value of the land's enjoyment, Mr Barry submits that the outcome would be that the lands would be rendered totally useless.
5. Submitted that the development is contrary to proper and orderly planning and denies landowners rights.

Mr Barry requests other objections made in connection be circulated and any additional information from the applicant to be notified to him.

4.9 Additional Information submitted by Cork County Council

By letter dated 12th September 2008, Cork County Council submitted additional information requested by the Board (see para **1.2** above) The information covers the points raised in the Board's letter of 25th August 2008. Six separate issues were raised and the replies are outlined in para. 4.10 to 4.15 below.

4.10 Separation of foul sewage, Cobh.

In relation to a query on the extent of separation of foul and surface water in Cobh, the Local Authority stated that the existing system comprised 16 kms of combined sewer. There are plans to provide an extensive surface water collection system which would comprise 20 kms of surface water sewers. Estimated storm runoff for 2 year 30 minute storms are given for 5 existing outfalls.

The request for additional information referred to the DEHLG document "Criteria and Procedures in relation to Stormwater Overflows" produced in 1995. The response given is that the receiving waters are not designated as either sensitive or as bathing waters and hence the limit on permitted overflows per annum is not applicable. *(This issue is referred to in the Assessment chapter)*

4.11 Residence time in rising mains and size of Rafeen Pumping Station

The Local Authority estimated the residence time for flow from West Beach Pumping Station to Shanbally WWTP site at 9 hours and 44 minutes. It also stated that approximately 30% of flows in Cobh would be transferred through 4 pumping stations in series. Dimensions and other details of the proposed Rafeen Pumping Station were also submitted.

4.12 Energy Cost Fluctuations

The Local Authority gave details of a sensitivity analysis which is stated supports the choice of Option 2 with an assumption of fuel prices being raised by a further 20%

4.13 Location of outfalls and discharges

Figure 5.1 is included in the response from the Local Authority which shows the locations of 10 municipal outfalls, 7 wastewater treatment plants including Carrigrenan, Carrigtohill and Middleton, 9 No. IPPC discharges and 2 No. Section 4 (Water Pollution Act) discharges. Table 5.1 which draws on information in the Preliminary Report for the scheme gives details of the discharges including source and daily volume where available.

4.14 Consultations with South Western River Basin District Group

Details are given of the consultation relating to the RBD studies indicate that the consultants for the proposed WWTP at Shanbally are also the lead consultants on the RBD project. It notes that one of the basic measures is to comply with the Urban Wastewater Treatment Directive and that the requirement for supplementary measures was not known at the time of reply (Sept 2008)

4.15 Cork Lower Harbour baseline water quality data.

The response includes data for faecal coliforms in Cork Harbour from 2005-2007. The response notes that while the current outfalls do not discharge to designated bathing areas some of the locations are used for recreational purposes. It states that water quality data in the vicinity of the current discharge outfalls is not available but that it could be expected that microbiological and nutrient levels would be higher than in deeper water away from the shore. The response states that the proposed development would involve decommissioning of 9 No. outfalls but that some would be used as Storm Water Overflows in accordance with DEHLG publication of 1995.

The response states that a comprehensive model does not exist in relation to the overall nutrient and microbiological contribution to Cork Harbour and that what was done was to identify the inputs into the harbour. It states the inputs from the current discharges were modelled and compared with the future scenario and it is contended that the data presented provides an accurate representation of the relative improvement in water quality following from the scheme.

4.16 Preliminary Report

Volumes 1 and 2 of the Preliminary Report cover the description of the existing and proposed infrastructure and options for effluent disposal and sludge treatment. Volume 5 contains Appendices G-H. It is noted that infiltration studies were carried out for each major sub catchment. Some areas are described as having significant infiltration levels. It also notes a shortage of gullies in some areas leading to rainwater running over roads which is described as not being an appropriate solution to the conveyance of stormwater.

On page 142 of Volume 1 it is stated that parts of the Lee Estuary are now designated as sensitive waters and that overflows in the passage West/Monkstown area (on the east of the channel from Cobh) would have to be limited to 20% of the rainfall run-off

volume. In relation to the Cobh catchment, it is noted that a previous preliminary report (1997) assumed a wastewater treatment plant local to the catchment and this report discusses different possibilities for storm overflows. It notes that it would not be feasible to totally separate the collection system.

It is clear that the Preliminary Report has comprehensively examined the collection system and the extent of new storm sewers is noted. For Cobh, the relevant drawings are figures 3.3.2 – 3.3.6.

The concern would be the achievement of a satisfactory level of storm overflow control to ensure compliance with current and future statutory controls. The DEHLG document "Procedures and Criteria in relation to Storm Water Overflows" is dated 1995 and the requirements for compliance have not been set out in detail for this development.

5.0 ASSESSMENT

5.1 **Alternatives** : The consideration of alternatives involved evaluation of alternative sites and of combinations of sites for locating the treatment plant. The examination is considered to have been very comprehensive. Provided the issues of satisfactory stormwater overflow control can be addressed in a satisfactory manner, the choice of a single treatment plant for the entire catchment is considered satisfactory.

5.2 Outfall: The location of the outfall is considered satisfactory and has been evaluated with respect to hydraulic modelling. Use of the existing IDA outfall has obvious advantages in relation to minimising construction related impacts.

5.3 Treatment Levels: The outfall location is to an area of the harbour which is not designated as "sensitive", nor is it close to any such designated area. The proposal involves treatment of effluent to standards required by the Urban Wastewater Treatment Regulations and are considered appropriate. Nutrient removal is not proposed but the EIS states the plant can be designed to allow easy retrofitting of nutrient removal facilities in the future. The proposals are considered satisfactory. It is noted that the provisions of Regulation 42 of the Wastewater Discharge (Authorisation) Regulations of 2007 are that an interim situation pertains relating to discharge standards.

5.4 Storm Overflows: The majority of the catchment is on a combined sewer system, where storm flows in wet weather conditions could be expected to exceed 6 dwf on a regular basis and by a considerable multiple. The current situation during wet weather conditions is not discernibly different than dry weather in relation to pollution load and in fact might even appear better when the dilution factor of the rainwater is taken into account.

The situation post development would be different in that in times of dry weather or where rainfall amounts do not involve more than 6 times dwf, the position regarding impact on water quality would be greatly improved. However if the storm overflows came into use, the apparent position would be noticeably worse, although in practice a smaller volume and strength of effluent would be involved in comparison with the pre-development situation.

In particular the flows from Cobh, which has the oldest sewer system, are planned to be pumped 4 times in series before reaching the proposed treatment plant as all flows must pass through the pumping stations at West Beach, Carrigaloe, Monkstown and Raffeen. There would appear to be an increased risk of more frequent overflows in this particular regime. The statement in the EIS (para 2.11.1, page 49) that future collection systems would be separated as far as reasonably possible would appear to be somewhat aspirational. However, the additional information supplied by the applicant on 15th September

2008 states clearly that 20 kms of a proposed dedicated surface water system is planned in order to remove surface water from the combined system and hence it would appear that the success of this operation is based on the ability of the proposal to limit storm water overflows to levels which would be acceptable in regard to certification or licencing by EPA under the Wastewater Discharge Regulations.

Therefore, the proposed separation of foul and surface water flows in Cobh is considered critical to the success of the scheme in relation to water quality impacts. A programme of works which would ensure compliance with the DEHLG and EPA requirements in relation to the operation of storm overflows would need to be agreed prior to the commitment to detailed design of the proposed pumping of all effluent to Shanbally. A condition is recommended in this regard

Volumes 1, 2 and 5 of the Preliminary Report for Cork Harbour Main Drainage Scheme indicate that very comprehensive analysis of the network has been carried out but the actual potential achievement of a satisfactory control of overflows is not demonstrated.

5.4 Impacts on Air:

In relation to the proposed WWTP at Shanbally, although the treatment process is not established, it is reasonable to accept the predictions in the EIS in relation to impacts arising from the construction and more particularly the operation of the WWTP. It is considered that the plant would not give rise to significant impacts on air quality and that odour levels should not cause problems. A condition is recommended in relation to odours.

The pumping stations, particularly those which receive sewage effluent which has already passed through a rising main have much greater potential to result in persistent odour problems. Septicity in rising mains has been the cause of many long term difficulties in respect of odour and there is somewhat of a shortage of details in the EISA in relation to odour control. It is also noted that the residence time from Cobh to Shanbally is estimated at over 9 hours and there are up to 4 major pumping stations involved in-series It would also appear possible that some smaller pumping stations cold contribute to the generation of odours.

Notwithstanding the reservations on pumping station odours, it is considered that an odour management system should be capable of being provided for the pumping stations. A condition is recommended in that regard. Compliance with odour management conditions is problematical as EIA approvals do not carry ongoing monitoring and enforcement possibilities. The most satisfactory method of providing for compliance would appear to be the requirement to publish an annual report on monitoring to be available at the Offices of the Local Authority and to establish a liaison forum from the commencement of construction.

5.5 Landscape and Visual Impacts

The provisions in the EIS in relation to the architectural treatment of individual pumping stations are considered appropriate.

Screening is proposed in the vicinity of the proposed WWTP. The conclusion in the EIS that the urban fringe landscape character would not be changed as the greater surrounding area is capable of absorbing the development is accepted The review of planting in 7-10 years is considered appropriate

5.6 Cultural Heritage Impacts

The EIS identifies 27 sites of either archaeological or architectural significance and sets out measures including fencing and monitoring. The mitigation measures proposed are considered appropriate and the conclusion in the EIS that there would not be significant residual archaeological or architectural impacts is accepted.

5.7 Ecological Impacts

It is noted that the marine and littoral habitats are rated mainly of local importance. Reference is made to mitigation in relation to one badger sett near the WWTP site and the effect on mullet is regarded as being a neutral impact overall. It is accepted that marine fauna should generally be positively impacted upon by a cleaner water regime. It is considered that there would not be significant ecological impacts arising from the development.

5.8 Socio -Economic impacts

The EIS predicts positive impacts on towns and villages in the catchment. It also predicts that it would facilitate further growth in the residential and commercial development in Cork Lower Harbour. It is arguable that there is not a direct link between a WWTP and positive socio-economic impacts as it is an accepted requirement that waste water be adequately treated irrespective of the level of development envisaged. From the description in the EIS it is considered that there would not be any significant negative socio-economic impacts associated with the proposed development provided adequate control can be exercised on effluent standards and on odour and noise generated.

5.9 Impacts on Soils

Having noted possible karstification in the area, with mitigation it is considered that the impacts are not likely to be significant in relation to soils, geology and hydrogeology.

5.10 Water Framework Directive – Discharge Regulations

Reference is made in the EIS (p143) to the South Western River basin District which was established in the context of the Water Framework Directive (WFD) which has the objective of achieving "good status" for water bodies by 2015. A stage in the process is the Programme of Measures and a draft River Basin Management Plan, which were published in December 2008. The Draft Plan is open for public comment until June 2009.

Further reference is made to the WFD in the additional information and indicates that within the overall harbour area, municipal discharges from Carrigrenan (Cork City, outfall south of Little Island), Carrigtohill (discharge to head of Slatty Water) and Middleton (described as a tidal tank discharging to the east channel of Great Island) could impact on water quality in the lower harbour and could be part of a cumulative impact on water quality. IPCC and Section 4 (Water Pollution Act) discharges, together with storm overflows could also impact on the overall situation.

While it would be preferable that the evaluation of the impact of the proposed development should be made in the context of all other relevant discharges in the potential area of influence, it can be concluded that the removal of more than 10 existing outfalls of raw sewage is beneficial. However, the overall impact of storm water outfalls, together with the other discharges identified in the submission of further information should preferably have been considered in the context of the Programme of Measures which was published at the end of 2008.

In relation to the Wastewater Discharge (Authorisation) Regulations (SI No 684 of 2005) it is noted that Cork County Council applied to the EPA for a Discharge Licence in respect of the existing outfalls and outlined the overall proposals for the proposed construction of a single WWTP and outfall.

5.11 Additional Information of 12 Sept 2008.

The additional information is described in paragraphs 4.9 – 4.15 above. The assessment of the submission is as follows:

- Taking note that Cobh has a largely combined system and given the age of the system, it is likely that transfer of surface water could pose problems in respect of older buildings. Therefore there would be concern, even if the 20 kms of surface water sewers are provided that sufficient separation might

not be achieved to allow effective control of storm overflows to comply with the likely requirements of an EPA discharge licence. If this proved problematical it would undermine the proposal to pump all flows to one central treatment plant. A further study would appear to be required to determine the feasibility of pumping all flows to Shanbally. Such a study would not invalidate the choice of Shanbally as a location for the WWTP but might reduce the overall capacity required if, for example, a second treatment plant were constructed on Great Island.

- The residence time of up to 9 hours in the rising main indicates that there would be a high risk of septicity in sections of the rising main. The most likely locations for odours to be problematic are the intermediate pumping stations as the effluent pumped from the upstream pumping station would mix in the well of the station before being pumped onwards. The issue is recognised in the EIS but no specific proposals are indicated. This part of the scheme appears to be likely to be directly provided by the Local Authority. Appendix 5B, EIS gives indicative odour contour lines for each of the main pumping stations and does not appear to make particular reference to the long residence time of the raw effluent in the rising mains. The prediction is for low odour generation but there are a considerable number of residential units in close proximity to a number of the pumping stations.

  It is considered that in view of the potential for odour generation and the need to address any problems at the earliest possible stage, that a liaison committee to include representatives of residents should be established at construction stage and that the liaison committee be appraised of all monitoring of odours being carried out. Based on observations of other wastewater treatment plants where odours have been an issue, it is considered that the involvement of residents' representatives at an early stage would be important. A condition is recommended in this regard.

- The information submitted in relation to cost appraisal in a high energy cost scenario is considered to have addressed the issue raised.

- The information regarding existing outfalls and discharges is noted and is referred to in relation to the relevance of the Water Framework Directive under 5.10 above.

- Details of consultation with the South Western River Basin District project group were submitted and the information given is considered to address the question raised.

- Clarification was given in relation to the status of water quality data in Lower Cork Harbour. It was confirmed that the data supplied does not give an indication of overall water quality but illustrates the point that the impacts on water quality are lower with the scheme in place than in a do-nothing situation.

5.12 Submissions and Objections

The submissions by designated bodies including the Railway Safety Commission (RSC) the SWRFB, HSE, DEHLG and Coastal zone Management Division of DAFF are considered to be capable of being accommodated in consultation during detailed design and in the construction phase. The submissions of Mr Kevin Loftus and Mr Ml Barry (see 4.8 and 4.9 above) are not considered to give grounds for rejection of the development

6.0 CONCLUSION

The need to upgrade the existing sewerage system and for pumping effluent to a central treatment plant or plants is well established. The examination of alternatives was carried out very comprehensively. Residual impacts on material assets, noise, ecology, landscape and visual issues and cultural heritage are considered not to be likely to be significant. There is a concern regarding possible difficulties with storm water overflows, particularly in the Cobh area and concern also with the long length of rising mains coupled with the pumping of raw sewage in series through four major pumping stations. Conditions are proposed to address both concerns.

As the development is during the transition stage regarding the implementation of the Wastewater Discharge Authorisation Regulations a condition is recommended regarding final effluent quality. It is noted that the discharge point from the Shanbally outfall is not to sensitive waters.

7.0 RECOMMENDATION

I recommend approval by An Bord Pleanála, subject to the conditions outlined below, of the construction of a wastewater treatment plant at Shanbally, Ringaskiddy Co Cork and the construction of four major pumping stations at West Beach (Cobh), Carrigaloe, Monkstown and Rafeen together with the modification of Church Road (Carrigaline) pumping station to result in an overall catchment network of 20 small and 5 large pumping stations and a single outfall off Ringaskiddy which is already in operation.

Reasons and Considerations

Having regard to the following:

1. The Cork County Development Plan 2003
2. Cork Area Strategic Plan
3. Requirements of the Urban Wastewater Directive
4. County Cork Sludge Management Plan
5. Mitigation Measures proposed in the Environmental Impact Statement
6. The provisions of the Water Framework Directive.

