Dublin City Council
Comhairle Cathrach Bhaile Átha Cliath

Drainage Division, Environment & Engineering Department,
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24/4/2009

FAO:- Mr. Patrick Byrne
EPA
McCumiskey House
Richview,
Clonskeagh,
Dublin 14

Re: **Application for Discharge Licence Ref. No. D0034-01 - Ringsend Agglomeration**

Dear Mr. Byrne

We refer to our meeting in your office on 28th January 2008 and our letter to you dated 10th February 2009 outlining the further information required in support of the above application.

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Ringsend Wastewater Treatment Works (WwTW) represents a major regional infrastructural investment for Ireland, which provides a very high level of treatment and coupled with ongoing capital investments will continue to meet the region's needs into the future. We were delighted to read the media reports on 22/4/2009 about the dolphins in Dublin Bay, which is testament to the marked improvements arising from Ringsend WwTW.

The further information can be summarised under the following four headings:

1. Proposals re compliance with required standards for Total Suspended Solids (TSS).
2. Proposals re compliance with Total Nitrogen and Total Phosphorus standards
3. The impact of both the "primary" and "secondary" discharges on receiving waters.
4. An appropriate Assessment of the discharge on Natura 2000 sites.

1. Proposals Re TSS

As you are aware, Dublin City Council (DCC) is currently constructing an extension to the sludge treatment process. As part of this project, we will be adding three more surplus activated sludge (SAS) thickeners. This will double the SAS thickening capacity and reduce the amount of SAS that is co-thickened with primary sludge in the lamella settlers. Other facets of the extension project will improve process reliability, thereby reducing recycle loads to the lamella settlers. We are happy to report that the SAS thickener installation is proceeding ahead of schedule. The

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equipment submittals have been approved and procured. The foundations have been poured and are curing. We are currently anticipating commissioning of these facilities in **December 2009.**

While the sludge stream improvements will unquestionably reduce the loadings to the lamella settlers and hence to the sequencing batch reactors (SBRs), additional works may be necessary to take account of the wind effects on the SBRs which are affecting the TSS discharge standards. We propose to also reduce the wind impacts on the exposed upper level of the double-decked SBRs. These wind impacts increase turbulence in the SBR's during the settling and decant phases resulting in the carry over of solids in the treated effluent.

We are in contact with H R Wallingford in the UK and to arrange with them laboratory testing of prototype solutions. DCC and its consultants are meeting with H R Wallingford in the UK on 30th April to progress this laboratory testing. We will report back to EPA shortly after our meeting with Wallingford to further elaborate and to propose a firm schedule.

In summary with regard to TSS is that the three additional activated sludge thickeners are proceeding ahead of schedule and that the technical issues with the SBRs are being addressed.

This Section supersedes the Section dealing with TSS in our submission of 10/2/2009.

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2. Proposals re Total Nitrogen and Total Phosphorus Compliance

Dublin City Council, in conjunction with the EPA, is currently carrying out an extensive monitoring programme in Dublin Bay, funded by the DoEHLG, with regard to the draft European Communities Environmental Objectives (Surface Waters) Regulations 2008.

The UWWT Directive Regulations (SI 254, 2001) require that, if the Ringsend WwTW continues to discharge to the Liffey Estuary, nitrogen in all of its forms shall be reduced to an annual mean concentration of not more than 10 mg/l and Total Phosphorus shall be reduced to an annual mean concentration of not more than 1 mg/L.

Our consultants have explored a number of alternatives to bring the WwTW into compliance with nutrient limits in advance of the full Extension contract.

Phosphorus Control

In terms of treatment at the plant for phosphorous control metal salts can be added to the wastewater upstream of the primary clarifiers or to the SBR. The phosphorus would be removed by precipitation. If added ahead of the primaries, chemically enhanced primary treatment (CEPT) would also reduce TSS, and to a lesser degree BOD, loading on the overloaded SBRs. Alternatively, if added directly to the SBRs, there would be no decrease in BOD loading, but there may be a more direct improvement in effluent TSS concentrations.

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The negatives with implementing chemical treatment are: cost of chemical; increased sludge production and an increased cost to treat and dispose of the sludge. There will be insufficient capacity to treat the additional sludge until the ongoing sludge stream improvements are completed, but implementation of CEPT could be accomplished shortly, thereafter.

This arrangement is not desired as a long term improvement, because of the chemical use and the large quantities of sludge (perhaps as much as 20 tonnes dry solids per day) generated. In addition, the use of metal salts fixes the phosphorus chemically, making it less desirable for land application, which is currently the only means of sludge disposal. Because of the sludge production and disposal issues associated with chemical precipitation, biological phosphorus removal processes are favoured - albeit this would have to be augmented by chemical dosing in order to guarantee compliance with the discharge standard. However, the difficulty with biological removal is that additional process volume would be required - an obvious difficulty given the restricted nature of the site. Biological phosphorus removal would also need to be considered in conjunction with biological nitrogen removal.

Nitrogen Control

Our consultant's studies have shown that the existing facilities are limited in the degree to which they can nitrify. They have estimated the capacity assuming the water surface elevation of the upper tanks can be restored to their original design point and that the pre-react zone will be operated in an aerated mode. The capacity was converted to population equivalents (PE) for the sake of comparison with the commonly used rating parameter. They estimate the maximum achievable nitrification capacity - using the existing SBR's - to be 1.2 to 1.3 million PE during the winter months. The current average daily loading to the Works is approximately 1.8 million PE. A complicating factor is that there will be some nitrogen associated with the cell mass (TSS) in the final effluent. If the Works is in full compliance with the TSS standard, 35 mg/L, the solids will contain 2 to 3 mg/L of nitrogen as TKN. Thus, the soluble forms of nitrogen would have to be in the range of 7 to 8 mg/L to achieve full compliance. Citing limited nitrification capacity and residual TKN with the existing facilities they advise us that the standard of 10 mg/L will not be achievable unless significant additional capacity is provided for nitrification and subsequent denitrification.

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In order to bring Ringsend Wastewater Treatment Works into full compliance with all necessary regulations will require substantial works to be carried out and will mean that very significant costs will be incurred. It is necessary, given the current budgetary climate within the public sector that further detailed consideration is given to all available options in order to determine the most robust and cost effective solution that can be carried out in the shortest practicable timeframe.

DCC wishes to assure the EPA that it is making every possible effort to advance proposals for, and the implementation of improvement works which will achieve the objectives, as outlined above. These considerations will take some more time to complete and we set out the following timetable for this and for the works implementation:

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- Complete Treatment Options Analysis July 2009
- Prepare Contract Documents June 2010
- Procurement June 2011
- Construction and Commissioning June 2014

We would also point out that implementation of the above projects is entirely dependent on finance being provided to DCC in a timely manner by the DoEHLG.

3. Impact of Primary and Secondary Discharges on Receiving Waters

We enclose a disc and hard copy of a modelling study carried out by the Danish Hydrology Institute on the impacts of these discharges on Dublin Bay.
The methodology, assumptions and conclusions are all outlined within this report.

4. Appropriate Assessment of Impacts of Primary and Secondary Discharges on Natura 2000 Sites

We enclose the Appropriate Assessment carried out by our consultants following advice and consultation with both our Biodiversity Officer here in DCC and your Ms Karen Creed. The assessment follows the methodology outlined in the relevant DoE circular and agreed between the above parties.

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We trust that the above information satisfies your requirements. DCC would welcome an opportunity to meet the EPA to provide a complete briefing in relation to the issues outlined above - including details of the analyses carried out, and to answer any queries the EPA might have.

In the meantime should you require any further information or wish to arrange a meeting, please contact Mr. G. Doherty, 01-222 2930.

Regards,

P. Cronin

P. Cronin,
Executive Manager (Engineering)

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CDM

Dublin City Council
Comhairle Cathrach Bhaile Átha Cliath

DHI WATER & ENVIRONMENT

Modelling the impact of Ringsend Wastewater Treatment Works and Storm Overflow Discharge in the Liffey and Tolka Estuaries and Dublin Bay

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April 2009 **Final Report**

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Document Control Sheet

Client	Dublin City Council
Project	Ringsend Wastewater Treatment Works Extension
Report	Scope of Work and Data :Modelling of the Impact of Ringsend WwTW and storm overflow discharge in the Liffey and Tolka Estuaries and Dublin Bay
Date	April 2009

Project No: 67511	**Document Reference:** 67511/40/DG10 – S

Version	**Author**	**Reviewed**	**Checked**	**Date**
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Distribution	**Copy No.**
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1.0 Introduction

Dublin City Council (DCC) engaged CDM (Ireland) Ltd. (CDM) to undertake a study into the impact of existing Ringsend Wastewater Treatment Works (WwTW) and storm water overflow on the receiving waters of the Liffey and Tolka estuaries and Dublin Bay.

CDM subcontracted DHI (Danish Hydraulic Institute) to provide mathematical hydraulic and water quality modelling of the receiving waters using a MIKE3 model previously established for the Waste to Energy Plant at Poolbeg Study and further developed for a pre-feasibility study for a potential system of flood defence barrages in Dublin Bay.

The results of this study will form part of a Wastewater Discharge Licence application to the Environmental Protection Agency.

Dublin City Council as the lead authority with co-authorities Fingal County Council, South Dublin County Council, Dun Laoghaire-Rathdown County Council and Meath County Council applied to the Environmental Protection Agency in December 2007 for a Discharge Licence for Ringsend WwTW discharge and storm overflow (Reg. No. D0034-01). The EPA requested two sets of further information.

The purpose of this study is to fulfil some of the EPA requirements for additional information in relation to the discharge license application, namely:

- To assess the impact of the existing primary discharge (SW1).
- To provide details of modelling and discussion of the impact of the discharge and comparison with relevant water quality standards, discussion of any limitations of the model and inclusion of relevant drawings.
- To assess the impact of discharges from SW2 (Storm Water Outfall).

This document presents the final report of the modelling undertaken and the results obtained. The report is structured as follows:

Section 2.0: Overview

Section 3.0: Executive Summary

Section 4.0: Available Data

Section 5.0: Approach

Section 6.0: Results

Section 7.0: References

Appendices: Data and Results

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2.0 Overview

This study was conducted to assess the impact of the Ringsend Wastewater Treatment Works (WwTW) on the receiving waters. Ringsend WwTW receives wastewater from throughout the Greater Dublin urban area, treats it and discharges it to the Liffey Estuary through an outlet (SW1). In times of very heavy rainfall, the flows reaching the treatment plant are too large to treat immediately and in such events some of the flow is diverted to storm overflow tanks for temporary storage until they are pumped back to the plant for treatment. In rare cases of extreme rainfall, the storm overflow tanks may reach their capacity, at which point excess wastewater spills into the Liffey via -SW2.

The Ringsend WwTW is operating well for certain substances and where problems with other substances exist, these have been identified and enhancements to the Works are being assessed. The European Union Water Framework Directive was enacted in 2000 demanding that Member States across Europe have a more consistent and holistic approach to water management. New legislation has been and will be enacted in Ireland to meet these requirements. The Wastewater Discharge (Authorisation) Regulations 2007 (S.I. No. 684 of 2007) require all discharges to waters to have a license. The model was simulated to show the impact of discharges from SW1 and SW2 on receiving waters

This modelling was conducted as part of Dublin City Council's application for a Wastewater Discharge License from the Environmental Protection Agency (EPA) for Ringsend Wastewater Treatment Works and associated storm overflow. The application is based on data that covers a 12 month period from the 1 November 2006 to the 31 October 2007.

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Model

A number of different two week scenarios were modelled to characterise the impact of the plant during periods which include extreme discharge conditions. The simulations assessed the impact of:

- A high concentration wastewater discharge during the winter season from both SW1 and SW2
- A high concentration wastewater discharge during the summer season from both SW1 and SW2 in the bathing season
- An extremely high concentration wastewater discharge from SW2 with a normal discharge from SW1.

Results

The results generally showed that for the scenarios modelled the impact of the SW1 and SW2 overflow for substances that cause a reduction in oxygen in the estuary (Biochemical Oxygen Demand), suspended particles (Total Suspended Solids) and Faecal Coliforms (Escherichia Coli (E.Coli)) is largely restricted to the Liffey and Tolka estuaries.

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SW1 and SW2 discharge of nitrogen and phosphorus parameters (Molybdate Reactive Phosphorus and Dissolved Inorganic Nitrogen) were found to impact both the estuaries and a section of Dublin Bay.

The effect of wind was also modelled with varying winds representative of the wind directions and speeds experienced in the last ten years in Dublin. The effect of these wind conditions was not very significant and in most cases only slightly altered the results of simulations without wind, by reducing the spread of the substances modelled.

It should be noted that the model was run with SW1 and SW2 discharging into estuary and bay waters with assumed zero concentrations of pollutants. The purpose of this was to be able to identify the impact of SW1 and SW2 alone. Whilst these results might show that the plant alone is not causing failures of the legislation outlined below, it is possible that when the background quality is considered, the cumulative effects may exceed the standards set.

It should also be noted that the legislation below applies to a year or an entire bathing waters season of data, not just a two week period. It should also be noted that the scenarios modelled are relatively extreme and by their nature, these 'high concentration' scenarios are above average.

Impact of the existing primary discharge (SW1) and the storm overflow (SW2)

When the impact of the WWTW discharge (SW1) was compared to the storm overflow (SW2) it was found that during heavy rainfall, SW2 can have a much bigger impact on the estuaries and bay than SW1. However when the rainfall ceases, and the spill from SW2 ends, the model predicts that the impact is quickly diluted. Overall the impact of both SW1 and SW2 over the extreme two week scenarios modeled was found to be similar.

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3.0 Executive Summary

The study was conducted using a 3 dimensional model (MIKE 3 FM) that was established by DHI for the Dublin Waste to Energy study (WTE)[1] and the 2030 pre-feasibility study of a potential system of barrages in Dublin Bay[2]. The model simulates the water levels, currents, salinities , temperature and certain water quality parameters of the Liffey Estuary, Tolka Estuary and Dublin Bay.

This modelling was conducted as part of Dublin City Council's application for a Wastewater Discharge License from the Environmental Protection Agency for Ringsend Wastewater Treatment Works and associated storm overflow. The application period covers data from the period 1 November 2006 to the 31 October 2007.

Wastewater discharges were simulated from the Ringsend WwTW (SW1) and the adjacent Storm Overflow (SW2) as shown in Fig. 1.

Figure 1: Ringsend Wastewater Treatment Works and Storm Overflow Discharge.

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1. The following nutrient and bacteriological effluent discharge substances were modeled with simple decay. The Total Suspended Solids simulations were simulated using a sediment transport approach which models the suspended solids as fine sediments with characteristics similar to cohesive sediment. Total Suspended Solids (TSS)

2. Biochemical Oxygen Demand(BOD)

3. Faecal Coliform (summer simulations only)

4. Dissolved Inorganic Nitrogen (DIN)

5. Molybdate Reactive Phosphorus (MRP)

ESB cooling water thermal discharge was including in the monitoring and as the effects of wind.

Three two week scenarios were modelled as indicated in Table i below:

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Table i: Sequence of Simulations

No.	Scenario	Wind	No. Storm Overflow Spills	Discharge Data Period	Boundary Condition Period
1	Summer Two Week	No	8	10 – 25 June 2007	12 – 26 Sept 2002
2	Winter Two Week	No	2	1 – 15 Dec 2006	1 – 15 Feb 2006
3	Summer Two Week	Yes	8	10 – 25 June 2007	12 – 26 Sept 2002
4	Winter Two Week	Yes	2	1 – 15 Dec 2006	1 – 15 Feb 2006
5	Extreme Storm Event	No	6	5 – 20 Aug 2007	12 – 26 Sept 2002
6	Extreme Storm Event	Yes	6	5 – 20 Aug 2007	12 – 26 Sept 2002

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Results of the simulations were compared with:

- The Draft European Communities Environmental Objectives (Surface Waters) Regulations 2008 drafted in September 2008 and not yet enacted (" Draft Environmental Objective Regulations"). They set physiochemical Environmental Quality Standards (EQS) for transitional and coastal waters under the Water Framework Directive with the aim of achieving Good Status in all waters;
- Quality of Bathing Waters Regulations, 1992 (S.I. No. 155 of 1992); and
- Water quality standards under the Blue Flag Programme for Beaches.

Overview of Results

The results generally showed that the impact of the WwTW outlet and storm overflow for BOD, TSS and the Faecal Coliforms is largely restricted to the Liffey and Tolka estuaries. Discharge parameters MRP and DIN impact both the estuaries and Dublin Bay.

1. **TSS:** The impact of TSS on the two week simulation was found to be local to the mixing zone. It is important to state that the TSS can be resuspended and spread over a long period and that the effect shown in the model is a short term effect. Over a long period TSS will become part of the sediment budget in the area.

2. **BOD:** For BOD the draft EQS for the estuaries was only exceeded in the mixing zone immediately adjacent to the discharge outfalls after which dilution occurs.

3. **Faecal Coliform:** For Faecal Coliforms the Bathing Water Standards were again only surpassed in the mixing zone immediately adjacent to the discharge outfalls

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and entirely within the estuary. The receptors in this case, the four Bathing Water Beaches in Dublin Bay were not impacted by the modelled scenarios.

4. **DIN:** The model shows dispersion of DIN from the outfalls into the Liffey Estuary, Tolka Estuary and reaching in some cases the North Bull Island Estuary. Under the Draft Environmental Objective Regulations no EQS was set for transitional (Estuarine) waters. The model results show exceedances of the EQS for coastal waters around the mouth of the Liffey.

5. **MRP:** The Draft Environmental Objective Regulations were exceeded in the Liffey and Tolka estuaries for MRP. Under the Draft Environmental Objective Regulations no EQS was set for coastal waters.

It should be noted that simple impact modelling was conducted and, therefore, background monitoring data was not included. Whilst these results may show that a parameter discharging from the WwTW does not surpass the EQSs discussed, when the background concentrations in the receiving waters are considered, the discharges may be causing an impact or an exceedance of that standard. Appendix E shows background concentrations of DIN and MRP in the Tolka and Liffey Estuaries as monitored by CDM for DCC (December 2008– March 2009).

It should also be noted that the results are for the simulations delineated in Table i. On this basis the results show the effects of periods of high discharge and loadings and not the everyday running of the plant. The legislation above applies to a full year of data, in the case of the Draft Environmental Objectives Regulations, 2008 or a full bathing water season in case of the Bathing Water Regulations, 1992 or the Blue Flag Programme for Beaches.

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Impact of the existing primary discharge (SW1) and the storm overflow (SW2)

The existing primary discharge, SW1, is continuous and of a lower bacteriological level, nutrient and physical loading than SW2. The discharge from the storm overflow is discontinuous with a high bacteriological, nutrient and physical loading. During storms there will be periods when the storm overflow SW2 has a much larger impact than the Ringsend WwTW discharge point SW1. However it was found that the time averaged impact of SW1 and SW2 are of the same order of magnitude.

Two types of result files were created during the modelling; maximum concentration plots and exceedance concentration plots (Appendix C and D). Maximum Concentrations show the absolute maximum results that occur at each point in the estuary over the entire 2 week simulation period; exceedance concentration plots compare the model results over the 15 day simulation period to a set limit. If the maximum concentration plots are considered then SW2 has a larger impact compared to SW1 however if one considers the exceedence frequencies shown in the exceedance concentration plots, then the impacts of both outlets are similar.

Maximum concentration plots display maximum points in time where exceedance concentration plots show the percentage of time within an entire simulation that a

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set standard is surpassed. This implies that, for the periods simulated, whilst a spill at SW2 can have a more significant impact in terms of loading at the time of the spill, the impact of both SW1 and SW2 are similar when the entire simulation period is considered.

Since the simulations show periods of significant activity at SW2 (16 of the 24 spills in sample period October 2006 – November 2007 are modelled in these simulations), it is likely that over the course of the year SW2 has a lesser impact that SW1.

Limitations of Model

Whilst the model was thoroughly calibrated against available data in the Liffey estuary including water levels, currents, temperature, salinity and thermal plume extensions, this exercise is subject to some limitations:

- The background concentration of parameters was not modeled
- The use of constant decay rates omits the effects of natural transformation processes.

Additionally it should be mentioned that whilst wind effects have been modeled and have shown little effect, the model has not been thoroughly calibrated for wind.

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4.0 Available Data

The Poolbeg Peninsula with the locations of the principal discharges and sampling points are shown above in Figure 1. The primary Ringsend WwTW Discharge is shown as SW1 on Fig 1. It discharges into the ESB cooling water channel where it mixes with the cooling waters from the ESB power generation station before flowing over a weir at approximately MSL (Fig. 2). The WwTW storm overflow tanks discharge upstream of SW1 at SW2 over an elevated weir. Whilst flow from SW1 is continuous, SW2 is, by its nature, largely discontinuous.

4.1 Data Period

The original application for a Wastewater Discharge License to the EPA in December 2007 used a full year of data from the 1 November 2006 to the 31 October 2007. To ensure consistency this data set will be used in the modelling.

4.2 Outlet Structure

Wastewater from Ringsend WwTW is discharged directly to a mixing channel at the point indicated SW1 Dublin Primary Discharge Outfall in Figure 2 below. This channel was originally constructed by ESB as cooling water discharge channel. The wastewater is released through a line of 10 diffusers.

The original design of the structure is to allow cooling waters and wastewater discharge to mix and then be released over a quarter circle weir of diameter 96m. Whilst an exact height for the weir could be not found, an ESB Thermal Plume Survey obtained by the project team (22825/67511/30/MM10) lists the 'lip level (as) being half way between high and low water marks', this has been interpreted as Mean Sea Level (+2.41m to chart datum).

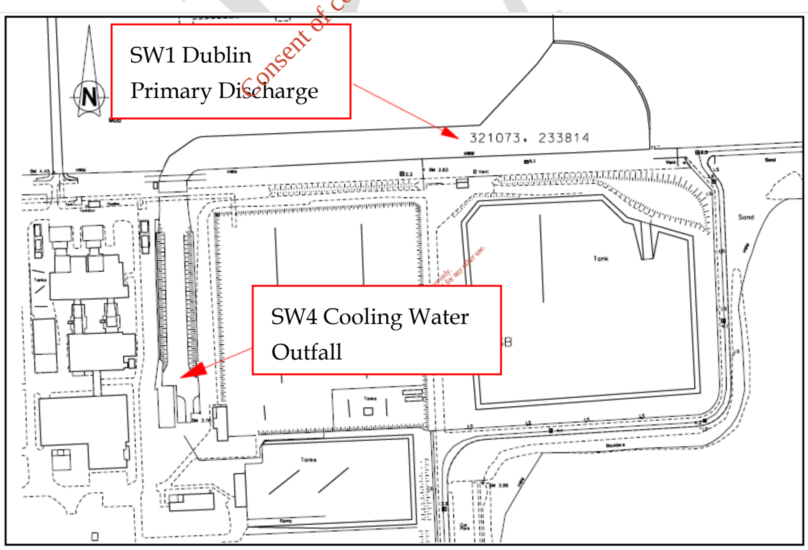

Figure 2: The outlet weir structure where mixing of ESB cooling waters and WwTW discharge occurs before release to Dublin Bay. Indicated in red are discharge locations and sampling points.

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4.3 ESB Cooling Waters

Water is abstracted from the Liffey Estuary by the ESB Power Generation Station for use as cooling waters. The Cooling Waters have an elevated temperature so they have two impacts on the WwTW discharge; dilution and increased buoyancy.

ESB Cooling Water Discharge

CDM met with Mr. O'Gadhra, the ESB Power Generation Service Manager of the Poolbeg Power Station (22825\67511\MM10).

There are currently two power generation plants at Poolbeg; the Thermal Plant and the Combined Cycle Gas Turbine (CCGT). The CCGT is run continuously whilst the Thermal Plant is only used during periods of peak demand. The CCGT is serviced by 2 Cooling Water (CW) Pumps at $5m^3/s$ flow each, which gives a continuous base CW discharge of $10m^3/s$. When the Thermal Plant is used it is serviced by either 2 CW pumps at $4.5m^3/s$ ($9m^3/s$ total) or 1 CW pump at $7m^3/s$ with 1 at 4. $5m^3/s$ ($11.5m^3/s$ total). The Thermal Plant is due to be decommissioned on the 31st March 2010.

The CW flow, therefore, currently varies from a minimum of $10m^3/s$ to $21.5m^3/s$. From April 2010 onwards there will be a constant discharge of only $10m^3/s$ from the plant. A low discharge leading to the least dilution would be a worst case scenario. *A constant discharge of 10m³/s was, therefore, selected for use in the model.*

ESB Cooling Water Discharge Temperature

An ESB Cooling Water dataset (22825\67511\MM10\ MM10 Attch 2) was provided to DCC with 1 year of CW discharge temperature data from 1 November 2007 – 31 October 2008 (excluding June 2008) for the Combined Cycle Gas Turbine (CCGT). The temperature of the water increases as it passes through the plant by a measured temperature differential (ΔT).

$$\text{Temperature } CW_{out}\ (^{o}C) - \text{Temperature } CW_{in}\ (^{o}C) = \Delta T$$

The dataset provided includes occasional forced power outages. Power outages are identified in the dataset as periods with a Δt of less than 2°C, these were removed from the dataset before it was used for statistical analysis.

The temperature of the cooling water affects the buoyancy of the pollutants and hence the transport and dispersion rates. There is no relationship between the Cooling Water flow rates and its temperature and so an average ΔT was calculated for use in the model. Statistical analysis of CW Δt showed values predominantly fall within the 6°C - 8 °C range. Table 1 shows the minimum, maximum and average ΔT at the plant. *The average of 7.6 °C will, therefore, be used in the modelling.*

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Table 1: Temperature Differential of ESB Cooling Waters

Annual Temperature Difference (ΔT) (°C)		
Min ΔT	Max ΔT	Average ΔT
2.38	15.64	7.61

4.4 WwTW Discharge loadings

Simulation Criteria

The model has been established for boundary conditions lasting two weeks covering both spring and neap tides. It is , therefore, necessary to select discharge data sets of two week durations for each model simulation. Three two-week periods were selected after analysis of the data sets to meet the following criteria:

Faecal Coliform is only monitoring during the bathing water season (summer).

Periods including storm water overflow from Ringsend WwTW

Periods of high loading

Due to the lower temperature of the influent wastewater in the winter months, treatment using biological processes within the WwTW tends to be less efficient. For this reason a winter period should be considered.

Laboratory Data

The parameters to be modeled include the parameters most representative of Wastewater Treatment Works Discharges as follow:

- TSS
- BOD
- Faecal Coliform
- DIN
- MRP

Monitoring data from the Ringsend WwTW was provided by the operator, Celtic Anglian Water. Two laboratories monitor effluent at the Works, City Lab Analysts and the DCC Central Laboratory. City Lab Analysts conduct the sample analysis for both the Storm Overflow and the WwTW Discharge on a more regular basis than DCC. For this reason the results from City Lab Analysts were predominantly selected. MRP and DIN are monitored uniquely by DCC Central Lab and , therefore, the Central Lab dataset was used for those two parameters.

The parameter sampling results for the three selected periods are shown in Appendix A. Linear interpolation has been used to bridge data gaps. Grab

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samples are taken during storm water overflow events. The grab samples are used for analysis of BOD, COD, TSS, E Coli, and Faecal Streptococci. In order to simulate the concentrations of MRP and DIN from the storm overflow, WwTW inflow data will be used.

Storm Overflow Events

Ringsend Wastewater Treatment Works has six storm overflow tanks with a total capacity of 58,600m^3. The flow readings of spills from the Storm Overflow Tanks are instantaneous, the readings are then summed to a daily total in m^3/day and the data is stored as daily totals. For this reason the spill volume is known but the spill duration is unknown.

During certain storm events water is diverted from the WwTW to the storm tanks. In cases of extreme flow this results in an overflow from the storm tanks to the Liffey Estuary at the point labeled SW2 on Figure 1. We can assume that the flow from the storm tanks back to the WwTW only occurs after extreme flows to the WwTW have reduced and the storm event has ended. Table 4 shows the flow to the storm tanks during storm events in the study period, any overflow that may have occurred and the flow that returned to the WwTW on a daily basis.

For most of the storm overflow incidents, there is significant return flow to the WwTW on the same day. This would indicate that the overflow lasted less than 24 hours. In the absence of detailed datasets we have , therefore, assumed that the spill events are of 12 hour duration.

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Table 2: Storm Tank Effluent Flow and Return Flow to WwTW

Date	Flow to Storm Tanks	Storm Tanks Overflow	Storm Tank Return Flow to WwTW
	m^3/d	m^3/d	m^3/d
1-Dec-06	o/s	0	9,281
2-Dec-06	o/s	0	12,657
3-Dec-06	o/s	0	0
4-Dec-06	o/s	0	10,058
5-Dec-06	o/s	0	21,759
6-Dec-06	o/s	0	15,515
7-Dec-06	o/s	21,174	19,366
8-Dec-06	o/s	0	54,202
9-Dec-06	1,777	0	10,497
10-Dec-06	3,373	0	1,166
11-Dec-06	15,088	0	17,545
12-Dec-06	1,332	0	0
13-Dec-06	1,863	0	0
14-Dec-06	55,128	0	859
15-Dec-06	73,842	49,227	23,287
10-Jun-07	4,198	0	1,882

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11-Jun-07	19,853	0	6,479
12-Jun-07	78,878	13,091	21,515
13-Jun-07	71,428	40,212	33,776
14-Jun-07	63,913	34,871	34,012
15-Jun-07	57,735	41,231	27,510
16-Jun-07	1,319	0	41,561
17-Jun-07	1,308	0	7,970
18-Jun-07	1,309	0	0
19-Jun-07	66,363	13,735	0
20-Jun-07	8,193	4,134	23,600
21-Jun-07	14,216	0	23,841
22-Jun-07	128,881	81,855	19,603
23-Jun-07	16,974	4,588	22,042
24-Jun-07	0	0	31,411
25-Jun-07	1,427	0	13,157
5-Aug-07	370,514	343,407	0
6-Aug-07	98,331	81,404	14,650
7-Aug-07	19,355	8,222	58,764
8-Aug-07	18,256	0	33,274
9-Aug-07	6,544	0	5,782
10-Aug-07	2,572	0	5,046
11-Aug-07	10,126	0	5,304
12-Aug-07	4,950	0	173
13-Aug-07	1,973	0	0
14-Aug-07	73,358	25,311	70
15-Aug-07	79,063	63,045	33,234
16-Aug-07	1,210	0	39,699
17-Aug-07	2,956	0	1,560
18-Aug-07	36,075	0	25,617
19-Aug-07	1,723	0	12,525
20-Aug-07	159,542	77,091	53,386

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Selected Simulation Periods
Three two-week periods were selected for simulation in the model to meet the criteria listed above:

Table 3: Selected Period Simulation Criteria

No.	Simulation Periods	Time Frame	Average Parameter Concentrations	Storm Overflows
1	Elevated Seasonal Parameter Loadings from WwTW with simultaneous Storm Tank Overflow Events (Winter)	1 December 2006 – 15 December	Above to significantly above average annual loadings for most parameters (Table 4).	Two Storm Overflows during the two week period (one week apart) (Table 5).
2	Elevated Seasonal Parameter Loadings from WwTW with simultaneous Storm Tank Overflow Events (Summer)	10 June 2007 – 25 June 2007	Average to slightly above average loadings for most parameters (Table 4).	Eight Storm Overflows during the two week period the largest of which, at 81,855m^3/day, is the fourth largest spill during the data period (Table 5).
3	Extreme Storm Overflow Event	5 Aug 07 – 20 Aug 07	Above to significantly above average annual loadings for most parameters (Table 4).	Six Storm Overflows during the two week period including the annual largest spill of 343,407m^3 (Table 5).

Table 4 shows average loading during the selected periods. Table 5 shows the average flow from the storm overflow during the two selected weeks and an annual average.

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Table 4: Average Loadings from Ringsend WwTW Effluent Discharge (SW1) for the selected simulation periods.

	Laboratory	Ringsend WwTW Effluent Discharge (SW1) Parameter Loadings (t/d) City Analysts			DCC Central Lab	
Simulation Periods (Seasonal/Annual Averages)	Date	BOD	TSS	NH 3-N	DIN	MRP
1. Winter 2 week	1 Dec 06 - 15 Dec 06	15.4	30.1	1.9	6.2	0.8
2. Summer 2 week	10 June 07 - 25 June 07	5.0	6.4	1.2	5.9	1.7
3. Extreme Storm Water Spill Event	5 Aug 07 - 20 Aug 07	6.2	8.3	1.1	5.8	1.4
(Annual)	1 Nov 2006 - 31 Oct 2007	7.0	11.8	1.3	6.1	1.14
(Winter)	01 Dec 2006 - 28 Feb 2007	11.5	20.5	1.6	6.0	0.98
(Summer)	1 May 2007 - 31 July 2007	4.6	6.9	1.0	5.5	1.20

Table 5: Average flow from Storm Overflow at Ringsend Wastewater Treatment Works (SW2)

		Storm Overflow (SW2)	
Simulation Periods (Annual Average)	Dates	No. Spills	Range of flow during spill (m^3/day)
1.Winter 2 week	1 Dec 06 - 15 Dec 06	2	21,174 – 49,227
2. Summer 2 week	10 June 07 - 25 June 07	8	4,134 – 81,855
3. Extreme Storm Water Spill Event	5 Aug 07 – 20 Aug 07	6	8,222 – 343,407
(Annual)	1 Nov 2006 - 31 Oct 2007	24	1,729 – 343,407

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4.5 Wind Speed and Direction

ESB cooling waters which have an elevated temperature are mixed with the Ringsend WwTW effluent discharge before release to Dublin Bay. The elevated temperature of the mix can result in buoyancy of the effluent over the cooler estuarine waters. The model to be used is a three dimensional (MIKE3) model of Dublin Bay. Using a 3D model the effect of this buoyancy can be studied. The effect of wind on the buoyant discharge plume could be significant. For this reason we will run the simulations with and without wind.

Figure 3 shows a ten year wind rose for Dublin Airport Met Eireann Synoptic Station. It indicates the percent frequency of wind directions during this period. It shows a strong westerly and south westerly wind influence. The station, and Dublin itself is thought to be protected from southerly winds by the Dublin Mountains.

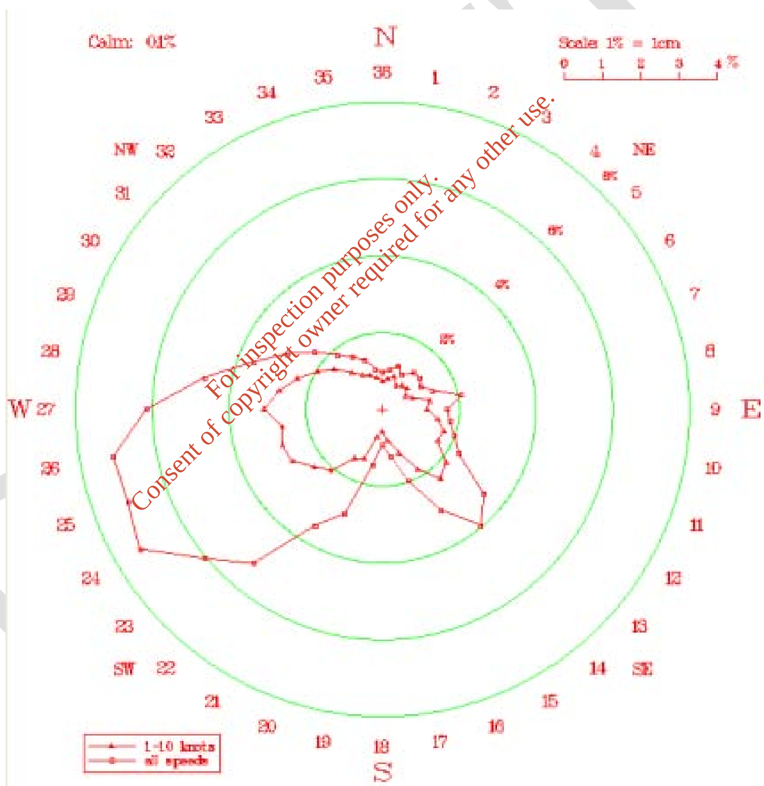

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Fig 3: Wind Rose for Dublin Airport based on 1999-2009 Data

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A 2001 wind speed and direction dataset was provided to DCC. This was used to create a unique one year wind rose shown in Fig 4. This was used as a basis of a 15 day wind time series, shown in Table 6, used in the model to simulate the most frequent wind speeds and directions.

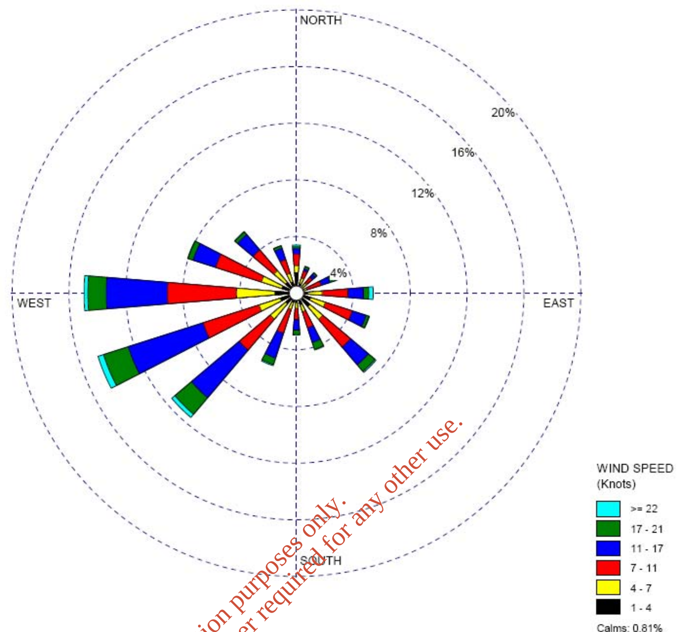

Figure 4: Wind Rose for Dublin, 2001.

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Table 6: Wind Speed and Direction for Model Scenarios with wind.

Day	Tide	Wind Direction	Speed (m/s)
Day 1	I	SW	10
Day 2	I	W	7.5
Day 3	S	SW	7.5
Day 4	S	SW	10
Day 5	S	W	5
Day 6	S	W	7.5
Day 7	I	S	7.5
Day 8	I	SSW	5
Day 9	I	SW	10
Day 10	N	W	7.5
Day 11	N	SW	7.5
Day 12	N	SW	10
Day 13	N	W	5
Day 14	I	W	7.5
Day 15	I	S	7.5

Tide Key S = Spring ,N= Neap;I = Intermediate

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4.6 Description of existing model

A thermal model using DHI's 3D model system, MIKE 3 Flexible Mesh (FM), was set up for the area during the "Dublin Waste to Energy" (WTE) study. The geographical coverage of the model includes the Liffey estuary (upper and lower), Tolka estuary and the Dublin Bay area in order to ensure a correct prediction of the circulation of the area. The boundary of the model is shown in Figure 5 with applied bathymetry from C-Map™.

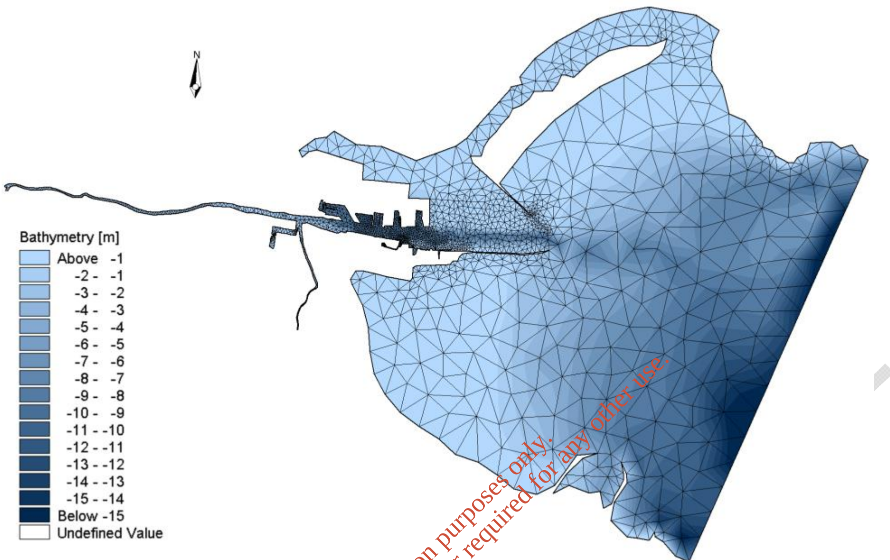

Figure 5: Boundary and bathymetric data of the Dublin WTE study thermal model.

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MIKE 3 FM is applicable for analysing free-surface flow hydrodynamics and heat dispersion in coastal areas and seas. The MIKE 3 FM flow model is a 3D model based on an unstructured flexible mesh and uses a finite volume solution technique. The meshes are based on linear triangular elements. This approach allows for a variation of the horizontal resolution of the model mesh within the model area to allow for a finer resolution of selected sub-areas. The flow in the Liffey and Tolka estuaries varies both vertically and horizontally and , therefore, a 3D model capable of calculating the buoyancy effects due to salinity stratification and the thermal plumes is required.

The vertical model resolution was based on a discretization in layers of varying thicknesses. The so-called sigma layers. The number of layers is the same all over the model area, regardless of variations in water depth and water level. The principle of resolving the vertical part of the computational model grid by using sigma layers is demonstrated diagrammatically in Figure 6. The computational triangular grid of the model was made with sufficient discretization to resolve the detailed geometries of the intake and outfall structures, i.e. with triangles just a few metres wide around these structures. The number of layers included in this study has been selected to properly re-solve the vertical gradients in temperature and salinity.

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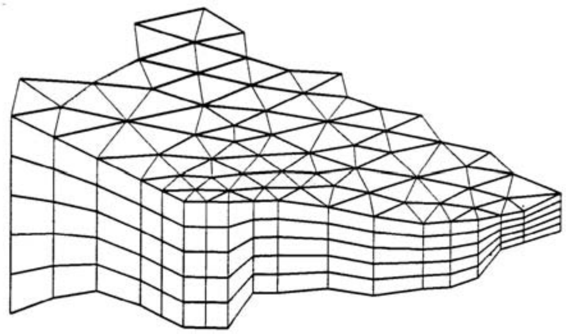

Figure 6: Example of three-dimensional triangular grid using the Flexible Mesh solution technique.

The computational model mesh has been generated on the basis of a combination of bathymetric data available with C-Map™ and bathymetric survey data collected during the Dublin WTE study.

Driving forces of the model are water levels, wind, air and water temperature and relative humidity. Heat exchange between the water surface and the atmosphere was accounted for due to the evaporation rate of the area. Water temperature and salinity was applied to the model boundaries based on information on temperature and salinity profiles collected during the initial phase of the WTE study.

The model was thoroughly calibrated against available data in the Liffey estuary including water levels, currents, temperature, salinity and thermal plume extensions.

An overview of the applied parameters in the study is given in Table 7.

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Table 7: Summary of model set-up.

Time step	Adaptive
Mesh, number of elements	3100
Number of vertical layers	5
Horizontal Turbulence	Smagorinsky formulation
Vertical Turbulence	Logarithmic profile
Bottom Friction (bed roughness)	Roughness 0.05 m
Horizontal Diffusion	Scaled Eddy Coefficient, unit factor
Vertical Diffusion	Scaled Eddy Coefficient, unit factor

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5.0 Approach

5.1 Simulation Criteria

This section details the approach taken to modelling the Ringsend WwTW and storm overflow discharges. The calibrated 3D model was modified to provide better resolution on the Liffey and Tolka estuaries. The approach was to simulate the discharge from the WwTW and storm overflow for extreme seasonal conditions (summer and winter) and for an extreme storm event over 15 day periods incorporating a full spring and neap tidal sequence (with data inputs as described in Section 3).

The six periods selected for simulation are shown in Table 8. Each of the simulations modeled the five parameters listed below and considered the thermal plume from ESB cooling waters with constant temperature and flow criteria.

Parameters:

Simulation of typical month for the following parameters with simple decay.

- TSS
- BOD
- Faecal Coliform
- DIN
- MRP

Constants:

- ESB Cooling Water Discharge: 10m3/s
- ESB Cooling Water ΔT Temperature Differential: 7.61ºC

Wind:

The wind speed and direction used is defined in Table 6.

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Table 8: Sequence of Simulations

No.	Scenario	Wind	No. Storm Overflow Spills	Discharge Data Period	Boundary Condition Period
1	Summer Two Week	No	8	10 – 25 June 2007	12 – 26 Sept 2002
2	Winter Two Week	No	2	1 – 15 Dec 2006	1 – 15 Feb 2006
3	Summer Two Week	Yes	8	10 – 25 June 2007	12 – 26 Sept 2002
4	Winter Two Week	Yes	2	1 – 15 Dec 2006	1 – 15 Feb 2006
5	Extreme Storm Event	No	6	5 – 20 Aug 2007	12 – 26 Sept 2002
6	Extreme Storm Event	Yes	6	5 – 20 Aug 2007	12 – 26 Sept 2002

Boundary Condition Periods

The model is calibrated for two boundary condition periods covering full spring neap tidal cycles. The boundary condition periods set the flow in the rivers and the tidal conditions. They are based on measured data from two specific periods. The two boundary condition periods cover the winter and summer season as follows:

- A full neap-spring period in a situation with colder ambient conditions and high river run-off (February 2006). This represents the winter simulations.
- A full neap spring period in a situation with warmer ambient conditions and low river run-off (September 2002). This represents the summer simulations.

The boundary condition period used for each simulation is shown in Table 8.

Model Sources

The detailed hydrodynamic field is computed with MIKE 3 FM that includes five layers and seven sources of water intakes, outfalls or discharges. The sources include the rivers Liffey, Tolka and Dodder, ESB Cooling Waters, and the Ringsend WwTW (SW1) and storm overflow discharge points (SW2). [1]Both the SW1 and SW2 discharges were added to the surface layer.

The applied setting for the sources is shown in Table 9.

[1] The seventh source mentioned is a thermal discharge from Dublin Port at North Wall.

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Table 9: Source Settings

	Discharge [m^3/s]	Temperature [Degrees C]	Salinity [PSU]
SW1	Varying (3.6 – 9.7)	10 (Constant)	0
SW2	Varying (0 -1.12)	14 (Constant)	0
ESB Cooling Waters	10	7.61 (Increase*)	0 (Increase*)

* For the ESB Cooling Waters, a sink in the model takes water from the estuary with temperature and salinity as set in the model for 'use' in the ESB Power Generation Station. (Increase) as shown in Table 9 implies an increase to the estuarine waters as they pass through the plant. For temperature this means the ESB Cooling Waters are at a temperature of 7.61ºC higher than the temperature of the estuary, for salinity this means the salinity is not changed by the process.

All sources are added to the model at the surface. In reality some of the sources are placed at the sea bed. However all the sources are buoyant compared to the surrounding water and, therefore, the plume will rise to the surface. This process cannot be resolved at the present resolution however it is known from many studies of the process that this will happen within a relatively short range from the outlet position, most probably inside the same calculation cell that the discharge was released in. Therefore the sources are applied at the surface in all cases. The applied discharge and concentration time series of the sources are shown in Appendix B.

Model Modules

The dispersion of the effluents was simulated with the Advection/Dispersion and the Mud Transport module of MIKE 3. The transport module calculates the resulting transport of materials based on the flow conditions found in the hydrodynamic calculations. The approach is to introduce a tracer that represents the pollutant and analyze its dispersion due to the hydrodynamic movements and a constant rate of decay. This is a simplified approximation of the nutrient and bacteriological decay processes. To take into account the effects of substances being transformed into others and their complicated interactions would require full ecological modelling.

The TSS was simulated in the Mud Transport module of MIKE 3 FM using a settling velocity of 0.5 mm/s and a relatively low critical shear stress for erosion of 0.1 N/m^2. The critical shear stress for deposition was set to 0.07 N/m^2. The other substances are simulated with MIKE 3 AD.

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5.2 Decay Coefficients

In order to simulate the nutrient and bacteriological effects a decay rate was introduced. The objective is to approximate a decay rate that represents the complex interactions that each pollutant is subject to once introduced into the Estuary. Based on DHI experience in similar projects worldwide the decay coefficients were established. It is important to keep in mind that the use of an empirical constant coefficient limits the accuracy of the results and if a more refined evaluation is required a full ecological model should be calibrated and applied.

In the model the linear decay of a component is generally described by:

$$dC/dt=-kc$$

where dC/dt is the decay rate (change in concentration over time), c is the specific concentration and k [s^{-1}] is the decay constant. Numerically the decay term is added to the general transport equation. The decay rate, specified individually for each component can be found in Table 10.

Table 10: Decay rate of the simulated substances.

Substance	Decay Rate
E-Coli	4.400e-004 c/sec
BOD	1.157e-006 c /sec
MRP	8.102e-007 c /sec
DIN	1.157e-006 c /sec

The decay rates are chosen in such a way that they, on average, give the correct decays however should the daily variations or some of the other effects be deemed necessary to understand then a full ecological module should be used.

The introduction of a constant empirical decay coefficient is sufficient for an impact analysis of the behavior of the pollutants on the Liffey Estuary. However there are some limitations to this approach. For example, E-Coli concentration is strongly controlled by the sun's radiation and pH of the receiving water. The daily variation of the sun's radiation and secchi depth plays an important rule on the decay of the bacteria. The accumulation of E-Coli on bottom sediment is relevant to control its concentration in the water column.

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6.0 Results

6.1 Standards for comparison to modelling results

The results will be compared to standards as determined by European and Irish legislation. Environmental Quality Standards drafted in the Draft European Communities Environmental Objectives (Surface Waters) Regulations 2008 for compliance with the Water Framework Directive (2000/60/EC) and Bathing Water Quality Regulations 1992 Standards will be used. In addition the more stringent bathing water quality standards required by the Blue Flag Beaches Programme will be assessed. The standards are shown in Tables 11 -13. The impact of the discharge at a number of important receptors will also be assessed as shown in Figures 7-9.

Water Quality Limits

The Water Framework Directive (2000/60/EC) was enacted in Ireland in 2003. Draft Regulations were proposed in September 2008 establishing Environmental Objectives and Environmental Quality Standards for the classification and management of Surface Waters and requiring the implementation of measures to reduce water pollution and protect and restore surface waters. The standards for physiochemical parameters affecting transitional and coastal waters are shown in Table 11.

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Table 11: Draft European Communities Environmental Objectives (Surface Waters) Regulations 2008 - Physiochemical Standards for Transitional and Coastal Waters.

Draft European Communities Environmental Objectives (Surface Waters) Regulations 2008, Physiochemical Standards supporting Biological Elements		
Parameter	Transitional Water Body	Coastal Water Body
Temperature	<1.5ºC rise in ambient temperature downstream of a point of discharge	
Biochemical Oxygen Demand (BOD) (mg O_2/l)	≤4.0mg/l (95%ile)	N/A
Dissolved Inorganic Nitrogen (mg N/l)	N/A	≤18µM
Molybdate Reactive Phosphorus (MRP) (mg P/l)	(0-17 psu) ≤ 0.060 (median) (35 psu) ≤ 0.040 (median)	

The Bathing Water Quality Regulations 2008 (S.I. 79 of 2008) will repeal and replace the Quality of Bathing Waters Regulations, 1992 (S.I. No. 155 of 1992) with effect from 31 December 2014. Until the first monitoring calendar as specified in the new Bathing Water Regulations, 2008, is established for each Bathing Water on the 24th March 2011, the Bathing Water Standards as set in Schedule 2 Part I of the Quality of Bathing Waters Regulations, 1992 remain relevant and therefore will be used for comparison to model results. The standards are shown in Table 12.

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Table 12: Quality of Bathing Waters Regulations, 1992 (S.I. No. 155 of 1992)

Bathing Water Quality Standards Second Schedule Part I		
Parameter	Unit	Standard
Total coliforms	No./ 100ml	(a)≤ 5,000; (b)≤ 10,000
		(To be conformed with, in the case of (a), by 80% or more of samples and, in the case of (b), by 95% or more of samples. Standard not to be exceeded by any two consecutive samples in any case.)
Faecal coliforms (E.Coli)	No./ 100ml	(a) ≤ 1,000; ≤ (b)2,000
		(To be conformed with, in the case of (a), by 80% or more of samples and, in the case of (b), by 95% or more of samples. Standard not to be exceeded in any case by any two consecutive samples.)

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In addition a number of Bathing Water Beaches in Dublin seek to obtain Blue Flag Status. The Blue Flag Programme for beaches and marinas is run by the non-governmental, non-profit organization 'Foundation for Environmental Education' (FEE). The Programme is run in Ireland by An Taisce. The more stringent Blue Flag standards are shown in Table 13.

Table 13: Blue Flag Programme for Beaches – Water Quality Standards

Parameter	Unit	Standard	Accepted % of test results higher than standard
Total coliforms	No./ 100ml	<500 Good Bathing Water <10,000	20 5
Faecal coliforms (E.Coli)	No./ 100ml	<100 Good Bathing Water <2,000	20 5
Faecal Streptocci	No./ 100ml	<100 Good Bathing Water	10

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Receptors
The modelling results will be used to assess impacts on a number of receptors in the bay. The Liffey Estuary, Tolka Estuary and Dublin Bay are the waterbodies which experience the primary impact from Ringsend WwTW. In addition there are stations monitored under the Water Framework Directive, areas protected under the Birds and Habitats Directives and beaches protected under the Bathing Water Directive (Figs. 7-9).

Fig 7: Water Framework Directive Coastal and Transitional Monitoring Stations

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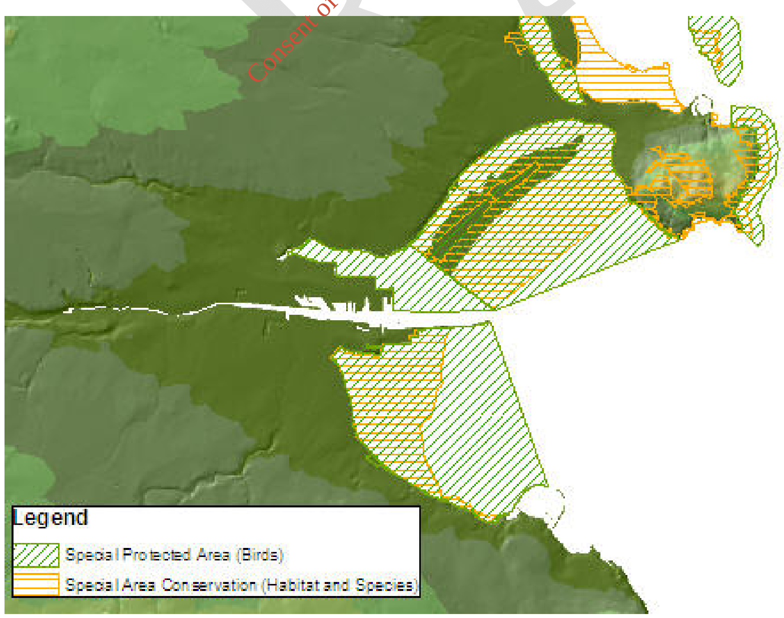

Fig 8: Special Areas of Conservation and Special Protected Areas in Dublin Bay

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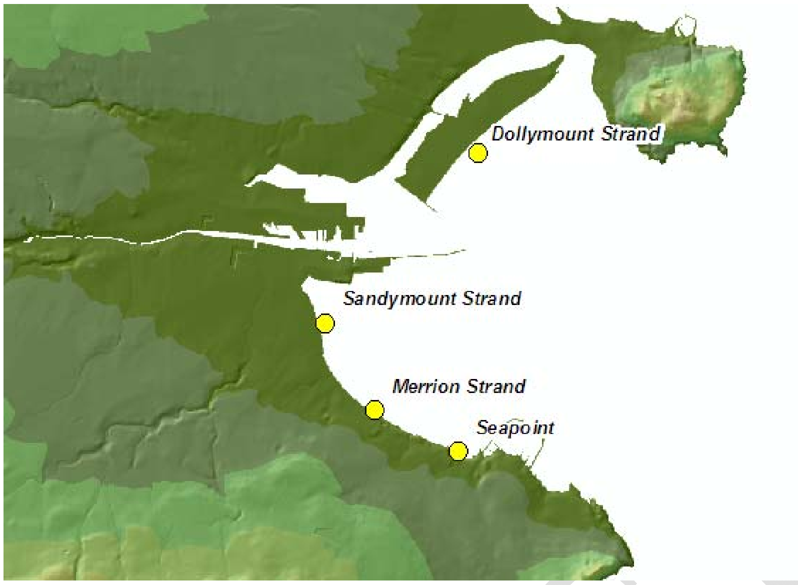

Fig 9: Bathing Water Beaches – Monitoring Points Dublin Bay.

6.2 Model Results

To assess the impact from the existing Ringsend WwTW and storm water overflow on the receiving waters of the Liffey and Tolka estuaries and in Dublin Bay, the model results for each substance are presented in the following way:

- Maximum Concentration Plots for the period simulated; defined as the maximum concentration simulated in each triangular element (see Section 3.6) of the mesh during the 15 day simulation. This means that the concentration plotted in adjacent triangular elements might be from different time-steps within the simulation
- Exceedance Plots defined as the percentage of time during the simulation for which the concentrations of parameters are higher than a certain threshold value.

For all the results the surface concentrations were higher than in the other layers. Therefore all figures presented in this report are at the surface layer.

Section 6.3 – 6.7 presents the summary result for each parameter modelled. Each parameter is discussed with particular reference to the scenario that caused the greatest impact of that parameter on the receiving waters. In most cases this is Scenario 6 – the extreme storm event (no wind). A full set of maximum concentration plots and exceedance plots for each scenario is shown in Appendix C and D respectively.

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6.3 Faecal Coliforms

In the following section the maximum values and the exceedance values for the Faecal coliform bacteria will be presented. The maximum values will be presented for the purpose of evaluating compliance with the Bathing Water Regulations 1992 given in Table 12. The figures present the highest concentration of Faecal Coliform occurring throughout the simulation.

The exceedance figures are defined as the percentage of time the concentration of a given substance is above a given limit and these plots are used for comparison with the 1992 regulations and the blue flag requirements given in Table 13.

6.3.1 Maximum Values

The maximum values of Faecal Coliforms are presented below. Based on the Bathing Water Quality Regulations, 1992 (S.I. No. 155 of 1992), the maximum values of Faecal Coliforms should not exceed 1000 No./100ml in 80% or more samples taken in the season. This value is indicated by the dark blue color in the figures below. Similarly the concentration should stay below 100 No/100ml at the beaches in order to maintain the blue flag.

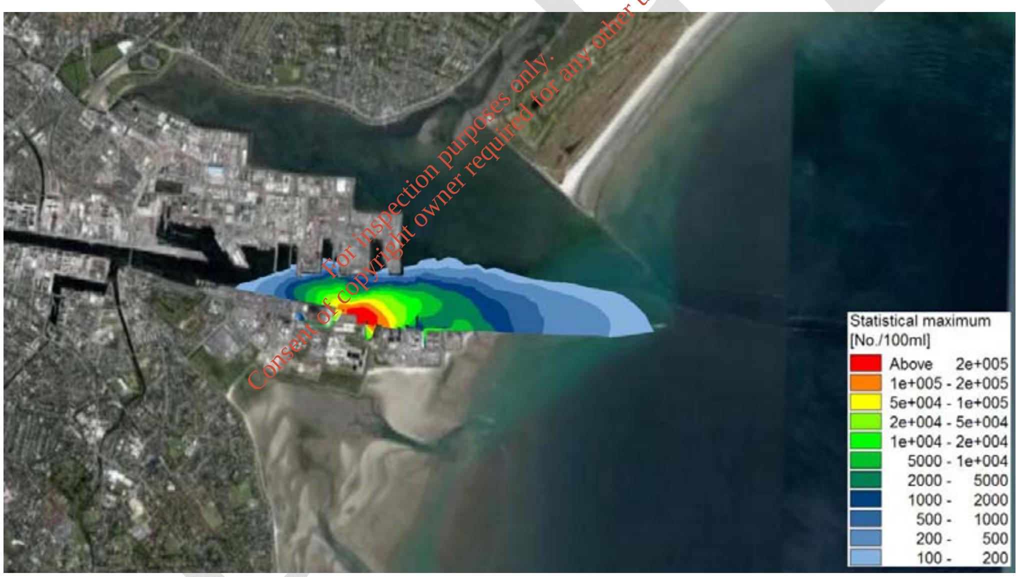

Figure 10: Maximum concentration of Faecal Coliforms [No./100ml] for the Scenario 5 – summer storm, no wind.

For all scenarios the concentration is seen to be less than 1000 No./100ml in all points of interest. In fact, the impact of the Faecal Coliform does not impact the coastal waters or bathing beaches.

Is should be noted that background concentrations of Faecal Coliforms in the estuary have not been included in the model and thus the actual concentrations at certain locations may be higher.

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6.3.2 Exceedance Values

The statistics of the exceedance values represent the percentage of time for which the concentrations of the parameters are higher than a certain threshold value. The threshold for Faecal Coliform is delineated in the Bathing Water Regulations 1992 and the Blue Flag Beach Programme requirements. For Blue Flag beaches the concentration must be below 100 No./ml for 80% of samples taken during a bathing water season and below 2000 No/ml for 95% of the samples. For the Bathing Waters Regulations, 1992 the concentration should be below 1000 No/100ml 80% of the samples and below 2000 No./100ml 95% of the samples. Figure 11 evaluates the Bathing Water Regulations 1992 criteria.

Figure 11: Exceedance values for concentrations larger than 1000 No./ml of Faecal Coliforms (%) for Scenario 5 (Extreme Storm event, no wind).

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Figure 11 shows that the Bathing Water Regulations, water quality standards are only exceeded to a significant extent adjacent to the outfall locations.

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6.4 Biochemical Oxygen Demand

In this section the maximum biochemical oxygen demand will be presented. The maximum will be presented for the purpose of evaluating the draft Environmental Quality Regulations 2008 which set a standard of 4mg/l concentration in estuarine waters (see Table 11). The draft Environmental Quality Regulation do not set a limit for BOD in coastal waters.

The exceedance is defined as the percentage of time the concentration of a given substance is above a given limit. In this case these plots are used for comparison with the draft Environmental Quality Regulation 2008 requirements given in Table 11 which set the standard of 4mg/l for 95% of results.

6.4.1 Maximum Values

The maximum concentrations of BOD emerging from the WwTW and storm overflow are shown in Figure 12.

Figure 12: Maximum concentration of BOD [mg/l] for the Scenario 4, Winter, with

Wind.

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The results show that the limit for BOD of 4 mg/l in estuaries is only exceeded adjacent to the outlet.

Is should be noted that background concentrations of BOD in the estuary have not been included in the model and thus the actual concentrations at certain locations may be higher.

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6.4.2 Exceedance Values

The maximum exceedance values for BOD found for the six scenarios is presented in Figure 13.

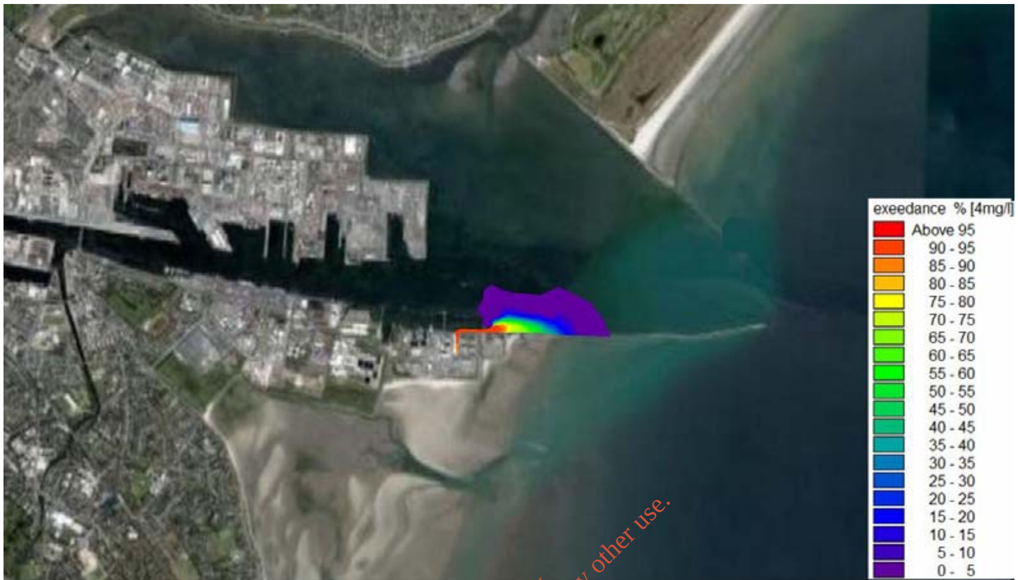

Figure 13: Exceedance values for concentrations larger than 4 mg/l for Scenario 4, winter with wind.

From this it can be seen that the limit of 4mg/l is only exceeded significantly within the ESB cooling water channel or in the immediate vicinity. The spreading of BOD due to the Ringsend WwTW and storm overflow alone is thus not in conflict with the draft Environmental Quality Regulations, 2008.

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6.5 Molybdate Reactive Phosphorus

In the following section the maximum Molybdate Reactive Phosphorus concentration plots and exceedance plots will be presented in comparison to the draft Environmental Quality Regulations 2008 for estuarine waters.

6.5.1 Maximum Values

The maximum concentration for the MRP in estuaries at the surface was simulated in Scenario 5 – Extreme Storm Event (no wind) shown on Fig. 14. The standard limit for estuaries varies with salinity. For less saline waters the standard is 0.06mg/l MRP. A more stringent limit of 0.04mg/l applies to waters of salinities up to 35 PSU. The 0.04mg/l limit was used for comparison as it is more stringent.

Figure 14: Maximum concentration of MRP [mg/l] for the Scenario 5, Extreme Storm Event with Wind.

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Results show that the critical limits are exceeded in the Liffey and Tolka estuaries. It should be noted that background concentrations of MRP in the estuary have not been included in the model and thus the actual concentrations at certain locations may be higher. Appendix E shows background concentrations of DIN and MRP in the Tolka and Liffey Estuaries as monitored by CDM for Dublin City Council (December 2008– March 2009).

The plume also travels into Dublin Bay. No standard for MRP has been set for coastal waters under the draft Environmental Quality Regulations, 2008. Results show that values exceeding the estuarine standard of 0.04mg/l are present very close to the beaches on the northern and southern side of the mouth of the estuary, but this is quickly diluted.

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6.5.2 Exceedance Values

Figure 15: Exceedance values for concentrations larger than 0.04mg/l Pfor Scenario 5, Extreme Storm Event without wind.

The standard for MRP is 0.04mg/l P based on a median of all results. The exceedance plot in Fig. 15 shows the percentage of time the MRP concentration in the estuary and bay due to the WwTW discharges exceeds 0.04mg/l. The standard for MRP demands a median of 0.04mg/l. Whether or not these values will cause a failure is dependent on the location of the sampling points and the type of discharge occurring on the day. If this type of event were to occur regularly, standard failure would be recorded.

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6.6 Dissolved Inorganic Nitrogen

In the following the maximum concentration and exceedance plots for Dissolved Inorganic Nitrogen (DIN) will be presented in comparison to the draft Environmental Objective Regulations, 2008 (Table 11).

6.6.1 Maximum Values

The maximum values at the surface of DIN are presented on Figure 16 below. Under the Draft Environmental Objectives Regulations, 2008 the standard limit of this substance is 18µM (micro Moles) or 0.252mg/l in Dublin Bay whilst no limit has been set for the estuarine waters.

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Figure 16: Maximum concentration plot of MRP [mg/l] for the Scenario 5, Extreme Storm Event without wind.

It can be seen that high concentrations occur in the Liffey and Tolka estuaries although no Water Quality Standard is set for the estuaries. The plume also spreads into the bay generally remaining offshore. Please note that some wind events may push the plume towards shore. As shown in Figure 7 there are up to 5 Water Framework Directive Monitoring Sites located within this plume area that could be negatively affected.

It should be noted that background concentrations of DIN in the bay have not been included in the model and thus the actual concentrations at certain locations may be higher. Appendix E shows background concentrations of DIN and MRP in the Tolka and Liffey Estuaries as monitored by CDM for Dublin City Council (December 2008– March 2009).

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6.6.2 Exceedance Values

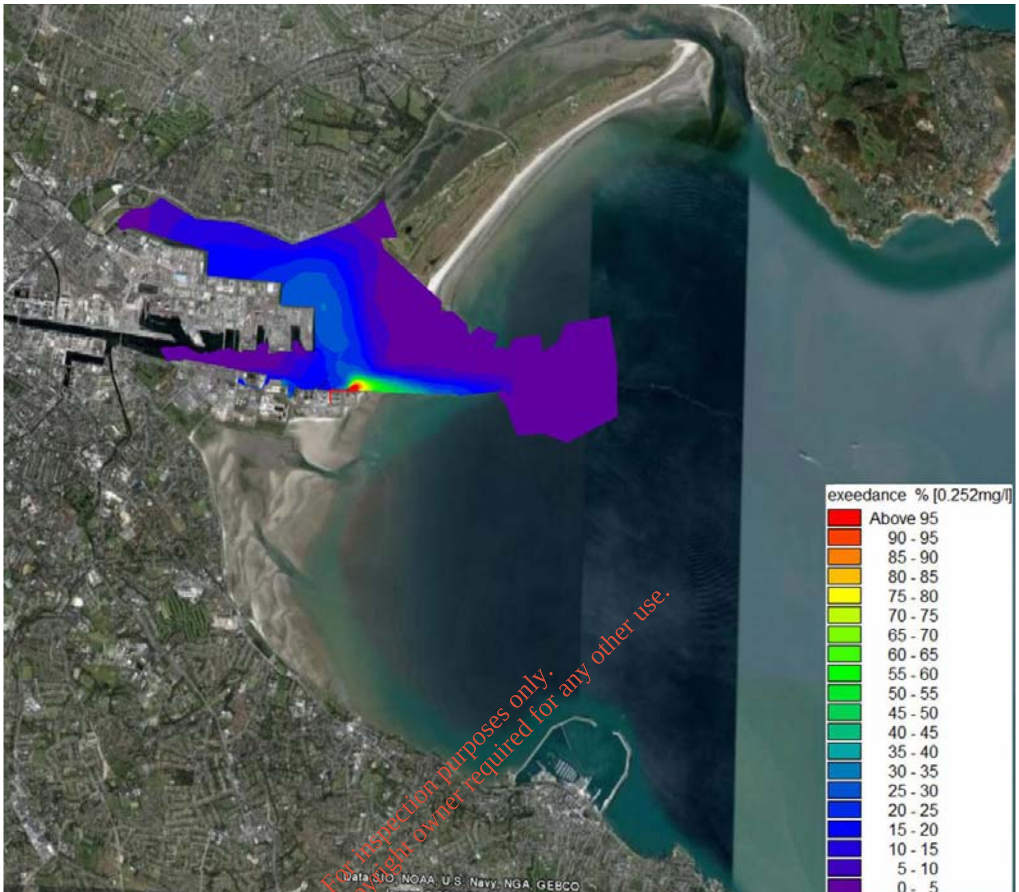

Figure 17: Exceedance values for DIN concentrations larger than 0.252mg/1 DIN for Scenario 5, Extreme Storm Event without wind.