It is considered that the provision of a wastewater treatment plant at Shanbally will not have significant adverse effects on the environment and would be in accordance with the proper planning and development of the area

Conditions

1. That a study be carried out in relation to the operation of storm overflows in the Cobh (Great Island) sewerage network to confirm the potential to comply with the requirements of the DEHLG publication "Criteria and Procedures in relation to Storm Water Overflows" as related to the Waste Water Discharge (Authorization) Regulations (2005). The results of the study shall be made available for inspection by the public at the offices of Cork County Council prior to the appointment of a Contractor for the development.

Reason: To confirm that it is practical to achieve sufficient separation of foul and surface water in the Cobh system to achieve satisfactory operation of storm water overflows.

2. That a Local Liaison Committee shall be established by Cork County Council at the detailed design stage to act as a forum for disseminating information on planning and construction work in relation to the Waste Water Treatment Plant and the major pumping stations. The Committee shall be representative of the Local Authority, their consultants and Contractors when appointed, and one representative of residents from the immediate vicinity of each of the major pumping stations and of the Waste Water Treatment Plant. The results of all odour monitoring shall be made available to this committee.

Reason: To provide a consultative forum for local residents likely to be affected by construction activities and from possible noise and odour emissions from the development

3. The following treated effluent discharge standards shall be achieved:

Biochemical Oxygen Demand	25 mg / l on a 95 percentile basis
Chemical Oxygen Demand	125 mg / l on a 95 percentile basis
Suspended Solids	35 mg / l

Reason: To protect the aquatic environment

4. The odour level emanating from the site of the proposed Wastewater Treatment Plant shall not exceed 3 Ou M/ ^{m3} at the 98th percentile of hourly averages at he site boundary of the Wastewater Treatment Plant and at all sewage pumping stations

Reason: To mitigate odour impacts.

5. A suitably qualified Archaeologist shall be engaged to carry out monitoring on pipeline routes and during excavation work in relation to the wastewater treatment plant, pumping stations and the proposed marine crossing

Reason: To ensure that all archaeologically important items are located and evaluated

6 That the South Western Regional fisheries Board be consulted in relation to all crossings of watercourses by pipelines and the marine pipeline crossing as part of the detailed design of the works.

Reason : To protect aquatic ecology.

D G. O'Connor

Engineer Gd I
5th March 2009

APPENDIX 1: ENVIRONMENTAL IMPACT STATEMENT.

The Environmental Impact Statement is in three volumes as follows: -

- Volume 1 – Non Technical Summary.
- Volume II – Environmental Impact Statement in four chapters.
- Volume III – Appendices.

1.1 The **introduction** to the EIS sets out the legislative framework, the background, methodology used and the consultation carried out. It gives details of the responses of some of the consultees and notes that there was public consultation in 2006/2007 which included public open evenings at Ringaskiddy Community Hall.

1.2 **Description of the development – (EIS, Pages 9 – 55)**

The EIS states that the section would describe the existing drainage system and the characteristics of the proposed development. It states that the WWTP would be constructed using DBO Procurement System. It states that a contractor would be appointed to **design, build and operate** the WWTP for a period of 20 years to achieve the required standard within the defined design constraints.

In relation to the existing public sewerage scheme, the EIS states the existing infrastructure within the lower harbour area comprises sewers, pumping stations, overflows and outfalls. It states that some of the structures have been in existence for more than 50 years and in some cases are no longer adequate for their intended purpose due to structural damage, excessive infiltration and lack of capacity. Reference is made to Figure 2.1 showing the location of existing outfalls and the proposed outfall. The EIS describes the various systems as follows: -

1 **Carrigaline Collection System** – stated to be both combined and separate sewers. It states the effluent from the catchment is directed to the Church Road pumping station via interceptor sewers. It notes there are two smaller pumping stations in Carrigaline which pump the wastewater from the central low lying catchments on either side of the Owenboy River to the interceptor sewers.

2. **Ringaskiddy, Shanbally and Coolmore Collection System** - the EIS states that the main collection system serving the industrial section of Ringaskiddy catchment was developed by the IDA. It notes that the IDA sewer runs through the centre of the Shanbally / Coolmore residential development areas. It states Shanbally is served by a combined sewer system which gravitates to the Shanbally pumping station. Two smaller sub-catchments to the north and west of Shanbally are served by septic

tanks. The EIS states that Ringaskiddy village has its own combined collection system which discharges the untreated effluent directly north of the village and untreated effluent from Carrigaline is pumped from the Church Road pumping station to a foul manhole located on the IDA sewer upstream of the Shanbally connection.

3. **Crosshaven Collection System** – the EIS states that effluent originating from Crosshaven is currently pumped without treatment to the collection system at Carrigaline. (No indication of the pumping main or pumping station(s) are in drawing No 2 9, but it is noted that no alteration to the existing position is proposed)

4 **Passage West / Monkstown Collection System** – population equivalent in design year given as 11,500 p.e. The EIS notes that the collection system drains to three major outfall points in the catchment. It states the Cork Road pumping station in Passage West serves the low-lying catchments to the north-west of the town. It states all the flows from that area are directed to the passage outfall via a comminutor chamber near the old railway line in north Passage. It states all flows from central Passage, Glenbrook and Carrigmahon are directed to the Glenbrook comminutor and outfall adjacent to the Glenbrook ferry slipway. The EIS states the Coast Road Pumping Station takes the flow from the houses south of Monkstown village and pumps it to the pumping station on the Sand Quay in the centre of the village.

5 **Cobh Collection System** – design year population equivalent is 27,000. The EIS does not state whether the sewerage system is combined or separate for Cobh, but states that the wastewater discharges largely untreated into the tide with the exception of that from eastern Cobh which passes through a comminutor before discharging into the harbour via an outfall at White Point. The EIS states the collection system drains to five major outfall points serving different catchment areas within the town. The EIS describes the collection system for each outfall and notes that the majority of flows from west Cobh were directed to a major outfall at White Point. It notes there are also a number of smaller outfalls serving low-lying areas close to the shore.

Section 2.3 on Page 11 of the EIS deals with the **consideration of alternatives** and commences with an alternative wastewater treatment scheme. It notes that 19 potential WWTP sites were evaluated in the lower harbour area and the EIS sets out the criteria used. It notes the preliminary evaluation identified ten sites as being unsuitable and nine sites were considered in more detail. It notes that of the nine sites, five were identified as having good potential to accommodate wastewater treatment facilities for the entire catchment and those were subjected to a more detailed evaluation in terms of incorporation into the overall scheme. On Figure 2.2, these sites were No. 2 at Loughbeg, No. 3 at Loughbeg West, No. 8 at Coolmore, Site No. 18 at Shanbally (all four sites in the vicinity of Ringaskiddy) and Site No. 11 at Marino on the north-west of Cobh which was identified as suitable for wastewater only and not for sludge treatment.

Sites Nos. 1, 7, 16 and 19 were identified as having good potential for local WWTP facilities. It is noted that No 19 is the existing city plant at Carrigrennan on Little Island.

Options considered included the use of 1, 2, 3 or 4 WWTP's and from these ten separate options were considered. From these options, Option 2 involving a single WWTP at Shanbally and Option 3 using Shanbally and Marino (Sites Nos. 18 and 11) were considered further. On Page 15, the EIS concludes that Option 2 was the most advantageous location. Advantages were listed including lower environmental impact, discharge to the outer harbour, most cost effective and the location being central to the population centres being considered.

Section 2.4 describes procurement options and alternatives and lists the advantages and disadvantages of Design and Build (DB), Design/Build and Operation (DBO) and Design/Build/Finance/Operate (DBFO). The possibility of using a conventional contract was also examined and the conclusion was that the gravity sewers and rising mains including the pumping stations should be procured following the conventional route of detailed design by a Consulting Engineer, followed by open tendering. The EIS states however that pumping stations pumping directly to the WWTP would form part of the WWTP contract. The EIS concludes that the WWTP procurement should follow the DBO route.

Section 2.5 describes the **characteristics of the development** and lists the main items as follows:-

- Widening and upgrading of the site access road.
- Marine crossing.
- New wastewater pumping stations.
- Laying of rising mains, surface water sewers and gravity wastewater sewers.
- New wastewater treatment plant.

The EIS states the site is a greenfield site located approximately 11 kilometres south of Cork City and 2.24 kilometres west of Ringaskiddy in the townland of Shanbally. It states the village of Shanbally is located 625 metres to the north-east of the site and Carrigaline is approximately 1.06 kilometres to the south-west. It notes the (proposed) N28 National Primary Road linking Cork City to Ringaskiddy is less than 490 metres form the northern boundary and the proposals to improve the N28 would use lands immediately north of the proposed WWTP site.

The EIS describes the site as consisting of two large agricultural fields located on sloping ground and currently used for pasture. The site has an area of 7 36 hectares at approximately 30 metres OD. It states that it is located between two overhead high voltage power lines to the north and south of the site and it is bounded on all sides by adjoining agricultural fields with the exception of a Bord Gais substation. The EIS notes the site is zoned for **utility and infrastructure** development by the Carrigaline Electoral Area Local Area Plan of 2005 (with adopted amendments, January 2007). The EIS notes that a significant portion of land in the vicinity of the site has been zoned for industrial development. It notes an area of 5 23 hectares located 134 metres from the site boundary is zoned residential. It notes that planning permission for residential development has been granted at that site. The proposed site is described as being 405 metres east of a minor road LS427 (Cogan's Road) which links to the N28 National Primary Route just east of Raffeen Bridge

Section 2.5.3 describes the proposed design and refers to Table 2.2 which gives the base year and design year loadings. It notes that the effluent will be treated in accordance with the **Urban Wastewater Treatment Directive** and would have regard to the **Water Framework Directive**.

The EIS notes that the Cork Lower Harbour has not been designated as a sensitive or less sensitive area by the Department of the Environment. It states that nutrient removal would not be required at present. It states that in the event of a change of designation, the proposed WWTP would be designed to allow easy retro- fitting of nutrient removal facilities at a later stage should it be required. The EIS notes that the overall area of the two fields on the site is approximately 17 5 hectares, but because of the overhead high voltage cables, the area of 7.36 hectares is available between the power lines.

The EIS refers to the **Sludge Management Plan** for County Cork of March 2000 which recommends that all municipal sludge produced be treated in a hub centre located in the Ringaskiddy area. Region 19 which is involved consists primarily of the lower harbour towns including Cobh, Passage West, Monkstown, Ringaskiddy, Carrigaline, Crosshaven, Shanbally, Coolmore, Minane Bridge, Whitegate and Aghada.

The EIS states that in addition to treating the sludge arising from the population centres from the Cork Harbour main drainage scheme, sludges would also be imported form Minane Bridge septic tank which is 1,000 population equivalent. The EIS states that Whitegate and Aghada are located at the opposite side of Cork Harbour and domestic sludge is recommended to be treated at Middleton.

The EIS states that the Sludge Management Plan for County Cork recognises the potential for the co-treatment of municipal wastewater and biological industrial sludge at a hub centre located in the Ringaskiddy area. It states that no provision will be made in the design of the sludge treatment system for the Cork Harbour WWTP for the treatment of industrial sludges produced in the region. Reference is made to Section 2.5.4 for further discussion on this item.

Table 2.2 is reproduced on Page 24 of the EIS which gives the base year and design year loadings for the various components of the catchment.

Section 2.5.4 deals with alternative treatment options within the context of DBO. It lists criteria which will be applied and lists a number of elements of treatment which would be expected in a plant.

The EIS describes possible **preliminary treatment** and notes that there is a **strong potential for septic conditions** to arise in the collection and conveyance systems due to the length of the system and the distance from the population centres to the treatment plant. It notes that parts of the town of Cobh are approximately 12 kilometres in sewer length from the proposed wastewater treatment plant, with Passage West and Crosshaven being up to 11 kilometres from the plant. It states the resultant residence time in the sewer network and conveyance system would be expected to give rise to **septic conditions** in the wastewater.

The EIS states to overcome that problem, it was intended to provide septicity control in the form of chemical addition at critical pumping stations. The EIS states that the two principal methods used would be nitrate compounds or ferric sulphate. The EIS notes the use of chemicals as well as aeration. It notes a requirement that the inlet channels and chambers be covered, vented and connected to an odour control system.

The EIS describes screening and the requirements for same and also refers to grit removal. In relation **stormwater handling and disposal,** the EIS states the peak flows reaching the WWTP would correspond approximately to six times DWF and would be experienced when all of the duty pumps were operating simultaneously at full capacity. It states the variation in flows could be handled in one of two ways at the WWTP. It states that to accommodate six times DWF would result in operational difficulties and much larger tankage. It notes the alternative was to accommodate flows up to three times DWF with excess flows being taken to a storage tank where it would be allowed to settle. The EIS states that the stormwater settlement tanks typically used are either circular radial flow tanks or rectangular tanks. It states both options are comparable and either could be used at the Cork Harbour (Shanbally) WWTP.

In describing the **primary treatment** involved the EIS states an advantage of primary settlement is that it provides a simple means of removing approximately 30% of BOD and 60% of suspended solids. It states that the primary sludge can be odorous, but is ideally suited to treatment by anaerobic digestion with consequent energy recovery. The EIS states that because of the potential septic conditions in the sludge, the design of primary tanks should incorporate adequate odour control measures.

The EIS notes that there are some secondary treatment processes which can provide the necessary standard of treatment without primary settlement and therefore do not produce a primary sludge.

The EIS describes the alternatives in relation to secondary or biological treatment and lists four main types of treatment and 16 alternatives in total. The EIS notes that as the plant would be constructed using DBO, it would be constructed with a type of treatment technology proposed by the successful contractor and agreed with Cork County Council It states that regardless of the process, all structures would be restricted to a **maximum height of 12 metres** above the current ground level.

The EIS refers to sludge treatment and states that the towns to be served by the proposed new wastewater treatment plant would not generate sludges locally. It states the Ringaskiddy area is proposed as a more suitable location for the treatment hub-centre for Region 19 as defined in the Sludge Management Plan for County Cork, 2000. The plan is stated to identify 6,082 tonnes of dry solids to be generated annually in relation to non hazardous wastewater sludges in the county.

The EIS states that although it recommended that sludges from Whitegate and Aghada be diverted to the Middleton hub centre for treatment, they may also be transported to the proposed WWTP site. It notes that no provision has been made in the design of the sludge treatment system at the Cork Harbour (Shanbally) WWTP for the treatment of industrial sludges The EIS notes that as the WWTP will be constructed using DBO procurement, the type of sludge treatment process will be selected by the successful contractor. It notes that the Sludge Management Plan for County Cork recommends advanced fluidised composting, which is a sludge destruction technology. It states that in the absence of an industrial sludge contribution, the ultimate end use of the bio-solids product would not be restricted to disposal to landfill and could include beneficial reuse and agriculture. It discusses the phosphorus balance in Cork and considers there is sufficient spare capacity in the county to facilitate the land spreading on agricultural land of the municipal wastewater sludge produced in the county.

On Page 32 of the EIS there is a list of acceptable sludge technologies and lists six processes, but notes that the type of technology to be used would not be limited to the list. It states the appointed contractor could also determine that it would be more economical to employ a solids destruction form of sludge treatment and dispose of the end product landfill. The EIS states that either option would be compatible with the general recommendations of the Sludge Management Plan for County Cork The EIS notes that Regulation 14 of the UWWT Directive states the sludge arising from wastewater treatment should be a re-used whenever appropriate. It states the sludge and process tanks and structures such as pasteurisation tanks and digesters would depend on the sludge treatment process chosen, but in any event, these would be not more than 12 metres above current ground level.

The EIS states that thickening and de-watering facilities are likely to be provided, but also states the sludge drying may be included as a possible process.

In relation to sludge storage, it states that storage facilities will be provided on site and that all sludge holding tanks would be covered and the head spaces would be vented to an odour treatment facility.

The EIS refers to sludge reuse/disposal and states that it would likely be recycled to agriculture lands. It states also that it would be possible that the sludge could be used in energy recovery systems or other applications.

The EIS describes the operation of an energy recovery system and includes reference to gas storage and a gas flare.

The EIS lists a number of possible systems for order control and states that they would be installed external to buildings.

In relation to **buildings,** the EIS lists the various elements and notes that the number of buildings and the facilities accommodated would depend on the final process design selection. It puts a limit of 12 metres above current ground level and a limit of an overall plan area of buildings not to exceed 3,100m².

The EIS describes instrumentation, control and automation which will be incorporated into the WWTP. It states the treated effluent discharge would be directly to the nearby IDA sewer which gravitates to the Ringaskiddy outfall. It states the site discharge is higher than the IDA sewer which would eliminate the need for treated effluent pumping.

In relation to **the outfall location,** the proposal is to use the existing IDA outfall and this is stated to extend eastwards terminating at Dognose bank on the eastern side of the mouth of Cork Harbour.

Section 2.5.5 describes proposed WWTP options. Two different indicative designs are shown on Figures 2.6 and 2.8 and the treatment processes are shown schematically on Figures 2.5 and 2.7. Indicative Design No. 1 involves preliminary treatment, stormwater treatment, primary settlement, secondary treatment and settlement and also has sludge thickening and treatment.

Indicative Design No. 2 is described as an alternative treatment system and involves preliminary treatment as per indicative Design No. 1 with a variation on the stormwater treatment system. It notes that by the nature of the alternative treatment system primary settlement is not a requirement of the option. It describes the secondary treatment involving 4 no. SBR (Sequencing Batch Reactor) tanks and the EIS also describes secondary treatment, sludge thickening and treatment and it is noted that odour control would be common to both systems.

Section 2.6 describes the construction of the WWTP and notes that it would be expected to extend over a two year period. It notes also that blasting was not envisaged for the development. The EIS describes the construction sequence and notes that the quantity of surplus excavated materials would depend on the final process design. It states that the maximum estimated volume of surplus

material would be of the order of 10,000m³. It states that it is anticipated the tanks would not be excavated to depths greater than 5 metres below current ground level.

The EIS states that a detailed **Construction Environmental Management Plan (CEMP)** would be drawn up for all construction activities and it lists a number of provisions to reduce the environmental impact of the construction activities.

The EIS refers to the commissioning of the WWTP which it states would be expected to extend for approximately 12 weeks after start-up of the plant. In relation to licensing requirements, it notes that a waste licence from the EPA is necessary where storage is provided at the proposed WWTP for longer than six months prior to disposal to landfill or reuse on land

It also notes that the new Wastewater Discharge (Authorisation) Regulations, 2007 (S.I. No.684 of 2007) would require a licence (certificate) from the EPA as the discharge was in excess of 500 p.e. The EIS recommends a pre-application consultation with the EPA.

Section 2.9 describes the operation of the WWTP and notes it would be operational at all times. It states that automatic control of the plant would be undertaken by a computerised control system with key information and alarms relayed to the relevant Cork County Council Office.

The EIS states that an **Operational Environmental Management Plan (OEMP)** and a maintenance manual would be produced for the site.

The EIS lists a number of safety measures which it is stated would minimise the risk to personnel, visitors and / or intruders. It lists also nine sets of regulations and directives relating to health and safety legislation which the contractor would be required to comply with. It states that all critical items of plant and equipment such as pumps, blowers etc., would be provided with standby facilities which would automatically be brought into operation upon failure of the duty unit.

Section 2.10 refers to **wastewater monitoring** and the requirements of the Fifth Schedule of the UWWT Regulations of 2001 (SI No. 254 of 2001) is quoted in relation to the requirements for Urban WWTP's with population equivalents of over 50,000. The EIS states that it is likely that additional monitoring would be conducted by the appointed contractors to ensure effective process control. It notes in advance of the WWTP becoming operational, the Council would arrange pre-application discussions with the EPA for a wastewater discharge license under the Wastewater Discharge (Authorisation) Regulation of 2007. The regulations apply specifically to the discharge itself and to stormwater overflows. (*Note: definition of "wastewater discharge" which includes discharges from stormwater overflows and emergency overflows and is on Page 12 of the Regulations*).

Section 2.11 describes ancillary developments including the sewerage collection and conveyance system. It notes in the EIS that the scheme includes for upgrading the existing sewer network and that it is expected that wastewater and stormwater collection will be separated as far as reasonably possible.

By way of overview, the EIS refers to Figure 2.9 which shows the associated development works and includes major pumping stations at: -

- West Beach Cobh.
- Carrigaloe.
- Monkstown.
- Raffeen.

It also notes there are minor pumping stations and the major pumping stations are shown on Figures 2.10 to 2.13. The EIS states that the potential impact on the receiving waters from emergency overflows from the major pumping stations is likely to be **more negative** than the current situation. It states that overflow discharges at those pumping would include the wastewater from Cobh and from Passage West in the case of the pumping stations at Monkstown and Raffeen. The EIS states that **as a minimum** an automated control operating system should be put in place to ensure that if a downstream pumping station fails to operate, the upstream pumping station would cease pumping. It notes also that noise and odour abatement measures would be included at the pumping stations.

On Page 51 of the EIS **stormwater overflows and emergency overflows** are described. It states that pumped forward flows will be in the range of 6-7 DWF as a result of the industry practice referred to as Formula A being adopted. It states this approach has been recognised by the DoEHLG as a core design principle on many sewerage schemes throughout the country. The EIS states that all wastewater from the population centres within the Cork Harbour Main Drainage Scheme is discharged directly to the lower harbour. It states that consequently the quality of the discharge from any future overflows will be a significant improvement on current practice.

It states that where overflows occur, their design will be refined at detail design stage to the extent that they will meet all accepted industry design parameters. It states that all pumping stations and associated overflows will be designed in accordance with the DoEHLG Guidelines including the guideline document issued entitled **"Procedures and Criteria in relation to Stormwater Overflows"** (issued with a circular letter to Local Authorities in 1995). The EIS states that emergency overflows would be located on the collection system at individual pumping stations and pumping stations would at a minimum incorporate a facility to allow the connection of standby

generators. The EIS states that all overflow arrangements would be designed to minimise nuisance and associated health hazards.

The EIS states that twin rising mains would cross the West Passage channel of Cork Harbour from Cobh to Glenbrook. It states the proposed route is downstream of the ferry crossing and there would be screening and grit removal associated with the crossing. The EIS states that the precise locations of the proposed pumping stations and the routes of the gravity sewers and rising mains have yet to be finalised. It states that in the event of relocation of any element of the collection system, an environmental assessment will be required to determine that the environmental impacts are the same or less than those anticipated in the EIS.

In Section 2.11.2 the EIS describes the access arrangement for the WWTP and the impact of the proposed upgrading of the N28 on the proposal. It notes the requirement for power, water and chemical inputs and refers to the choice of polyelectrolytes for sludge thickening

In relation to **climate change**, the preliminary design of the collection system is stated to have a maximum tide level of 2.5 metres OD and the collection system was designed to eliminate direct connections between the tidal waterbody and the main collection system. It states that where possible, the contractor is recommended to utilise a number of measures to reduce the carbon footprint for both the construction and operational phases of the development. The EIS refers to the requirement for an **Energy Management Action Plan (MAP).**

The EIS refers to sustainability and notes the other schemes in the area which were included in the Water Services Investment Programme of 2007 – 2009. It does not anticipate that the plant will be decommissioned in the future.

Figures and maps in the EIS are included in relation to Section 2 from Pages 56 – 70 inclusive.

1.2 Receiving Environment: - (EIS Pages 71 – 92) – (Impacts on Human Beings)

This section describes the impacts on **human beings**, together with the mitigation measures proposed. Figures referred to in the text are included in Pages 93 – 96.

The EIS sets out the methodology used including reference to population statistics obtained from the Central Statistics Office. Tables 3.1.1 – 3.1.3 are referred to in relation to assessment criteria for impact quality, magnitude and duration.

Section 3.1.3 describes the population and housing situation in relation to the existing environment and notes again the location of the proposed site at 11 kilometres south of Cork City and 1.06 kilometres north-east of Carrigaline and 2.24 kilometres west of Ringaskiddy. It refers to Table 3.1.4 which gives

the population of selected settlements in the Cork Lower Harbour area. This table gives the relative populations in 2002 and 2006 and Figure 3.1.1 indicates the District Electoral Division of Carrigaline. The statistics indicate that Carrigaline is the largest town at over 12,800 population. Figure 3.1.2 shows the proximity of residential dwellings and the EIS states that the nearest residential development is 261 metres to the east of the WWTP site along minor road L6470. It notes however that planning permission has been granted for a site approximately 134 metres to the east of the proposed WWTP site.

The EIS refers to employment and economic activity and states that there are over 100 pharmaceutical and chemical firms operating in the Cork Harbour area. It refers also to the oil refinery at Whitegate. The EIS describes Carrigaline and its economic activity and also refers to the activity in Ringaskiddy including reference to the ferry terminal. In relation to Cobh, it describes it as becoming a satellite town to Cork City. It notes that industrial and enterprise activity had diminished with the closure of both the steel and fertiliser plants with a variety of smaller industrial undertakings having grown up in redundant buildings formerly associated with Rushbrook Docks. Passage West, Glenbrook and Monkstown are referred to as residential centres with associated services and small-scale enterprises. It notes that Cross River Ferries Limited has been running a car ferry service from Glenbrook to Carrigaloe since 1993.

The EIS states that statistics show that in Carrigaline, clerical, managing and government occupational groups are the largest employment sector while in Cobh, manufacturing is the largest sector. These figures are shown on tables 3.1.5 – 3.1.7 which indicate the numbers employed in the various sectors.

The EIS refers to **land-use** and refers to Figure 3.1.3 which shows adjacent land uses to the WWTP site. The EIS notes the proposals in relation to the rerouting of the N28 National Primary Route and the planning application for residential development which has been granted in the area. It states that a number of tourism and recreational related land-uses occur in the vicinity of the proposed development site. It refers to a golf and country club to the north-west of the site.

The EIS refers to **tourism and recreation** and notes the harbour is a major asset to the Cork region with significant potential with respect to marine and leisure activities. The Car ferry terminal is again referred to and it is also noted that Cork International Airport is located approximately 6 kilometres south of Cork City and approximately 8 kilometres from the proposed development.

The EIS states the Cork Lower Harbour area has a number of beaches which include Fountainstown, Myrtleville, Church Bay, Roberts Cove and Ringabella Bay. The EIS also lists some of the recreational facilities including sports clubs, sailing clubs and marinas.

The EIS in referring to health and safety states that some of the existing drainage infrastructure is no longer adequate for the intended purpose. It states that public health does not seem to be effected by the discharge of untreated wastewater into Cork Lower Harbour, but the discharge into the marine environment is not a desirable situation due to the high levels of bacteria and micro-organisms in untreated effluent, many of which are pathogenic.

The EIS describes the existing road network including the access to the site and Table 3.1.8 gives AADT for the N28 road at various locations. It notes that from the junction of the R610 to the west, an AADT of over 50,000 is recorded in 2003.

Table 3.1.9 gives the traffic turning data for the minor roads L2490 and LS472. Section 3.1.4 deals with impact assessment and reference are made to the **Cork Area Strategic Plan (CASP)** which is stated to be an initiative jointly sponsored by Cork City Council and Cork County Council. It states that this plan seeks to ensure that infrastructure, including transport and utility services are provided in advance or in tandem with housing and other development. It states that the Water Services Investment Programme (WSIP) identified Cork Lower Harbour Sewage Scheme as one of the projects for investment during the period 2007 – 2009.

The EIS describes the construction phase impacts and states that at the WWTP the works will involve normal construction activities such as excavation, pumping, pipe laying, concrete works and mechanical installation. In relation to the collection system, the provision of a marine crossing and new wastewater pumping stations including the laying of rising mains, surface water sewers and gravity wastewater sewers is noted.

In relation to impacts on economic activity and employment, the EIS states there would be a short term positive impact in relation to the WWTP and the collection system. In relation to the marine crossing the approval of the Department of Agriculture, Fisheries and Food (DAFF) is noted as being required as would consultation with other relevant stakeholders including the Port Authority and Cross River Ferries Limited.

In relation to impacts on land use, the existing use is noted as being agriculture pasture. The zoning of ***utility and infrastructure*** development is noted. The EIS states that the loss of 7.36 hectares of agricultural land for community purposes is not considered to be a significant impact.

The EIS states the construction of the pumping stations at Raffeen and Westbeach, Cobh would result in the permanent loss of reclaimed land. The impact is deemed neutral with respect to land-use, due to the extremely low ecological and economic value of the land as described in EIS

Impacts in relation to tourism and recreation are described in the EIS and it is stated that if the development did not proceed that untreated discharge would continue to negatively impact on the lower harbour. It states that construction

of the WWTP should not have any impact on tourism in the area. In relation to the collection system, the impacts of the marine crossing are noted.

In relation to health and safety, the EIS states that the Safety, Health and Welfare at Work (Construction) Regulations 2006 would be implemented during construction In relation to traffic, the EIS states there would be an increase in traffic volumes associated with the construction phase of the development. It states that the routes of the pipelines are primarily concentrated along existing road infrastructure. The EIS refers to the operational phase impacts on population and housing and states that the 2006 estimate of the population based on the census figures is 32,411. It notes the proposed capacity is for approximately 80,000 population equivalent. The EIS states this would facilitate the increased residential and commercial development in the environs of the Lower Harbour.

In relation to the collection system, the EIS states that the operational phase of the development would have a moderate positive impact due to the good quality water being discharged. It states that emergency operation of the stations is essential to minimise the risk of untreated effluent being discharged into Cork Harbour. The EIS states that it is essential that the pumping stations include for standby power arrangements to prevent overflow discharge of raw effluent to the harbour. The requirements for standby power arrangements, noted on Page 51 are repeated.

The impacts on employment and economic activity in relation to the WWTP are considered by the EIS to be significant positive long term impacts. It states the collection system would indirectly have positive impact on employment and economic activity due to the potential for increased housing and development in the area. In relation to land-use the loss of agricultural land is noted and the impacts of the pumping stations is also noted. Apart from Raffeen and Whitebeach, which are on reclaimed land, the other pumping stations are planned for areas of existing artificial surfaces.

The EIS states that the proposed WWTP would facilitate the improvement of water quality in Cork Harbour. It states that at present there are many wastewater outfalls to the receiving waters at locations used for recreational activities Reference is made to figure 2.1 in the EIS which **indicates 15 outfalls** not including the proposed outfall. These include one outfall at Ringaskiddy, three at Passage West/Monkstown and eleven in Cobh.

The EIS states that the untreated wastewater contains high levels of bacteria and micro-organisms which are stated to be very dangerous and pathogenic and may be deleterious to human health. The EIS states that the proposed WWTP would have a neutral impact with regard to public safety. It states the existing pumping station at Carrigaline would be upgraded to accommodate future demand and the other new pumping stations would eliminate the existing regular discharges of untreated wastewater to Cork Lower Harbour.

In relation to traffic the operational phase would give rise to truck movements involving sludge removal. The EIS states that the new route for the upgraded

N28 would result in decommissioning of the northern section of the LS472 and access to the site from the N28 would be from the south via the L2490. It states this would cause a permanent increase in traffic movements along the L2490 and also along the southern section of the LS472. It states the impact is considered to be slight due to the low number of employees accessing the site and there would be a maximum of four HGV movements per day. The EIS states that following consultation with the NRA, it was agreed that a detailed Traffic Impact Assessment (TIA) was not necessary due to the minor increase in daily traffic movements during the operational phase of the development.

The EIS states that a do nothing scenario was not a desirable situation due to the high levels of bacteria and micro-organisms present in the untreated wastewater.

Section 3.1.5 describes mitigation measures and during the construction phase, the EIS states that the impacts would be restricted to daylight hours and would cease on completion of the construction phase. It states that a **Construction Environmental Management Plan (CEMP)** would be drawn up for all construction activities to be carried out on site. In relation to the collection system, the EIS states a detailed CEMP would be drawn up for all construction activities.

In relation to land-use, the EIS states that landowners whose lands are directly adjacent to the site would be consulted and any appropriate measures would be taken to minimise disturbance to livestock.

With regard to tourism and recreation, the EIS states the detailed CEMP would address activities likely to affect aspects of the environment. It also states that a Traffic Management Plan would be implemented to ensure the control of movements of materials, plant and labour to and from the site.