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The exceedance results indicate that the limit is only exceeded only exceeded less than 5% of the time in the bay. Since this is for an extreme storm event which only occurred once during the study period, it is unlikely that the discharges would cause a failure of the DIN draft Environmental Quality Standard for coastal waters.

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6.7 Total Suspended Solids

In the following the maximum TSS (Total suspended solids) will be presented. No exceedance values will be presented since there is no limit to compare with.

6.7.1 Maximum Values

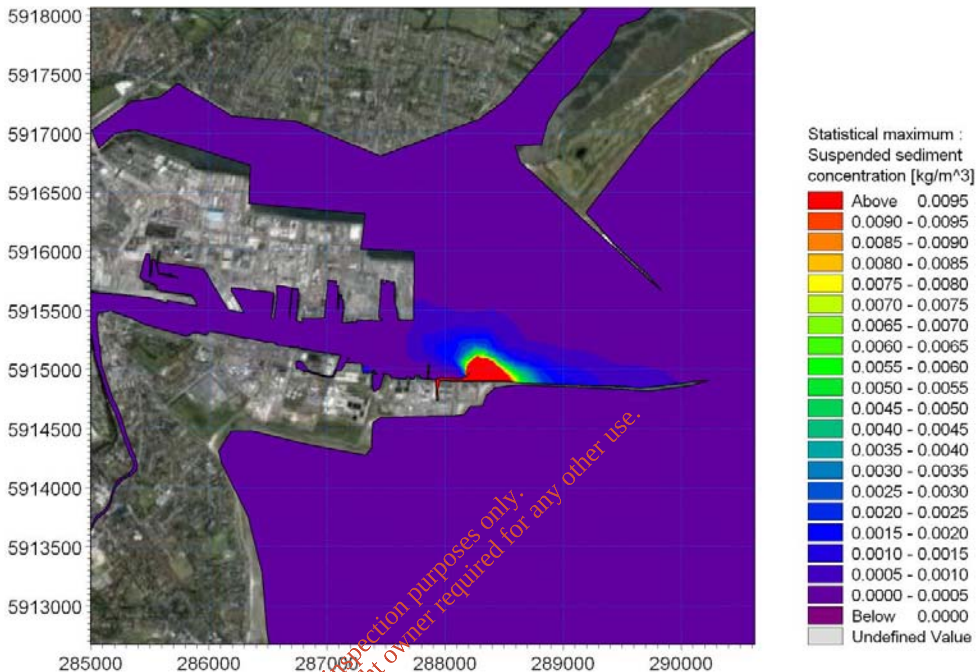

Figure 18: Maximum concentration of MRP [mg/l] for the Scenario 5, Extreme Storm Event without wind.

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From Figure 18 it can be seen that the impact from the TSS is local. It will, therefore, not affect any of the protected areas. In this connection it is important to state that the TSS can be resuspended and spread over a long period and that the effect shown here is a short term effect. However over time the TSS will also be diluted and, thus, the suspended amounts will at some point become part of the general sediment budget in the area.

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6.8 Discussion of Results

Impact of Wind

The effect of wind is seen to be relatively small. Physically one would expect that the wind will drive the upper layer in the direction of the wind. The flow in the bay is dominated by a strong tidal circulation and , therefore, the effect of the wind may be less important compared to this. A rule of thumb is that the surface speed of the water usually does not exceed 0.5% - 1% of the wind speed. The maximum wind speeds were 10 m/s which means that the maximum current speeds due to winds should be 0.05m/s - 0.1 m/s. The tidal currents reach 0.3m/s - 0.6 m/s thus the tide is the dominant part. The geometry and the limited extension of the bay and the estuary flow also dictate a certain flow pattern.

It can be seen from comparisons between scenario two and four and between scenario 1 and 3 that there is a wind effect. This is illustrated in Figure 19. As it can be seen the wind dampens the dispersion of pollutants into the Tolka Esturary.

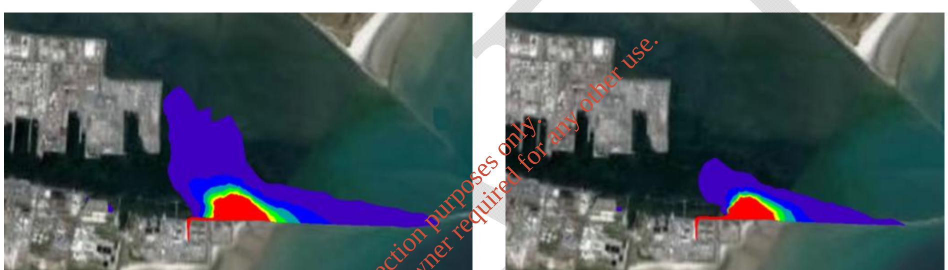

Figure 19: Illustration of the wind effect in the estuary. Scenario 2 on the left (No wind) and scenario 4 on the right (wind)

It should be noted that the model has not been calibrated with regards to the wind shear stress on the surface. This may induce some uncertainty regarding the wind effect. The top layer in the model is relatively thick (>1m) compared to the velocity profile usually generated by winds and the effect of the wind may, therefore, be slightly underestimated. When evaluating the location of the plumes and whether they reach the beaches or not one should take this into account.

Decay Coefficients

The decay coefficients were chosen based on DHI experience. In a previous study called the "Dublin Bay Study" in January 1997[3] a similar set of decay coefficients were derived. Though this is also a numerical study the choice of parameters gives an indication of the validity of the chosen decay coefficients. The comparison is between the two models is shown in Table 14.

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Table 14: Decay coefficients compared to the EIS study

Parameter	Decay used in EIS model[3]	Decay used in DHI model
Faecal Coli	Varying	T90 = 13.4 h
BOD	0.025 c/day	0.1 c/day
MRP	Not modelled	0.07 c/day
DIN	0.1 c/day	0.1 c/day

The table shows that the parameters are similar. It should be taken into consideration in this connection that the EIS model was a more complicated model allowing transformation from one substance to another. But the conclusion is that the chosen decay coefficients are similar to the decay coefficients applied in the EIS model.

Combined Effect of SW1 and SW2

In Section 6 the combined effect of SW1 and SW2 on the estuary was evaluated. In order to study the effect of SW1 and SW2 separately, the results from the two discharge points can be separated.

Two types of result files were created during the modelling; maximum concentration plots and exceedance concentration plots (Appendix C and D). Maximum Concentrations show the absolute maximum results that occur at points in time within a simulation period, exceedance concentration plots compare the model results over the 15 day simulation period to a set limit. If the maximum concentration plots are considered then SW2 has a larger impact compared to SW1 however if one considers the exceedence frequencies shown in the exceedance concentration plots, then the impacts of both outlets are similar.

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Maximum concentration plots display maximum points in time where exceedance concentration plots show the percentage of time within an entire simulation that a set standard is surpassed. This implies that, for the periods simulated, whilst a spill at SW2 can have a more significant impact in terms of loading at the time of the spill, the impact of both SW1 and SW2 are similar when the entire simulation period is considered.

During the simulations the impact area for SW2 tended to disperse upstream whereas the impact area for SW1 has a tendency to disperse downstream. An example is shown in Figure 20.

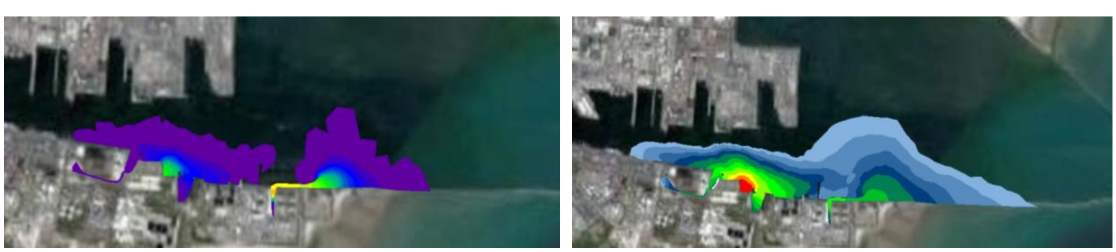

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Figure 20: Example of impact areas for scenario 1. The exceedence plot for Faecal Coliform is shown on the left and the maximum concentration plot to the right.

The impact of an outfall has two parts; the discharge and the load. In the example shown in Fig. 20, SW1 has a constant discharge but a lower load of Faecal Coliform where the SW2 has a discontinuous discharge but a loading that is more than ten times higher. For this reason the maximum concentration plot is significantly bigger at the SW2 outlet.

The two outlets are different in discharge and load, but the overall impact over the 15 days is in this case comparable since the SW2 is diluted in a timely manner after the storm. The extent of the maximum plume from SW2 can be much more significant for SW1 for a short while during and after a storm. But since storms come and go the overall impact as shown in the exceedance plot still is of the same order of magnitude. This is to say that failures due to the SW2 are no greater than failures due to SW1. This is shown particularly well in Figure 21.

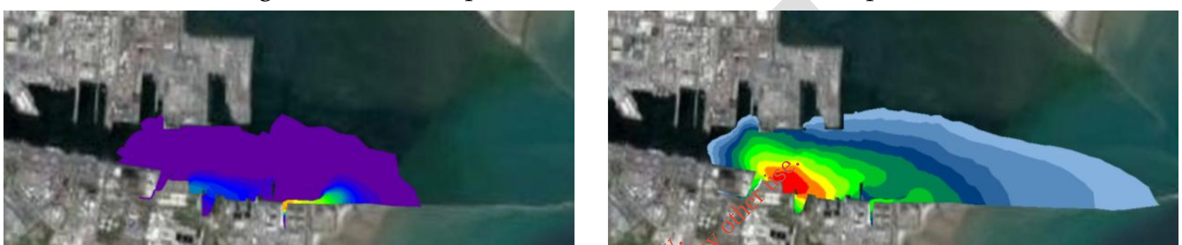

Figure 21 Example of impact areas for scenario 6. Exceedence concentration plot for Faecal Coliform to the left and maximum concentration plot to the right.

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7.0 References

1. Dublin Waste To Energy Study. DHI report for Elsam Engineering AS 2006

2. Dublin Flood Protection System. DHI report for CDM 2007.

3. Environmental Impact Statement No.1: Ringsend Treatment Works, Volume 3 – Mathematical Water Quality Modelling Data & Results. The Dublin Bay Project 1997.

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Appendix A: Ringsend WwTW and Storm Overflow monitoring data for simulation periods.

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Date	Storm Water Treatment Overflow	WwTW Inlet Flow	WwTW Final Effluent	Storm Water Discharge			Inflowing Wastewater			Final Effluent					
							(City Analysts)	(Central Labs)		(City Analysts)				(Central Lab)	
				BOD	TSS	Faecal Coliform	NH3-N	MRP	DIN	BOD	TSS	NH3-N	E Coli	DIN	MRP
	m3/d	m3/d	m3/d	t/d	t/d	MPN/100ml	t/d	t/d	t/d	t/d	t/d	t/d	MPN/100ml	t/d	t/d
1-Dec-06		521,919	545,249						14.0		4.4			6.3	
2-Dec-06		465,863	483,559				4.0			2.9	5.3	2.3			
3-Dec-06		798,589	775,167								60.5				
4-Dec-06		589,255	618,488				11.9	0.9		13.6	18.6	1.2			0.8
5-Dec-06		681,872	713,469				12.8	1.3	12.7	20.0	24.3	1.4		6.8	1.1
6-Dec-06		529,000	561,137				12.4	1.4	9.1		19.1			6.1	0.9
7-Dec-06	21,174	759,345	676,871	3.3	3.4	1300000	11.2		17.5					7.8	1.0
8-Dec-06		663,474	734,831							16.9	29.4	1.5		7.6	
9-Dec-06		506,870	530,720								18.0				
10-Dec-06		517,896	533,964				9.0				27.2				
11-Dec-06		596,855	615,386				11.3	1.0		7.4	28.9	2.0			0.8
12-Dec-06		475,862	482,173				11.6	0.7	9.9	18.3	32.8	2.3		5.0	0.6
13-Dec-06		447,418	463,713				13.4	0.9	8.7	14.8	31.1	2.4		5.4	0.6
14-Dec-06		636,096	591,837				12.3	0.8	15.7	33.1	90.0	2.7		7.8	0.6
15-Dec-06	49,227	861,578	834,035	4.2		1700000	10.5			11.7	31.7	1.7		3.1	
10-Jun-07		320,154	333,807								8.0				
11-Jun-07		330,204	338,391				4.9	0.7		7.4	16.9	0.7	9330.0		1.4
12-Jun-07	13,091	348,206	304,451	3.9	1.4		5.8	1.2	5.6	3.3	4.6	1.3	46110.0	5.6	1.7
13-Jun-07	40,212	435,790	416,005				6.4	0.9	9.6	7.5	6.7	2.8	43520.0	4.8	2.2
14-Jun-07	34,871	485,266	467,023	7.9	9.1		5.6	1.0	11.2	5.1	5.1	2.1	17890.0	6.5	0.9
15-Jun-07	41,231	602,912	591,091	12.2	10.8	660000	7.2		11.7	7.1	23.1	1.2	14500.0	7.7	
16-Jun-07		406,209	465,635								6.5				
17-Jun-07		363,726	386,780								5.8				
18-Jun-07		367,778	384,401				10.7	1.1		3.1	3.5	0.8	2010.0		1.7

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Date	Storm Water Treatment Overflow	WwTW Inlet Flow	WwTW Final Effluent	Storm Water Discharge			Inflowing Wastewater			Final Effluent					
							(City Analysts)	(Central Labs)		(City Analysts)				(Central Lab)	
				BOD	TSS	Faecal Coliform	NH3-N	MRP	DIN	BOD	TSS	NH3-N	E Coli	DIN	MRP
	m3/d	m3/d	m3/d	t/d	t/d	MPN/100ml	t/d	t/d	t/d	t/d	t/d	t/d	MPN/100ml	t/d	t/d
19-Jun-07	13,735	503,026	463,454				9.3	1.2		5.1	7.0	0.9	1350.0		1.5
20-Jun-07	4,134	476,625	521,029	0.7	0.3		8.8	0.9	7.5	4.2	2.6	1.0	630.0	6.3	1.0
21-Jun-07		420,200	452,764				8.1	4.3	8.1	6.3	4.1	0.9	4960.0	5.1	3.7
22-Jun-07	81,855	516,106	451,393	9.8	5.7		4.9		11.0	3.2	1.8	0.9	6130.0	5.2	
23-Jun-07	4,588	570,291	621,463								0.6				
24-Jun-07		481,985	522,545								3.1				
25-Jun-07		368,922	384,658				6.9	0.9		2.7	2.7	0.8	7120.0		1.0
5-Aug-07	343,407	1,114,190	733,545		22.7						23.5				
6-Aug-07	81,404	810,768	720,766				7.7			5.0	13.0	1.4			
7-Aug-07	8,222	672,441	689,445				8.8			5.5	9.0	1.4	5570.0		
8-Aug-07		538,637	531,657				8.1	1.1		4.8	10.6	1.1	2660.0		0.5
9-Aug-07		475,359	467,160				9.2	1.4	7.4	9.3	5.6	0.9	7590.0	3.4	1.2
10-Aug-07		170,534	115,633				2.7		3.4	2.1	1.9	0.2	46110.0	1.4	
11-Aug-07		537,859	552,131								8.8				
12-Aug-07		492,412	479,372								8.1				
13-Aug-07		458,504	442,141				4.6	0.9		8.8	6.2	0.9	24890.0		1.2
14-Aug-07	25,311	614,451	505,811	4.0	3.9	1410000	4.9	1.7	8.4	7.6	8.6	1.0	5940.0		1.3
15-Aug-07	63,045	752,258	687,823				12.2	1.5	10.6	6.2	6.9	1.4	9330.0		1.0
16-Aug-07		503,947	494,712				11.4	7.6	8.8	6.4	6.9	1.0	310.0	8.6	3.6
17-Aug-07		526,651	475,454				11.4		11.0	3.8	6.2	1.0	1350.0	10.0	
18-Aug-07		600,624	539,501								4.9				
19-Aug-07		496,359	451,425								5.0				
20-Aug-07	77,091	808,562	680,950	9.3	10.3	3000000	9.5	1.3		8.2	8.2	1.5	5630.0		1.3

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Appendix B: Discharge Time Series used in Model

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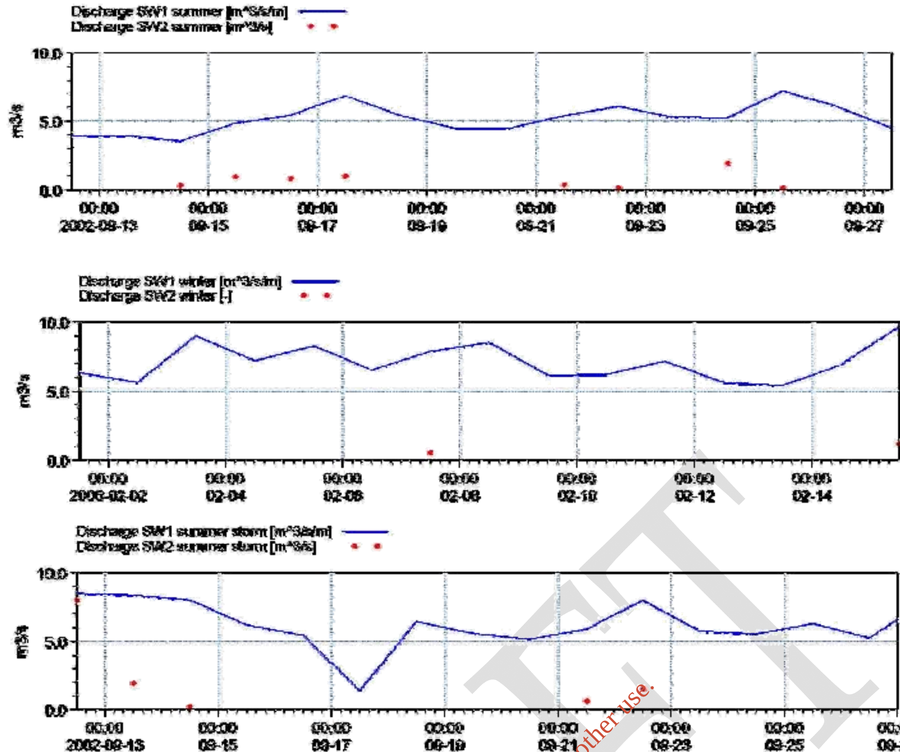

Figure B.1: Applied flow rates in the modelling. Top is summer two week scenario, middle is winter two week scenario and bottom is extreme storm event.

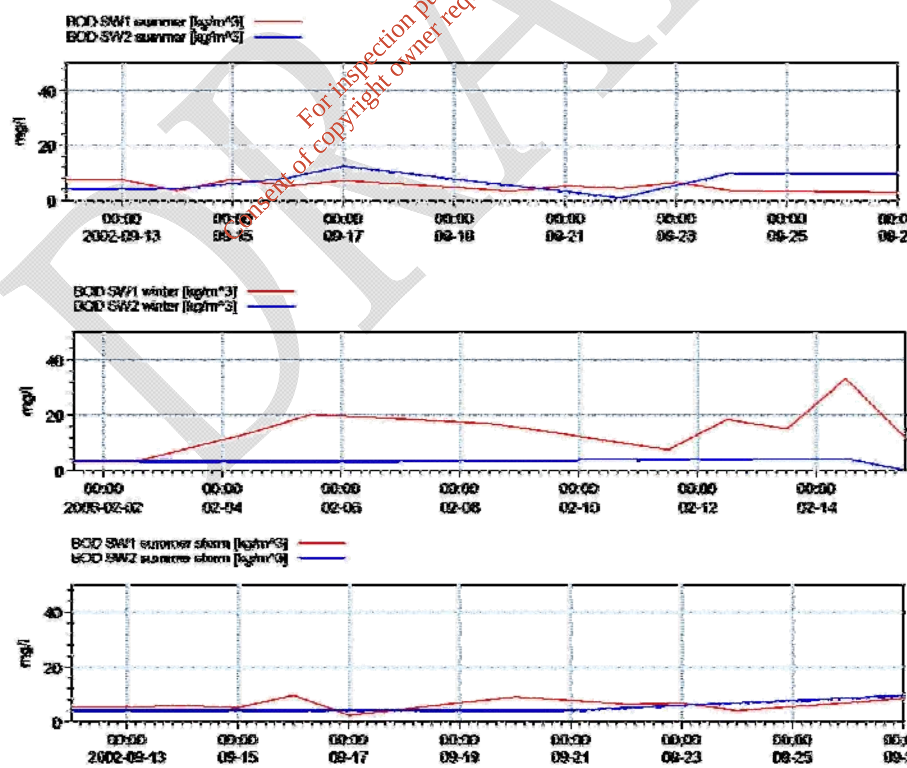

Figure B.2: BOD concentrations applied in modelling. Top is summer two week scenario, middle is winter two week scenario and bottom is extreme storm event.

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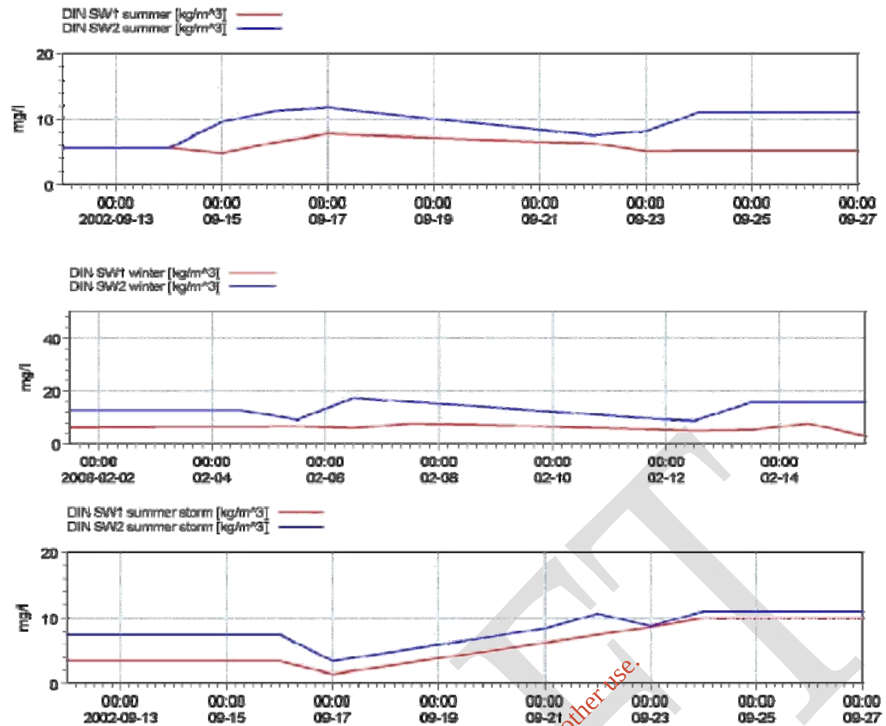

Figure B.3: DIN concentrations applied in the model. Top is summer two week scenario, middle is winter two week scenario and bottom is extreme storm event.

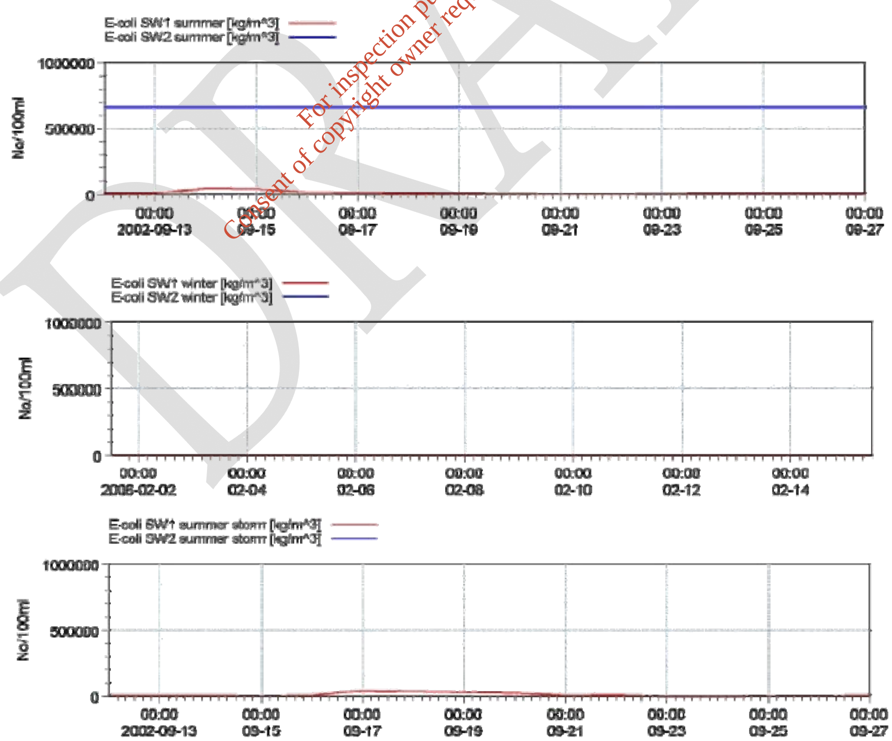

Figure B.4: Faecal Coliform concentrations applied in the model. Top is summer two week scenario, middle is winter two week scenario and bottom is extreme storm event.

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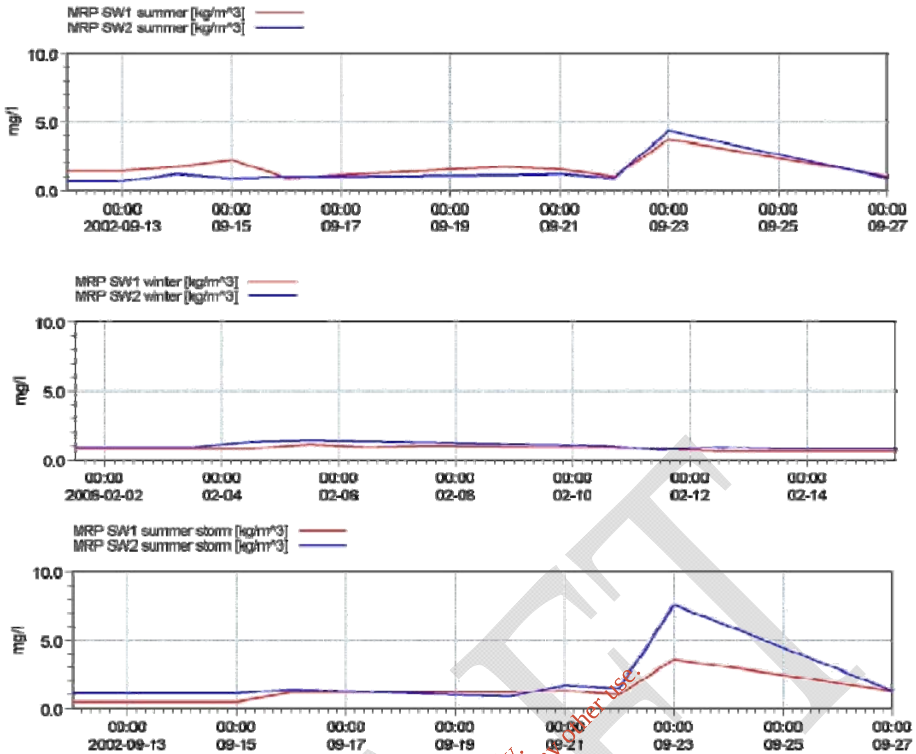

Figure B.5: MRP concentrations applied in the model. Top is summer two week scenario, middle is winter two week scenario and bottom is extreme storm event.

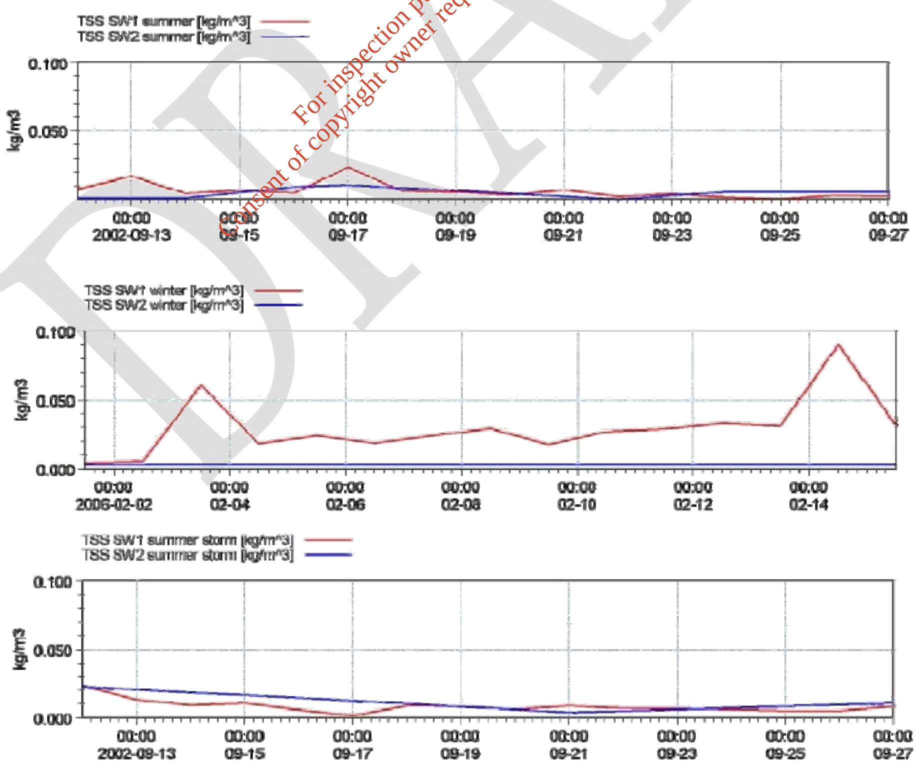

Figure B.6: TSS concentrations applied in the model. Top is summer two week scenario, middle is winter two week scenario and bottom is extreme storm event.

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Appendix C: Maximum Concentration Plot Results

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Maximum Concentration Results: Faecal Coliform

The Draft Environmental Objective Standards and Bathing Water Quality Standards are shown in Tables 11-13.

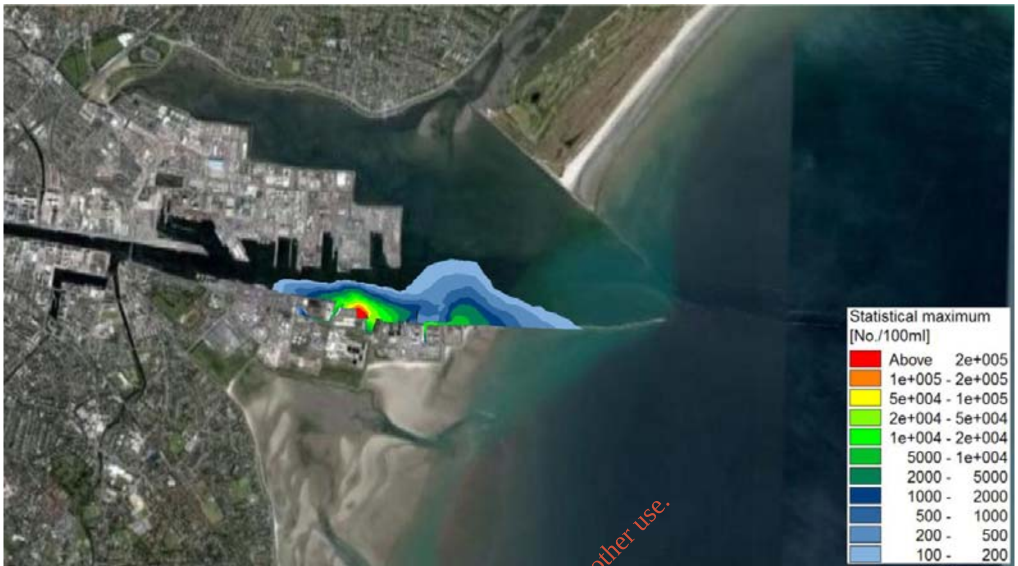

Fig C.1: Maximum concentration for Faecal Coliform for Scenario 1

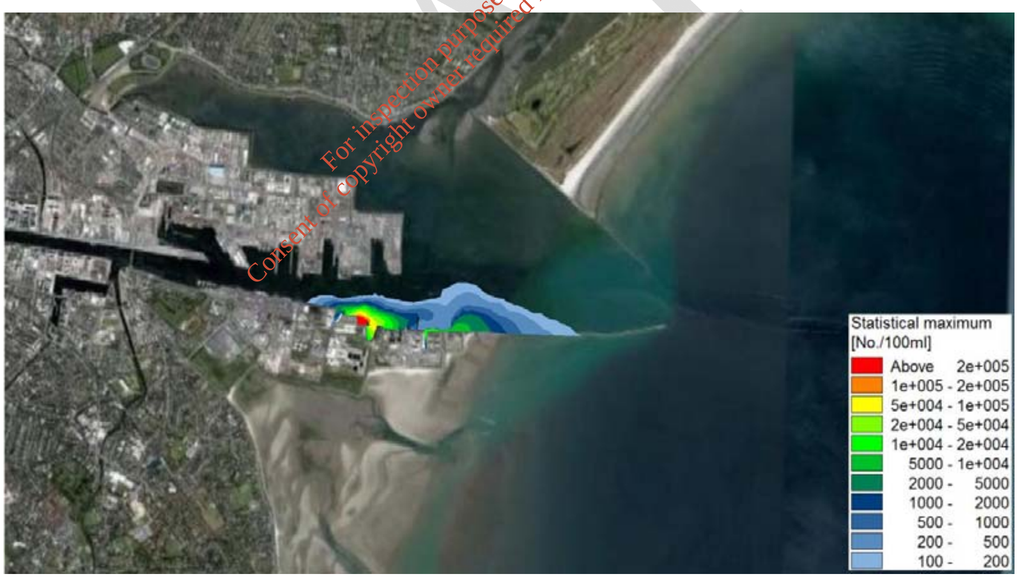

Fig C.2: Maximum concentration for Faecal Coliform for Scenario 3

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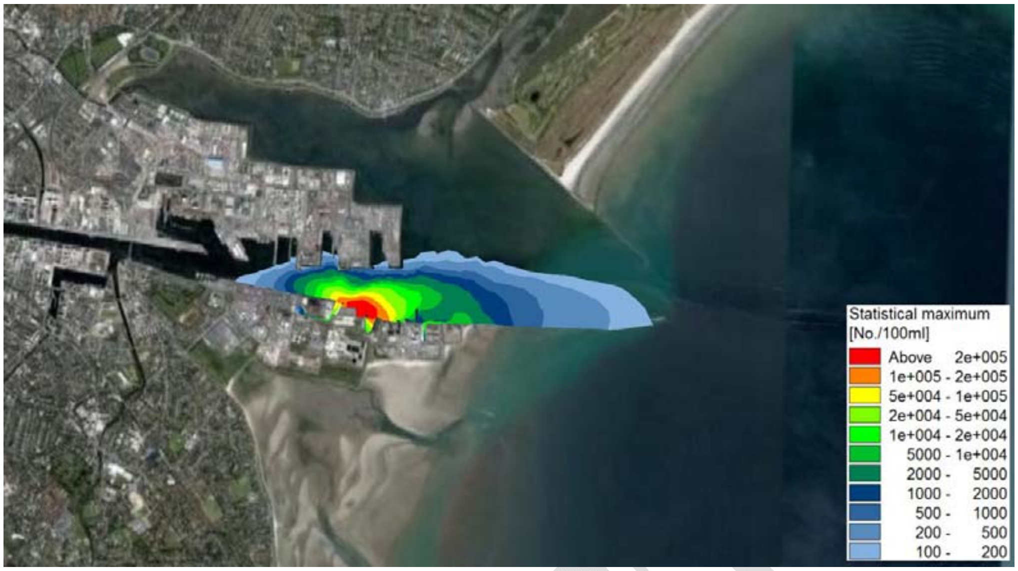

Fig. C.3: Maximum concentration of Faecal Coliform for Scenario 5

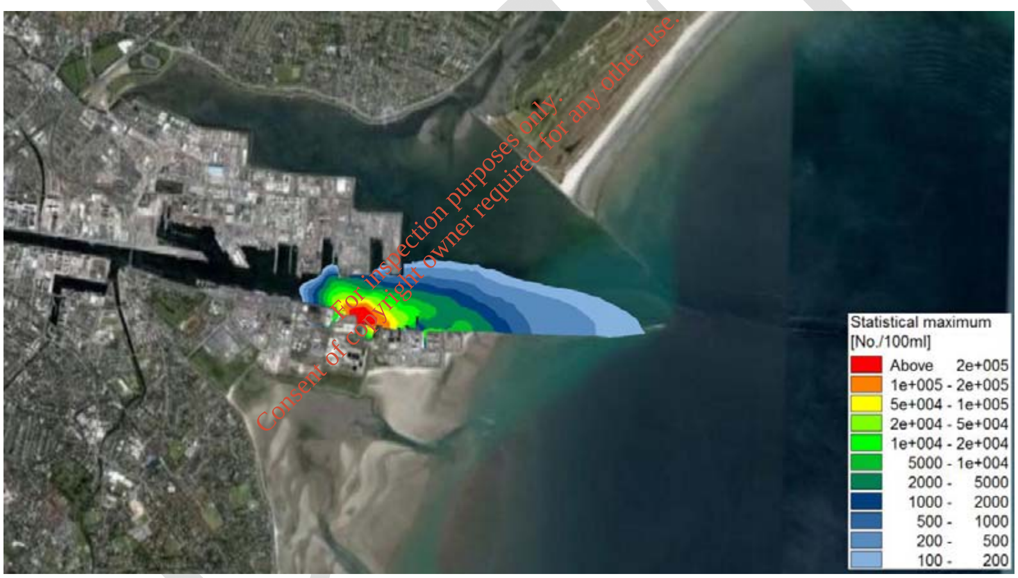

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Fig. C.4: Maximum concentration of Faecal Coliform for Scenario 6

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Maximum Concentration Results: Biochemical Oxygen Demand

The Draft Environmental Objective Standards and Bathing Water Quality Standards are shown in Tables 11-13.