Mitigation measures during the operational phase are referred to. For the WWTP it states that preliminary treatment must include for septicity control in addition to screening and grit removal due to the length of the conveyance system. The EIS recommends that preliminary treatment facilities should be incorporated within a building with air extraction to an odour control system. It states that the pumping station should include for standby power arrangements to prevent overflow discharge of raw effluent to the harbour. It states there is a strong potential for septic conditions to arise in the collection and conveyance systems and it is essential that the inlet channels and chambers are vented and connected to an odour control system. It states that the appointed contractor would be required to comply with the Wastewater Treatment (Prevention of Odours and Noise) Regulations, 2005 (S.I. No. 787 of 2005).

The EIS states that mitigation is not required in relation to employment or economic activity or land-use. It lists requirements for health and safety and states that there would be no residual negative impacts on human beings to be anticipated from the proposed development provided that the development is

managed effectively during the construction and operational phases and all mitigation measures are implemented.

1.3 Terrestrial and Marine Ecology (EIS Pages 97-119)

The text of the EIS is supplemented by figures and maps which are contained in pages 120 – 124. The section of the EIS was prepared by Ecofact Environmental Consultants Limited on behalf of Mott McDonald Petit to address the potential impacts of the proposed WWTP and upgraded collection system on the ecology of the receiving environment. Reference is made to the full report which is in Volume III Appendix 2A.

The EIS sets out the methodology used and notes that shore or littoral and sub-littoral sampling was undertaken at 23 stations during low spring tides with a further four stations sampled from a boat. The study was carried out with reference as applicable to the EPA guidelines. The EIS notes that consultation was held with 11 statutory bodies including the NPWS, EPA, SWRFB, Marine Institute and Bird Watch Ireland. Consultation was also held with the Department of Agriculture, Fisheries and Food, Bat Conservation Ireland, The Irish Whale and Dolphin Group, the NRA, Botanical Society of the British Isles and Cork County Council.

Table 3.2.1 sets out the criteria used in assessing the ecological importance of features, while table 3.2 sets out the criteria for assessing impact type. Table 3.2.3 sets out the criteria for assessing impact magnitude.

Section 3.2.3 refers to the existing environment and states that Cork Harbour is a large sheltered bay system with several river estuaries. The main estuaries noted are those of the Lee, Owenboy, Douglas and Owenacurra. The harbour is described as being connected to the Atlantic Ocean by a narrow inlet between Roches Point and Crosshaven at the south of the harbour. The EIS states that Cork Harbour has a surface water area of around 100 km² and has a large sheltered natural deep water harbour. It states that the strong estuarine influences dominate the upper reaches and the coastline is mixed. It states that owing to the sheltered conditions, the inter-tidal flats are often muddy in character.

The EIS refers to the designated areas and these are shown in Figure 3.2.1. The Cork Harbour Special Protection Area (SPA) has the Site Code of 004030. This is an internationally important wetland site supporting in excess of 20,000 wintering waterfowl. It notes there are several species which occur and are listed on Annex I of the EU Birds Directive. It notes that the proposed works are associated with the development which is located within 2 kilometres of the Great Island Channel SAC which has the Site Code of 0001058. It notes that the Great Island Channel stretches from Little Island to Middleton.

Monkstown Creek Natural Heritage Area (pNHA) has a Site Code of 001979 and is indicated on Figure 3.2.1. The Owenboy River pNHA has a Site Code 001990 is also shown on Figure 3.2.1.

The EIS states that following the Phase 1 Habitat Survey, the different habitat types were identified. The terrestrial habitats are listed in the EIS as follows: -

- **Improved agricultural grassland** – covers the proposed site and most of the proposed pipeline routes running through fields – Described as of local importance.

- **Amenity grassland** (GA2) – near the site of the proposed Monkstown Pumping Station – rated local ecological importance

- **Hedgerows** (WL1) – located around the field boundaries – of high local ecological importance.

- **Mixed broadleaved woodland** – present along the southern area of Cobh – includes Sycamore, Ash, Sessile Oak and Beech. – Stated to be possible wildlife corridor and nesting area for bird species – habitat rated high local ecological importance.

- **Tree lines** – near proposed Monkstown Pumping Station – rated local ecological importance.

- **Arable Crops** – fields of wheat located to the south of the WWTP – habitats generally modified and use of herbicides ensures plant diversity is at a minimum – habitat of local ecological importance.

- **Tilled land** – to the south of the WWTP site – rated of local ecological importance

- **Stone walls** – important food source for terrestrial animals and rated of local ecological importance.

- **Artificial surfaces** – some pumping stations located on artificial surfaces and rated of low ecological importance

- **Grassy verges** – located beside most of the proposed pipelines and rated as of local ecological importance

- **Ornamental/non-native shrub** – habitat within garden areas and rated of a local ecological importance.

- **Spoil and bare ground** – low ecological importance.

- **Rare flora:** EIS states that habitats were assessed as to their potential suitability for rare plants and none of the species were recorded during the current survey and habitats were recorded as generally sub-optimal for those species.

The EIS lists the Marine Habitats similarly and notes that the exact location of emergency storm outfalls is not finalised as the finalised design for the WWTP and collection system is not complete

- **Estuaries and sea inlets and bays** – Cork Harbour and the River Lee Channel at Passage West are a continuum between the above habitats. The Owenboy and Monkstown Creeks are estuaries. The EIS states the salinity of the areas is variable due to riverine inputs and tidal currents and the habitat type corresponds loosely with the EU Annex I Habitats for Estuaries and Large Shallow Inlets and Bays and is of international importance.

- **Infralittoral gravels and sands** – present in the harbour at Haulbowline and along the IDA pipeline – habitat has links to the Annex I Habitat of Sand Banks which were slightly covered by seawater all the time and therefore of international importance.

- **Infralittoral muds** – occurring at Monkstown/Passage West and rated as high local importance.

- **Seawalls, piers and jetties** – rated local importance.

- **Shingle and gravel shores** – present at East Beach Cobh and is a moderately exposed shore with accumulations of mobile rocky material – evaluated as being of high local importance.

- **Mud shore** (LS4) – this habitat occurs immediately south of the proposed Raffeen Pumping Station, at Carrigaline, at Crosshaven, at Passage West and Rushbrook and White Point, both on Great Island. – Mud shores found to support communities of polychaete worms. Noted that these worms are usually present where there is significant freshwater influence. The EIS evaluates the habitat as being of national and international importance at the area south of the Raffeen Pumping Station, due to being within a pNHA and SPA. It states at all other sites, mud shores are evaluated as being of high local importance.

- **Sand shore** (LS2) – habitat occurs at Ringaskiddy on the east-facing beach – rated of high local importance

- **Mixed sediment shore** – habitat occurring at Crosshaven, the Owenboy Estuary, south of Great Island, the eastern shore of Ringaskiddy and the margins of Loughbeg. – Supports some fucoids, carrageen and sea lettuce. Areas of this habitat are said to be present within the pNHA and SPA along the Owenboy Estuary and the habitat is evaluated as being of national and international importance. Other sites with mixed sediment shores are of high local importance.

- **Moderately exposed rocky shore** (LR2) – occurring at the eastern end of Cobh and at the east-facing beach at Ringaskiddy. The shores are stated to

be dominated by communities of barnacles, molluscs such as periwinkles, with bivalves also present. The habitat is rated of high local importance.

- **Sheltered rocky shore** (LR3) – occurring at Passage West, White Point and the proposed West Beach Pumping Station. Noted that dense growths of fucoids occurred at these sites. Diverse range of macro-fauna with barnacles and keel worms were recorded. The habitat is rated of high local ecological importance.

- **Mixed substrata shore** (LR4) – occurring near the proposed Carrigaloe Pumping Station, at Crosshaven, Ringaskiddy and at Monkstown. The shore comprises a mixture of rock and sediment. This habitat is stated to be of high local importance

The EIS refers to fauna and lists birds, mammals, reptiles and terrestrial invertebrates and crustaceans.

In relation to **estuarine birds**, Cork Harbour is stated to be an area of international importance for wintering waterfowl. Sections of the harbour are designated as an SPA and also as an SAC and pNHA. Regarding inland bird populations, the EIS states that the bird populations of the proposed WWTP site and areas affected by pipelines are of local importance. In relation to **mammals**, a badger sett within 30 metres of the proposed development is noted and no otter holes or evidence of otters was found in the immediate vicinity of the proposed outfall sites. It states that due to the presence of bats in the area, hedgerows and tree lines in the study area are likely to be used by bats for foraging and commuting.

It states that Cork Harbour is known to contain both resident and vagrant populations of common dolphins and the harbour porpoise has being recorded in Cork Harbour as well as common dolphin and killer whales. It notes that seals have been observed in Cork Harbour. In relation to reptiles, the viviparous lizard is stated to occur in County Cork but no direct observations were made in the study area.

In relation to **crustaceans** which include crabs and lobsters, a total of seven species were recorded. The EIS gives details of where each species was noted. It states that freshwater shrimp was recorded at four sites. In winter it states that most crustaceans migrate out to deeper water, so generally numbers are higher in estuaries in summer.

The EIS refers to **fish and fisheries** and states the harbour is deemed important as a nursery ground for juvenile fish before they return to the sea. It states adult mullet were seen grazing on algal films from the soft substrata at the Owenboy Estuary and also on the River Lee Western Passage. Reference is made to marine fisheries survey undertaken by the Central Fisheries Board in 2001. It states a total of 13 species were taken at the north most point of Ringaskiddy. Table 3.2.4 lists the fish species expected in areas affected by the proposed development.

In relation to **shellfish**, the EIS notes that Cork Harbour is a shellfish production area and Table 3.2.5 indicates the production area, boundaries, bed name, species and classification. The **classifications** where all the sites for oysters in Cork Harbour **is given as B**.

With reference to **water quality**, the EIS notes the growth of enteromorpha and ulva which arise from high concentrations of nutrients such as nitrates and phosphates. It states that a hydro-dynamic model found that the untreated discharge from the Cork Lower Harbour would contribute a concentration of 1,500 faecal coliforms/ml to parts of Passage West, Cobh and Ringaskiddy shores.

Section 3.2.4 deals with impact assessment and construction phase impacts in relation to the WWTP site are not regarded as being of ecological significance in relation to habitats. It states that there would be short-term negative impacts on the terrestrial mammals, such as badgers. The EIS states there are no bat roosts which would be affected by the proposed development. It states also that there are no potential nest sites or areas important to peregrine falcons that would be affected by the proposed development.

Disturbance of hedgerows in relation to collection system is stated to be of slight to moderate negative significance, but it is noted that the route of the pipeline network is mainly restricted to the existing road infrastructure. It states the potential impact on flora is rated as imperceptible negative. It states that the disturbance of improved agricultural grassland and other similar habitats would be of imperceptible negative impact.

The EIS states that works associated with the foreshore at the Owenboy River could result in a significant habitat loss for marine animals. It states in the EIS that estuarine habitats with very high natural levels of suspended solids the impact of pipeline laying would be negligible with suitable mitigation

The EIS states that lower water clarity could affect the quantity, type and depth to which bottom-living microscopic algae and seaweeds can grow and could affect the feeding abilities of visual fish feeders such as mullet. The EIS states that mullet are recorded in the Owenboy River at Carrigaline and occur throughout the estuary, but their ability to relocate with ease would decrease the chances of a decline in their status.

The EIS describes the marine crossing impacts and states that this would be tunnelled or laid by open cut techniques. It states that the pipes would be lightly encased in concrete for protection in shallower sections. The EIS states that it is not envisaged that the construction of the marine crossing would involve particularly invasive underwater construction works. It states that localised sediment plumes could represent a small level of habitat disturbance to seals. It states that limpets would not be expected to be affected. It states the impact on mussels, starfish and other fauna would be more than compensated for by the cleaner conditions brought about by the proposed

development. The EIS states that should tunnelling be used rather than open cut, the impacts on the marine ecology would be significantly reduced.

The EIS states that the impacts on the foreshore of the Owenboy River could reduce the foraging areas for wintering birds. It states that one of the pipelines associated with the scheme would also run along the road bordering the Monkstown Creek pNHA and noise disturbance and runoff could have significant impacts in the absence of mitigation.

The EIS notes that pipeline construction would be in mainly older type roads which do not have pollution control used in modern highway systems. It states that during the construction phase, pollutants from chemicals could contaminate the area. It states that with mitigation, potential impacts would be reduced to imperceptible. It refers to sources of pollution listed in the Scottish Environment Protection Agency list of the main sources of pollution from construction sites.

The **operational phase impacts** regarding the WWTP are referred to on Page 113. It states that disturbance to local mammal communities arising from the operation of the WWTP would be minimal. It refers to the current nutrient inputs by foul sewage outfalls into the affected aquatic areas and notes that these would be significantly reduced during the operation of the proposed scheme. It states that phytoplankton blooms would be expected to be less frequent and that **restrictions on the edibility of shellfish** would ease considerably due to the reduction in associated bio toxins. (It does not state if the area would be reclassified). The EIS points out that a reduction in some species would not be a negative impact, because they would be replaced by other species.

Referring to water quality, the EIS states that the risk of large-scale eutrophication occurring would be extremely low in a modern well managed plant. It notes that the proposed WWTP would require a discharge licence from the EPA under the **Wastewater Discharge (Authorisation) Regulations 2007.** (*transitional arrangements regarding authorisation are discussed under the assessment chapter of this report*)

It states the normal operating quality of the proposed discharge in the Cork Harbour would be much improved from the existing discharges it would replace. It states that this would lead to a decrease in algal mats and would be a moderate positive impact. The EIS states the eco system around the outfall would continue to change until a sustainable balance was reached where organisms suited to the new environmental conditions would thrive. It states the value of Cork Harbour as a nursery for young fish would increase with improved water quality and the consequences would extend beyond the mouth of the harbour. It states that **adult mullet** would not be as concentrated around previously present outfalls. The EIS states this is considered to be a neutral impact. It states the reduction of nutrients into the affected aquatic areas would improve water quality, habitats and diversity and consequently add to the conservation status of Cork Harbour SPA, Owenboy River pNHA and Monkstown Creek pNHA.

The EIS states the hydrodynamic modelling conducted predicted that the concentration of faecal coliforms would be significantly reduced by 80 – 95% on the current scenario.

The EIS refers to the collection system and states that it has been designed to ensure that minimal maintenance of the collection system would be required. It states that a do-nothing impact would result in continuing discharge of untreated effluent into Cork Lower Harbour.

The EIS refers to mitigation measures in Section 3.2.5 commencing on Page 116.

In relation to flora and habitats, the EIS states that restrictions will be placed on the removal of scrub on a seasonal basis and also that landscaping works would use native species and this would be developed in consultation with an appropriately qualified ecologist.

The EIS states the badger sett located near the proposed WWTP would be fenced off during construction. Monitoring of the sett would be in accordance with criteria developed in consultation with the NPWS.

The **mitigation measures** in relation to the collection system include the timing of excavation works on the foreshore during August and September and the avoidance of the release of pollutants. The EIS states the appointed contractor would prepare detailed method statements prior to initiating construction works. The EIS states that construction of the marine crossing would be timed to avoid sensitive periods for fish such as spawning. Consultation with the statutory bodies in this regard is also proposed.

The EIS states that excavation works on the foreshore would ensure that the top layer of sediment would be reinstated. It refers to measures to prevent chemical pollution involving storage and bunding.

Mitigation measures in the operational phase include a management plan for the maintenance of hedgerows, lawns and tree lines. It refers to the monitoring of the badger sett near the site and notes that low level lighting would be selected for external lighting around the treatment plant to reduce any impacts on fauna.

The EIS proposes **continuous monitoring** and sampling and wastewater to control plant operations, but to comply also with the UWWT Regulations. The EIS states that it is not anticipated that the WWTP would be staffed 24 hours a day and automatic control of the plant would be undertaken by a computerised control system. The EIS states that key information on alarms would be relayed to the relevant Cork County Council office.

In relation to the **collection system**, the mitigation measures proposed include an automatic control operating system to ensure that if a downstream pumping station failed, the upstream pumping station would cease pumping.