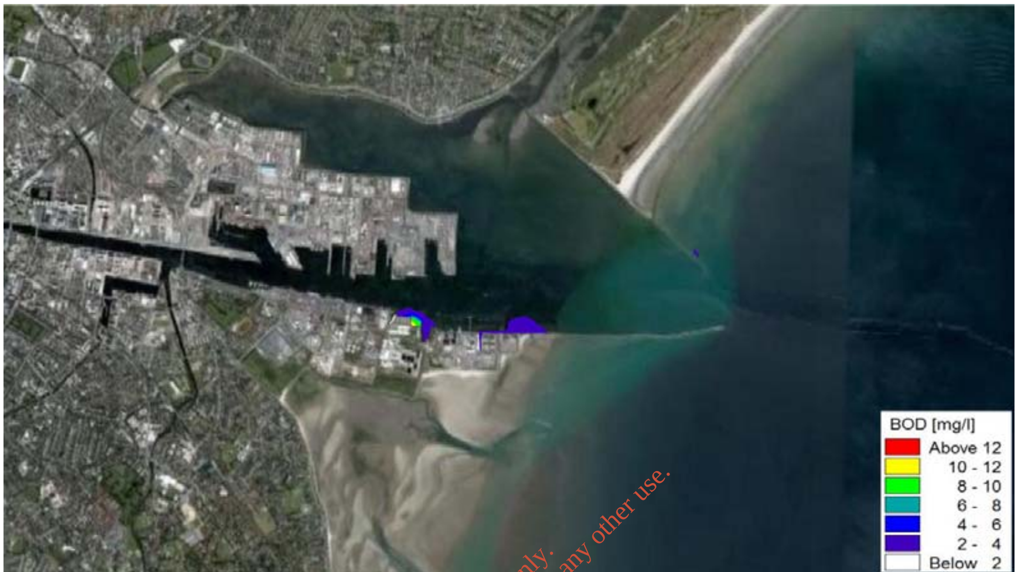

Fig C.5: Maximum concentration of Biochemical Oxygen Demand for Scenario 1

Fig C.6: Maximum concentration of Biochemical Oxygen Demand for Scenario 2

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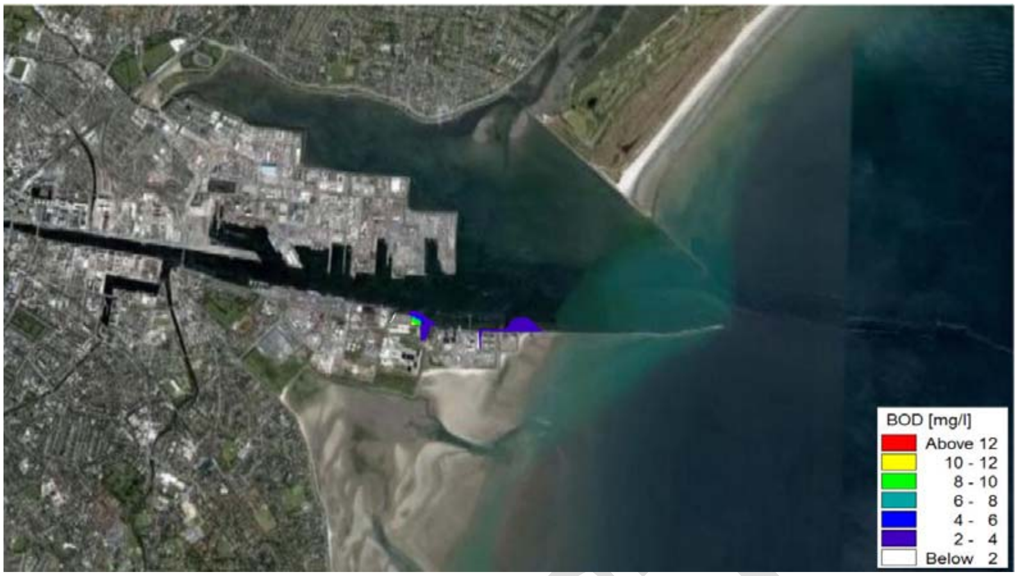

Fig C.7: Maximum concentration of Biochemical Oxygen Demand for Scenario 3

Fig C.8: Maximum concentration of Biochemical Oxygen Demand for Scenario 4

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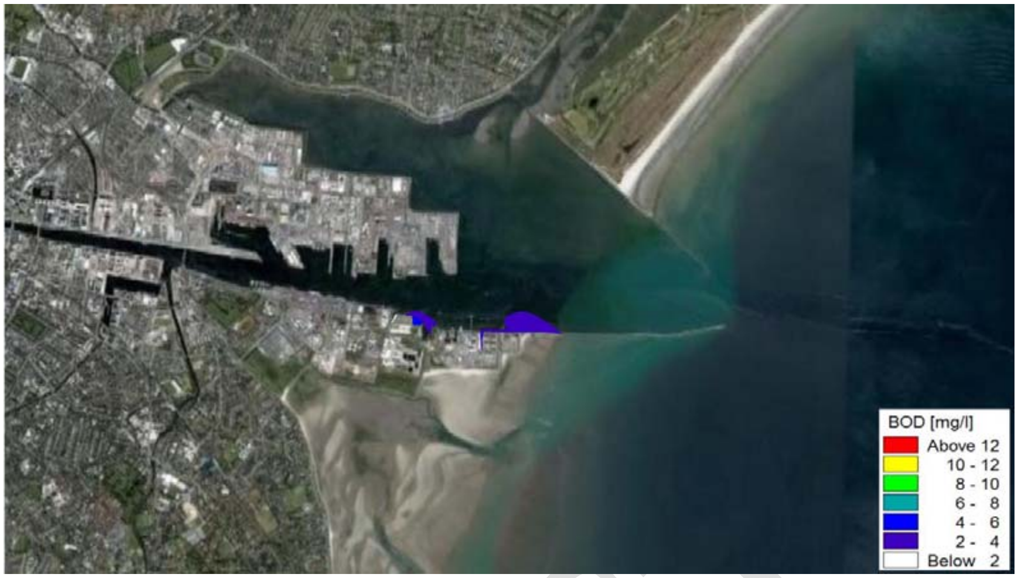

Fig C.9: Maximum concentration of Biochemical Oxygen Demand for Scenario 5

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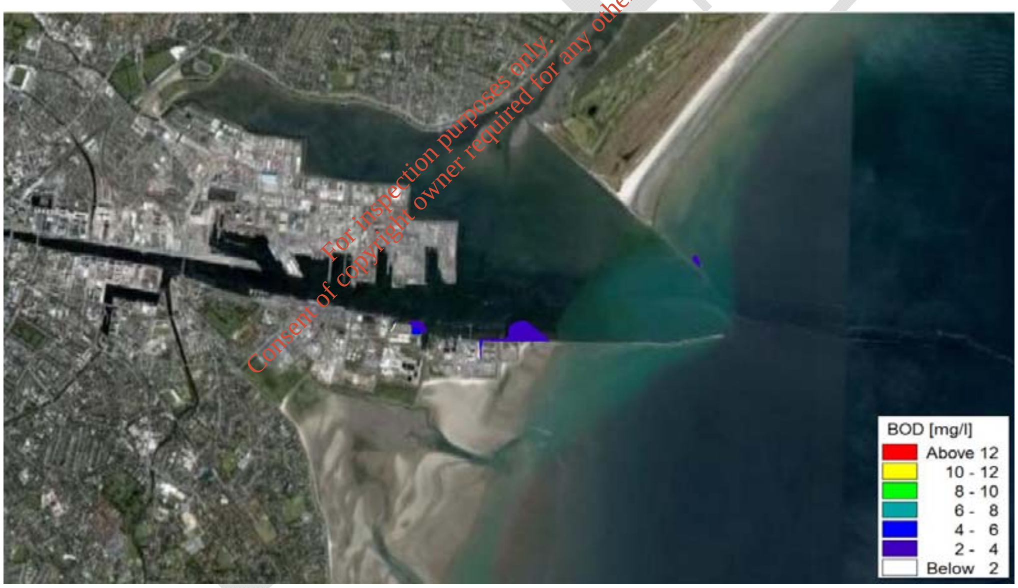

Fig C.10: Maximum concentration of Biochemical Oxygen Demand for Scenario 6

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Maximum Concentration Results: Molybdate Reactive Phosphorus (MRP)

The Draft Environmental Objective Standards and Bathing Water Quality Standards are shown in Tables 11-13.

Fig C.11: Maximum concentration of MRP for Scenario 1

Fig C.12: Maximum concentration of MRP for Scenario 2

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Fig C.13: Maximum concentration of MRP for Scenario 3

Fig C.14: Maximum concentration of MRP for Scenario 4

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Fig C.15: Maximum concentration of MRP for Scenario 5

Fig C.16: Maximum concentration of MRP for Scenario 6

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Maximum Concentration Results: Dissolved Inorganic Nitrogen (DIN)

The Draft Environmental Objective Standards and Bathing Water Quality Standards are shown in Tables 11-13

Fig C.17: Maximum concentration of DIN for Scenario 1

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Fig C.18: Maximum concentration of DIN for Scenario 2

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Fig C.19: Maximum concentration of DIN for Scenario 3

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Fig C.20: Maximum concentration of DIN for Scenario 4

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Fig C.21: Maximum concentration of DIN for Scenario 5

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Fig C.22: Maximum concentration of DIN for Scenario 6

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Exceedance Concentration Results: Total Suspended Solids (TSS)

The Draft Environmental Objective Standards and Bathing Water Quality Standards are shown in Tables 11-13

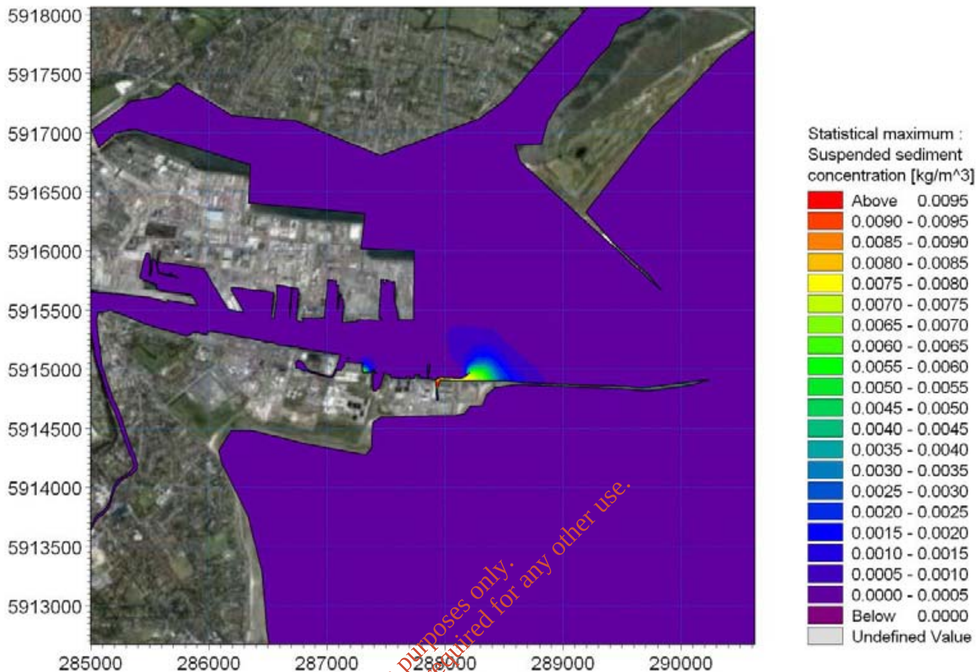

Fig D.1: Maximum concentration of TSS for Scenario 1

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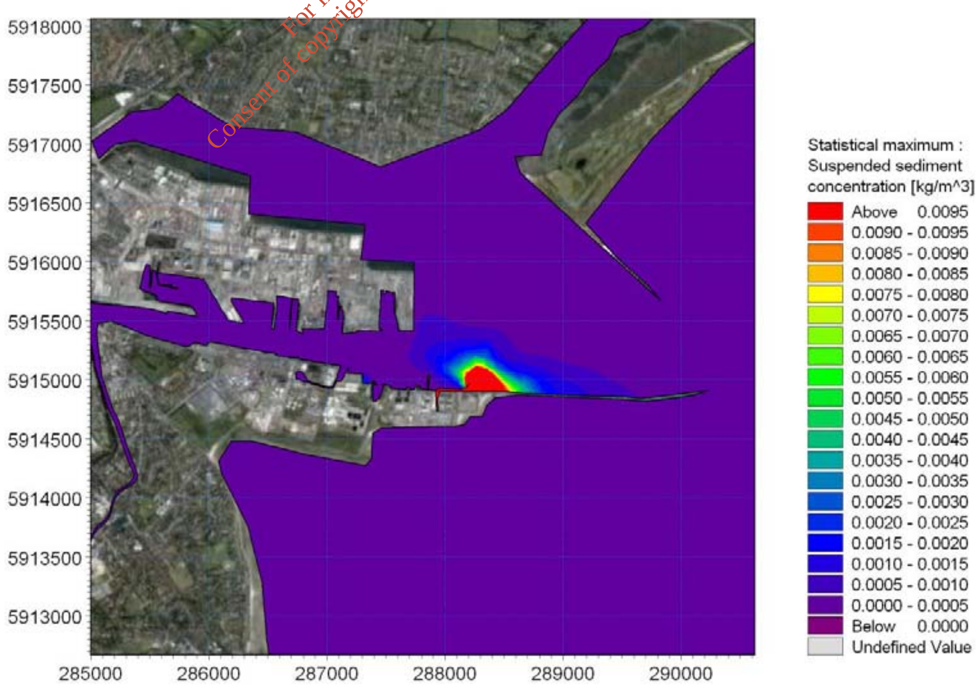

Fig D.2: Maximum concentration of TSS for Scenario 2

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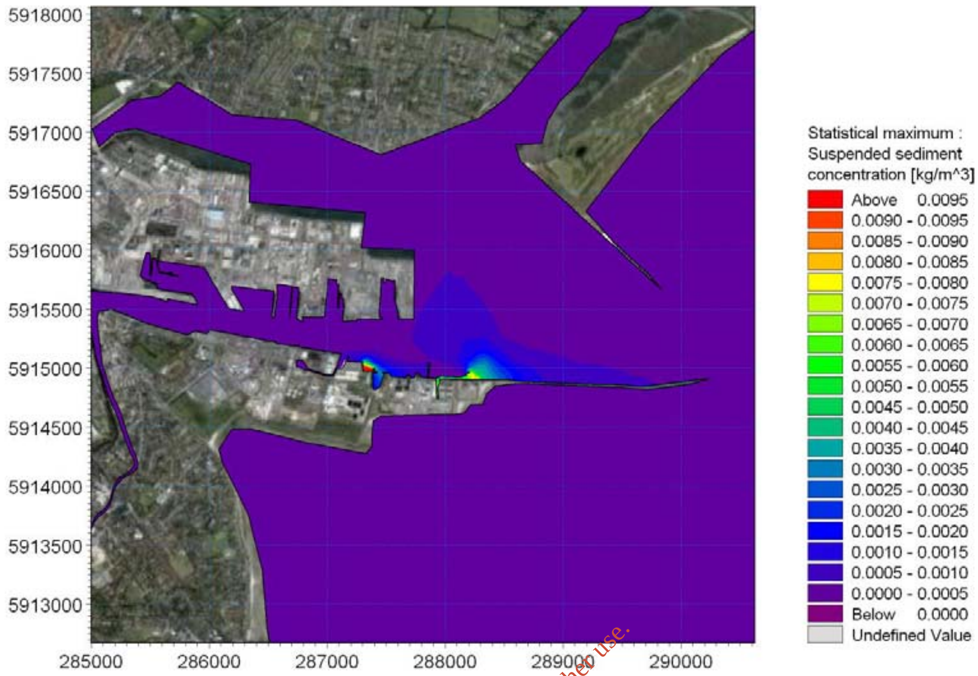

Fig D.3: Maximum concentration of TSS for Scenario 3

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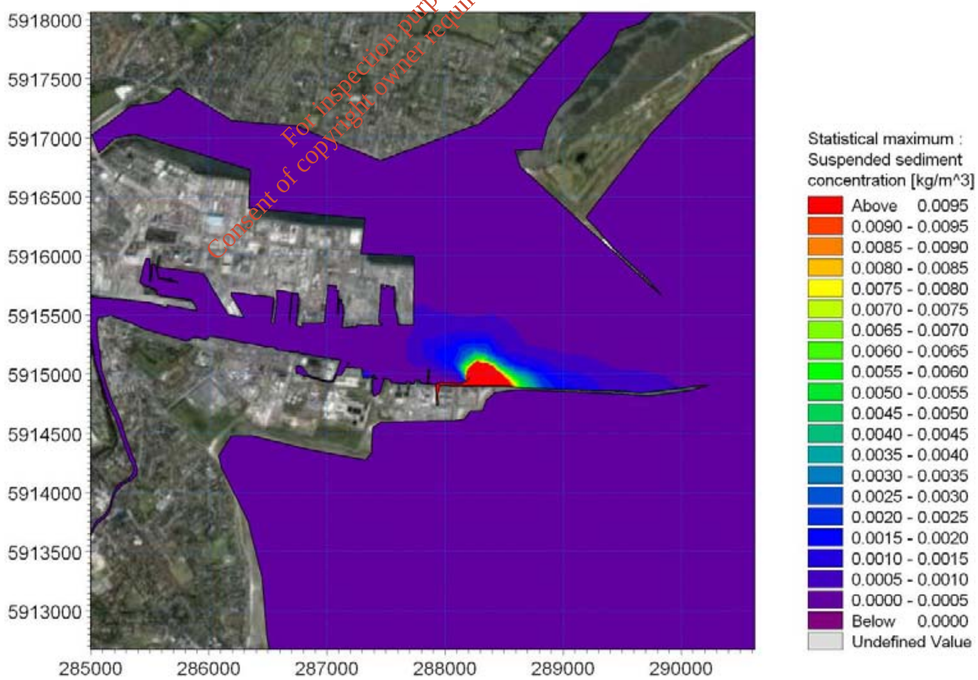

Fig D.4: Maximum concentration of TSS for Scenario 4

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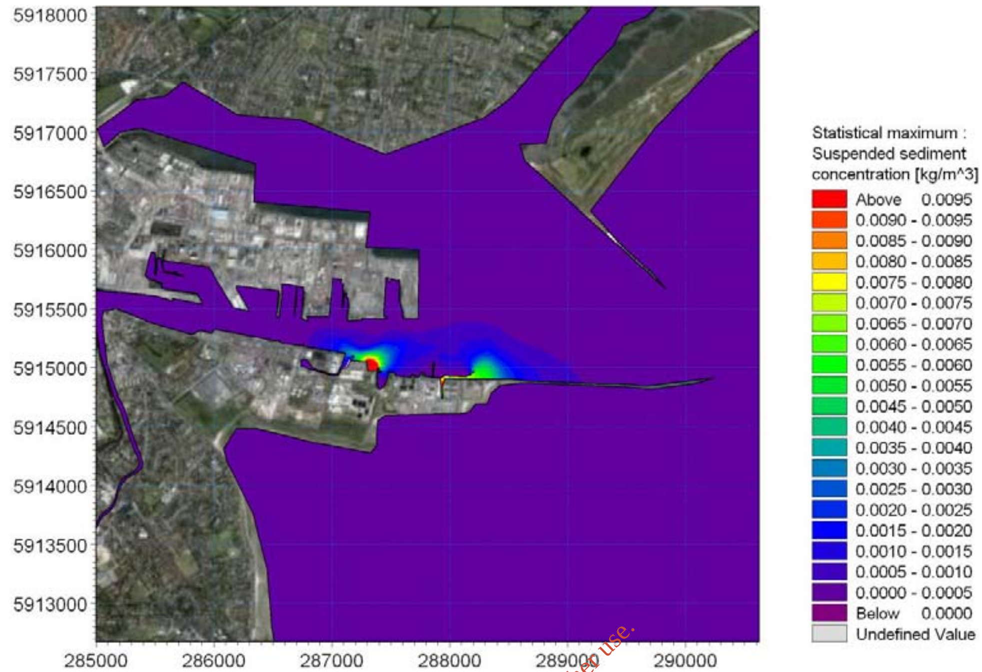

Fig D.5: Maximum concentration of TSS for Scenario 5

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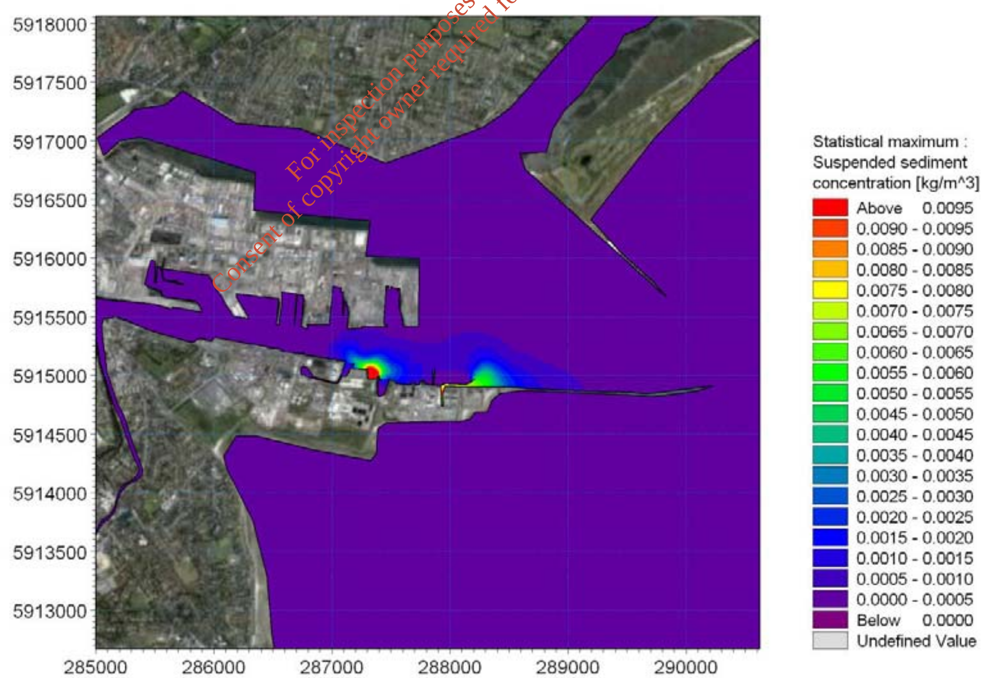

Fig D.6: Maximum concentration of TSS for Scenario 6

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Appendix D: Exceedance Concentration Plot Results

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Exceedance Concentration Results: Faecal Coliform

Fig D.1: Exceedance concentration plot of Faecal Coliform for Scenario 1

Fig D.3: Exceedance concentration plot of Faecal Coliform for Scenario 3

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Fig D.5: Exceedance concentration plot of Faecal Coliform for Scenario 5

Fig D.6: Exceedance concentration plot of Faecal Coliform for Scenario 6

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Exceedance Concentration Results: Biochemical Oxygen Demand (BOD)

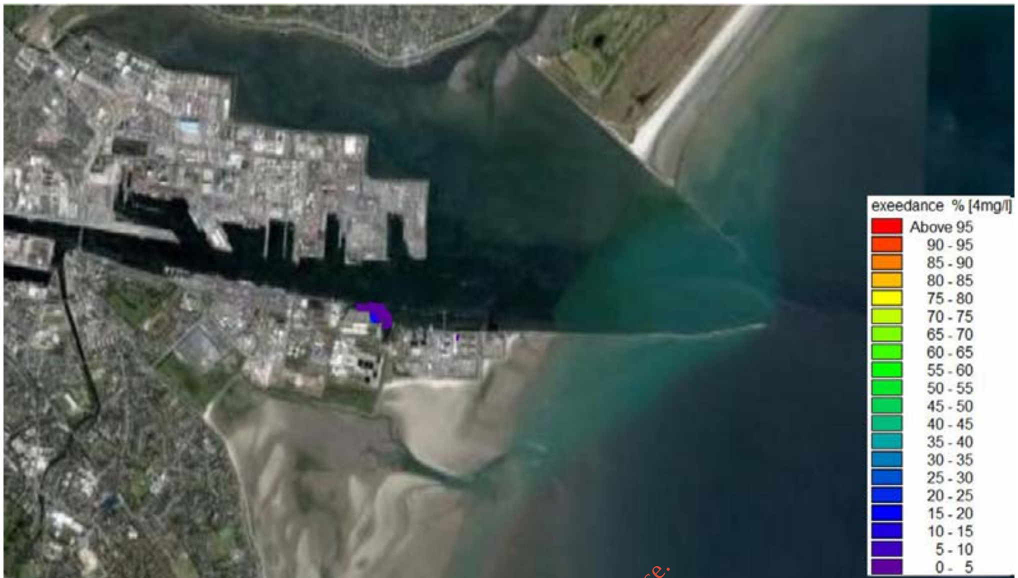

Fig D.7: Exceedance concentration plot of BOD for Scenario 1

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Fig D.8: Exceedance concentration plot of BOD for Scenario 2

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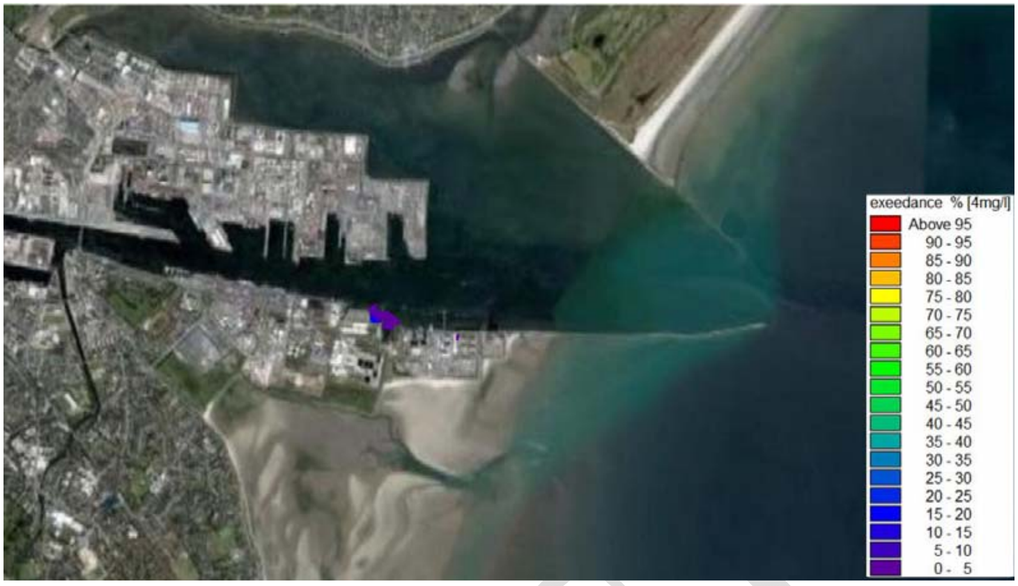

Fig D.9: Exceedance concentration plot of BOD for Scenario 3

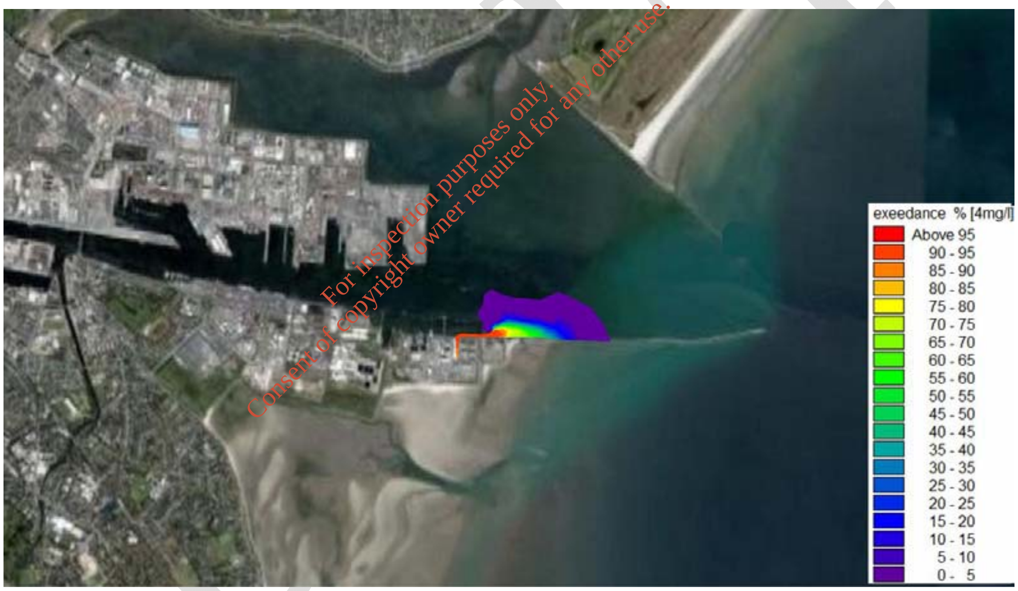

Fig D.10: Exceedance concentration plot of BOD for Scenario 4

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Fig D.11: Exceedance concentration plot of BOD for Scenario 5

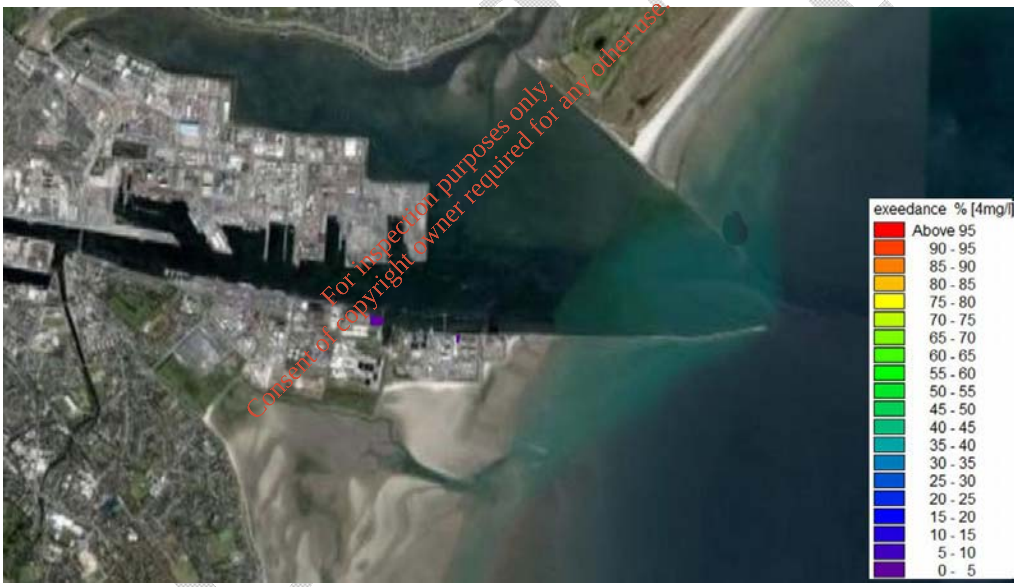

Fig D.12: Exceedance concentration plot of BOD for Scenario 6

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Exceedance Concentration Results: Molybdate Reactive Phosphorus (MRP)

Fig D.13: Exceedance concentration plot of MRP for Scenario 1

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Fig D.14: Exceedance concentration plot of MRP for Scenario 2