Referring to residual impacts, the EIS states that there would be a permanent loss of habitat at the WWTP site which is not considered a significant impact. It states that improvement in water quality would result in long-term moderate positive impacts for marine flora, estuarine birds, marine invertebrates, mammals and fish species. It states that with moderate benefits for biodiversity following the improvement of water quality, the value of the designated areas would be expected to increase in Cork Lower Harbour.

1.4 Water Quality: - (EIS Pages 125 – 145)

The EIS states that the University College Cork were commissioned to conduct a detailed hydro-dynamic and water quality modelling study of the proposed discharge, to **assess the likely impacts** of the development on water quality. It states that a literature review was conducted to assess the baseline information.

A computer model referred to as OH-2 covering the old Head of Kinsale to the waterworks weir in Cork City was developed. It states the model assimilates the release, transport and decay of various micro organisms in Cork Lower Harbour. It states it was configured to assimilate the release of untreated waste from the towns in the lower harbour and secondly configured to assimilate the release of treated wastewater from the proposed WWTP and Ringaskiddy. It refers to Volume III, Appendix 3A for the detailed report.

Table 3.3.1, to 3.3.3 set out criteria for assessing the quality, magnitude and duration of impacts.

Section 3.3.3 describes the existing environment. It states that Cork Harbour is the second largest natural harbour in the world consisting of an upper and lower harbour. The EIS states that the west channel is the larger of the two channels joining the harbours and the majority of the tidal exchange volume occurs through the west channel.

The EIS states that the coastal zone is officially designated for protection which includes specials areas of conservation and special protection areas for birds. It notes that within the lower harbour there are a number of protected conservation areas, including Cork Harbour SPA, Great Island Channel SAC and the Monkstown Creek NHA and Owenboy River pNHA. It notes that the west passage of the River Lee is designated as sensitive water under the Urban Wastewater Treatment Directive, but the lower harbour is not designated as sensitive water.

The EIS states there are no designated bathing areas within the study area with Fountainstown Beach being the closest at 5.25 kilometres from the existing IDA outfall. Table 3.3.4 gives the quality requirements for bathing water and refers to the 1976 Directive and the national limit values. It notes that the 2006 Directive is not yet transposed in Irish Law.

On Page 129 of the EIS, the existing water quality in Lower Cork Harbour is described. The EIS states that based on criteria levels of nutrient enrichment, the trophic status of water can be classified into eutrophic, potentially eutrophic, intermediate and unpolluted. The EIS discusses the trends in the Cork Harbour area and Table 3.3.5 gives water quality results for 2005 – 2007 for the following parameters: -

- **DIN** – Dissolved inorganic nitrogen – considered to represent bio-available nitrogen.
- **MRP** – Molybdate reactive phosphorus – represents bio-available dissolved inorganic phosphorus.
- **Chlorophyll** expressed as chlorophyll concentration
- **DO%** saturation – dissolved oxygen relative to normal for ambient temperature and pressure.

The water quality results are broken down into summer and winter sampling.

The EIS notes the improvement which has occurred in the general area since the Carrigrennan WWTP, (which treats wastewater from Cork City) commenced operation in 2005. It states that the lower harbour is **classified as intermediate** and the only parameter which exceeded the criterion values were the winter levels of DIN.

The EIS states that the lower harbour is not designated as a sensitive bathing or shellfish water and it notes also there is no published data on concentrations of **norovirus** in Cork Lower Harbour and also that there are no legislative requirements to monitor norovirus in Ireland at present.

Figure 3.3.1 and 3.3.2 show **faecal coliforms** concentrations in Cork Lower Harbour at high tide and low tide for period 2005 – 2007. The graph indicates peaks of 44 mpn/100 mls for high tide and 1,120 for low tide, both in winter months. Table 3.3.6 gives the current outfall locations and their discharge rates based on 2001 data. On page 113, the EIS notes that the concentrations indicated in table 3.3.6 are not representative of the **actual water quality** in the Harbour, but of the concentrations in the Harbour due to the untreated discharges in the Lower Harbour area.

The total flow for dry weather conditions is estimated at 7,500 m^3/day of which 4,000 relates to the Ringaskiddy outfall. Figure 3.3.3 gives the location of 15 points of interest within Cork Lower Harbour and at Table 3.3.7 gives the predicted average in maximum concentrations of faecal coliforms at these points for 2010 with untreated effluent. Table 3.3.8 gives the average and maximum concentrations of norovirus at the same locations with untreated effluent, while Table 3.3.9 gives the concentrations of nitrogen, ammonia and nitrate. The EIS notes that the maximum number of norovirus in the untreated

waste simulation range from 2 – 18,000 per cubic metre. Concentrations of ammonia range from 0.000655 to 0.008214 milligrams per litre.

Section 3.3.4 deals with impact assessment and commences with the construction phase impacts which relate mainly to accidental spillages and the construction of the marine crossing. Regarding the WWTP and the collection system, the EIS refers to the hydrodynamic modelling study which estimated the relative reduction following the construction of the proposed WWTP in relation to: -

- **Faecal Coliforms**
- **Novovirus.**
- **Organic Nitrogen.**
- **Ammonia.**
- **Nitrate.**

The upgraded collection system is stated to result in a reduction in the number of outfalls to one single outfall in the deepwater channel near Dognose Bank.

The EIS states that wastewater from the lower harbour catchment area is only one of the many factors contributing to water quality in the harbour. It states that the positive impacts are moderate.

The EIS states that 90% of organic matter would be removed and this would have the effect of reducing faecal coliforms by a factor of 10 so that in the treated effluent, it would be equivalent to 1.0×10^{10} faecal coliforms or e-coli per cubic metre of treated effluent which would be equivalent to $1.0^{x} 10^{6}$ per 100 ml. Table 3.3.10 gives the average and maximum concentrations of faecal coliforms in Cork Lower Harbour for the year 2010 with treated effluent. The highest levels predicted are upstream of the outfall and at Roches Point.

Table 3.3.11 gives the average and maximum levels of **intestinal enterococci** in the lower harbour in 2010 for treated effluent. This indicates the highest figures upstream of the outfall and at Roches Point

The EIS states that there would be assumed to be 50 million novovirus/m^3 in raw sewage and that the WWTP would remove 90%. The EIS states that comparison of the concentrations of norovirus in untreated and treated effluent would indicate there is an 80% relative reduction in the concentration of norovirus following secondary treatment in the entire harbour area with the exception of the area immediately adjacent to the outfall. Table 3.3.12 gives the concentrations of the 15 points of interest which indicates that upstream of the outfall, the maximum is over 3,000 per m^3 while at Roches Point, it is

estimated to be 1,254. It is noted that the predictions for Cobh is that it would be 1,374 per m^3.

The EIS states that in relation to **organic nitrogen, ammonia and nitrate**, concentrations in the harbour would decrease following secondary treatment of the effluent with the exception of organic nitrogen concentrations at Fountainstown, Myrtlelville, and Roches Point and upstream of the IDA outfall. It states that the slight increases would be due to the discharge of all treated effluent through a single outfall, compared to the present scenario where there are numerous outfall points. It notes that the DIN levels in the harbour have exceeded the criterion value during winter sampling periods in recent years. It states the reduction in nitrate and ammonia in treated effluent from the proposed WWTP would have a moderate positive impact on water quality in Cork Lower Harbour in terms of DIN. Table 3.3.13 indicates that raw and treated sewage has the same concentration of organic nitrogen and nitrate, but that ammonia would be expected to reduce from 25 mg/l to 12.5 mg/l. Table 3.3.14 gives the maximum concentration for nitrogen, ammonia and nitrate in the lower harbour area for the 15 points of interest.

The EIS states that from the data presented, the water quality in Cork Lower Harbour would be expected to **moderately improve** with the operation of a WWTP. It states the potential impact on the receiving waters from emergency overflows from pumping stations could affect water quality, but the risk would be extremely low in a modern well managed plant as proposed. The EIS states that during storm events, the potential exists for stormwater overflows to be discharged directly to the harbour. It states that the large size of the harbour along with tidal currents would mean the receiving waters have a high resilience to such unlikely events and the risk of such an event happening with the proposed WWTP would be much lower than is currently the case.

The EIS refers to cumulative impacts and lists the other schemes being promoted by Cork County Council in the area. These include Little Island, Middleton and Carrigtohill.

The EIS refers to **Water Framework Directive** and its objectives and notes that at present the EPA proposed quality standards for surface water classification is open for public consultation. The EIS notes that the EPA will make recommendations to the Minister for the Environment, Heritage and Local Government for input into additional regulations which will give statutory effect to the measures for implementation of the WFD. The EIS states that at present, there are **no statutory regulations** with regard to a programme of measures and quality standards for the South-Western River Basin District (SWRBD).

The EIS states that Cork County Council are investing in several WWTP's and sewerage schemes in County Cork and contributing to the achievement of good ecological and chemical status in surface waters, with reversal of pollution trends and ceasing the discharge of priority hazardous substances. These are stated to be objectives of the WFD.

The EIS refers to a do-nothing scenario which would include deterioration of water quality arising from the effects of increased population A worst-case scenario impact is described where the mitigation measures were not implemented correctly or failed.

Section 3.3.5 refers to **mitigation measures**. During the construction phase, good site management including bunding is referred to and arrangements for notification of the Irish Coastguard in case of spillage are also referred to It states that if open cut techniques are employed on a marine crossing, the disturbed area would be protected so as to reduce potential bed erosion by tidal movements during construction. In relation to the operational phase, it states that emergency overflows would be located on the collection system at individual pumping stations to prevent localised flooding in the event of a power failure. It states that where overflows would occur, the design would be refined at detailed design stage to the extent that they would meet all accepted industry design parameters and would not have a significant impact on water quality. It states that they would designed in accordance with the DoEHLG Guidelines including the guideline document issued entitled **"Procedures and Criteria in relation to Stormwater Overflows"**. The EIS states that an automated control operating system would be put in place to ensure that if a downstream pumping station failed to operate, the upstream pumping station would cease pumping. It states that provision of continuous monitoring and sampling of wastewater would be provided and to comply with the **Wastewater Discharge (Authorisation) Regulations of 2007**, a wastewater discharge licence would be required from the EPA. It also states that the WWTP would be designed so that it could be retro-fitted for nutrient removal, if required in the future.

Section 3.3.6 refers to **residual impacts** and states that following the implementation of mitigation measures, the impacts would include improved water quality in Cork Lower Harbour which in turn would have positive impacts for ecology, aquaculture, recreation, economic activity and development in Cork Lower Harbour.

1.5 Soils, Geology and Hydrogeology: - (EIS Pages 146 – 169)

In addition to the text, Figures 3.4.1 – 3.4.5 as well as Plate 3.4.1 are included after Page 169

Section 3.4.2 sets out the methodology and lists the existing literature search. Tables 3.4.1 – 3.4.4 set out the groundwater and geology sensitivity, the definition of magnitude of impacts, significance criteria and duration of impacts.

Section 3.4.3 deals with the existing environment. It states the new WWTP will be constructed on a greenfield site in the townland of Shanbally. The EIS states the geology and soils play an important part in determining the environmental characteristics of the region and the nature of the rock has a

bearing on the nature of the soil formed which affects the natural vegetation and type of agriculture or horticulture that can be sustained.

The receiving environment is described as follows: -

- **Geomorphology** – the area is described as the development of a large number of broad u-shaped valleys and a number of buried valleys infilled with sand and gravel.

- **Topography** – the site is located in a coastal region of undulating terrain with the topography of the local area defined by ridgelines running east-west.

- **Drift geology** – noted that thick melt-water sands and gravels have been identified in the Cork Harbour region. Soil classification maps identify acid brown earths 70% - association 13. Walkover survey was carried out at the proposed WWTP in 2007 and no springs or areas of standing water were observed. A number of minor ground depressions with one noticeable feature were observed in the eastern field. A conical shaped depression of 3-4 metres diameter is illustrated in Plate 3.4.1. The EIS suggests that underlying limestone may be subjected to solution weathering. Table 3.4.5 gives borehole summary details and Table 3.4.6 gives trial pit summary details. The EIS refers to a geophysical survey.

- **Bedrock geology** – Table 3.4.7 gives the bedrock geology summary for the WWTP site and the pumping stations.

- **Marine geology** – survey carried out in the West Passage in 2005 – demonstrates the extension of bedrock across the West Passage and the nature of sediment to depths greater than 20 metres.

- **Structural geology** - complexity in the structure noted. Cork Harbour is stated to lie in a fold thrust terrain characterised by a series of horizontal upright east-west anticlines and synclines. Bedrock in Shanbally is stated to form part of the Ringaskiddy anticline and Cloyne syncline

- **Karstification** – EIS describes the process and refers to geophysical survey from Volume III. The EIS states that an area of possible faulting/fracturing or karstification was identified in the south-east corner of the site.

- **Radon** – Information indicates the site is within a moderate radon area.

- **Geological heritage** – EIS states there are no areas of geological heritage significance which could be impacted on by the WWTP site and collection system.

- **Hydrology** – no streams or rivers cross or are adjacent to the development site.

- **Hydrogeology** – main bedrock aquifers in Cork Harbour are intensely karstified limestones.

- **Aquifer classification and vulnerability** – Table 3.4.8 gives summary of GSI bedrock and aquifer data. The EIS states that the Cuskinny member beneath the proposed new WWTP site is considered to be a locally important bedrock aquifer and Waulsortian limestone is considered to be a locally important karst bedrock aquifer.

- **Groundwater chemistry** - hardness of the limestone and sand and gravel waters usually range from 200 – 400 mg/l. Groundwaters in most of the synclines have been identified as vulnerable to pollution. The SWRBD Group has characterised the groundwater body for the WWTP site as 1b which is "probably at significant risk" in their study in relation to the Water Framework Directive.

- **Contaminated land** – EIS considers the risk of encountering contaminated materials or soil as low.

The EIS considers impact assessment in Section 3.4.4. In relation to construction phase impacts on drift geology and topography, reference is made to the excavation for elements of structures and the access road. It notes there is a potential for construction activities to impact on soil erosion and also to cause to leaching of contaminants into the groundwater.

In relation to marine sediment, the EIS describes the pipeline route and the marine crossing. It states method statements would be generated in advance of any works on the marine crossing in consultation with the NPWS and the DAFF. (Dept of Agriculture, Fisheries and Food)

The EIS states the depth to bedrock beneath the WWTP is expected to range between 8 and 20 metres below ground level and no blasting is anticipated to be required.

In relation to marine bedrock geology, apart from the marine crossing which is previously discussed in the EIS, works on the foreshore are noted. It states that the foreshore works would have minimal disturbance to bedrock geology and would have negligible impact.

In relation to hydrology and hydrogeology, the EIS notes that karst groundwater becomes polluted more easily than water in non-karstic aquifers. It states that no groundwater discharges are proposed and that the site is located in an area where saline or brackish water would be anticipated. The EIS states that additional precautionary measures would be implemented to ensure any accidents or spillages would not negatively impact on the groundwater quality.

The EIS states that the survey of November 2007 suggests an absence of groundwater at 10-15 metres below ground level. It states that it is unlikely that direct contact with the watertable would be made.

On Page 165 the EIS considers the operational phase impact under the headings previously set out. It states that the soil classification in the Cork Lower Harbour area would not be impacted on by the operational phase of the development. It states that the operational phase should have a positive impact on soils arising from sludge management proposals.

The EIS states that it is not anticipated there would be any significant impact on the physical properties of the marine sediments during the operational phase

Section 3.4.5 considers mitigation measures in both the construction and operational phases. During the construction phase, the EIS proposes to verify the ground conditions under the site in advance of construction. It states that surplus or unsuitable excavated materials would be disposed of to an appropriately licensed landfill site or permitted recovery facility. The EIS states the effects of soil stripping would be minimised by the removal of topsoil during dry conditions and the effects of soil erosion would be minimised by ensuring that all ground disturbances or excavations are completed and re-vegetated as soon as practical.

The EIS states the main threat posed to soils and groundwater arises from soil contamination from construction materials. It states that any spillages would be immediately contained and also that refuelling of vehicles would be undertaken in specific designated areas with interceptors in place. It notes that there would be an emergency response plan and training of on-site personnel.