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Fig D.15: Exceedance concentration plot of MRP for Scenario 3

Fig D.16: Exceedance concentration plot of MRP for Scenario 4

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Fig D.17: Exceedance concentration plot of MRP for Scenario 5

Fig D.18: Exceedance concentration plot of MRP for Scenario 6

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Exceedance Concentration Results: Dissolved Inorganic Nitrogen (DIN)

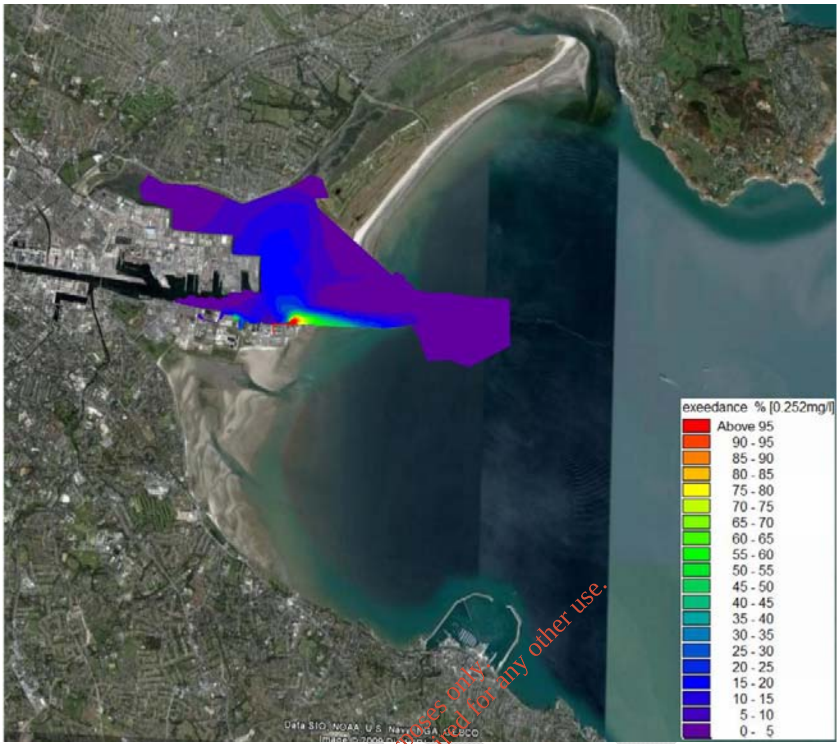

Fig D.19: Exceedance concentration plot of DIN for Scenario 1

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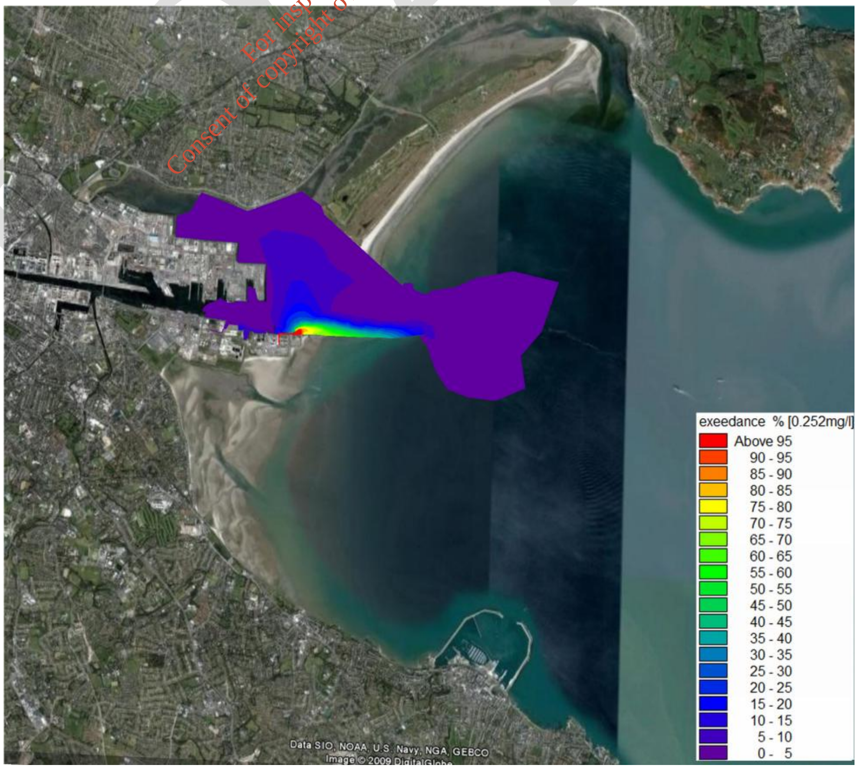

Fig D.20: Exceedance concentration plot of DIN for Scenario 2

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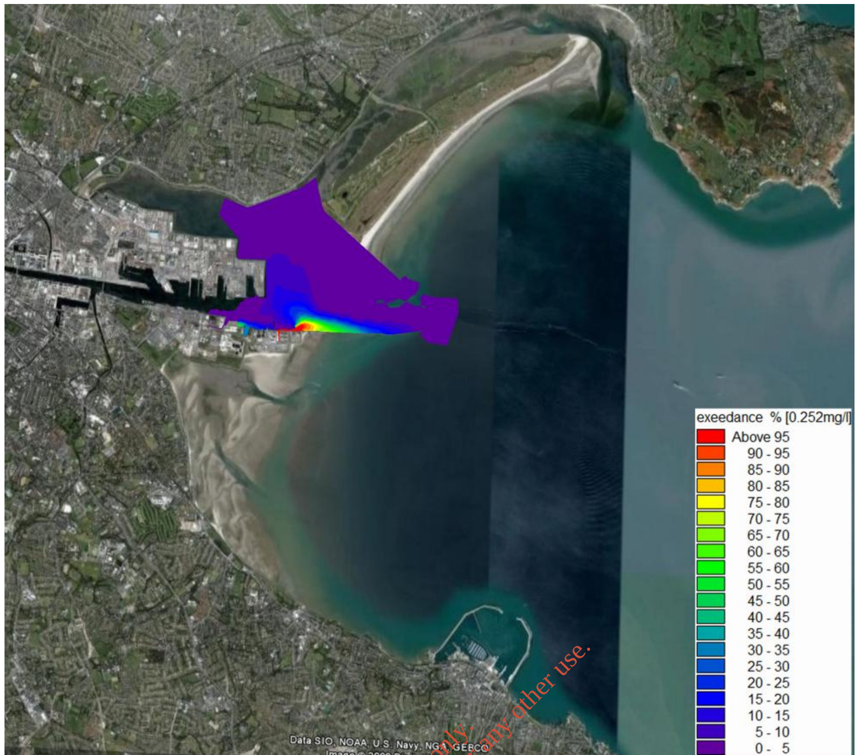

Fig D.21: Exceedance concentration plot of DIN for Scenario 3

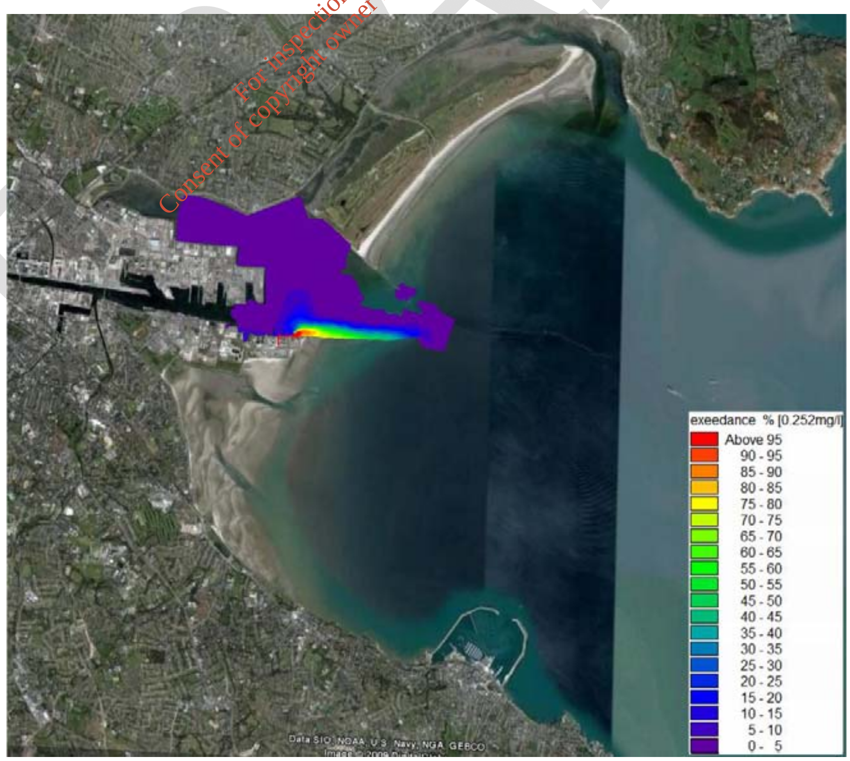

Fig D.22: Exceedance concentration plot of DIN for Scenario 4

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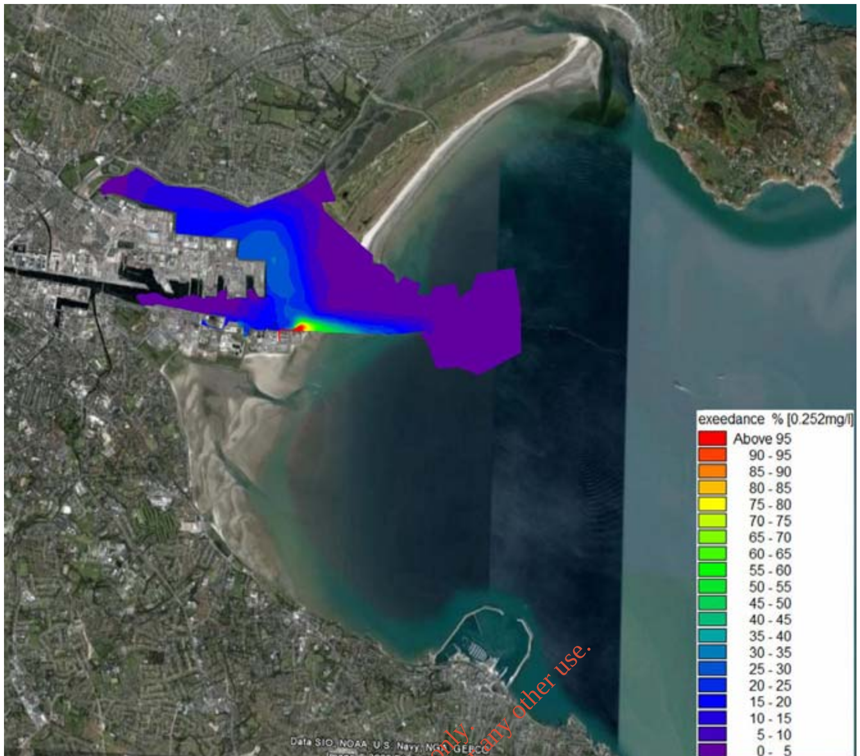

Fig D.23: Exceedance concentration plot of DIN for Scenario 5

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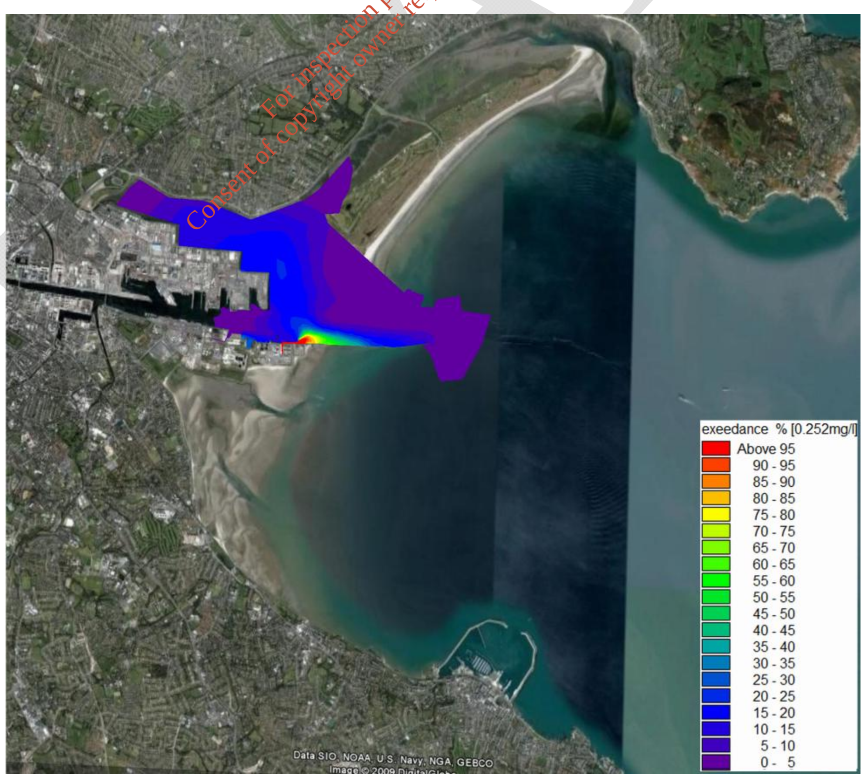

Fig D.24: Exceedance concentration plot of DIN for Scenario 6

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Appendix E: Background Concentration Plots in Liffey and Tolka Estuaries

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Background Concentrations of MRP and DIN in the estuaries

The following four graphs show the background concentration of MRP and DIN in the Tolka and Liffey Estuaries. This data was collected as part of the Mobile Monitoring Unit Water Framework Directive monitoring of coastal and estuarine waters and also from the Dublin Bay Surveying Project carried out by CDM for Dublin City Council. The graphs are based on four months of data from December 2008 to March 2009.

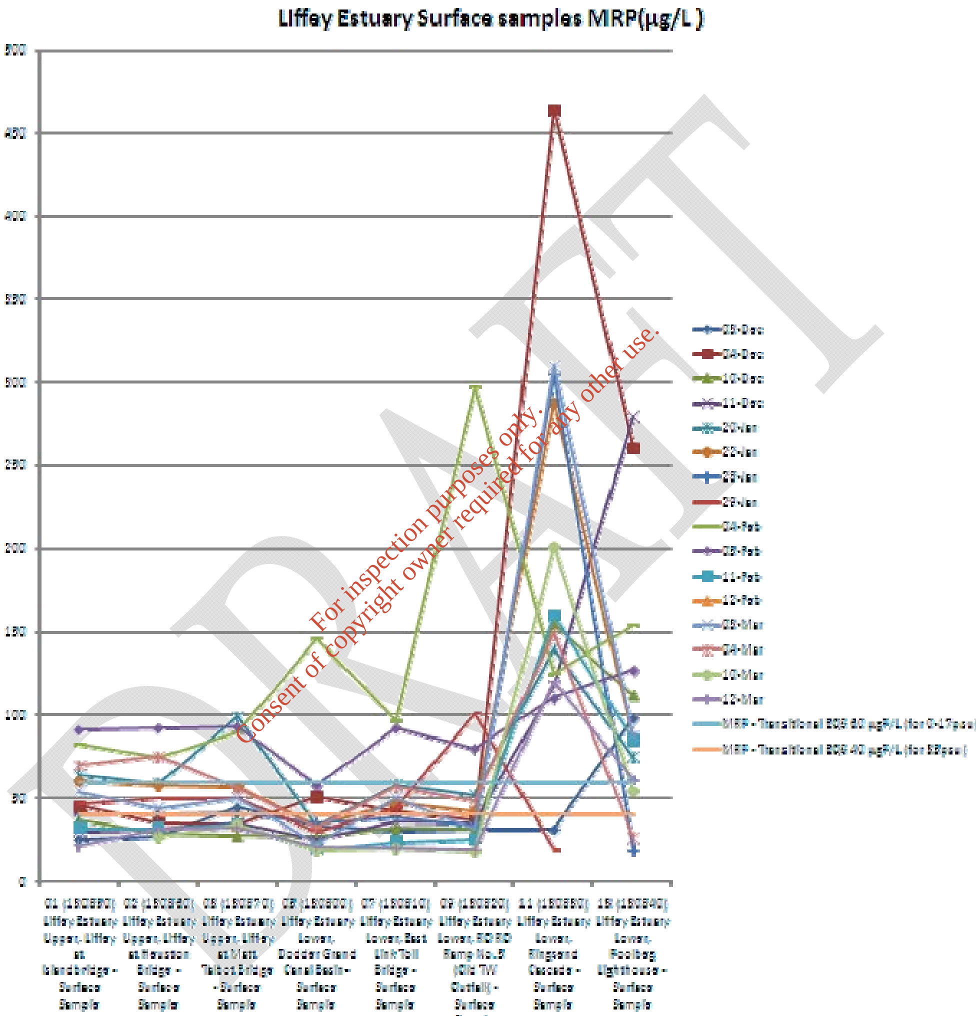

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Figure E.1: Background Concentration of MRP in the Liffey Estuary (Surface Samples) from Islandbridge (left) to Poolbeg Lighthouse (right)

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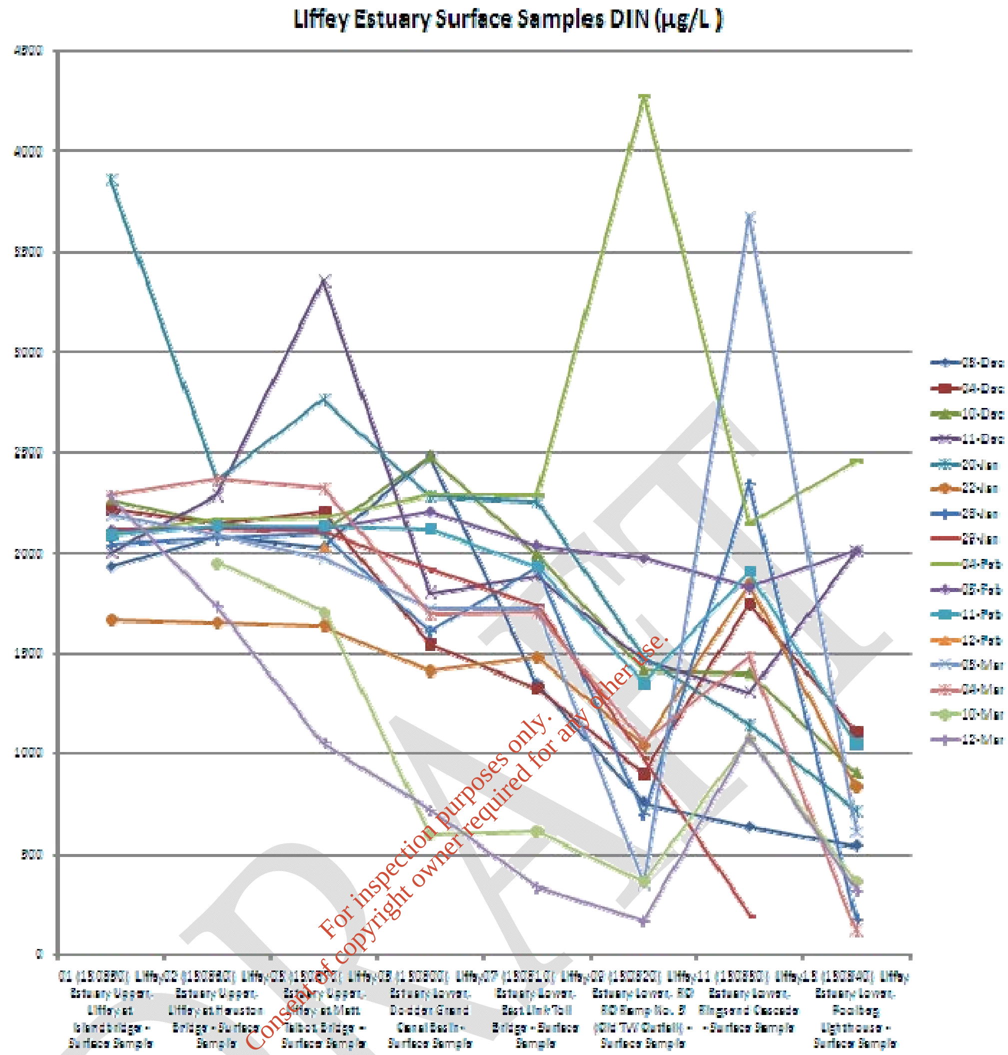

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Figure E.2: Background Concentration of DIN in the Liffey Estuary (Surface Samples) from Islandbridge (left) to Poolbeg Lighthouse (right)

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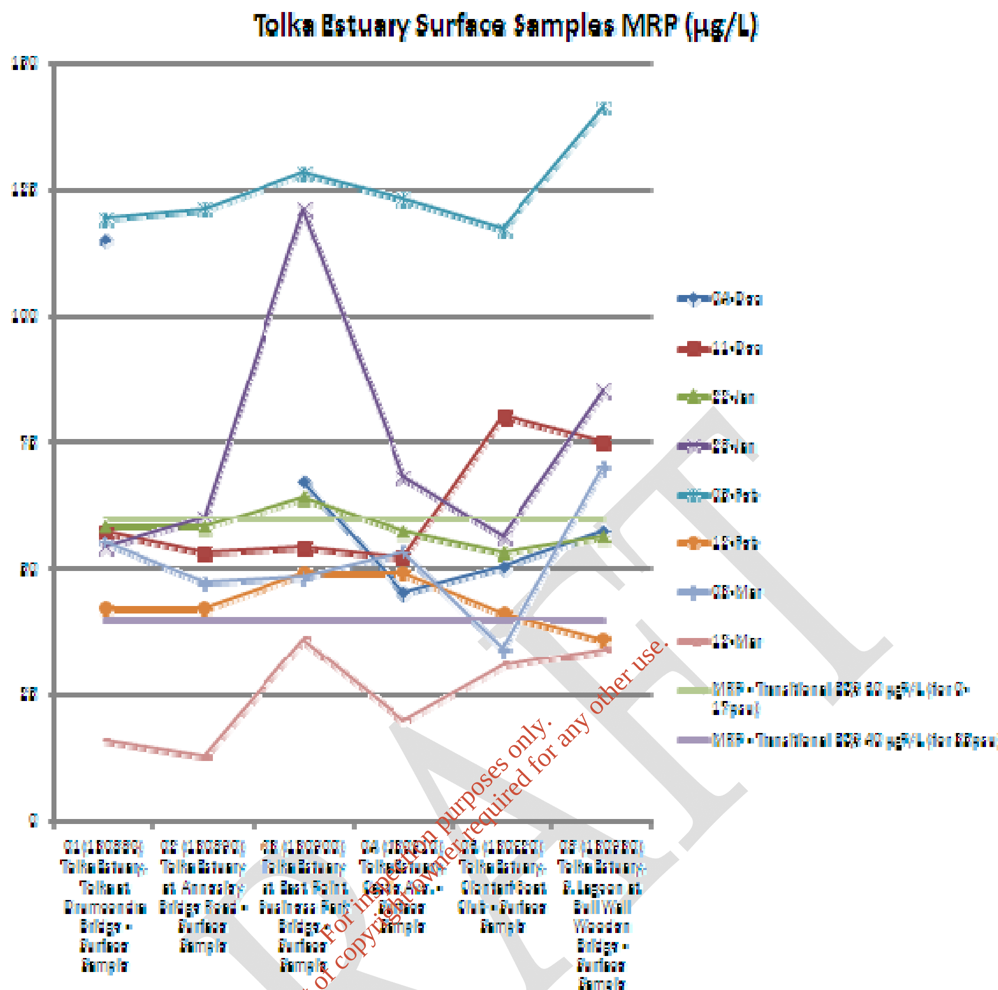

Figure E.3: Background Concentration of MRP in the Tolka Estuary (Surface Samples) from Drumcondra Bridge (left) to Bull Wall Wooden Bridge (right).

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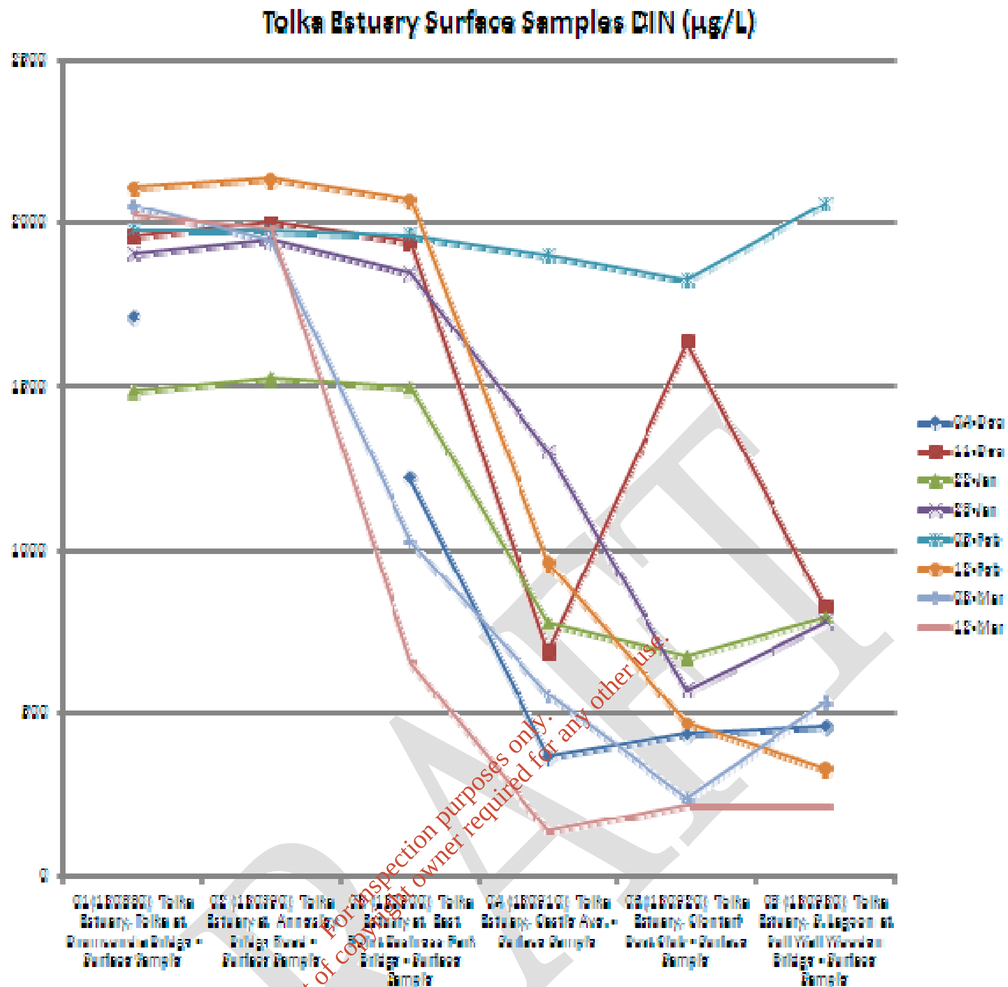

Figure E.4: Background Concentration of DIN in the Tolka Estuary (Surface Samples) from Drumcondra Bridge (left) to Bull Wall Wooden Bridge (right).

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Appendix F: Ringsend WwTW and Storm Overflow Plume: 7th December 2006

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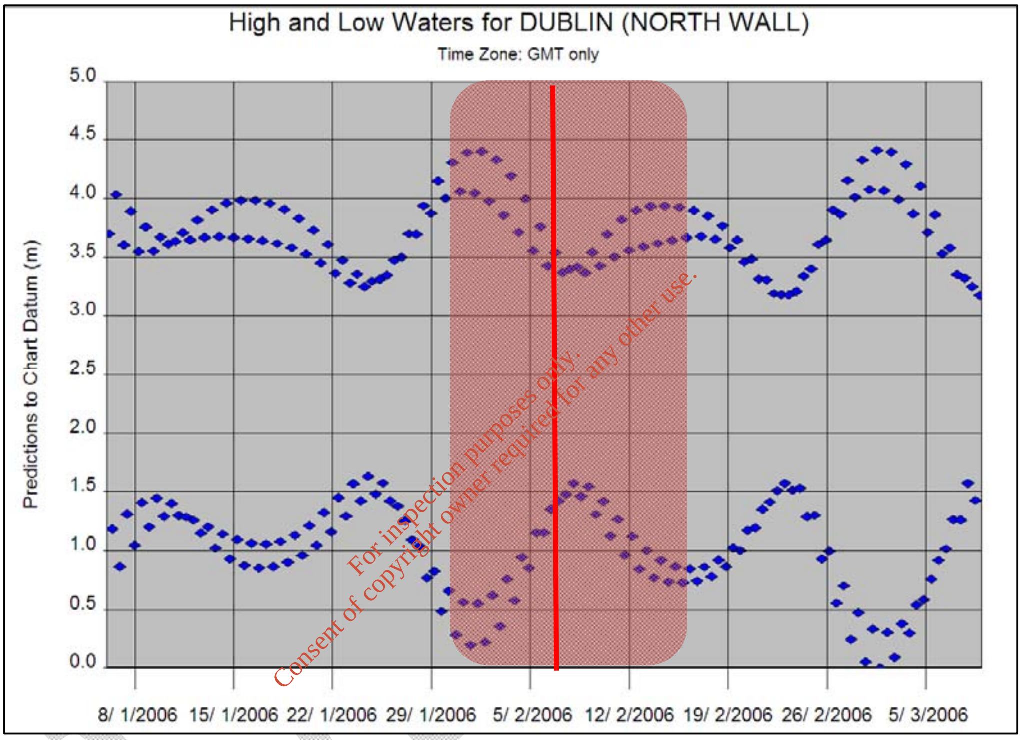
Ringsend WwTW and Storm Overflow Plume: 7th December 2006

This appendix shows the movement of the plume from the WwTW and Storm Overflow on a day during the simulated Winter Two Week simulation (see Table 8). The day presented is the 7th December 2009 and the parameter is MRP. The tidal conditions on that day are presented in Figure F.1 below showing that the tide is between spring and neap tides.

Figure F.1: Tide of boundary conditions during modelled Winter Two Week period.



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The simulation begins on the 1st December 2006. By the 7th December there is some accumulation of MRP in the Liffey and Tolka Estuaries. On the 7th December 2006 there was a small spill from the storm overflow (SW2) over a 12 hour period.

Figure F.2 shows the tide on the 7th December 2006.

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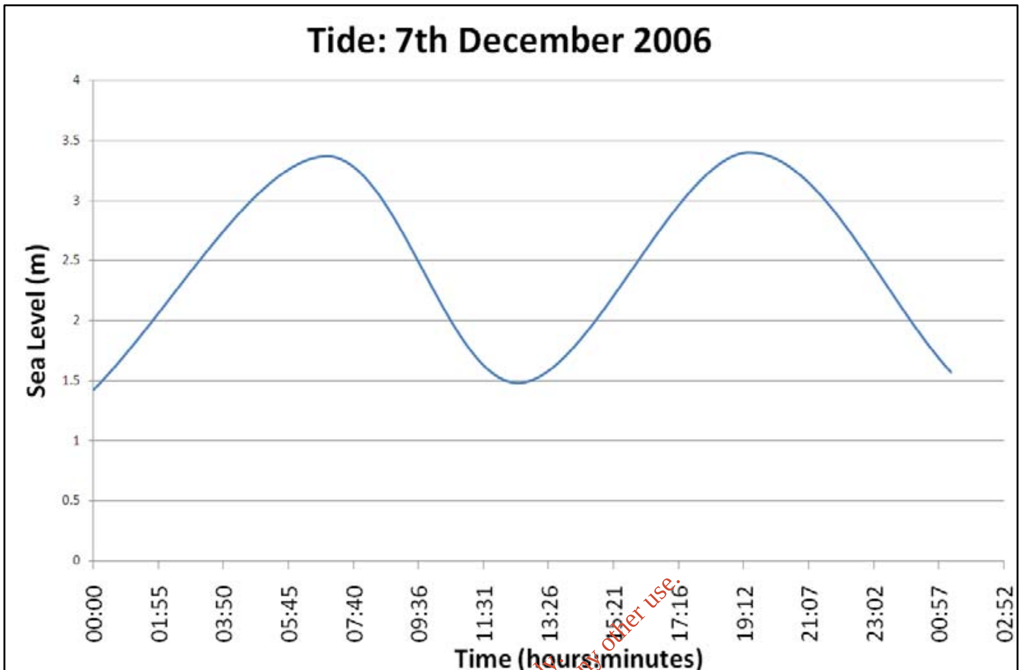

Figure F.2: Tide on 7th December 2006

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Figures F.4 to F.11 show the progression of the MRP in the Liffey and Tolka Estuaries and Dublin Bay starting at low tide at 00:00am on the 7th December 2006.It should be noted that the Winter Two Week Simulation is a maximum winter event for the year of monitoring data used, these plots therefore show maximum concentration events.

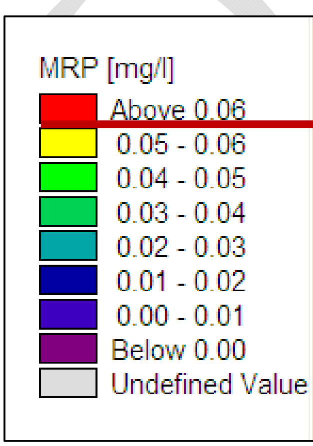

Figure F.3: Plume Diagram Legend

The coloured plumes in Figures F.4 to F.11 show the concentration plumes of MRP in the estuaries and bay due to the discharge from the WwTW and Storm Overflow.

Figure F.3 shows the scale used. The Environmental Quality Standard (EQS) set for MRP in the Draft Environmental Quality Regulations is 0.06mg P/l (0-17 PSU) in estuarine waters or the RED colour. No EQS has been set for coastal waters. It should be noted that the EQS applies to the median of an annual dataset rather than unique events as presented here.