The EIS states that during the operational phase no mitigation measures are recommended as there are no foreseeable impacts on geology.

Section 3.4.6 refers to **residual impacts** and their definition in the EPA Guidelines *"the degree of environmental change that will occur after the proposed mitigation measures have taken place"* It states that when the recommended mitigation is implemented, it is considered there would be no significant residual negative impacts on the soils or geological/hydrogeological environment.

1.6 Material Assets: - (EIS Pages 176 – 88)

The EIS defines materials as comprising physical resources in the environment which may be of human or natural origin It sets out the methodology used and the criteria for assessing the quality, magnitude and duration of impacts. It lists assets of human origin as including towns and villages, recreational facilities, transport infrastructure and public utilities. Assets of natural origin

are described as natural resources, natural amenities and natural heritage, while cultural assets are described as archaeological and built heritage.

The EIS describes the existing environment including the towns adjacent to the WWTP and the collection system. The recreational facilities mentioned include a Golf Club close to the site which includes facilities for other sports. It notes also that Hibernian AFC and Shamrocks GAA Club are located close to the site also. The EIS notes the marine based recreational facilities associated with the harbour.

It describes the transport infrastructure and notes that the widening of the access road into the site has a 10-metre right of way acquired. It notes the likely impact of the improvement of the existing N28. It also notes that the majority of the pipelines are to be installed along existing roads.

In relation to public utilities, the EIS notes that the drainage network is the most relevant. It states that the existing network for the Cork Lower Harbour area is primarily a combined system and covers the towns within the scheme.

In relation to natural resources, the EIS states that the surrounding topography is undulating with ridgelines running east to west. It states the development of a WWTP at the proposed site is consistent with the objectives of the Carrigaline Electoral Area Local Area Plan (2005) and the adopted Amendments of January 2007. In relation to natural amenities, it states that Cork Harbour is the second largest natural harbour in the world in terms of navigational area. It describes extensive bird life and woods in the area. The EIS states the Owenboy Estuary is designated as an area of visual/scenic importance. It states also that scenic routes designated under the Cork County Development Plan of 2003 include the road between the Carrigaline and Crosshaven from which the development is visible and the road between Passage West and Ringaskiddy from which it states that the proposed development site is not visible

The EIS states there are **no conservation designations** immediately adjacent to the WWTP site. It states that Section 3.8 of the EIS deals with the cultural heritage and notes there are two recorded archaeological features outside the boundary of the WWTP. It also notes that 25 archaeological / architectural constraints were identified in relation to the pipelines and pumping stations

Section 3.5.4 deals with impact assessment and commences with the construction phase impact which is stated would be short-term negative arising from increased noise, dust and construction traffic. It applies to both the towns and villages and the recreational facilities. It notes in relation to the collection system, the need to have a consultation with the Department of Agriculture, Fisheries and Food in relation to foreshore and in-stream work. In relation to transport infrastructure, the EIS notes there would be an increase in traffic volumes. It states that the laying of pipes would result in slight temporary negative impacts due to traffic disruption.

The EIS notes the requirement of the power source for most aspects of the facility for both the WWTP and the pumping stations. The EIS states that the loss of 7 36 hectares of agricultural land would be considered neutral in the light of the zoning of the area. The EIS states that in relation to natural amenities, there would be a slight negative impact on the scenic route between Carrigaline and Crosshaven. It notes the construction of the marine crossing would have moderate to significant temporary negative impacts on Cork Harbour, which would include disruption to harbour traffic. It states there would be no impacts on natural heritage arising from the WWTP, but there would be temporary negative impacts on the Owenboy River and Monkstown Creek. In relation to archaeological and built heritage, it states that one of the two features adjacent to the site could be impacted during construction. It states the majority of the potential impacts on collection systems are indirect.

In relation to operational phase impacts, the EIS predicts a moderate long-term positive impact of the WWTP on the towns and villages. In relation to recreational facilities, it predicts a positive impact arising from improved water quality and with respect to the collection system, the elimination of outfalls is stated to have a long-term positive impact on water quality. It notes that where outfalls are to be retained, they would operate only during storm conditions.

In relation to transport infrastructure, a slight negative impact on transport is predicted and in public utilities, the improvement in the wastewater collection system is listed as a significant positive impact. The WWTP and collection system is predicted to have a significantly positive impact on water quality in Cork Harbour. The pumping station at West Beach in Cobh is predicted to have a slight negative visual impact on the cultural town of Cobh and it requires a sensitive design of the structure

The EIS refers to a do-nothing scenario which would increase the amount of untreated discharges in the harbour and the worst-case scenario which would arise where mitigation measures were not implemented correctly or failed

Section 3.5.5 deals with **mitigation measures** for both the construction and operational phase. For the construction phase, a detailed Construction Environmental Management Plan (CEMP) would be developed to address effects such as noise, dust, odour, traffic, run-off, spillages, etc. It states a Traffic Management Plan would be implemented to ensure the control of movements of material plant and labour. No mitigation measures are deemed necessary in relation to public utilities and in relation to natural resources and natural amenities, the EIS states that a drilling programme is recommended to verify the ground conditions under the site.

It states that as there are no designated natural heritage areas located adjacent to the WWTP, no mitigation measures are deemed necessary and prior to any works within or directly adjacent to pNHAs, there would be consultation with the NPWS.

In relation to the operational phase, the EIS refers to the need for septicity control in addition to screening and grit removal due to the length of the conveyance system which was previously referred to in the description of the development. It notes the requirement for stand-by power arrangements at pumping stations and an automated control system to ensure that if a downstream pumping station fails to operate, the upstream pumping station would cease pumping.

It states there are no mitigation measures proposed for a transport infrastructure, natural heritage or the archaeological and built heritage.

In Section 3.5.6 relating to residual impacts, the EIS states that if the proposed mitigation measures are implemented, no significant negative residual impacts are expected to occur as a result of the proposed development.

1.7 Air Quality, Odour and Climate: - (EIS Pages 189 – 216)

In addition to the text, Figure 3.6.1 – 3.6.10 are included and these indicate monitoring locations and predicted odour emissions

The EIS sets out the methodology used and notes that 12 sample locations were chosen to represent the baseline air quality which was assessed between July and August 2007. The locations are listed in Table 3.6.1 and presented in Figures 3.6.1 – 3.6.6 which includes the locations in the vicinity of the WWTP and the pumping stations.

The EIS sets out the methodology in relation to odour and deals with dispersion modelling and the factors influencing the site.

The EIS states that in the case of the proposed scheme, all significant odour sources capable of generating offensive odours would be enclosed, sealed and negatively ventilated to an odour control systems. It states that only aeration tankage, secondary settlement tankage and stormwater tankage within the works would be open to atmosphere. It also states that for all pumping stations, an Odour Management System would be implemented to ensure that no uncontrolled release of fugitive odours occurred.

The EIS sets out the Odour Impact Assessment carried out which includes use of 99.5th percentile (%-ile) of hourly average and a 98 th %-ile of hourly averages used in predicting odour envelopes. It states that all sensitive locations and areas of amenity should be located outside the 1.5 odour unit per cubic metre at the 98th percentile of hourly averages over a meteorological year. The EIS refers to the **hedonic tone** which refers to the pleasantness or unpleasantness of odours as measured by VDI at 3883:1997, Part 2.

Section 3.6.3 sets out the existing environment and refers to air quality and the BTEX concentrations which include the parameters benzene, toluene, ethyl benzene, and Para and Ortho- xylene. Reference is made to the air quality regulations, SI 271 of 2002 which relates to EU Directive 2000/69/EEC. The

average concentrations for NO_2 as related to Schedule 2 of the Regulations is given in Table 3.6.3 and similarly figures for SO_2, CO, PM_{10} are given in Tables 3.6.4 – 3.6.6.

The EIS refers to dust deposition and refers to the different standards available. It states there are no statutory limits for dust deposition in Ireland, but the EPA Guidance suggests a rate of 10mg/m^2/hour as being considered to pose a nuisance and that a maximum level of 350mg/m^2/day is a recommended limit value.

The EIS stated that the area was monitored for hydrogen sulphide and the data is given in Table 3.6.8. It is noted that for one site, a level of 7.5 ug/m^3 was recorded which is at the recommended limit, the EIS suggests that concentrations can be attributed to traffic movement on a nearby main road. It states hydrogen sulphide is generated from side product reactions of exhaust emissions with catalytic converters on diesel engines.

The EIS refers to speciated VOC's which include alkanes, mercaptans, organic acids, aromatics and nitrogen containing organics and these can lead to the formation of odours. The EIS states that samples were collected at two locations across the proposed WWTP site locations A6 and A7 and at one location in the vicinity of each of the five pumping stations. The results of main VOC constituents are given in Tables 3.6.9 to 3.6.15.

The EIS states there are no statutory limits in Ireland for total volatile organic compound concentrations (VOC) but research data is said to suggest a concentration of less than 250 ug/m^3 is required to limit odour impact. The EIS states that the overall background level of speciated VOC's is generally low in the vicinity of all site locations.

The EIS states that in terms of odour the existing background would be dominated by the influence of the rural environment and to a lesser degree to coastal location. It states that no background concentrations of mercaptans or sulphur containing organics were detected and it states that the absence of such compounds suggest in general that odour air quality is good in the vicinity of the site.

The EIS refers to climate and refers to a report from the EPA on climate change.

Section 3.6.4 of the EIS deals with impact assessment and this refers in the first instance to air. Construction phase impacts are stated to be mainly windblown dust and a number of sources of dust from construction are identified. The EIS refers to a do-nothing situation and a worst-case scenario.

In relation to odour, the EIS states that odour impacts are not predicted during the construction phase. For operational phase impacts, the EIS states that a contractor would be required to meet the following criteria: -

- All sensitive locations located outside the 1.5 $Ou_e m^{-3}$ at the 98th percentile of hourly averages

- All sensitive locations located outside the 3.0 $Ou_e m^{-3}$ at the 99.5th percentile of hourly averages.

- Hedonic tone should not be considered pleasant on a scale greater than -2.

The EIS states that an odour modelling assessment was carried out for the WWTP and pumping stations **based on the specimen design** In relation to the WWTP, the stated requirements are repeated and the EIS states they were chosen to ascertain the level of proposed impact to the surrounding residential and industrial population in the vicinity of the works.

Figure 3.6.7 and 3.6.8 give the plotted odour concentrations for the 1.5 and 3.0 odour units' standard. It notes that in terms of the 99.5th percentile, the overall odour plumes have a radial spread of 75 metres in an northerly and easterly direction, while the 98th percentile contour is the predicted spread of 80 metres from the boundary of the facility in a northern direction.

The EIS refers to Figures 3.6.9 and 3.6.10 and states these give the odour plume spread for individual grouped odour sources to include odour control units and tankage odour sources. It states all other offensive odour sources would be covered, sealed and negatively ventilated and odorous air directed to odour controlled units It states that odour control units would not exceed 2,314 Ou_{ES}^{-1} and the total odour emission should be 6,611 Ou_{ES}. This is indicated also on Table 3.6.16 In Table 3.6.17 the predicted overall odour emission rates from the five major pumping stations in odour units per second are given and it is noted that the highest rate is from the West Beach Pumping Station in Cobh at 360 odour units per second.

The EIS describes climate and states in conclusion that due to the nature and scale of the development, it is considered that there are no impacts arising which could affect the general climate of the area, either regionally or locally.

Section 3.6.5 deals with **mitigation measures** and in relation to air during the construction phase the Construction Environmental Management Plan is referred to which would include a traffic management and dust minimisation measures It refers to speed restrictions and a speed limit of 20km per hour and also to stockpiling of materials and material handling systems. The EIS states that it is envisaged the proposed development would not have a significant impact on the surrounding air quality. It states that if the level of dust is found to exceed 350mg/m^2/day in the vicinity of the site, further mitigation measures would be incorporated into the construction of the proposed site.

During the operational phase, the EIS states that it is not anticipated that dust would be a significant problem and that there would not be a significant impact on the surrounding air quality.

The EIS states the construction phase would not give rise to odours while the operational phase, the EIS recommends a number of measures: -

- Odour management, minimisation and mitigation procedures at the WWTP and the pumping stations.
- Maximum allowable odour emission rate to be 6,611 $Ou_E s^{-1}$ with limits on odour emission rates from control units and requirements as to hedonic tone of the odour.
- Odour management systems at the pumping stations to be sufficient to prevent any uncontrolled fugitive odours.
- Maintenance of good housekeeping practices within the WWTP and the pumping stations.
- Avoidance of accumulation of floating debris in channels and holding tanks.
- Enclosure and sealing involved primary treatment, wet wells and sludge handling processes.
- Eliminate overloading and under-loading in the WWTP.
- Odour scrubbing technologies to be implemented
- Dispersion modelling to be provided by the contractor to demonstrate that emission values are being complied with.

In relation to climate, the EIS states it is envisaged that the facility would have no impacts on the regional or local climate.

Section 3.6.6 deals with residual impacts. In relation to air, the construction phase requires good working practices and mitigation measures are outlined In the operational phase, reference is made to traffic impacts it states that the net impact of the development would be a slight negative impact in relation to NO_2 and PM_{10}, but air quality would remain well within the Irish and EU legislative limit values.

In relation to odour, the EIS states that a worst-case odour emission scenario was modelled. It states that no odour impact would be perceived at sensitive receptors in the vicinity of the proposed scheme WWTP and it states that all residents and industrial neighbours would receive /experience an odour concentration at or less than 1.5 odour units per cubic metre for the 98^{th} percentile and less than 3 odour units per cubic metre for 99.5^{th} percentile.

In relation to the pumping stations, the conclusion in the EIS is that no odour impact would be perceived at sensitive receptors following the implementation

of good design in terms of odour management. It states that many of the pumping stations are located in populous areas and it states that for that reason the design of the collection system would include best practice and adequate odour management system to prevent odour complaint and impact

1.8 Noise and Vibration: - (EIS Pages 227 – 246)

In addition to the text, Figures 3.7.1 – 3.7.8 are included after Page 246. Section 3.7.1 gives an introduction which is followed by the methodology and refers to the maximum permissible construction noise levels at the façade of dwellings during construction. These range between and 60 and 70 dB on a one-hour average noise level. Table 3.7.2 gives the gradation of adverse noise impact as a function of construction noise level. It notes the EPA Guidelines set a nighttime limit of 45 dBA and a daytime of 55 dBA at noise sensitive locations. The EIS refers to noise impact descriptors (*reference to severity, perception categories*) and the consideration of indoor noise levels at nighttime. It also sets out the criterion for continuous plant and process noise emissions which it states would be at 45 dBA at 20 metres from the plant boundary. In relation to the criteria for daytime work activity noise emission, this is calculated to be 45 dBA at 134 metres to the east which is the nearest noise sensitive location.

Section 3.7.3 refers to the existing environment and states that at the WWTP site, the noise environment was determined primarily by distant traffic, agricultural machinery, and wind noise with a contribution from aircraft noise during daytime. Eight locations were chosen and these are listed in Table 3.7.3 which indicates noise levels (l_{aeq}) between 44 and 62 by day with the highest level, reference N8 being close to the existing N28 road.

Table 3.7.4 gives the daytime and nighttime noise surveys for the sites of the proposed major pumping stations. These range for daytime between 55 and 63. The level of 63 dBA at Carrigaloe has a daytime noise level due to local road traffic, ferry traffic and has a steady underlying background noise level of 49 dBA during daytime and 39 dBA at nighttime. It also states that minor pumping stations noise levels range from 44 to 69 dBA, depending on the local traffic flows. Table 3.7.5 gives the daytime short-term orientation noise surveys at the 20 proposed minor pumping stations and Table 3.7.6 gives the same data for nighttime.

Section 3.7.4 deals with impact assessment. The construction phase impacts at the WWTP are stated to be associated with site clearance and excavation. It states during the construction of the plant facility and equipment, noise emissions would be considerably lower. It states that the construction noise level in the sports field to the north-east of the site would be expected to be in the range of 50 – 55 dBA and would have negligible impact on outdoor activities in the area. In relation to excavation work for sewer lines, the EIS states that for houses set back 10 metres from the sewer line, noise levels could exceed 70 dBA for the short period during which works are in progress

immediately adjacent to the house. It states that beyond 50 metres, the noise levels would be less than 60 dBA. The EIS states that the construction noise would be audible above the existing ambient noise, but would not be considered intrusive in the context of the limit of duration of the works.