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Figure F.4:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 00:00am Low Tide

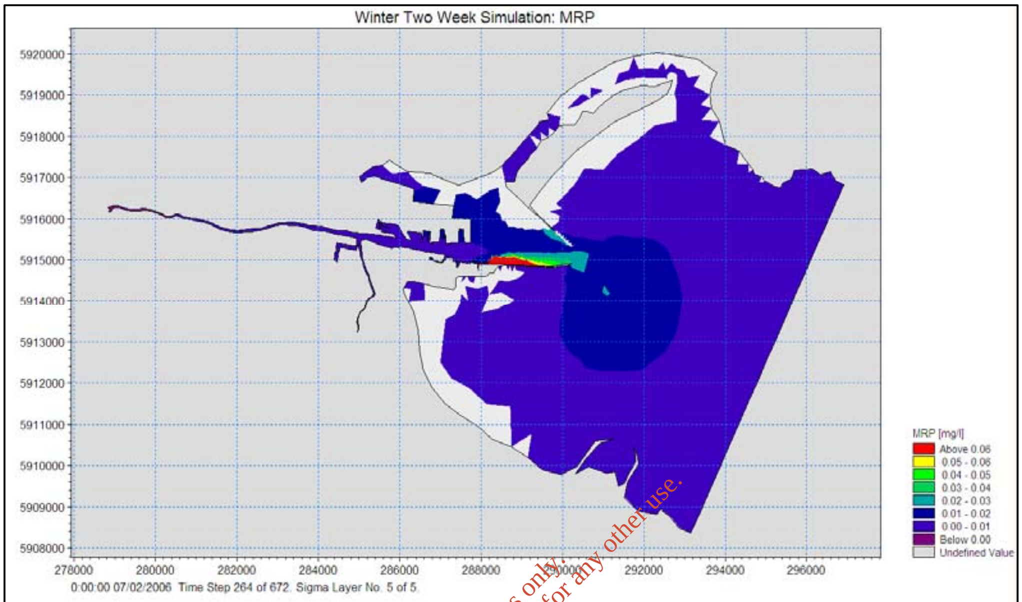

Figure F.5:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 3:30am

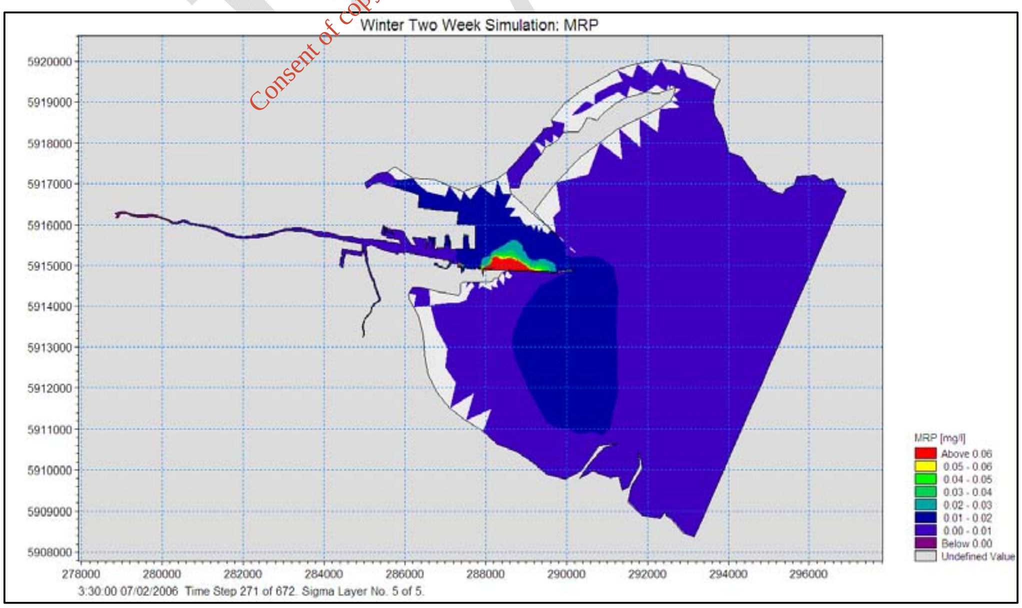

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Figure F.6:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 7.00am High Tide

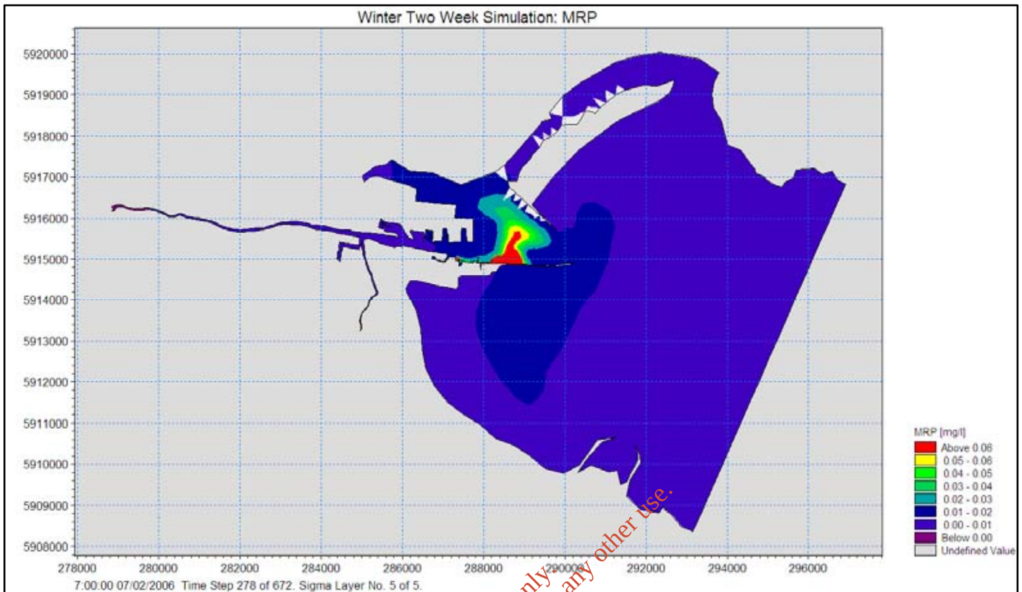

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Figure F.7:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 9.30am

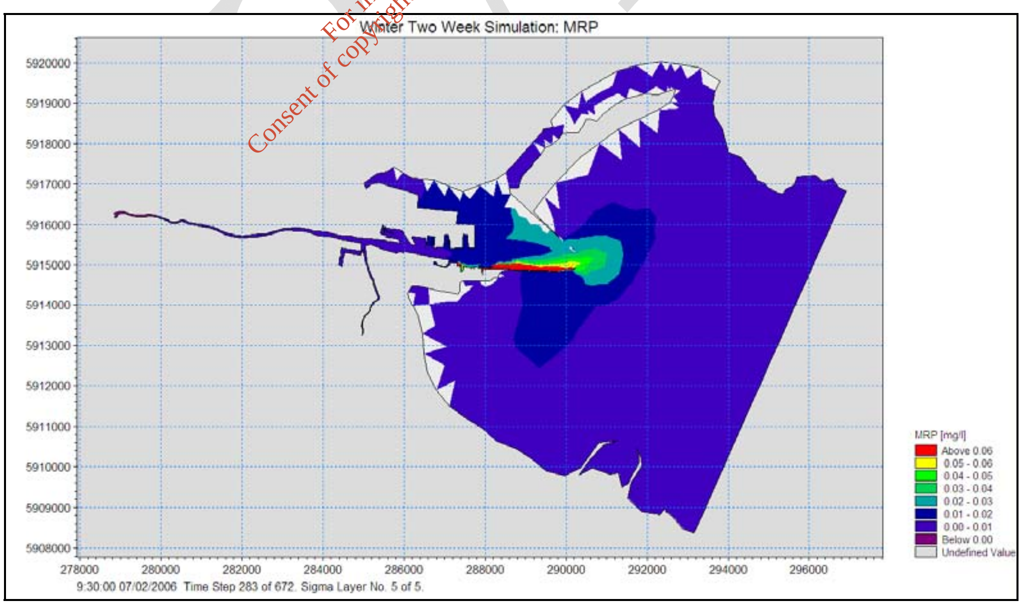

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Figure F.8:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 12.30pm Low Tide

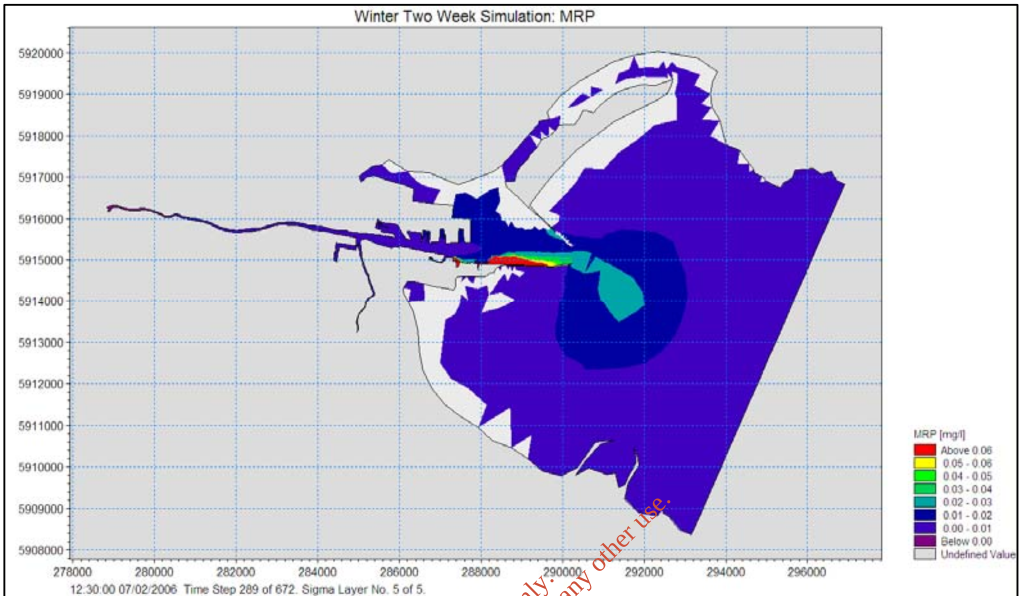

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Figure F.9:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 16.30pm

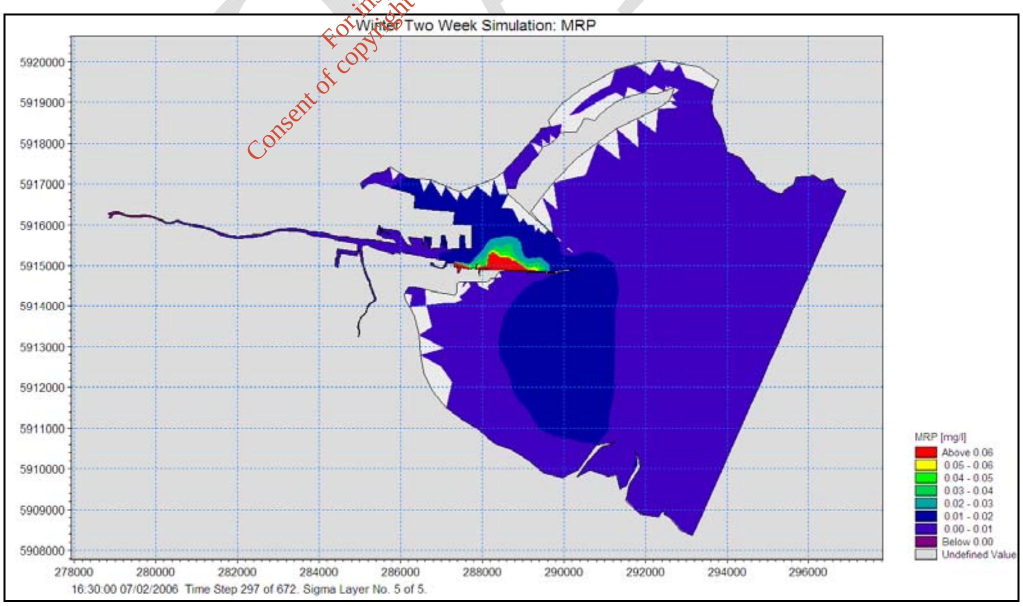

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Figure F.10:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 7.30pm High Tide

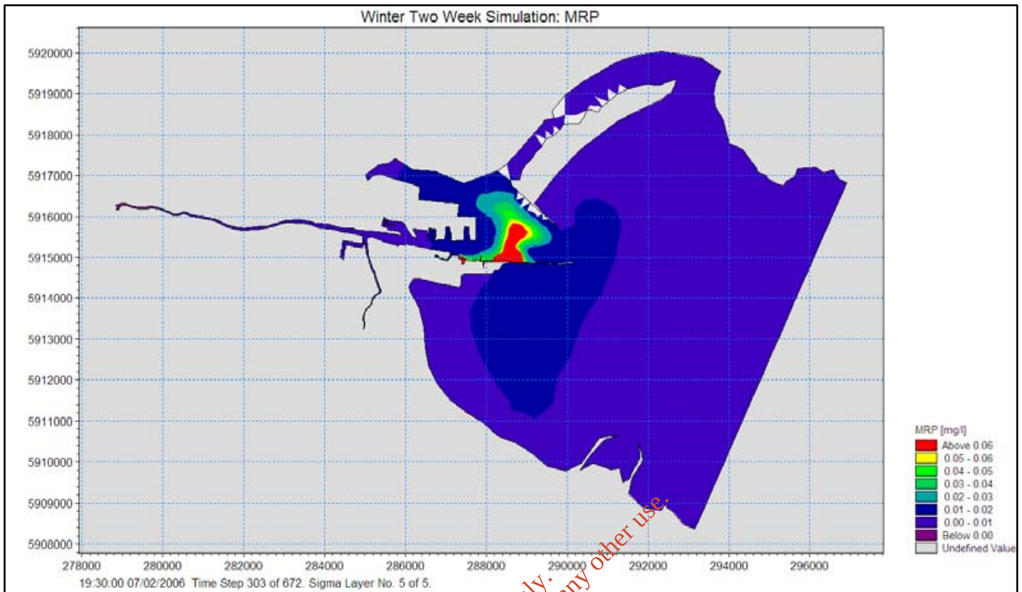
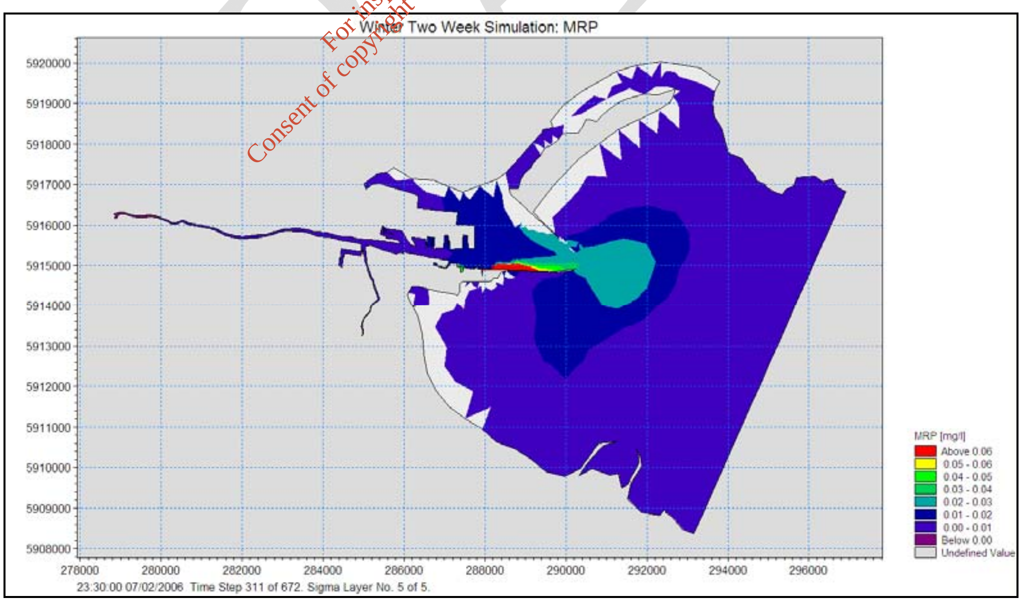


Figure F.11:MRP Plume during Winter Two Week Simulation: 7th December 2006 at 11.30pm



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RINGSEND WASTEWATER TREATMENT WORKS

APPROPRIATE ASSESSMENT

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CDM

April 2009

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Document Control Sheet

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Report	Appropriate Assessment			
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Project No: 67 511		Document Reference: DG11		
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Draft 02	Dawn Keating	Kieran O'Dwyer	Dawn Keating	22 April 09

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Non Technical Summary

This Appropriate Ecological Assessment has been prepared in response to a request by the EPA in relation to further information required as part of a Application for a Discharge Licence for Ringsend Wastewater Treatment Works.

This Assessment focuses on the impact of the existing discharges from the plant on the qualifying interests (species and habitats) of Natura 2000 sites as well as their conservation objectives.

Natura 2000 Sites

The Natura 2000 sites assessed were:

1. North Bull Island SPA;
2. North Dublin Bay cSAC;
3. South Dublin Bay cSAC; and
4. South Dublin Bay and River Tolka Estuary SPA.

Receiving Water Quality

The EPA Water Quality in Ireland Report (2000) which assesses quality for the period 2002-2006 states that since the improvements to the treatment works (completed in 2004) there has been a continuing improvement in the water quality of the Liffey and Dublin Bay. The Bay was classified as being unpolluted while the estuary was classified as being intermediate due to a failure to meet the winter ortho-phosphate threshold.

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The Ecological status was GOOD for the Liffey Estuary and MODERATE for Dublin Bay. The Ecological status determined by the lower of the quality element values for the physico-chemical and biological elements. The Biological Element for the Dublin Bay is GOOD to HIGH. The MODERATE ecological status for Dublin Bay is due to the elevated dissolved inorganic nitrogen.

The draft classifications for Dublin Bay and the Liffey Estuary under the Water Framework Directive (WFD) were published at the end of 2008. Dublin Bay has MODERATE water quality WFD Classification. Water quality is generally very good. There is only one breach in standards and that was for Winter DIN.

It is acknowledged that the Liffey Estuary is a sensitive water under the 2001 (S.I. 254 of 2001) (UWWT) regulations and amendments and that the discharge should be treated to meet the nutrient standards for Phosphorus and Total Nitrogen. This is currently being addressed and the improvements in the Ringsend WWTP will comply with all aspects of the UWWT regulations.

Status of the Natura 2000 Sites

The conservation objective is to maintain the favourable conservation status of the species listed in Annex 1 of the EU Birds Directive, Annex 11 of the EU Habitats

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Directive and habitats listed on Annex 1 of the EU Habitats Directive as well as other important species and habitats.

There are no reports of any loss of integrity of the designated sites. There are no records of any significant decrease in numbers of birds that are protected under the SPA designation. At present the conservation status is favourable and the concentrations of Internationally and Nationally important species remains consistent with previous years findings.

Impacts.

It should be noted that the criteria used assess the cumulative impact of the all the activities that may effect the aquatic environment

This overall quality status and the fact that the water quality has been observed to improve since the upgrading of the works was completed in 2004 would indicate that the risk of an adverse impact on the protected sites has reduced over the past years. The principal effect on water quality is marginally elevated nutrients. While there may be a breach in the proposed environmental quality objectives there is no reason to suggest that there is an impact on the qualifying interests of the Natura 2000 sites.

The fact that there is no deterioration the integrity of the protected areas also indicates that there is no impact.

Mitgation/ Improvements

While there is no evidence of impacts on the qualifying interests of the Natura 2000 Sites further improvements are being undertaken on the Ringsend Wastewater Treatment Works. The Liffey Estuary is a designated sensitive water and treatment for the reduction of nutrients is required under the UWWT

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1 Introduction

An application for a Wastewater Discharge Licence has been submitted to the EPA by Dublin City Council. As part of a request for additional information Dublin City Council were requested to undertake an Appropriate Ecological Assessment of the existing Ringsend Wastewater Treatment Works effluent.

Improvements to the wastewater treatment works were completed in 2004 and further works are currently proposed to expand the works to maximise its capacity in order to meet future needs and to comply with the Urban Waste Water Treatment Regulations.

This Appropriate Assessment is issued without prejudice to any future surveys and assessments that may be required as part of any planning application or any other information that may be made available by the National Parks and Wildlife Service (NPWS) or others.

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2 Regulatory Context

The Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora) formed a basis for the designation of Special Areas of Conservation (SACs). Similarly, Special Protection Areas are legislated for under the Birds Directive (Council Directive 79/409/EEC on the Conservation of Wild Birds). Collectively, SACs and SPAs are referred to as Natura 2000 sites. In general terms, they are considered to be of exceptional importance in terms of rare, endangered or vulnerable habitats and species within the European Community. Under Article 6(3) of the Habitats Directive an Appropriate Assessment must be undertaken for any plan or program that is likely to have a significant effect on the conservation objectives of a Natura 2000 site. An Appropriate Assessment is an evaluation of the potential impacts of a plan on the conservation objectives of a Natura 2000 site, and the development, where necessary, of mitigation or avoidance measures to preclude negative effects.

The main aim of the EU Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna) is "to contribute towards ensuring biodiversity through the conservation of natural habitats of wild fauna and flora in the European territory of the Member States to which the treaty applies". The Directive was transposed into Irish law by the European Communities (Natural Habitats) Regulations, SI 94/1997.

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Article 6, paragraphs 3 of the Habitats Directive state that:

" Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public".

The EU Birds Directive (Council directive 79/409/EEC on the Conservation of Wild Birds) is the main mechanism for protecting wild bird species that occur within the European Union. It provides for the protection, management and control of bird species. According the Article 4 of the Birds Directive "Species mentioned in Annex I shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution." The key element of the Birds Directive is that it provides for the creation of Special Protection Areas (SPAs) for the protection of Annex I species as well as for regularly occurring migratory species not listed in Annex I. The Birds Directive is implemented in Ireland under the Wildlife Act (1976) and the Wildlife Amendment Act (2000).

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The Natura 2000 network is a European network of ecologically important sites (SPAs and SACs) that have been designated for protection under either the Birds Directive or the Habitats Directive. The statutory agency responsible for these designated areas is the National Parks and Wildlife Service of the Department of Environment, Heritage and Local Government.

The European Court of Justice has recently (December 13 2007) issued a judgment in a legal case against Ireland that found that Ireland has failed in its statutory duty to confer adequate protection on designated areas. Following on from this the Circular Letter 1/08 & NPWS 1/08 on Appropriate Assessment of Land Use Plans (from the Department of the Environment, Heritage and Local Government) states that all plans and projects will be subject to critical assessment to ensure that they comply with all relevant legislation.

The appropriate assessment is focussed on the potential impacts on the "integrity of the site". This relates to the conservation objectives of the Natura 2000 site. The integrity of the site has been defined as the "coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site will be classified" (PPG 9, UK Department of the Environment, October 1994). These concepts are discussed further in Chapter 5. In accordance with the precautionary principle, if there is insufficient information available to make a judgment decision, it should be assumed that there is potential for a significant effect.

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The Stages in an Appropriate Assessment

There are 4 stages in an Appropriate Assessment as outlined in the European Commission Guidance document (2001). The following is a brief summary of these steps.

Stage 1 - Screening: This stage examines the likely effects of a project either alone or in combination with other projects upon a Natura 2000 Site and considers whether it can be objectively concluded that these effects will not be significant

Stage 2 - Appropriate Assessment: In this stage, the impact of the project on the integrity of the Natura 2000 site is considered with respect to the conservation objectives of the site and to its structure and function.

Stage 3 - Assessment of Alternative Solutions: Should the Appropriate Assessment determine that adverse impacts are likely upon a Natura 2000 site, this stage examines alternative ways of implementing the project that, where possible, avoid these adverse impacts.

Stage 4 - Assessment where no alternative solutions exist and where adverse impacts remain: Where imperative reasons of overriding public interest (IROPI) exist, an assessment to consider whether compensatory measures will or will not effectively offset the damage to the Natura site will be necessary.

As it has been directed that an Appropriate Assessment be carried out, this report covers Stage 2. A summary of Stage 2 – Appropriate Assessment is given in the Appendix B.

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3 Methodology and Approach

3.1 Introduction

The EPA have indicated that the discharge licence application for the Ringsend Wastewater treatment Works requires the completion of an Appropriate Ecological Assessment. It should be noted that this assessment differs from the assessment of other proposed plans in the fact that the activity which is being assessed is already taking place. The objective of the Appropriate Assessment Process is to evaluate whether there is or there will be a significant impact on the Natura 2000 sites. It is the impacts on the qualifying interests (species and habitats) together with the conservation objectives of these sites that will be assessed.

This assessment was carried out with reference to the relevant guidance, in particular:

- Assessment of Plans and Projects significantly affecting Natura 2000 Sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, European Commission 2002
- Managing Natura 2000 Sites – The Provisions of Article 6 of the 'Habitats Directive' 92/43/EEC, European Commission, 2000
- Circular L8/08 Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments. 2 September 2008

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3.2 Approach

Consultations with EPA Inspector (Karen Creed) indicated that the impacts of the discharge should be the focus of the assessment. A review of areas designated (or being considered for designation) for nature conservation was carried out by consulting the National Parks and Wildlife Service (NPWS). These included Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) for birds.

The approach adopted is summarised as follows:

- The plan or activity being assessed is the discharge of treated effluent to the Liffey Estuary at Ringsend.
- The consequence of this activity is a change in background water quality in the receiving waters.
- The change in the receiving water quality is variable and the effects are attenuated with time and distance.
- The receptors that this assessment is directed at are Natura 2000 sites in the vicinity of Ringsend with the potential capacity to be affected but the discharge. Specifically the impacts of the discharge (change in water

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quality) on qualifying species and habitats and conservation objectives associated with the sites is being assessed.

- The pathway by which the receptors can be impacted is through the aquatic environment.

- The discharge from the WwTW at Ringsend can only impact directly on the aquatic elements of the qualifying interests of the Natura Sites. This would eliminate habitats such as dunes, cliffs etc. as well as flora that are based on dry land.

- It is possible that indirect impacts could occur where the change in quality could affect the food chain and consequently impact on species who rely on the receiving water environment for their food.

- Due to the fact that the discharge is already existing it is possible to assess the impacts on the basis of a number of criteria.

  a) An assessment of the change in receiving water quality as a result the discharge, i.e., the baseline water quality at the Natura 2000 Sites. This water quality can then be compared to the various quality standards to provide an indication of the significance of the alteration in quality.

  b) Identifying whether a pathway exists by which an effect can be imparted to the Natura 2000 site. If no pathway exists then it follows that there can be no impact on a particular qualifying interest.

  c) An examination of whether there has been any significant deterioration in the status of the site. If no deterioration has been observed and its status is satisfactory then it follows that the existing activity is not significantly impacting the site. If a deterioration has been observed it still remains to establish whether the discharge is the cause of the deterioration.

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Based on the results of the various assessment criteria a subjective assessment may be required if sufficient information is not available to provide definitive proof.

3.3 Methodology

Desk Study

A range of data relating to the discharges and the baselines conditions in the bay as well as data on the relevant designated habitats was reviewed. This data included:

- Submitted discharge licence and supporting data;

- Various studies undertaken in relation to the flora and fauna of the designated areas in the vicinity of the discharge point; and

- EPA Water Quality Reports; and

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- Eastern River Basin Management Plan Reports.

It should be noted that due to the improvements in the treatment process in 2004, that many studies carried out prior to this do not reflect current baseline receiving water conditions.

Consultation

- BirdWatch Ireland data were provided by Dublin City Council (DCC) along with bird count data previously commissioned by DCC in relation to the proposed development and potential impacts on protected bird species in the area.

- The National Parks and Wildlife Service (NPWS) was consulted in relation to designated areas and records of protected species within the study area.

- The Parks Department, Planning Department, Water Services Department and Heritage Officer of Dublin City County Council were also consulted as part of this study.

The EPA will forward copies of this report to the NPWS and other statutory bodies for comment.

Description of the Natura 2000 Areas in the vicinity

Data was obtained from NPWS including descriptions of the Natura 2000 designated areas in the vicinity and the qualifying interests (species and habitats) together with the conservation objectives.

Assessment of impacts

Once the qualifying interests and conservation objectives which have the potential to be impacted have been established an appropriate assessment will be undertaken. The assessment criteria have been described in 3.1 above. The findings will be contained in the assessment tables in Appendix B.

Mitigation Measures

Regardless of whether the screening process identifies significant impacts, it is proposed to provide information on the improvements to the wastewater treatment works that are in train and to illustrate that the effect of the discharge in the future will be less than that at present.

The assessment tables will be filled in to provide the summary of the findings.

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4 Study Area, Discharge Details and Background Water Quality

4.1 Study Area

The area of interest comprises the Liffey Estuary and Dublin Bay.

The Liffey enters Dublin Bay between Clontarf and Ringsend in the channel formed by the North Bull Wall and the Great South Wall. The North Bull Wall is a natural bank reinforced by a stone embankment that is only inundated at half tide. It therefore holds back the water flowing out of the harbour at and after half ebb. The navigation channel runs close to the South Wall and extends from the Port area through the mouth of the harbour. This navigation channel is maintained at a depth of 7 to 8 metres below chart datum by dredging and natural scouring. To the north of this channel are extensive areas which dry out at low water. These mudflats extend from the mouth of the River Tolka almost to the end of the Bull Wall and north-eastwards to the Bull Island Causeway at St. Annes.

Dublin Bay is a shallow bay with water depths not greater than 20m at low tide at its outer limit between Sorrento Point and Baily at Howth. The water depth decreases towards the harbour with depths of less than 5m occurring in the inner half of the Bay. North of the harbour at Bull Island and south around Sandymount extensive areas dry out at low tide. These areas provide important habitats for wading birds and wildfowl.

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Figure 4.1 Liffey Estuary

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The tidal flow characteristics of Dublin Bay reflect the tidal regime in the Irish Sea. On the flood tide, the tidal stream enters from the south of the bay past Dalkey Island and runs north creating a clockwise flow. On the ebb, the tidal stream flows eastward past Howth Head and then southwards towards the shore at Dalkey Island. The resulting dominant feature is therefore a clockwise tidal circulation giving a strong eastwards net flow.

The currents in Dublin Port are dominated by the tidal fluctuations and are only to some extent influenced by wind and pressure fields over the east coast of Ireland and Dublin Bay, except during extreme weather conditions. The freshwater inflow influences the currents and a salt water wedge can be observed in the estuary. In the upstream part around Butt Bridge the estuary is highly stratified. The stratification decreases downstream. From Ringsend and towards the mouth the estuary can be considered well mixed. Stratification and location of the salt water wedge depends on the tidal conditions and the river discharge. The salinity of the sea water in the outer part of Dublin Bay and along the eastern coast of Ireland shows insignificant annual variation and is around 35 PSU all year round.

Dublin Bay contains a number of designated conservation sites including Special Areas of Conservation (SAC) and Special Protection Areas (SPA) as discussed in further detail in Chapter 5 and shown in Figures 4.2 and 4.3.

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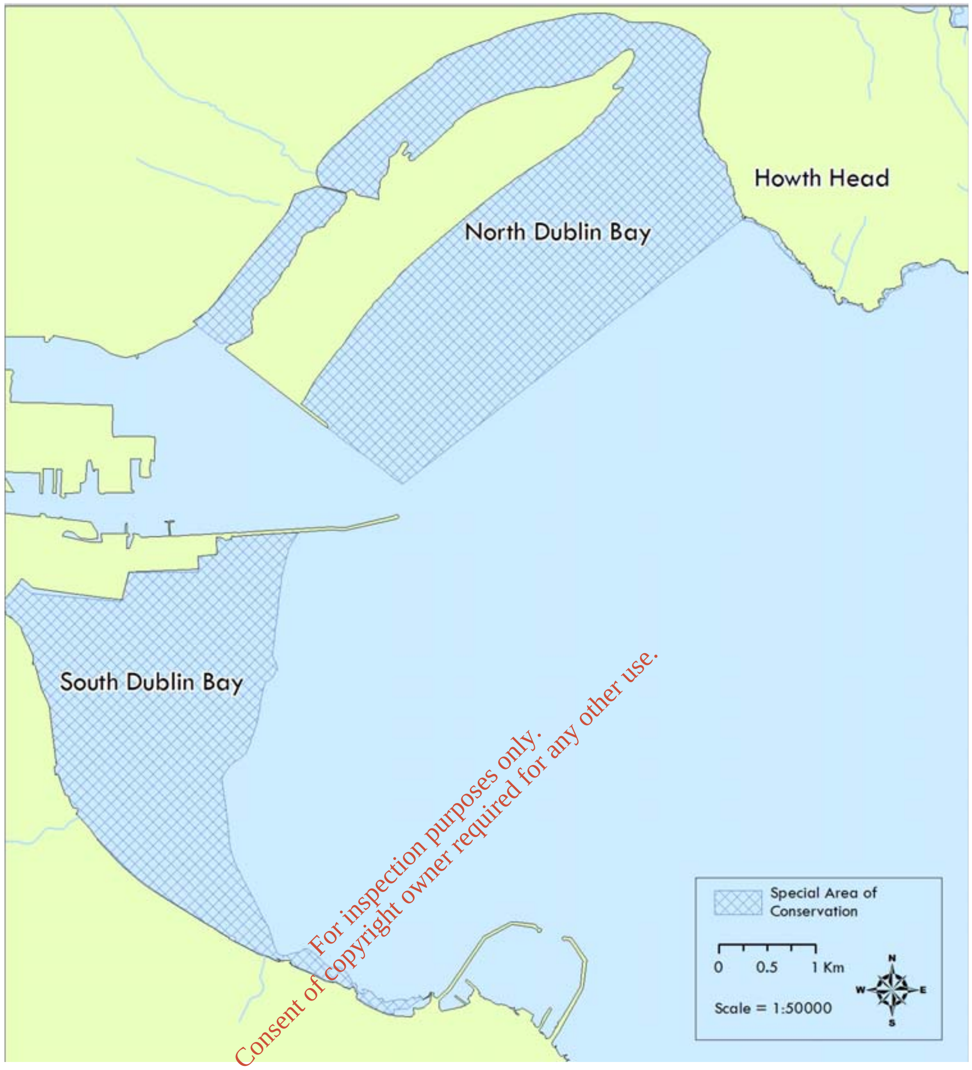

Fig 4.2: Special Areas of Conservation in Dublin Bay

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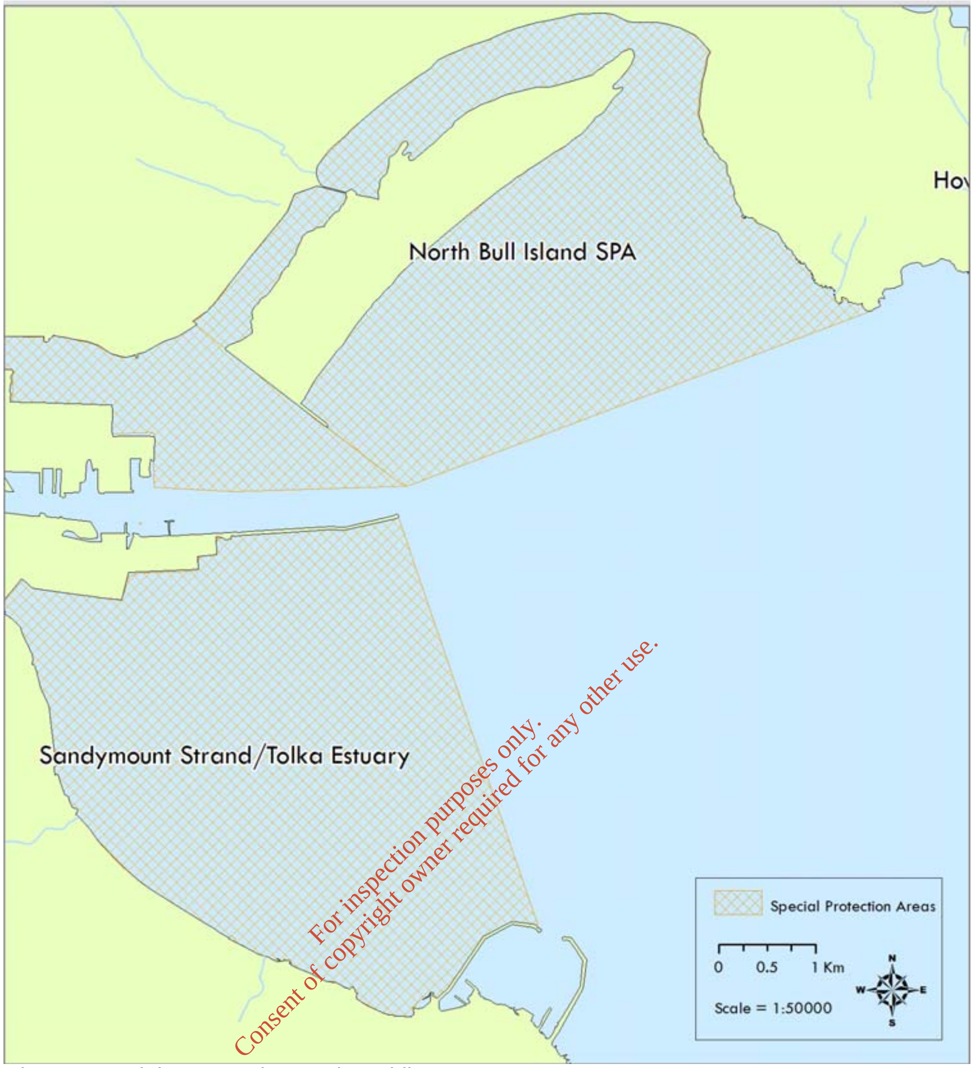

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Fig 4.3: Special Protected Areas in Dublin Bay

4.2 Effluent Analysis

The works has demonstrated the ability to adequately remove BOD and has often performed exceptionally well under stressed conditions.

Over the period of 1 July 2007 through 31 August 2008, the average effluent BOD concentration was 15 mg/L as compared to the 95%-ile standard of 25 mg/L. The average BOD removal rate was 93.2% and 99.2% of the flow received full secondary treatment. The effluent achieved compliance with the effluent standard of 25 mg/L 90.8% of the time. While not achieving the required 95%-ile compliance rate, 69% (18 of 26) of the exceedances occurred during days on which the influent loadings exceeded the design basis. There were seven days when the effluent exceeded the not-to-exceed limit of 50 mg/L.

There was one 30-day period between 24 April 2008 through 23 May 2008 in which the average BOD loading to the works averaged 188.3 tpd (3.14 million PE), or

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192% of the design basis. During this stressed period, the biological treatment system performed exceptionally well, achieving an average effluent concentration of 14.4 mg/L with no days in excess of 25 mg/L. The overall BOD removal rate was 97.0% and all of the influent flow received full secondary treatment.

Another high stress month was August 2008, during which time the works saw very high flows, averaging 6.7 m^3/s, or 17% higher than the design ADF. The maximum day flow was 13.2 m^3/s and the peak instantaneous flow was 21.0 m^3/s. During this period, 99.6% of the flow received secondary treatment. The average effluent BOD was 7.0 mg/L and there were no days in excess of 25 mg/L. The overall BOD removal rate was 97.0%

TSS removal is not on par with BOD removal. Over the period of 1 July 2007 through 31 August 2008, the average effluent TSS concentration was 30.1 mg/L as compared to the 95%-ile standard of 35 mg/L. The average TSS removal rate was 87.8%. The effluent achieved compliance with the effluent standard of 35 mg/L 81.4% of the time. There were seventeen days when the effluent exceeded the not-to-exceed limit of 87.5 mg/L. These exceedances correlate better with high influent loading than with high inflow, with fifteen days exceeding the design average influent TSS loading and eight days in which the inflow exceeded the design ADF. There were seven days in which both the design influent flow and TSS loading parameters were exceeded.

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During the high load period of April-May 2008, the effluent averaged 35.6 mg/L, with 13 exceedances of the 35 mg/L standard. During the high flow period in August 2008, the effluent averaged 18.6 mg/L and there was only one exceedance of the 95%-ile standard. The average removal rate was 90.0%. During the stressed months it again appears that influent loading has a greater influence on effluent quality that influent flow.

Another correlation that is apparent is the sludge volume index (SVI) and effluent TSS. SVI is not measured every day, so direct day-for-day correlations are difficult to obtain. However, over the last 12 month period, there were 77 exceedances of 35 mg/L and almost 60% of them occurred when the SVI exceeded 150 ml/g.

In 2007, effluent Total-N and NH_3-N averaged 22.1 mg/L and 4.6 mg/L, respectively. The works is reliably achieving its ammonia limit of 18.75 mg/L as required by the Contract between DCC and thte Operator Celtic Anglian Water (CAW). The works is not currently meeting the 10 mg/L Total-N Urban Waste Water Treatment (UWWT) limit for Nutrient Sensitive Waters.

In 2007, the effluent contained an average of 3.6 mg/L TP. The UWWT limit is 1.0 mg/L. There is no current requirement in the Contract between DCC and CAW (the operator) to remove P.

Disinfection is required from 1 May through 31 August, annually. During this period, the standard is 100,000 faecal coliforms per 100 ml (FC/100 ml) and 80% compliance must be achieved over an 8-week rolling average. Both laboratories performing bacteriological analyses for the works (i.e. Central Labs for DCC and City Analysts Ltd. for CAW) had difficulty providing reliable and reproducible

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faecal coliform results. Discussions centred on the appropriate bacteriological standard took place in 2006 between senior microbiologists from both labs, DCC and CAW. Water-quality studies indicating excellent correlation between Escherichi coliform (E. coli) and faecal coliform were cited. It was also noted that in 1986, the U.S. Environmental Protection Agency (USEPA) recommended that E. coli be used in place of faecal coliform bacteria in State recreational water-quality standards as an indicator of faecal contamination. As are result of these discussions, DCC and CAW agreed to monitor E.Coli instead of faecal coliforms from 1 May 2006 forward. Since that time, the works has always been in compliance with the revised standard.

4.3 Current Water Quality

The rates of exchange of water between the Liffey estuary and Dublin Bay and between Dublin Bay and the open sea are very good. This ensures that when effluent leaves the estuary very little is returned on the subsequent tide.

Low level of phosphorus shows good water quality in the bay. Water quality of the bay is considered high in terms of nutrient and chlorophyll levels. Bacterial contamination in the bay is low.

Biochemical oxygen demand (BOD) concentrations in the Liffey Estuary, Dublin Bay and adjacent coastal waters are generally low. Oxygen saturation levels are generally within the range of normal saturation (80-120%) and levels in the waters adjacent to the WwTW outfall are indistinguishable from the remainder of the outer Liffey estuary.

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EPA classification

The present assessment of the Liffey estuary would appear to confirm that water quality in the estuary continues to improve with only phosphorus levels in winter marginally exceeding the set criterion. Since the 1995-1999 period the trophic status of the estuary has improved from eutrophic to intermediate in 1999-2003 and in the current assessment period. As in the previous assessment summer chlorophyll levels in the estuary remained low with values of 3.2 (median) and 5.6 (90 percentile) µg/l respectively. Dissolved oxygen levels showed little evidence of disturbance ranging between 80 and 119 per cent saturation (EPA,2008).

The observed improvement in water quality in the Liffey estuary is clearly a result of the installation of significantly upgraded treatment facilities at the Ringsend WwTW, though further investigation is still required to track the change in nutrient levels as the full effect of the works is realised. In the previous period 1999-2003, there was some evidence to suggest that while total and ammoniacal nitrogen concentrations had fallen as a consequence of nitrification, oxidised nitrogen levels had increased. It had been suggested that this situation should be kept under review in case it might lead to the reoccurrence of excessive nitrogen availability in the estuary. It would appear though from examination of data collected during the current assessment period that levels of total oxidised nitrogen in the estuary have changed little in the intervening period (EPA,2008).

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BOD concentrations were generally low, as indicated by the median value of 2.0 mg/l O_2 in both the estuary and Dublin Bay. Given that this value is also the limit of detection for the method used, at least half of the reported measurements were less than 2.0 mg/l O2. In Dublin Bay, 80 per cent of BOD values were reported at the limit of detection indicating that the 'true' median value for the Bay is much lower than the limit of detection. However, the Liffey estuary and Dublin Bay were both in breach of the recommended 95 percentile BOD value of 4 mg/l O_2. In the estuary the exceedance was the result of a small number of high BOD values in the range 12 – 27 mg/l O_2 collected adjacent to the Ringsend effluent cascade. These high BOD values were mostly restricted to 2002 and data collected since then indicate a decline in BOD values both within the lower estuary and particularly in the vicinity of the Ringsend discharge – again indicating an improvement in the quality of the discharge at this point. The reduction in organic loading from Ringsend, as indicated by declining BOD values, is also reflected in the considerable improvement in the bacteriological quality of the Liffey estuary and bathing areas within the Dublin Bay area (EPA,2008).

Water Framework Directive Classification

Dublin Bay comes under the terms of the recent Water Framework Directive (WFD) (2000/60/EC). The WFD sets quality standards for chemical and biological parameters, including an obligation to maintain or to restore to 'good ecological quality and sets a timetable for a series of actions, up to the final implementation of the WFD in 2015 (as discussed further below).

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The WFD specifies the factors, referred to as quality elements, which must be used in determining the ecological status or ecological potential and the surface water chemical status of a surface waterbody. The lists of quality elements for each surface water category are divided into three groups of elements:

- biological elements;
- hydromorphological elements; and
- chemical and physico-chemical elements.

Draft Regulations were proposed in September 2008 establishing Environmental Objectives and Environmental Quality Standards for the classification and management of Surface Waters and requiring the implementation of measures to reduce water pollution and protect and restore Surface Waters. The draft classifications for Dublin Bay and the Liffey Estuary under the Water Framework Directive were published at the end of 2008. Dublin Bay has ***MODERATE*** water quality WFD Classification. Water quality is generally very good. There is only one breach in standards and that was for Winter dissolved inorganic nitrogen (DIN).

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	DIN	MRP	DO	BOD
Dublin Bay	Moderate	Good	High	High
Tolka Estuary	Moderate	Moderate	High	High
Liffey Estuary Lower	Moderate	Good	Good	High
Biological				
	Phyto-biomass	**Seagrass**	**Reduced Species List**	**Fish**
Dublin Bay	High	High	Good	Moderate
Tolka Estuary	High			Moderate
Liffey Estuary Lower	High			Moderate
	Specific Pollutants	**Ecological Status**	**Surface Water Status**	**Conservation Status**
Dublin Bay	Pass	Moderate	Moderate	Moderate
Tolka Estuary		Moderate	Moderate	Moderate
Liffey Estuary Lower	Pass	Good	Moderate	Good

Table 4.1 Draft Water Framework Directive Classifications.

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Cumulative

It should be noted that the water quality data contained in both the EPA Water quality report and the Data from the Water Framework Directive (ERBD management plan) reflects the cumulative effect of all the discharges that end up in Dublin Bay. The River Liffey is considered to be the main source of diffuse nutrients to Dublin Bay and accounts for 85% of all riverine inputs. (Dublin Drainage Consultancy, 2005).

Other activities that may affect water quality and sediment quality are dredge spoil disposal, litter, chronic spillages of small amounts of oil, ores and other toxic substances and diffuse sources. Since 1999 there has been no dumping of sewage sludge at sea.

Water is abstracted from the Liffey Estuary by the ESB Power Generation Station for use as cooling waters. The ESB Cooling Waters mix with the WwTW discharge before final discharge to the estuary.

There are currently two power generation plants at Poolbeg; the Thermal Plant and the Combined Cycle Gas Turbine (CCGT). The CCGT is run continuously whilst the Thermal Plant is only used during periods of peak demand. The CCGT is serviced by 2 CW Pumps at $5m^3/s$ flow each, which gives a continuous base CW discharge of $10m^3/s$.

The effluents include condenser cooling water, discharge from the water treatment neutralisation tanks, boiler blowdown water and screen wash water. The IPPC Licences for these plants contain limits for the quality of the effluents in terms of physical and chemical properties.

CDM

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The observed improved water quality in the Liffey Estuary in recent years is, according to the EPA, *"clearly a result of the installation of significantly upgraded treatment facilities at Ringsend WwTW"*.

4.4 Modelled Water Quality

A 3D model system, MIKE 3 Flexible Mesh (FM) was used to model water quality as discussed in detail in the water quality modeling report 'Modelling the Impact of Ringsend Wastewater Treatment Works and Storm Overflow Discharge in the Liffey and Tolka Estuaries and Dublin Bay'. The geographical coverage of the model includes the outer parts of the River Liffey, Dublin Port and the Dublin Bay area in order to ensure a correct prediction of the circulation of the area. The model was thoroughly calibrated against available data in the Liffey estuary including water levels, currents, temperature, salinity and thermal plume extensions.

Three periods of 15 days were simulated, winter, summer and a summer storm with and without wind. The simulation periods cover a full neap spring tidal cycle. The results generally showed that the BOD, TSS, NH3-N and the Faecal Coli will stay inside the harbor. However, for discharge of molybdate reactive phosphorus (MRP) and dissolved inorganic nitrate (DIN) inside the harbor the central bay is affected. With respect to the protected areas, elevated levels of DIN and MRP values were found at the mouth of the Tolka.

The exceedance concentration plots show the percentage of time within the simulated period of 15 days that a set standard is surpassed as opposed to an average concentration. The exceedance concentration fields for the modelled summer period (both with and without wind effects) are shown below.

As can be seen from the figures below, the exceedance concentration fields for MRP and DIN are seen to extend into parts of the Tolka Estuary (as part of the Sandymount Strand/Tolka Estuary SPA) and parts of North Dublin Bay cSAC / North Bull Island SPA. For DIN this is seen to occur between approximately 5% - 15% of the modelled period and in a confined geographical area. MRP shows increased levels with the higher concentrations limited to the mouth of the Tolka.

It should be noted that simple impact modelling was conducted and, therefore, background monitoring data was not included. Whilst these results may show that a parameter discharging from the WwTW does not surpass the environmental quality standards discussed, when the background concentrations in the receiving waters are considered, the discharges may be causing an impact or an exceedance of that standard.

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Figure 4.4 Exceedance of 1000 No/100ml Faecal Coli for Summer Period (without wind)

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Figure 4.5 Exceedance of 1000 No/100ml Faecal Coli for Summer Period (with wind)

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Figure 4.6 Exceedance of 4 mg/l BOD for Summer Period (without wind)

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Figure 4.7 Exceedance of 4 mg/l BOD for Summer Period (with wind)

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Figure 4.8 Exceedance of 0.04 mg/l MRP for Summer Period (without wind)

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Figure 4.9 Exceedance of 0.04 mg/l MRP for Summer Period (with wind)

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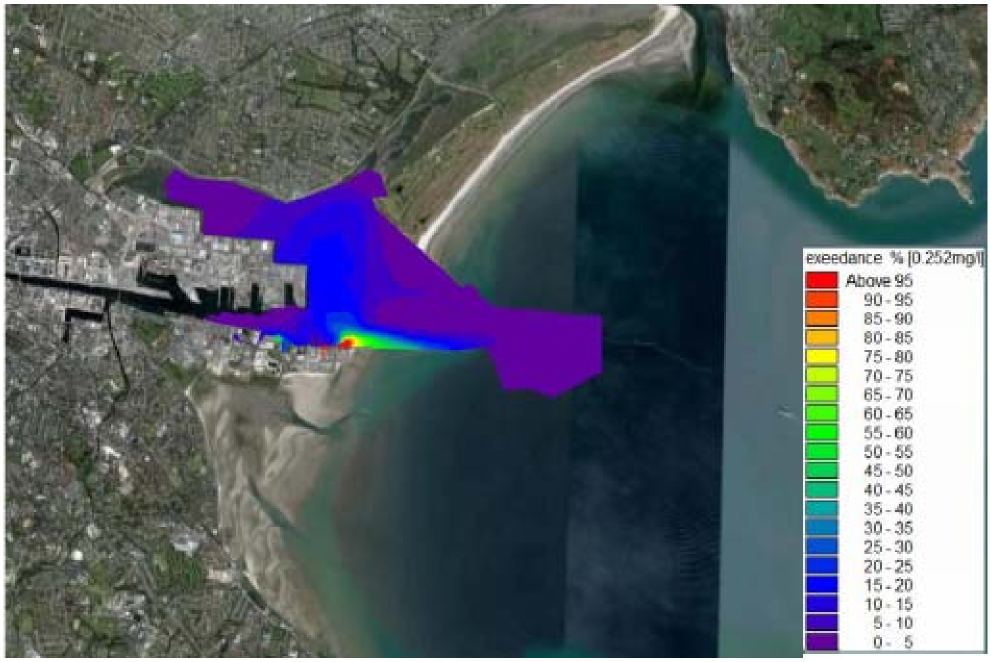

Figure 4.10 Exceedance of 0.252 mg/l DIN for Summer Period (without wind)

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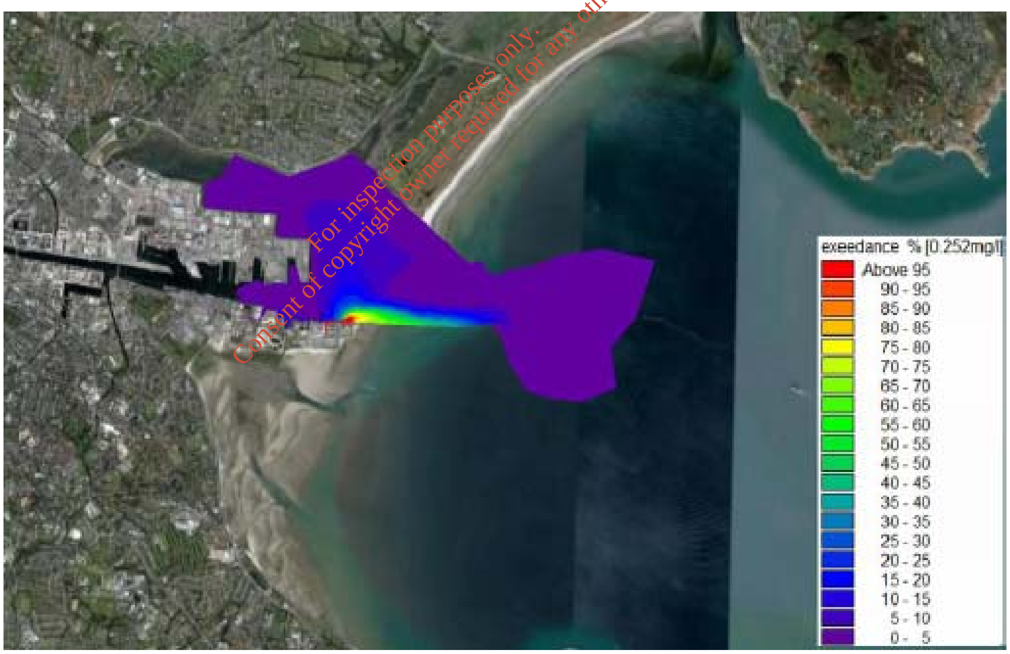

Figure 4.11 Exceedance of 0.252 mg/l DIN for Summer Period (with wind)

4.5 Planned and Future Developments

Waste to Energy Plant

The Environmental Protection Agency (EPA) has issued a licence to Dublin City Council, to operate a non-hazardous waste incinerator at Pigeon House Road, Poolbeg Peninsula. The licence provides for the operation of an incinerator to

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burn non-hazardous waste and to recover energy in the form of steam and electricity for export to the national grid, and for the transfer of heat to a municipal district-heating scheme, once such a scheme is available.

It is not predicted that there will be significant impacts on any of the sites of conservation importance in Dublin Bay as a result of the proposed discharge. The thermal plume should lose much of its energy by the time it reaches these sites. The biocides should also be diluted and deactivated to an extent that they will not directly impact the habitats. However, there would be potential absorption effects that could lead to bioaccumulation and subsequent adverse impacts in some high trophic level species including birds.

The modelling analysis indicates that hypochlorite and its degradation product may also occur in a concentration that may have toxic effects on the Liffey Estuary. However, it will only occur very locally to the proposed cooling water outfall. Similarily, concentrations of trihalomethane (THM) was only above the predicted no-effect concentration (PNEC) value very close to the outfall. Therefore, it would be preferred to use hypochlorite in the Facility for the preventation of biofouling.

The contribution of hypochlorite/chlorine and THMs from the other plants using hypochlorite/chlorine (Synergen and Poolbeg) is well below the PNEC values and the cumulative effect is thus on average considered negligible.

There will be a very local residual impact in the vicinity of the outlet of the cooling water system.

The joint discharges from Waste to Energy Facilites and the other plants in the area have been considered to ensure that there will not be significant adverse impacts on marine ecology in the extended study area (Elsam, 2006)

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Poolbeg Planning Scheme

The new planning scheme area, as set out in Ministerial Order 297/2007, comprises lands principally located on the Poolbeg Peninsula to the east of Sean Moore Road and west of the South Bull Wall.

New development will be dependent on the expansion of the wastewater treatment works to ensure that adequate capacity exists for treatment as otherwise water quality in the receiving waters could be affected through inadequate collection or wastewater treatment system capacity. Therefore, development will not proceed unless such capacity is provided in a timely manner. As a result, the plan is not expected to have a cumulative effect that would influence the assessment of the works discharge.

Port of Dublin Reclamation

Dublin Port has recently reclaimed land on the Poolbeg Peninsula north of the overflow tanks from the Ringsend Wastewater Treatment Works. They are currently examining the issue of further land reclamation in the North Port.

Any potential impacts would be centred on:

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- Hydrodynamics, particularly: changes to the wave and current regime, changes to the tidal regime, changes to the erosion and deposition of sediments, changes to suspended sediments during construction and operation of the development, and changes to flooding and flood risk; and

- Water quality, particularly: the re-suspension of sediments during construction and operation (maintenance dredging), the re-mobilisation of contaminated sediment during construction and operation (maintenance dredging), planned and unplanned discharges of polluting substances during construction and operation, and the longterm hydrodynamic changes as a result of the development.

Minor negative impacts are predicted to arise from the physical disturbance to benthic communities from reclamation and dredging, the smothering of benthic communities by resuspended sediments during dredging, the result of piling noise on fish (particularly migratory species), the release of contaminants during dewatering (during reclamation), increased suspended sediment concentrations in surrounding waters during dredging, an increase in deposition of sediment during dredging and an increase in contaminant levels in water during dredging.

Should the project proceed, it is not anticipated that there will be any cumulative discharges influencing this assessment (Royal Haskoning, 2008).

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Other Future Developments

Due to the tidal regime and dilution effects within the bay, it is anticipated that other developments such as the planned Portrane, Donabate, Rush & Lusk WWTS which will discharge effluent to the Irish Sea via a 600m pipeline will not result in any cumulative impacts on the modelled water quality discussed, with respect to potential negative effects on the designated areas.

Climate Change

According to an EPA report 'Climate Change – Scenarios and Impacts for Ireland' Environmental RTDI Programme 2000 – 2006, a sea level rise of 0.5 metres is expected during the period 1990 – 2100, i.e. an average rise of 0.45 cm per year. This may gradually influence many coastal habitats.

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5 Brief Description of Natura 2000 Sites

5.1 Designated Sites

A brief synopsis of the potentially affected designated sites and some of the relevant species and habitats with respect to the Appropriate Assessment to be carried out for the licensing of Ringsend Waste Water Treatment Works Discharge is below.

South Dublin Bay and River Tolka Estuary SPA

The South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay. It includes the intertidal area between the River Liffey and Dun Laoghaire, the estuary of the River Tolka to the north of the River Liffey, Booterstown Marsh and an area of grassland at Poolbeg, north of Irishtown Nature Park. A portion of the shallow marine waters of the bay is also included. The site is of special conservation interest for a number of bird species (Light-Bellied Brent Goose, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Redshank, Black-Headed Gull, Roseate Tern, Common Tern and Arctic Tern) and is important for wintering waterfowl and wintering gulls. An internationally important population of Light-bellied Brent Goose feed on the Eelgrass bed at Merrion and is also known to feed on the grassland at Poolbeg. The SPA is of international importance for Light-bellied Brent Goose and of national importance for nine other waterfowl species. It is also of international importance as an autumn tern roost.

The EU Birds Directive pays particular attention to wetlands, and these form part of the SPA, the site and its associated waterbirds are of special conservation interests for Wetlands and Waterbirds.

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North Bull Island SPA

North Bull Island is a sand spit that developed after the construction of the North Bull Wall. This island is covered in dune grassland. Other important ecosystems associated with the island are salt marsh and mud flats. The reserves are of international scientific importance for Brent Geese and also on botanical, ornithological, zoological and geomorphological grounds.

North Bull Island SPA is of international importance for waterfowl on the basis that it regularly supports in excess of 20,000 waterfowl. It also qualifies for international importance as the numbers of two species exceed the international threshold – Brent Goose and Bar-tailed Godwit. A further 15 species have populations of national importance – Shelduck, Teal, Pintail, Shoveler, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Black-tailed Godwit, Curlew, Redshank and Turnstone. The North Bull Island SPA is a regular site for passage waders, especially Ruff, Curlew Sandpiper and Spotted Redshank.

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North Dublin Bay cSAC

Annex I Habitats include fixed dunes, marram/shifting dunes, embryonic shifting dunes, dune slack, annual vegetation of drift lines, salicornia mud and sand flats, Atlantic salt meadows, Mediterranean salt meadows, mud and sand flats. Annex II species include Petalwort. The site overlaps with North Bull Island SPA.

South Dublin Bay cSAC

The site has extensive areas of sand and mudflats, a habitat listed on Annex I of the EU Habitats Directive. The largest stand of Eelgrass on the east coast occurs at Merrion Gates. New habitats are developing just south of Merrion Gates including embryonic dunes and a sand spit. This area is becoming increasingly important as a high tide roost site for waterfowl. The site overlaps with South Dublin Bay and River Tolka Estuary SPA

Wintering Waterfowl in Dublin Bay

Dublin Bay is internationally important for wintering waterfowl, because it supports more than 20,000 birds.

Threshold levels for international importance for individual species are set at 1% of the estimated species, sub-species or flyway population, and are subject to regular revision to take account of population change.

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Species occurring in Internationally Important Numbers

Five species occurred in internationally important numbers in Dublin Bay during the five-year period from 2001/02 to 2005/06: light-bellied Brent geese, knot, black-tailed godwit, bar-tailed godwit, and redshank. Three of these species have occurred consistently in internationally important numbers in Dublin Bay since the 1970s: Brent geese, bar-tailed godwit and redshank. Knot numbers have varied considerably through time; Dublin Bay held internationally important numbers of knot during the 1970s and 1980s, but counts were generally below the international threshold during the 1990s. Numbers of knot exceeded the international threshold level in 2001/02 and 2002/03, and again in 2004/05 and 2005/06. Black-tailed godwit numbers increased steadily during the late 1990s; peak counts in Dublin Bay have been above the international threshold in every year since 2000/01 (Mayes, 2007).

Species occurring in Nationally Important Numbers

Dublin Bay is nationally important for the following five duck species which feed in salt meadow and intertidal habitats: shelduck, wigeon, teal, pintail, and shoveler. Eight wader species occur in nationally important numbers: oystercatcher, ringed plover, grey plover, sanderling, dunlin, curlew, greenshank, and turnstone. Another wader species, golden plover, reaches the national threshold in some years.

Nationally important diving species are great crested grebe and red-breasted merganser. These birds feed on fish, and are found on open water in Dublin Bay, and feed over intertidal habitats at high tide.

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In coastal areas, important concentrations of wintering waterfowl generally occur in estuaries and bays which are naturally enriched by organic material carried in by rivers, by the growth and nutrient re-cycling of a variety of species of seaweeds including green algae, and by salt marsh habitats. Sheltered areas within bays and estuaries tend to accumulate organic material and fine sediments. These muddy habitats generally support high densities of macro-invertebrates which are not of conservation interest in themselves, but provide feeding for protected bird species.

Waterfowl distribution within Dublin Bay is determined by the distribution of the preferred feeding habitats of individual species, by tidal cycle and range, by the availability of roosting areas, and fresh water preening and loafing areas (which are important particularly for geese and duck). The availability of food and its comparative abundance in different parts of the bay is likely to be an important determinant of waterfowl feeding distribution (e.g. Yates et al, 1993). Bird distribution is also influenced by disturbance; a study carried out in South Dublin Bay indicated that uncontrolled dogs were the most significant source of disturbance to water birds (Phalan and Nairn, 2007).

Appendix A contains a summary of habitat distribution and use by waterfowl in Dublin Bay and peak counts of wildfowl and waders in Dublin Bay (Mayes, 2007).

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Fish including salmonids

The Liffey is not designated a salmon water under the Freshwater Fish Directive (78/659/EEC). However, it does support a salmon and sea trout population and as such must be conserved. Atlantic salmon is listed as an Annex II species under the EU habitats directive and must be protected.

Both salmon and migratory brown trout (sea trout) are anadromous fish, spending a significant proportion of their lives at sea. Estuaries serve as the natural linkage for salmon migrating between freshwater and ocean environments, providing the necessary habitat for their transition.

Eel, another migratory fish, is also present in the Liffey catchment. Unlike salmon and sea trout, eels are a catadromous species and migrate to sea to spawn and return as juveniles.

Seals and other marine mammals

Both grey (Halichoerus grypus) and harbour (Phoca vitulina) seals are protected in Ireland under the Wildlife Acts, 1976 and 2000. Both species are listed under Annex II of the EU Habitats Directive as species of Community Interest. This Directive requires Ireland to establish Special Areas of Conservation for conservation of both species of seal. Any activity likely to impact upon the seal population requires consent from the Minister. While there are well-established seal populations in the Dublin Bay area, they tend not to enter the area influenced directly by the River Liffey currents.

The Irish Whale and Dolphin Group show records of minke whales, dolphins and harbour porpoises in the Dublin Bay area. However, sightings are not frequent and there appears to be no resident populations in the bay or estuary.

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5.2 Integrity of the Site

The 'integrity of the site' relates to the site's conservation objectives. As regards the connotation or meaning of 'integrity', this can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation.

The 'integrity of the site' has been usefully defined as 'the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified'[1].

A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity for self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management support is required.

When looking at the 'integrity of the site', it is therefore important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term.

5.3 Conservation Status

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The conservation status is defined in Article 1 of the directive:

_ For a natural habitat, Article 1(e) specifies that it is: *'the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species …'.*

_ For a species, Article 1(i) specifies that it is: *'the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its population …'.*

The Member State has therefore to take into account all the influences of the environment (air, water, soil, territory) which act on the habitats and species present on the site.

The favourable conservation status is also defined by Article 1(e) for natural habitats and Article 1(i) for species.

For a natural **habitat**, it occurs when:

'its natural range and areas it covers within that range are stable or increasing;

the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future;

the conservation status of its typical species is favourable'.

---

[1] PPG 9, UK Department of the Environment, October 1994

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For a **species**, it occurs when:

'the population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;

the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future;

there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis'.

The favourable conservation status of a natural habitat or species has to be considered across its natural range, according to Articles 1(e) and 1(i), i.e. at biogeographical and, hence, Natura 2000 network level. Since, however, the ecological coherence of the network will depend on the contribution of each individual site to it and, hence, on the conservation status of the habitat types and species it hosts, the assessment of the favourable conservation status at site level will always be necessary.

5.4 Conservation Objectives

European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status areas designated as candidate Special Areas of Conservation. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

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According to the EU Habitats Directive, favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, is stable or increasing, and
- the ecological factors that are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable as defined below.

The favourable conservation status of a species is achieved when:

- population data on the species concerned indicate that it is maintaining itself, and
- the natural range of the species is neither being reduced or likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

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North Dublin Bay cSAC

Objective 1: To maintain the Annex I habitats for which the cSAC has been selected at favourable conservation status: Mudflats and sandflats not covered by seawater at low tide; Annual vegetation of drift lines; Salicornia and other annuals colonizing mud and sand; Atlantic salt meadows (Glauco-Puccinellietalia maritimae); Mediterranean salt meadows (Juncetalia maritimi); Embryonic shifting dunes; Shifting dunes along the shoreline with Ammophila arenaria (white dunes); Fixed coastal dunes with herbaceous vegetation (grey dunes); Humid dune slacks.

Objective 2: To maintain the Annex II species for which the cSAC has been selected at favourable conservation status: Petalophyllum ralfsii.

Objective 3: To maintain the extent, species richness and biodiversity of the entire site

Objective 4: To establish effective liaison and co-operation with landowners, legal users and relevant authorities.

South Dublin Bay cSAC

Objective 1: To maintain the Annex I habitat for which the cSAC has been selected at favourable conservation status: Mudflats and sandflats not covered by seawater at low tide.

Objective 2: To maintain the extent, species richness and biodiversity of the entire site.

Objective 3: To establish effective liaison and co-operation with landowners, legal users and relevant authorities.

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North Bull Island SPA

The site is selected for the Light-bellied Brent Goose, Shelduck, Pintail, Shoveler, Oystercatcher, Grey Plover, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Redshank, Turnstone, and 20,000 wintering waterbirds.

Additional Special Conservation Interests are Teal, Ringed Plover, Golden Plover, Sanderling, Curlew, Black-headed Gull, and Wetland & Waterbirds

The main conservation objective is to maintain the special conservation interests for this SPA at favourable conservation status: Light-bellied Brent Goose, Shelduck, Pintail, Shoveler, Oystercatcher, Grey Plover, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Redshank, Turnstone, 20,000 wintering waterbirds, Teal, Ringed Plover, Golden Plover, Sanderling, Curlew, Black-headed Gull, Wetland & Waterbirds.

South Dublin Bay and River Tolka Estuary SPA

The site is selected for: Light-bellied Brent Goose, Knot, Sanderling, Bar-tailed Godwit, Redshank, Roseate Tern, Common Tern, Arctic Tern

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Additional Special Conservation Interests are the Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Dunlin, Black-headed Gull and Wetland & Waterbirds

The main conservation objective is to maintain the special conservation interests for this SPA at favourable conservation status: Light-bellied Brent Goose, Knot, Sanderling, Bar-tailed Godwit, Redshank, Roseate Tern, Common Tern,, Arctic Tern, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Dunlin, Black-headed Gull, Wetland & Waterbirds

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6 Potential Impacts on the Integrity of Natura 2000 Sites

6.1 Natura 2000 Sites with Potential to be Impacted

The Natura 2000 sites that have the potential to be affected by the proposed project are those which are aquatic related and are in direct contact with the effect caused as result of the discharge (change in water quality).

5. **North Bull Island SPA**
6. **North Dublin Bay SAC**
7. **South Dublin Bay SAC**
8. **South Dublin Bay and River Tolka Estuary SPA**

Descriptions of these are contained in Section 5 and are detailed in the tables in Appendix B.

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6.2 Conservation Objectives of the SACs and SPAs

The objective is to maintain the favourable conservation status of the species listed in Annex1 of the EU Birds Directive, Annex 11 of the EU Habitats Directive and habitats listed on Annex 1 of the EU Habitats Directive as well as other important species and habitats. These are detailed in full in Chapter 5.

6.3 Qualifying Interests with Potential to be Impacted

The impact to be assessed is the impact on the qualifying species and habitats within the designated sites. To this end it is the aquatic based interests that can be impacted directly. Other aquatic dependent interests such as birds (waders and wildfowl) that frequent the qualifying habitat such as the mudflats could be indirectly impacted by a reduction in aquatic food sources. In this case, a deterioration in the eel grass beds could adversely impact the Brent Geese.

For the purposes of this assessment the interests that are considered to have the potential to be impacted directly are the aquatic habitats:

- Salicornia Sand and Mudflats;
- Atlantic Salt Meadows;
- Mediterranean Salt Meadows;
- Sand and Mud flats; and the
- Eel Grass beds below Merrion Gates (North Dublin Bay SAC).