The EIS refers to the channel crossing at Carrigaloe and states that final details would not be available at this planning stage. It states that noise emissions from the works would be subject to the construction noise limits set out in Table 3.7.1 which refers to the maximum permissible construction noise levels.

The EIS states that the construction works at the pumping stations would be at a significantly reduced scale compared with the construction of the WWTP. It states that for Monkstown and West Beach, the noise level would be calculated to be 70 dBA at the nearest houses, while at Raffeen and Carrigaloe they would be comfortably within the 70 dBA criterion. These results are shown in Table 3.7.8.

The EIS states that vibration impacts would be comfortably within the vibration limits for protection against cosmetic damage. It states that construction traffic would have only a slight impact.

Referring to operational phase impacts, the EIS refers to Table 3.7.9 for predicted levels of noise from the WWTP and states they would be comfortably below the EPA daytime noise limit of 55 dBA. The EIS states that nearest lands zoned are residential to the east of the site, the ambient noise level is calculated to increase by 2dB. It states that the noise impact at that location would be considered to be negligible. The EIS states that at the existing houses to the east, north, south and west, the calculated additional WWTP noise would be 8-14 dB lower than existing steady background noise level and would be inaudible.

In relation to night-time operations, the EIS states the additional noise levels are all comfortably in compliance with the EPA night-time noise limit of 45 dBA. Table 3.7.9 gives the predicted noise levels from the WWTP and the noise impact assessment. The assessment ranges from negligible to none.

The EIS states that based on noise surveys carried out by ANV Technology at other WWTP's, it was found that there is no perceptible ground vibration beyond the site boundaries associated with the operating equipment. It states that at the proposed site, the nearest sensitive location is 134 metres to the east and the EIS states there is unlikely to any significant potential for audible ground-borne vibration over that distance.

The EIS states that noise sources would be effectively enclosed in pumping stations, but at Monkstown and West Beach (Cobh) it would be prudent to consider the potential for generation of ground-borne vibration in the audio frequency range

The EIS states that in the operational phase, estimates of likely site traffic are relatively low and the additional traffic would not add detectibly to the average traffic noise level.

Describing a do-nothing impact, the impact of the proposed realignment of the N28 road is noted as being relevant if no development took place.

Section 3.7.5 deals with mitigation measures. It states that during the construction phase of the WWTP, no special mitigation measures are likely to be required and it refers to BS5228 in relation to noise impacts relating to the pumping stations and sewer lines. A number of site management measures are noted also in the EIS.

Referring to the operational phase, it states that achieving the noise level design criteria would be the responsibility of the developer's design team and also that no significant residual impacts are envisaged.

1.9 Cultural Heritage: - (EIS Volume II, Pages 255 – 285)

Included in the text are tables indicating the archaeological constraints inventory of recorded monuments. In addition to the text, Figures 3.8.1 – 3.8.14 indicate townland boundaries, RMP sites and aerial photographs. Plates 3.8.1 – 3 8 5 are also attached at the end of the section.

The cultural heritage assessment was carried out by Aegis Archaeology Limited and a specialist report is in full in Volume III, Appendix 7A.

Section 3.8 2 sets out the methodology used including the review of published material and the field assessment including on-shore, off-shore and the marine crossing. It notes that an underwater dive assessment was undertaken across the River Lee at Monkstown covering a width of approximately 390 metres. It states that for the marine crossing, the maximum seabed coverage was obtained using a diver-towed survey methodology and that the current was in excess of five knots during both the filling and ebb tides and during the tide change, this reduced to approximately two knots. It notes the maximum water depth of 16.68 metres was recorded for the central channel. The EIS states that the proposed inter-tidal/foreshore locations were field-walked to assess their archaeological potential and a photographic record was made.

Section 3 8 3 describes the existing environment. It describes the historical overview of Cork and the lower harbour and commences with the early Mesolithic period commencing at 8000 B.C. and continuing through to the Neolithic, Bronze Age and Iron Ages. It notes that an archaeological site dating to the Neolithic and Bronze Ages was excavated on Foaty Island in 1992 which is outside the study area, but which revealed the pre-historic complex of human occupation and possible burial pits.

The medieval and later medieval periods are covered and the EIS describes two ringforts located in the vicinity of the pipeline route, reference **CH1** and

CH16 while **CH3** is a ringfort at Parkgarriff. It states that References **CH9** and **CH10** are probable examples of ringforts situated near the proposed location of the WWTP site. It refers also to Holy Wells and one at Ballyfouloo reference **CH4** was not located.

The EIS refers to the early modern period between 1700 and 1900 A.D. and refers to Martello Towers, stating that none of the towers or their zone of archaeological potential are predicted to be impacted. It refers to limekilns at Monkstown and Shanbally which are located within the pipeline route. The EIS also refers to flour mills built within the harbour area and the Cork, Blackrock and Passage Light Railway. The EIS states that the railway serving Crosshaven through Passage West to Carriggaline ceased functioning in the 1930's, but the remnants of the line are embankments and small bridges which are outflows of smaller creeks to the harbour and are cultural heritage features of the study area. One feature forms part of an amenity walk from Carriggaline to Crosshaven.

Table 3.8.1 gives details of the townlands within the study area.

The EIS states the field assessment was carried out in five sections for the on-shore section and these were Passage West and area, Carriggaline, Shanbally, Ringaskiddy and Cobh. The desk-based assessment included a list of finds recovered from the townlands within and adjacent to study area and these are given in Table 3.8.2.

In relation to the off-shore/inter-tidal assessment, the EIS states there are no archaeological sites listed in the RMP for the immediate vicinity of the marine pipeline crossing. It says the history of maritime activity within the area is well established and there is a list of vessels in a ship wreck inventory for that stretch of coastline. The EIS describes the area including the remains of the **Royal Victoria Baths** which it states have been derelict since 1929

The EIS describes the Owenboy River and states that to the east of Carrigaline it becomes a tidal with extensive mudflats flanking the river at low water. It states there is a possibility that the mudflat sediments would retain isolated archaeological features such as log-boats (dug-out canoes) or other craft. Table 3.8.3 gives a list of RMP for the foreshore pipeline corridor. The EIS states the Royal Victoria Baths has a historic rather than an archaeological significance and the pipeline corridor at the Owenboy River is also described as having a poor archaeological potential

Section 3.8.4 describes the environmental impacts and in relation to on-shore impacts, it refers to the vibration in the vicinity of the WWTP, but states that the impact would be imperceptible following the implementation of mitigation measures. The EIS states that impacts to known sites of archaeological value would be as follows: -

- Digging of trenches adjacent to zones of archaeological potential – CH9 and CH18. Reference Figures 3.8.10 – 3.8.14.

- Seventeen sites and their zones of archaeological potential may be indirectly impacted by the proposed pipeline.

- Digging of trenches in greenfield areas could potentially result in the permanent destruction of subsurface archaeological features.

In relation to **landscape** and in the context of cultural heritage, the EIS draws attention to the town of Cobh and refers to the visual impact from major pumping stations and states that the pumping station proposed for the West Beach at Cobh should be designed sensitively.

The inventory of recorded monuments predicted to be impacted is given in Table 3.8.4 and an architectural constraints inventory is listed on Table 3.8.5. The EIS notes that some wayside monuments were noted during the inspection and these refer to in Table 3.8.6 entitled "Further Potential Architectural Constraints within the Study Area".

Off-shore impacts are described in Page 282 of the EIS and it is recommended that direct impacts to the northern wing of the Royal Victoria Baths be avoided. The EIS recommends archaeological monitoring under licence to the DoEHLG during all riverbed / seabed disturbances associated with the construction of the marine pipeline between Cobh and Monkstown. It states the insertion of a pipeline along the upper foreshore of the Owenboy River does not represent a significant impact to the existing foreshore environment. The EIS notes that this foreshore has already undergone extensive modern alteration with the placement of flood protection measures and a concrete encased pipeline.

Section 3.8.5 describes mitigation measures and the EIS refers to the measure identified in Tables 3.8.4 – 3.8.7 and states these would be subjected to archaeological monitoring under licence by an archaeologist. The EIS notes that it is the remit of the National Monuments Section and the National Museum of Ireland to legally recommend any one or a combination of measures or to make additional recommendations in relation to mitigation.

The EIS details the recommended operation of the recommended monitoring programme and states that if the mitigation measures are implemented, there would be no residual impacts of significance arising from the proposed development.

1.10 Landscape and Visual Assessment: - (EIS Pages 305 – 321)

In addition to the text, Figures 3.9.1 – 3.9.3 are included as well as Plates 3.9.1 – 3.9.4.

The EIS sets out the methodology used including the criteria for assessing impact quality, magnitude and duration. It gives a description of the existing environment and defines the topography in the local area as having ridgelines that typically run east – west and forms rolling landscape. It states the local landscape is heavily influenced by the existing pharmaceutical complexes in Ringaskiddy and the Loughbeg area and to the west of the site there is a substantial ESB Substation and Bord Gais Pumping Station. It states the site is accessed by a gravel laneway that leads to the Bord Gais facilities. The EIS states that this lane passes between the ESB Substation to the north and a small industrial complex with two warehouses to the south.

The EIS states the site in an agricultural landscape, but the surrounding area contains historical references. The EIS refers to the landscape at Coolmore, but states that the WWTP would not have any direct or indirect impact on the character of Coolmore House and its grounds. A similar comment is made in relation to Raffeen.

The EIS states that the development has the potential to impact on two areas of amenity or recreation and refers to the **playing pitches at Shanbally** and the **public walks along the Owenboy River** which has direct views to the site for a short distance at Frenchfurze.

The EIS states the site is contained within a large zoned area which is referred as "suitable for large stand-alone industry with suitable provisions for buffer tree planting, minimum 20 metres wide along the northern boundary to residential areas and provision for public open space and to include three playing pitches".

The EIS states there are areas surrounding the site which are designated as scenic landscape and it refers to the Cork County Development Plan objectives and policies in this regard. Policies quoted are ENV 3 – 4 regarding the objective to preserve visual and scenic amenities, ENV 3 – 5 to preserve the character of all important views and prospects Specific routes mentioned are Scenic Route A – 54 Passage West to Ringaskiddy which do not have views of the site and Scenic Route A – 56 from Carriggaline to Crosshaven which has long range views of the site.

The EIS deals with visual envelopes and refers to views of the site. It refers to areas which have views of the site as follows: -

- **Strawhall** – Junction of the R610 Road – views to the site distinguished by the overhead power lines.
- **Loughbeg** – not possible to look into the site, possible that higher elements of the development would be visible.
- **Currabinny** – south-east – site screened by existing vegetation, but possible that higher elements would be visible.

- **Coolmore** – 2.3 kilometres to the south-east – intervening topography generally limit views to small glimpses of the overhead power lines.

- **Barnahely** – power lines visible but views of the site are screened by topography and vegetation.

- **Frenchfurze** – 3 kilometres to south – site partially visible from the Myrtleville Road.

- **Carrigaline** – views in the direction of the site generally screened by existing vegetation and buildings.

The EIS describes landscape character and states that any description should be cognisant of the strong identity of the harbour. It quotes a study on behalf of Cork County Council which states that notwithstanding the rural character, the tell-tale signs of urban intensity are evident everywhere through the prevalence of infrastructure such as roads, bridges and electricity power lines and the frequency of urban clusters.

On Page 312 there is a description of the development which it is noted were given in detail in Section 2.5 of the EIS

Section 3.9.4 deals with impact assessment and notes the requirement during construction to provide compounds, stockpiles, upgrading access roads and construction of pipelines and pumping stations.

The EIS states the construction of the WWTP would give rise to an appearance of disruption over the proposed site. It states the construction of the collection pipelines would result in short-term impacts on the landscape and that impacts to hedgerows would be longer in duration as replacement planting would take 3-4 years to establish. It states that in the short-term there would be slight negative impacts as a result of the construction of the pipelines.

Table 3.9.4 gives a summary of construction impacts on the landscape which range from **slight to significant negative** and most of the impacts are described as temporary in nature.

The operational phase impacts are referred to on Page 314. It states that the greater surrounding area is deemed capable of absorbing the development without changing the character of the urban fringe landscape. In relation to the scenic landscape on the Owenboy River, the EIS states that initial slight negative impacts would be reduced to imperceptible impacts as planting matured.

Table 3.9.5 gives a summary of the operational impacts on the landscape and notes that in relation to land cover, pasture land would be replaced with buildings and structures which would be in keeping with the mixture of

industrial development in the Cork Harbour area. It states the overall quality of the Cork Harbour area would remain intact.

On Page 316, the visual impacts of the WWTP on the various locations surrounding the site with distant views are noted. It states that if the proposed N28 is realigned, the visual impact from the road could be expected to be slight negative to imperceptible. In relation to the proposed housing to the east of the site, the EIS states that impacts would be expected to be slight negative initially reducing to imperceptible.

The EIS refers to cumulative impacts on states that consideration had been given to the impact of the proposed WWTP in conjunction with the proposed realignment of the N28, the proposed development of housing and the existing pharmaceutical complexes. It states that cumulative impacts would be avoided as a Waste Water Treatment Plant would not converge with existing or proposed developments, but would remain as small singular element within the urban fringe landscape.

On Page 318, the visual impacts of the pumping stations are described. These are as follows: -

- **Carrigaloe Pumping Station** – largely below ground with a small building at ground level. – Proposed to be finished in the style of a boathouse. The EIS states that on completion, the visual impact would be neutral, as the building would neither cause a deterioration nor improvement to the local view.

- **Monkstown Pumping Station** – largely underground with a small single storey building at ground level. The building is stated not to result in the loss of any views and would over time become an accepted element in the townscape.

- **Raffeen Pumping Station** – reclaimed land is involved and works would not change the existing shoreline. Design of the pumping station would be likely to resemble a boathouse in keeping with the boatyard which is 200 metres to the north. The EIS states that on completion, visual impact would be moderate negative, as the building would continue to disrupt views across Monkstown Creek, but would be in keeping with the adjacent boatyard.

- **West Beach Cobh Pumping Station** – located in reclaimed land between the piers along the shore front. Impacts to be mitigated by the appropriate design of the building and the paved open space over the holding tanks. The EIS states the overall aim of the design would be to enhance the West Beach promenade area and maintain public access to the waterfront.

Section 3.9.5 refers to mitigation measures and states these would be to reduce visual impact through minimising negative impacts and to assist a visual

integration of future development into the surrounds with an appropriate scale of planting for the WWTP.

The EIS states that the mitigation measures associated with the WWTP site are to plant native woodland around the perimeter of the site with particular reference to the north and to the west The EIS states that within 7-10 years, the planting would form a 10-12 metre high dense cover, thus screening the majority of the buildings.

In describing residual impacts, the EIS states that these should be assessed when the proposed planting has reached the level of maturity after 7-10 years. It states the boundary planting would represent a noticeable change in the landscape, but the selection of native woodland species would be in keeping with woodlands at Monkstown Creek and Currabinny and cause neutral impact to the surrounding rural fringe landscape.

1.11 Interactions: - (EIS Pages 329 – 342)

This section includes reference to the various interactions and also includes a list of references applicable to the EIS.

Section 4 1 deals with human being interactions with water quality, material assets and air quality and odour These interactions are listed in Table 4 1 and range from moderate to significant negative during the construction period for landscape and visual assessment to positive for water quality in the operational phase

Terrestrial and marine ecology interactions are referred to in Section 4 2 and in Table 4 1, these range from slight negative during the construction phase to positive for material assets and water quality in the operational phase.

Soils, geology and hydrogeology interactions are dealt with in Section 4 4 and there are also sections covering material assets, air quality, noise, cultural heritage and landscape and visual. Table 4 1 gives the range of these impacts with the moderate to significant impacts occurring for cultural heritage and landscape and visual during the construction phase and imperceptible negative for most other interactions

1.12 Appendices – Volume III of the EIS

Appendices are grouped in eight separate groups as follows: -

- No. 1 – Consultation and Proposed Design Layout.
- No. 2 – Terrestrial and Marine Ecology and Hydrodynamic Modelling Reports.

- No. 4 – Geophysical Survey, Bedrock Geology, Geological Heritage and Well Search Results.
- No. 5 – Air, Odour and Climate Reports.
- No. 6 – Noise and Vibration Reports.
- No. 7 – Cultural Heritage Report.
- No. 8 – Landscape and Visual Assessment Report

APPENDIX 1

Appendix 1A gives the consultation letter and consultee addresses.

There is also a copy of the request to the statutory consultees for a written opinion on the information in the EIS.

Included in this appendix is a written request to An Bord Pleanála in relation to information to be contained in the EIS. The appendix includes the response by An Bord Pleanála.

Responses from the Department of Communications, Marine and Natural Resources, the NRA, South-Western Regional Fisheries Board, Bat Conservation Ireland, Bird Watch Ireland, Commission for Energy Regulation, Department of the Environment, Heritage and Local Government, Eircom, EPA, Cork County Council, Irish Aviation Authority, Irish Whale and Dolphin Group, Marine Institute, the OPW, Port of Cork, Radiological Protection Institute of Ireland, Bord Gais and the South-West Regional Authority are included.

Appendix 1B gives a summary of the preliminary assessment of the potential environmental impacts at the two short-listed development sites which is dated 2004.

Appendix 1C gives land use zoning maps and proposed design layout.

APPENDIX 2

Appendix 2A is the terrestrial and marine ecology reported, dated January 7th, 2008. This report contains 95 pages and includes a number of tables, figures and photographs. In the executive summary, the EPA is quoted as stating that the **water quality in Cork Harbour is only moderate** and this is reflected in high nutrient levels associated with the occurrence of algal blooms. It also states that algal mat growths are recorded and there are anoxic conditions on some mudflats which are adjacent to sewage outfalls.

The report sets out the methodology used and gives details of the sampling stations with an extensive description of habitats. Table 11 gives surveys of core sampling taken at 19 stations.

The fish species mentioned for the harbour include the Atlantic salmon, river and sea lampreys and the European eel. Table 12 lists the fish species expected in areas affected by the proposed development and Table 13 refers to designated areas for bivalve mollusc production areas (oysters).

Water quality is discussed from Page 43 to 45 and on Table 15 there is an assessment of the trophic status of the main waterbodies of Cork Harbour for the period 1999 – 2003. It is noted that this ranges from unpolluted for the Lee River, intermediate for the Lee Estuary, Owenacurra River, North Channel of Great Island and Cork Harbour, while Lough Mahon and the Owenacurra Estuary are described as being eutrophic

The report describes the characteristics of the proposal and in Section 3.2.5 describes the environmental impacts. These are divided into operational and construction phase impacts and elaborate on the information in the main volume of the EIS.

Section 3.2.6 deals with mitigation measures and under the section on residual impacts, these are predicted to be minor negative and moderate positive. Photographs include the area of the plant, and locations where the pipelines would traverse. There are also photographs of the littoral and inshore areas.

In Appendix II to the report, the site synopsis for the Great Island Channel, Cork Harbour SPA, Monkstown Creek NHA and Owenboy River NHA are included together with maps of the designated areas. Other appendices include plant species lists, bird counts from Cork Harbour and marine habitat and macro-fauna assessment. Table A 6.5 – 6.9 refers to numbers and weights of macro-fauna recorded at the 15 sites investigated.

APPENDIX 3

Appendix 3 A – Hydrodynamic and Modelling Report.

The authors of the report are Professor J. P. J. O'Kane and Kevin Barry of the Department of Civil and Environmental Engineering of University College Cork. The report contains seven chapters and extends to 169 pages. It is dated December 2007. In the executive summary, the report refers to the **norovirus** which is the **winter vomiting bug** and is stated to be related to the consumption of raw oysters in some cases. It refers to the simple nitrogen cascade exerted on the harbour eco system by organic nitrogen, nitrate and ammonia.

Chapter 1 of the report gives details of previous studies and outlines the model assumptions.

Chapter 2 gives data sets which includes the bathymetric data, water levels, hydrodynamic outputs, river flows and the complete list is given in Table 2-1.

Chapter 3 refers to the "Old Head_2" model which is the larger of the two models and the boundaries of both models are indicated in Figure 3.1.

Chapter 4 gives the faecal coliforms results for the scenarios where there is no treatment and where there is treatment for the years 2010 and 2030. In this chapter, the maximum concentrations of faecal coliforms are indicated in Figures 4.1 – 4.5. The exercise is repeated for different tidal conditions.

Section 4.4 refers to the 15 points chosen for examination and it is noted that for Cobh, the difference between treated and untreated scenarios was the greatest, while the highest concentrations in the treated situation exist at the proposed outfall. Chapter 4 also includes sensitivity analyses for faecal coliforms and the 24hour decay sensitivity is given in Figures 4.46 – 4.60. Intestinal enterococci and escherrichia coli concentrations are also referred to.

Chapter 5 deals with the norovirus concentrations predicted for the different scenarios. The conclusion was that with treatment in place, there would be less than 20% of the maximum concentrations that would happen with no treatment for the entire harbour area (with the exception of the area immediately adjacent to the outfall). It states that for areas of the inner harbour, the improvement was much greater with the maximum concentrations been less than 5% of the untreated scenario.

Chapter 6 of the report deals with nitrogen results and refers to the kinetics of the cascade model. It notes that assumptions are made at the rate at which ammonia is nitrified to nitrate also notes concentrations of ammonia and nitrate can accumulate throughout the harbour and disperse within and outside the harbour.

Tables 6-2 to 6-4 give the maximum and averaged nitrate concentrations with the 15 points of interest and Figures 6.1 – 6.15 give plots for organic nitrogen, ammonia and nitrate for both treated and untreated conditions.

Section 6.6 of the report deals with sensitivity analyses which considers a more conservative nitrogen removal efficiency of the treatment plant and the results are given in tables and Figures 6.21 – 6.35. The conclusion in Section 6.7 states that the proposed scheme would reduce considerably the forcing and primary production in the inner harbour and in the North Channel behind Great Island. It states there would also be an improvement throughout the outer harbour with the possible exception of the immediate vicinity of the diffuser itself.

Chapter 7 is titled "Discussion and Conclusion" and summarises the conclusions in relation to faecal coliform results, norovirus results and nitrogen results. In Section 7.5, the report states that a large area outside the mouth of the harbour between Ballycotton and Oysterhaven gradually accumulates material discharged from the outer harbour on successive ebb

tides. The report states that a large anti-clockwise eddy was simulated outside the mouth during the ebb. It notes that it was not possible to indicate with confidence and precision what affect the proposed scheme would have on the concentrations of coliforms and norovirus in the coastal waters between Ballycotton and Oysterhaven. It states that the model does show a reduction in concentration.

Appendix A of the report deals with the calibration of the RP_2 Model.

APPENDIX 4

Appendix 4 A – Geophysical Survey

This report by Minerex Geophysics Limited is a 10-page report with a number of maps and figures included

The geophysical survey is for the site at Shanbally and it describes the geology of the report and the methodology used. It stated that 2D- Resistivity profiles were located to give coverage of the site. 16 survey locations are referred to in Table 1 of the report.

The summary interpretation given in Section 3.3 of the report describes a four layered earth model below the site with very thick overburden overlying clean limestone and mudstone bedrock lithologies. It states that layer 1 consists of a thin loose/soft overburden/topsoil deposit of about 3 metres thick. It states layer 2 is between 3 and 22 metres thick is interpreted as overburden rather than rock. It states that layer 3 is similar to layer 2 and has a thickness from 2 to 15 metres and likely to be made up of gravely clay, but could be fractured or broken mudstone or limestone. It states that layer 4 has high seismic velocities and the values indicate clean limestone.

The report recommends a number of boreholes to be drilled. Map 1 indicates the location of the geophysical survey and Map 2 gives the ground conductivity contour map. Figures 1 – 3 give the results and interpretation of the 2D – Resistivity and seismic profiles

Appendix 4 B – Bedrock Geology Summary

This report is titled "Geology of South Cork" and is a publication by the Geological Survey of Ireland.

Appendix 4C – Geological Heritage Correspondence

Contains correspondence from GSI and a table referring to 3 sites.

Appendix 4 D – Well Search Results

This report is in spreadsheet form and is based on a GSI groundwater database The boreholes are referenced with a note on the aquifer, details of the drilling where available and reference to yield.

APPENDIX 5

Appendix 5 – Air, Odour and Climate

This appendix is divided into three sections, namely Appendix 5 A on air quality, 5 B on odour and 5 C on climate change.

Appendix 5 A – Air Quality

Outlines the baseline air quality examined with reference to a number of parameters and states that currently the air quality is averaged good with levels of criteria and baseline odour below relevant Irish and EU limits Figure 11.7.1 gives the overview of the monitoring locations in the vicinity of the WWTP, while further figures show the locations of the monitoring carried out at the pumping stations.

Appendix 5 B – Odour Report

Carried out by Odour Monitoring Ireland and comprises 49 pages The scenarios referred to included construction of the WWTP using the specimen design with the incorporation of odour mitigation protocols and a second scenario with the odour emission rate from the proposed five pumping stations, including the incorporation of odour management systems.

The study concluded that the overall emission rate from the new drainage scheme would not be greater than that required under the impact criterion. This was calculated at 6,611 odour units per second.

In Section 3 of the report, the methods employed including calculations of odour emission and modelling overview are set and tables indicate odour annoyance criteria and the ranking of environmental odours including the hedonic scores for different operations.

The results of the odour dispersion modelling are discussed and this is in greater detailed than that given in the main volume of the EIS.

Section 7 sets out the recommendation which include odour management systems and the maintenance of good housekeeping practices, as well as the avoidance of accumulation of floating debris It also lists the requirement to seal all primary treatment processes and that monitoring should be carried out to confirm compliance with requirements.

Section 8 of the report gives indicators of odour plume dispersion for different conditions and different levels of odour from the plant and also from the five pumping stations

Section 9 is an appendix which gives the background information on odours pertaining to the impact assessment. It refers to odour emissions at wastewater treatment plants and details of standard practice for odour management plans. It also sets out general rules for reduction of odour emissions for wastewater treatment plants and also odour abatement and management systems and procedures. The report also gives tables which indicate checking procedures and recording for odour controls.

Appendix 5 C – Climate Change Report

This report was carried out by Odour Monitoring Ireland and is dated October 2007. It deals with expected climate change in Ireland and the impact of climate change in hydrology. It refers to the possibility of inundation with sea level rises.

The summary to the report states that there will be a significant decrease in summer precipitation and could lead to long-term depletions of groundwater storage. It states that mean sea level is expected to rise by 0 9 metres, but that storm surges could occur more than once yearly

APPENDIX 6

Appendix 6 A – Noise and Vibration Report

This report has 43 pages of text and was prepared by ANV Technology.

The report refers to the noise sensitive locations examined and details the methodology used. Figure 2 gives the layout of the drainage scheme showing the sewerage network and the major pumping locations. It states that the proposed WWTP site is located within a predominantly rural area and that the main contribution to the existing ambient noise level is from traffic noise on the N28

Section 2.3.1 deals with existing noise environment in the vicinity of the WWTP site and refers to sites N1 – N8 which are given in overview in Table 3 with expanded details given in Table 4 and 5. Table 6 and 7 gives the daytime and night-time noise surveys for the major pumping stations and the comments in relation to the locations include reference to local traffic, church bells ringing, construction noise, ferry crossing and noise from nearby streams.

Figure 3 on Page 16 of the report plots the measured noise levels at positions at the WWTP site and notes that the L_{aeq} figures are generally between 40 and 60 dBA. Table 8 gives short-term noise surveys at the sites of proposed minor pumping stations by day and Table 9 gives the same information for night-time.

The noise impacts of the development are described and this is divided into construction and operational phases. Figures 6 and 7 show noise contours for day and night-time operations.

The report also deals with mitigation and notes that no special mitigation measures are likely to be required for the construction phase. It states that the design noise criteria namely 55 dBA at 20 metres from the boundary for daytime and 45 dBA during night-time should be adhered to.

APPENDIX 7

Appendix 7 A – Cultural Heritage Report

Aegis Archaeology Limited prepared this report in 2007 and there are approximately 150 pages of text over nine chapters and also includes an appendix involving the underwater/Intertidal study. There are 24 figures and 51 photographs also attached.

The report covers the introduction, legislative framework and methodology of the study and notes that it was not known at the time of the assessment what side of the roadway the pipelines might take or if the pipes going to be placed in existing culverts or new service trenches. It also noted that due to the scale of the proposed development, only those recorded archaeological sites whose zone of archaeological potential is predicted to be directly impacted by the route have been included in the assessment.

Describing the existing environment, the report subdivides into five sections and aerial photographs and maps of each section are included in the report. The area is divided as follows: -

- **Monkstown and Passage West -** this includes five Cultural Heritage (CH) sites with Zones of Archaeological Potential (ZAP) impacted. Figure 19 on Page 102 gives the detail on an aerial photograph.

- **Carrigaline and environs** – six CH impacted and Figures 21 and 23 on Page 103/5 show the aerial photographs for the area.

- **WWTP at Shanbally** – three CH features on the periphery of the site are noted.

- **Ringaskiddy** – four CH features noted

- **Cobh and environs** – Figure 20 shows seven CH figures and a separate number is allocated for the town of Cobh which is CH 26.

From Page 39 to 48, 51 photographs relate to the cultural heritage features on the pipelines and also give a view of the fields in which the WWTP is proposed.

Chapter 4 of the report gives the archaeological and historical background of the various sections of the study area, including reference to transportation, activities, construction features of note and buildings. It also includes reports on recent archaeological excavations in the study area

Section 4.3 refers to townland and barony boundaries and there are figures included indicating these boundaries.

Section 4.4 describes the protected structures and Table 4 gives a list of the protected structures in the vicinity of the pipeline excluding Cobh Town Two of these are listed as being close to the proposed pipeline.

Chapter 5 of the report refers to constraints inventory, predicted impacts and suggested mitigation Table 5 gives an inventory of the various cultural heritage sites. Tables 6 deals with the architectural constraints inventory

Chapter 6 has discussion and overview and Chapter 7 is titled "The Conclusions and Suggested Mitigation Summary". The report states that visual impact in relation to pipelines is predicted not to be permanent, as they are to be buried It states pumping stations and the WWTP are predicted to have permanent visual impacts on a number of CH sites and suitable screening is suggested in those cases Tables 5 – 7 indicate the specific impact information for each site. The report states that in the event of the mitigation measures as detailed being implemented, there would be no residual impacts arising from the proposed development.

The appendix to the report is the ADCO Report which assesses the Intertidal/underwater locations in the study area at the Owenboy River and the ferry terminal crossing between Passage West and Carrigaloe. This report was produced by the Archaeological Diving Company Limited and is dated 20th October 2007.

The report states that the insertion of a pipeline between Cobh and Monkstown would result in a direct and significant impact to the existing riverbed/seabed environment. It states no archaeologically significant material, structures or deposits were encountered during the survey. It states that the pipeline along the upper foreshore at the Owenduff River does not represent a significant impact to the existing foreshore environment. Archaeological monitoring is recommended. As an appendix, a list of shipwrecks is given from before 1800

Figure 6 and 7 at the end of the report indicate the locations in which a number of photographs were taken and these are also attached.

APPENDIX 8

Appendix 8 A – Landscape and Visual Assessment Report

This report sets out the methodology used and the impact assessment criteria and describes the receiving environment. It lists the scenic landscape objectives and the designated scenic routes. It notes the views of the site in the same order as given in the main volume of the EIS. The visual impacts of the treatment plant are also dealt with from the various points at which views are available. The report also deals with visual impacts at pumping stations and notes that in relation to residual impacts, they should be assessed after 7 to 10 years when planting has reached a level of maturity. It states that as there are no short-range views from the south, then distant views would result in barely noticeable glimpses of the treatment plant.

In an appendix to the report, landscape specifications are given and a larger scale drawing of the visual envelope and photo locations is included which is similar to that in the main volume of the EIS. A number of photographs are also included indicating the impact of the proposed WWTP site