The interests that have the potential to be impacted indirectly are the

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- Wild fowl and wading bird species (Light-bellied Brent Goose,Knot, Sanderling, Bar-tailed Godwit, Redshank, Roseate Tern, Common Tern, Arctic Tern, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Dunlin and Black-headed Gull.

6.4 Details of Plan/Activity (Discharge)

This assessment is concerned with the Impacts of the discharge of treated effluent from Ringsend Sewage Treatment Works. The average daily discharge is 5.7 m3/sec.

Average Daily Flow (ADF)	5.7 m^3/sec
Flow to Full Treatment	11.1 m^3/sec
Peak Instantaneous Flow	23.0 m^3/sec
Effluent BOD Standard	
95 Percentile	25 mg/L
Not to be Exceeded	50 mg/L
Effluent COD Standard	
95 Percentile	125 mg/L
Not to be Exceeded	250 mg/L
Effluent TSS Standard	
95% Percentile	35 mg/L
Not to be Exceeded	87.5 mg/L
Effluent Ammonia Nitrogen Standard	
95% Percentile	18.75 mg/L
Not to be Exceeded	37 mg/L

Table 6.1 Discharge Characteristics

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The effect of this discharge is a change in the receiving water quality and the dispersal plume which extends into Dublin Bay. This discharge is one of many that influence the quality of the water in the bay.

Up until December 2002, only primary treatment was carried out at the works. The works was upgraded and completed in 2004. Secondary Treatment was incorporated. This resulted in an improvement in the effluent standard. It is acknowledged that the present treatment standards do not comply with the Urban Wastewater Treatment (UWWT) regulations 2001 (S.I. 254 of 2001) and amendments for sensitive waters due to the fact that no phosphorus and nitrogen reduction is being undertaken. The Liffey Estuary has been designated a sensitive water under the regulations. Presently additional upgrading is planned and the preliminary studies are underway. This proposed upgrading will ensure compliance with the UWWT regulations.

6.5 Assessment Criteria.

The criteria adopted for this assessment are based on an assessment of the existing conditions prevailing in the Bay and whether these conditions are causing a significant impact on the qualifying interests of the Natura 2000 sites. Only the interests that are aquatic based are assessed. The qualifying interests that are not directly or indirectly aquatic based have been screened out in Section 6.3. To this

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end it is assumed that there is no connection to land based qualifying interests such as Dunes and landbased species and consequently no impact.

The effect of the discharge is an alteration in water quality in the receiving waters. Therefore the available data on water quality has been examined and assessed in terms of whether the water quality could result in the deterioration in the status of the Natura 2000 sites. It should be noted that this is an assessment of the effect of the cumulative discharges to the Bay.

The discharge was also assessed in terms of the present conservation status of the sites and whether any deterioration has been observed. If no reduction in the conservation status of the sites has been observed, it follows that there is no significant impact as a result of the discharge (or any other activity).

6.5.1 Water Quality.

Data on the water quality in the receiving waters has been provided from:

- The EPA Water Quality in Ireland Report 2008; and
- The Eastern River Basin Management Report 2008.

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Water Quality Modelling in the estuary and bay has been undertaken to support the discharge licence application as discussed in Chapter 4 and the separate Modelling Report ('Modelling the impact of Ringsend Wastewater Treatment Works and Storm Overflow Discharge in the Liffey and Tolka Estuaries and Dublin Bay').

Various water quality standards have been used to compare the quality.

EPA Water Quality Report 2008.

This report summarises the water quality in Ireland between 2002 and 2006. The improvements to the treatment works were completed in 2004 and the report notes that there was a continuing improvement in the water quality of the Liffey and Dublin Bay. The Bay was classified as being unpolluted while the estuary was classified as being intermediate due to a failure to meet the winter ortho-phosphate (MRP) threshold. There had been concern that the introduction of nitrification to the treatment process could result in increased oxidised nitrogen.

However, the report states that the levels of oxidised nitrogen had changed little in the period 2002 - 2006. One area of concern was the reoccurrence of opportunistic macroalgae in the Tolka estuary and along the south Dublin seashore. The occurrence of green opportunistic algal mats (mostly Enteromorpha spp.) in the intertidal area of the Tolka estuary, mainly behind the southern promontory of Bull Island, is of concern. The presence of these mats, which can have an adverse impact on marine benthic fauna, in terms of smothering the underlying sediment, is likely to result in the Tolka estuary being classified as less than good ecological status under the WFD.

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13 Dublin Bay

Season	Statistic	Salinity psu	Sample Sal psu	Temp °C	pH	Secchi depth m	DO % sat	B.O.D. mg/l	TON mg/l	NH_3/NH_4 mg/l	Free NH_3 Surface	DIN mg/l N	MRP µg/l P	Chlorophyll mg/m³
Winter	Minimum	30.7	30.7	6.4	7.9	1.0	93.7	2.0	0.04	0.010	0.0000	0.053	5	1.3
	Median	33.6	33.6	9.1	8.0	1.8	99	2.0	0.16	0.035	0.0005	0.192	26	1.7
	Maximum	34.4	34.4	12.0	8.1	5.8	113	6.0	0.33	0.171	0.0045	0.446	54	4.1
	n	*209*	*205*	*204*	*187*	*204*	*204*	*153*	*209*	*205*	*205*	*209*	*209*	*195*
Summer	Minimum	32.5	32.5	10.1	7.9	1.5	86.2	2.0	0.01	0.010	0.0003	0.019	4	0.4
	Median	33.9	33.9	14.5	8.1	3.5	101	2.0	0.01	0.010	0.0005	0.030	10	3.3
	Maximum	34.7	34.3	18.0	8.3	8.0	953	7.0	0.09	0.112	0.0038	0.163	51	17.6
	n	*281*	*239*	*281*	*270*	*231*	*277*	*123*	*270*	*271*	*271*	*270*	*235*	*248*

TSAS Classification: Unpolluted

	Threshold	Value	Score	Overall
Winter DIN	0.378	0.192	Pass	Pass
Winter MRP	42	26	Pass	
DIN	0.378	0.030	Pass	
MRP	42	10	Pass	
Chloro. Median	10.6	3.3	Pass	Pass
Chloro 90 percentile	21.1	6.5	Pass	
DO%sat 5 percentile	79	95.6	Pass	Pass
DO%sat 95 percentile	121	116.1	Pass	

14 Dublin Bay Adjacent Coastal

Season	Statistic	Salinity psu	Sample Sal psu	Temp °C	pH	Secchi depth m	DO % sat	B.O.D. mg/l	TON mg/l	NH_3/NH_4 mg/l	Free NH_3 Surface	DIN mg/l N	MRP µg/l P	Chlorophyll mg/m³
Winter	Minimum	32.8	32.8						0.09			0.090	8	
	Median	34.0	34.0						0.13			0.134	20	
	Maximum	34.5	34.5						0.24			0.241	29	
	n	*38*	*29*						*45*			*45*	*45*	
Summer	Minimum	32.8	32.8	11.9	8.0	1.8	86.8	2.0	0.01	0.010	0.0003	0.020	5	0.4
	Median	33.9	33.4	13.6	8.1	4.5	100	2.0	0.01	0.010	0.0004	0.040	10	2.0
	Maximum	34.3	33.6	16.1	8.4	8.0	113	2.0	0.09	0.050	0.0021	0.110	50	43.5
	n	*199*	*87*	*200*	*151*	*86*	*193*	*35*	*163*	*163*	*163*	*163*	*116*	*169*

TSAS Classification: Unpolluted

	Threshold	Value	Score	Overall
Winter DIN	0.314	0.134	Pass	Pass
Winter MRP	41	20	Pass	
DIN	0.378	0.040	Pass	
MRP	42	10	Pass	
Chloro. Median	10.6	2.0	Pass	Pass
Chloro 90 percentile	21.1	4.8	Pass	
DO%sat 5 percentile	79	94.3	Pass	Pass
DO%sat 95 percentile	121	105.6	Pass	

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12 Liffey Estuary

Season	Statistic	Salinity psu	Sample Sal psu	Temp °C	pH	Secchi depth m	DO % sat	B.O.D. mg/l	TON mg/l	NH_3/NH_4 mg/l	Free NH_3 Surface	DIN mg/l N	MRP µg/l P	Chlorophyll mg/m³
Winter	Minimum	0.5	0.5	3.6	7.4	0.3	78.5	2.0	0.05	0.010	0.0000	0.074	5	1.2
	Median	31.5	31.5	8.3	7.9	1.3	99	2.0	0.30	0.080	0.0013	0.421	45	1.7
	Maximum	34.5	34.5	18.0	8.2	4.0	156	13.0	3.02	8.270	0.0406	10.245	1253	6.3
	n	*500*	*497*	*489*	*479*	*269*	*488*	*383*	*493*	*462*	*462*	*493*	*501*	*248*
Summer	Minimum	0.3	0.3	9.6	7.4	0.5	60.7	1.0	0.01	0.009	0.0000	0.018	5	0.0
	Median	32.8	32.8	14.2	8.0	2.0	98	2.0	0.08	0.070	0.0022	0.197	38	3.2
	Maximum	34.4	34.1	23.8	8.3	7.5	143	27.0	2.45	2.518	0.0529	2.638	1068	101.0
	n	*1207*	*1151*	*1205*	*1190*	*617*	*1166*	*910*	*1176*	*1184*	*1184*	*1176*	*1084*	*616*

TSAS Classification: Intermediate

	Threshold	Value	Score	Overall
Winter DIN	0.506	0.421	Pass	Fail
Winter MRP	44	45	Fail	
DIN	0.442	0.197	Pass	
MRP	43	38	Pass	
Chloro. Median	10.8	3.2	Pass	Pass
Chloro 90 percentile	21.7	5.6	Pass	
DO%sat 5 percentile	78	80.0	Pass	Pass
DO%sat 95 percentile	122	119.0	Pass	

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Furthermore, the reoccurrence of substantial strands of brown macroalgae (Ectocarpus siliculosis) along the south Dublin seashore during the autumn months is also of concern. The abundance and distribution of opportunistic algal species within the Dublin Bay area will be assessed as part of the national WFD monitoring programme.

The exact reason for the occurrence of the ectocarpus blooms has not been established and specialist studies have been commissioned by DCC as part of the undergoing studies in connection with the further improvements in Ringsend WwTW. These studies will be directed at establishing whether the nutrients discharged at Ringsend are contributing towards the growth of the blooms.

Eastern River Basin Management Plan

The draft classifications for Dublin Bay and the Liffey Estuary under the Water Framework Directive (2000/60/EC) were published at the end of 2008. Dublin Bay has MODERATE water quality WFD Classification. Water quality is generally very good. There is only one breach in standards and that was for Winter DIN. The same standards are used for winter and summer but the data sets are divided seasonally. A total of 12 samples collected between 2006 and 2007 were reviewed and a median value of 0.8 mg/l was determined. Some of the PSU measured was less than 34 and the standard was adjusted to be 0.8 mg/l. Four samples were found to vary 0.79 – 0.89.

The Ecological status is GOOD for the Liffey Estuary and MODERATE for Dublin Bay. The Ecological status determined by the lower of the quality element values for the physico-chemical and biological elements. The Biological Element for the Dublin Bay is GOOD to HIGH. The MODERATE ecological status for Dublin Bay is due to the elevated dissolved inorganic nitrogen.

It is acknowledged that the Liffey Estuary is a sensitive water under the UWWT regulations and that the discharge should be treated to meet the nutrient standards for Phosphorus and Total Nitrogen. This is currently being addressed and the improvements in the Ringsend WwTW will comply with all aspects of the UWWT regulations.

Modelling of Discharge. The dispersal of the discharge has been modelled for various scenarios and the report ('Modelling the impact of Ringsend Wastewater Treatment Works and Storm Overflow Discharge in the Liffey and Tolka Estuaries and Dublin Bay') will also be submitted as part of the tranche of additional information requested by the EPA in connection with the Discharge Licence Application. The results of the modelling are further discussed in Chapter 4. The results of the modelling exercise has shown that in general the concentrations of elements in the discharge will disperse quickly. However it was shown that the exceedances for dissolved inorganic nitrogen could extend some distance into the bay and back up into the Tolka Estuary.

In summary, the water quality has been reported to have improved since the upgrading of the treatment works was completed in 2004. The only significant effect of the existing discharge is a slight elevation in the nutrient concentrations in the waters of Dublin Bay. In particular the levels of dissolved inorganic nitrogen

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exceed the environmental quality objectives. The present Biological Status of the Bay has been assessed as being Good-High for Dublin Bay. There is some concern regarding the occurrence of blooms of ectocarpus during the Autumn months. However there is no connection proved between the discharge of effluent from Ringsend WwTW and these Blooms. A study into ectocarpus is ongoing.

The quality of the treated effluent will be further improved to ensure compliance with the UWWT regulations. This can only have a further positive effect on the water quality within the Bay.

6.5.2 Status and Condition of Natura 2000 Sites

The second criterion used to assess whether the discharge is significantly impacting on Natura 2000 sites is the condition of the sites and whether there has a been a deterioration in the qualifying interests. Again if there has been no discernible deterioration than there can be no significant impact.

The protected areas in Dublin Bay support large concentrations of wintering waterfowl which occupy the habitats that are naturally enriched by organic material carried in by rivers, by the growth and nutrient re-cycling of a variety of species of seaweeds including green algae, and by salt marsh habitats. Sheltered areas within bays and estuaries tend to accumulate organic material and fine sediments. These muddy habitats generally support high densities of macro-invertebrates which are not of conservation interest in themselves, but provide feeding for protected bird species.

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Waterfowl distribution within Dublin Bay is determined by the distribution of the preferred feeding habitats of individual species, by tidal cycle and range, by the availability of roosting areas, and fresh water preening and loafing areas (which are important particularly for geese and duck). The availability of food and its comparative abundance in different parts of the bay is likely to be an important determinant of waterfowl feeding distribution. Bird distribution is also influenced by disturbance; a study carried out in South Dublin Bay indicated that uncontrolled dogs were the most significant source of disturbance to water birds (Phalan and Nairn, 2007).

Details of counts of important bird species numbers in Dublin Bay up to 2006 are contained in Appendix A. There are five species that exceed the international threshold. These are Light Bellied Brent Goose, Knot, Bar Tailed Godwit, Black Tailed Godwit nad Redshank. All of these species have been increasing indicating that there is no deterioration in the conservation objectives of the sites.

Both Common Tern and Arctic Tern breed in Dublin Docks, on a man-made mooring structure known as the E.S.B. dolphin; this is included within the South Dublin Bay and River Tolka Estuary SPA. Recent data highlights this site as one of the most important Common Tern sites in the country with over 400 pairs recorded here in 2007. The Dublin Port Tern project has enabled improvements to the ESB Dolphin and there are no negative impacts on the colony from the Ringsend WwtW discharge. The colony would be vulnerable to an increase in noise; however, there are no noise impacts associated with the discharge at Ringsend.

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Overall the bird counts have been either increasing in Dublin Bay or in cases where there has been a decrease in numbers the decrease has followed the national trend. There are several cases where there has been an increase in numbers in contrast to the national trend.

There are no reports of any loss of integrity of the designated sites. The bird counts indicate that the Annex I species are increasing. Overall the Natura sites continue to support wildfowl and waders in abundance. There is no evidence that the aquatic and semi-aquatic habitats that provide the foods source for the qualifying species are being adversely impacted.

The conservation objective is to maintain the favourable conservation status of the species listed in Annex 1 of the EU Birds Directive, Annex 11 of the EU Habitats Directive and habitats listed on Annex 1 of the EU Habitats Directive as well as other important species and habitats. This conservation objective has been shown to continue to be achieved.

6.6 Potential Impacts on the Integrity of Natura 2000 Sites

Having established the assessment criteria, the impacts associated with the discharge on the Natura sites have been assessed. The primary effect of the discharge is elevated nutrients (particularly Dissolved Inorganic Nitrogen) in the waters in the Bay. It should be noted that the quality of the discharged effluent has been improved in recent years and further improvements are planned in order to comply with the UWWT regulations regarding discharges to sensitive areas as discussed in Chapter 7. Using the assessment criteria outlined in Section 6.5, the direct and indirect impacts (actual and potential are summarised below)

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- There is no land take associated with the discharge and consequently there will be no reduction or fragmentation in area of the Natura Sites.

- The water quality in the bay is reported to be unpolluted (EPA Water Quality in Ireland 2008 report) or MODERATE (WFD classification). The classification would be GOOD but for the fact that there have been elevated inorganic nitrogen levels recorded. The water quality is also in compliance with the bathing water quality standards.

- While the change of water quality in Dublin Bay creates the potential for impacts on biodiversity, there is no evidence of the qualifying interests or conservation objectives being directly impacted. All the Natura sites are reported to have favourable status.

- The change in the water quality could potentially indirectly impact on the lower end of the food chain that supports the protected bird species. There has been no reported decrease in the numbers of birds in the SPAs. It is considered unlikely that the slightly elevated nutrients would result in a reduction in the foods sources available.

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- The improvement in the discharge quality over the past years would be such that the potential to impact on the Natura sites will have reduced. This potential will be further reduced once the current tranche of improvements in the Ringsend WwTW have been implemented.

Overall there is no evidence that the current discharges from Ringsend WwTW is resulting in any significant impact on the conservation objectives of the protected areas. It is considered unlikely that the Ringsend Wastewater Treatment Works discharge will result in a deterioration in the Protected Areas. This conclusion is made primarily on the basis that there have been improvements in the treatment systems implemented and that there has been an overall improvement in the water quality in the receiving water. However, adopting the precautionary principle it would be desirable to reduce the nutrients to meet the environmental quality objectives as well as necessary to comply with the Urban Water Treatment Regulations.

6.7 Cumulative Assessment

There has been and continues to be development, regeneration and improvement of the whole of the Dublin Bay area. Mitigation policies and objectives for biodiversity and water quality must be implemented and monitored as there is potential for impact on Natura 2000 sites

The approach to the assessment has been one of investigating whether there has been deterioration in the factors that could result in an impact i.e., the water quality. The water quality in the receiving waters is a reflection of the cumulative impact of the activities in the vicinity of Dublin Bay.

Similarly the condition of the protected areas is a reflection of all the activities that are taking place. The fact that Internationally and Nationally important species remains consistent with previous years findings indicate that the cumulative effect on the sites is not significant.

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7 Mitigation Measures and Process Improvements

Nitrogen and phosphorus control is required for discharge into the Liffey Estuary in accordance with the Water Framework Directive (2000/60/EC) specifically nitrogen in all of its forms shall be reduced to an annual average concentration of not more than 10 mg/l and Total Phosphorus shall be reduced to an annual average concentration of not more than 1 mg/L. If DCC decides to continue its discharge to the estuary, plans will be made to bring nutrients under control as an early step in the Ringsend Extension project. This decision is crucial to the determination of process selection for nutrients and cannot be made in the absence of the long term plan, which will be determined in the summer of 2009.

Bringing phosphorus under control is reasonably straightforward and can be done independent of any other improvements at the Works. Metal salts can be added to the wastewater upstream of the primary clarifiers as well as to the recycle streams from solids processes. The phosphorus would be removed by enhance precipitation in the primary clarifiers. The necessary chemical storage and feed facilities will not require very large areas and can be integrated onto the site without precluding the construction of other facilities.

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Nitrogen control will be far more difficult to implement. Nitrogen species must first be oxidized to nitrite and/or nitrate. Then the oxidized species must be reduced to nitrogen gas (de-nitrification), which is then released to the atmosphere. Studies to date have shown that the existing facilities are limited in the degree to which they can nitrify, with a current estimate of between 1.2 to 1.3 million population equivalent (PE) as the maximum achievable during the winter months. The current average day loading to the Works is approximately 1.8 million PE, leaving 0.5 to 0.6 million PE untreated with regard to nitrogen species. Thus, adding denitrification facilities as an interim measure without also upgrading the nitrification facilities is risky. The Ringsend Extension project will examine the requirements for nitrogen control in the context of the overall Works upgrade and specify early compliance with those standards, assuming that the Works will continue to discharge to the estuary.

Regardless of the final solution it will be a fundamental condition that the water quality in the Bay meets the Draft Environmental Quality Objectives. As a consequence of the improvements, there are no anticipated significant impact s on the conservation objectives of Natura 2000 sites as a result of the discharge of treated effluent from the Ringsend Treatment Works.

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8 Monitoring

Programmes of Environmental Monitoring

As per section E of the Discharge Application, it is proposed to use a number of monitoring sub-programmes:

- Primary discharge monitoring;
- Near field monitoring (downstream of ESB Weir); and
- Mixing zone boundary monitoring.

Emission limit values will apply to the primary point of discharge and water quality objectives (set by the Water Framework Regulations) will apply at the edge of a mixing zone. Water quality objectives ensuring at least good status in the receiving transitional waters of the Liffey Upper and Lower Estuaries, the Tolka Estuary and the coastal receiving waters of Dublin Bay will apply outside the boundary of the mixing zone defined in the licence.

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As the EPA's criteria for definition of an estuarine mixing zone could not yet be advised, a specific receiving water monitoring programme will be defined in liaison with the EPA and the MI (the public authorities assigned monitoring tasks in estuaries and coastal waters under the WFD monitoring programme).

Primary discharge monitoring (in the vicinity of the WwTW)

Points to be monitored include :

1. SW1Dublin - the primary discharge point
This is sampled daily at a location upstream of the UV treatment works using a 24-hour composite sampler. During the EU Bathing Season further grab-sampling is carried out to monitor the efficiency of the UV works. Effluent Flow is monitored by the Works Operator on a continuous basis.

2. SW2Dublin – the storm water flow from the works
Effluent Flow is monitored by the Works Operator.

3. SW3Dublin – the primary influent point to the works
This is sampled daily at a location upstream of the primary treatment plant using a 24-hour composite sampler. Sampling here will quantify the regulation of dangerous substances in the catchment and the removal efficiency Influent Flow is monitored by the Works Operator on a continuous basis.

4. SW4Dublin - ESB Cooling Water Discharge U/S Primary Discharge
Cooling water is abstracted from the Liffey Estuary, chlorinated and used for cooling in the power generation processes. The discharge is regulated under IPPC 718, as amended by 718/A. Cooling water flow is monitored by the ESB. It mixes with the Primary effluent discharge in the cooling water channel and the mixed plume travels into the receiving waters. The extent, shape and cross sectional area

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of the mixed plume depends on the state of the tide and varies continuously. Sampling will be carried out by Dublin City Council to determine water quality and initial dilution of the Primary Discharge.

Figure 8.1 Primary Discharge Monitoring Points

Near Field Ambient Monitoring Programme

(River Liffey Upstream and Liffey Estuary downstream of the ESB Weir)

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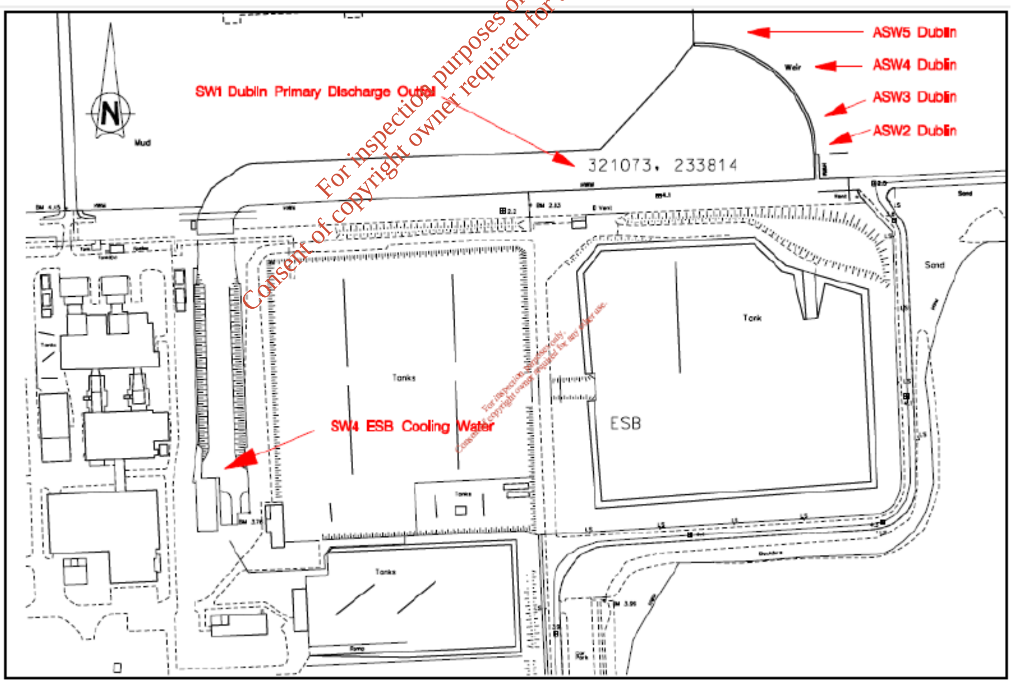

Figure 8.2 Ambient Monitoring Programme Monitoring Points

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Points to be monitored include :

5. ASW1Dublin - River Liffey (freshwater), U/S Islandbridge Weir.
This is a routine monitoring point under the existing Dangerous Substances Programme. This point is unaffected by the Primary discharge point.

6. ASW2Dublin – Mixed Ringsend Primary Discharge / ESB Cooling Water
Downstream of the Weir (25 m north of Poolbeg Wall)

7. ASW3Dublin - Mixed Ringsend Primary Discharge / ESB Cooling Water
Downstream of the Weir (50 m north of Poolbeg Wall)

8. ASW4Dublin - Mixed Ringsend Primary Discharge / ESB Cooling Water
Downstream of the Weir (75 m north of Poolbeg Wall)

9. ASW5Dublin - Mixed Ringsend Primary Discharge / ESB Cooling Water
Downstream of the Weir (100 m north of Poolbeg Wall)

Mixing Zone Boundary Monitoring Programme

The mixing zone boundary monitoring programme is to be advised by the EPA when the mixing zone is set. This programme will monitor compliance with licence conditions in terms of receiving water quality objectives (surface / mid / depth). It will be carried out following liaison with the Marine Institute / EPA – the designated authorities for the water bodies impacted by the Primary Discharge, the Liffey Estuary (Upper and Lower), The Tolka Estuary and Dublin Bay.

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Dublin City Council Ambient Monitoring Programmes

River Monitoring Programmes
Routine monitoring of the River Liffey in the tidal stretch from Islandbridge Weir to the East Link Toll Bridge is carried out by Dublin City Council.

Bathing Water Monitoring Programmes
Routine monitoring of designated and non-designated bathing waters in the Dublin Bay area is carried out by Dublin City Council.

Bird Counts and Monitoring

The Irish Wetlands Bird Survey (I-WEBS) is a joint scheme of BirdWatch Ireland, National Parks & Wildlife, Dúchas, The Heritage Service and the Wildfowl and Wetlands Trust. It is the principle tool for monitoring wintering waterfowl populations and their wetlands in Ireland. The survey's objectives are to monitor numbers and distribution of waterbird populations and to ascertain long term trends. The survey, comprising monthly co-ordinated site counts by professionals and amateurs over the September to April season, is ongoing allowing monitoring over time enabling assessment of protection at a local level and statutory designation.

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9 Conclusions

An Appropriate Assessment of the discharge from Ringsend Wastewater Treatment Works was carried out in accordance with the relevant guidance, in particular:

- Assessment of Plans and Projects significantly affecting Natura 2000 Sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, European Commission 2002
- Managing Natura 2000 Sites – The Provisions of Article 6 of the 'Habitats Directive' 92/43/EEC, European Commission, 2000
- Circular L8/08 Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments. 2 September 2008

There has been and continues to be development, regeneration and improvement of the whole of the Dublin Bay area. At present there are no discernible impacts on Natura 2000 Sites.

The approach to the assessment has been one of investigating whether there has been deterioration in the factors that could result in an impact i.e., the water quality. The water quality in the receiving waters that has been assessed and is a reflection of the cumulative impact of the activities in the vicinity of Dublin Bay. The water quality in the Bay has improved in recent years. The further improvements in the treatment processes at Ringsend will ensure that there continues to be no significant impact on the Natura 2000 areas.

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The elevated nutrient concentrations are not considered to effect a detrimental impact on the qualifying interests of the Natura sites, with respect to food chain or indirect impact on the protected birds. As part of the ongoing studies in connection with the further improvements in Ringsend WwTW, a study has been commissioned by DCC directed at establishing whether the nutrients discharged from the works are contributing towards the growth of occasional algal blooms. However, there is no evidence that these occasional blooms have had any significant impact on the Natura Sites.

Similarly the condition of the protected areas is a reflection of all the activities that are taking place. The fact that internationally and nationally important species and habitats remains consistent with previous years' findings indicate that the cumulative effect on the sites is not significant.

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11 Appendices

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Appendix A

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Table 1. Peak counts of wildfowl and waders in Dublin Bay in the years up to 2006 (Mayes, 2007)

	Mean peak 2001/02-2005/06	Mean peak 98/99-2002/03	Mean peak 1994/95-1998/99	Trend in Dublin Bay	National trend	Threshold 2005/06	
						National	International
Great-grested grebe	112	62	26	Increase	Increase	55	4,800
Cormorant	151	62	24	Increase	Increase	140	1,200
Grey heron	33	34	24	Increase	Increase	30	2,700
Little egret	7	-	-	Increase	Increase	20	1,300
Light-bellied Brent goose	3,181	2,907	1,930	Increase	Increase	220	220
Shelduck	1,140	1,287	1,261			150	3,000
Wigeon	855	785	924	Decrease*	Decrease	820	15,000
Teal	1,125	870	1,157			450	4,000
Mallard	90	135	90			380	20,000
Pintail	139	204	296	Decrease	Decrease	20	600
Shoveler	133	128	191	Decrease	Decrease	25	400
Goldeneye	17	13	34	Decrease	Decrease	95	4,000
Red-breasted merganser	40	40	35			35	1,700
Oystercatcher	4,349	4,177	2,526	Increase	Increase	680	10,200
Ringed plover	316	365	302			150	730
Golden plover	1,924	2,174	3,118	Decrease		1,700	9,300
Grey plover	573	629	705	Decrease		65	2,500
Lapwing	56	68	60		Decrease	2,100	20,000
Knot	4,475	3,503	3,575	Increase	Decrease	190	4,500
Sanderling	519	386	402	Increase	Increase	65	1,200
Dunlin	5,595	6,141	6,810	Decrease	Decrease	880	13,300
Black-tailed godwit	1,059	752	397	Increase		140	350
Bar-tailed godwit	2,026	1,901	1,669	Increase		160	1,200
Curlew	1,210	1,091	1,056	Increase	Decrease	550	3,200
Redshank	2,146	2,056	1,679	Increase	Increase	310	1,900
Greenshank	37	17	14	Increase	Increase	20	3,100
Turnstone	338	255	206	Increase	Decrease	120	1,000

Note: Internationally important numbers are shown bold-faced, nationally important numbers are in italics. Data for Brent geese and waders are combined Dublin Bay Project and I-WeBS data from 1998 on, other species and dates are I-WeBS data. National trends are indicated where these exceed 5% change between 1994/95-1998/99 and 1999/00-2003/04 (Crowe et al, 2008). Trends in Dublin Bay are indicated for changes of more that 10% between 1994/95-

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98/99 and 2001/02-05/06, because of the smaller database and difference in the time periods referred to. I-WeBS is a joint project of BirdWatch Ireland, the National Parks and Wildlife Service of DoEHLG, and the Wildfowl and Wetlands Trust. *Wigeon populations have declined by c. 7.7% nationally and in Dublin Bay. Please note that further revisions to threshold levels have taken place since 2006.

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Table 2. Summary of habitat distribution and use by waterfowl in Dublin Bay (Mayes, 2007)

Habitat	Main distribution	Use by waterfowl
Sand dune habitats	Bull Island Small areas of dune development in South Dublin Bay	Dune slack areas on Bull Island used as high tide roosts during spring high tides
Salt meadow	Bull Island, adjoining the intertidal sand and mudflats of the Bull Lagoons	High tide wader roosts. Most of the waders in Dublin Bay roost here at high tide. High tide feeding habitat for duck. Spring feeding habitat for Brent geese.
Barren sands above high tide	Dollymount Strand. Smaller areas of barren sand above high tide occur in South Dublin Bay, arising from recently accelerated sediment accumulation. The main area of barren sand is the sand bar between Merrion Gates and Booterstown, which has developed considerably since 1998/99.	The upper shore on Dollymount Stand in little used by waterfowl, probably due to a combination of human disturbance, and to the limited number of species which feed on the mid and lower shore at Dollymount. The sand bar between Merrion Gates and Booterstown is now the main wader roost in South Dublin Bay.
Rock-armoured shore	Throughout the bay, apart from areas where vertical sea wall is present at the South Bull Lagoon and Liffey Estuary	Rock armoured shore in South Dublin Bay (including the West Pier at Dun Laoghaire) is used for roosting by waders - less used in recent years since the sand bar near Merrion Gates has developed. Some feeding use by turnstone in the south bay.
Rocky shore	Outcropping rock occurs at Sutton, and in South Dublin Bay between Blackrock and Dun Laoghaire	Feeding habitat of oystercatcher and turnstone.

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Habitat	**Main distribution**	**Use by waterfowl**
Mixed substrate shore (Cobble/gravel with finer sediments)	North Dublin Bay distribution, with small ephemeral patches in the western South Bay. Extends in varying width from the base of the sea wall in the Liffey Estuary and South Bull Lagoon - supports a mussel bed near the Wooden Bridge. Also occurs on the mid to low shore in the North Bull Lagoon from Kilbarrack to Sutton, where it supports extensive mussel beds. This habitat supports attached species of green algae Enteromorpha and Ulva spp.	Brent geese and wigeon feed on green algae in this habitat. Feeding habitat of oystercatcher, grey plover, curlew, redshank and turnstone.
Habitat	Main distribution	Use by waterfowl
Littoral sands	Dollymount Strand. Parts of the lower shore, central South Dublin Bay	Sanderling
Littoral sand - muddy sand	South Dublin Bay, Bull Wall Sands, much of South Bull Lagoon, part of North Bull Lagoon. Green algae (Enteromorpha) grow in sheltered areas.	Oystercatcher, ringed plover, grey plover, knot, dunlin, bar-tailed godwit, curlew and redshank feeding habitat.
Littoral mud	Tolka Basin, part of South Bull lagoon, c. half of North Bull Lagoon. Mat-forming green algae (Enteromorpha spp.) grow in this habitat in sheltered conditions near Bull Island Causeway.	Duck feeding habitat, particularly near Bull Island Causeway. Mat-forming green algae eaten by Brent geese and wigeon. Feeding habitat of ringed plover, grey plover, dunlin, black-tailed godwit and redshank. Soft muds are preferred by duck, dunlin, black-tailed godwit and redshank.
Salicornia mud	North Bull Lagoon, near causeway.	Duck feeding habitat. Low tide curlew roost.

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The total intertidal area of Dublin Bay is c. 2,000 ha:

South Dublin Bay 840ha (41.7%)
North Bull Lagoon 310ha (15.4%)
South Bull Lagoon 75ha (3.8%)
Liffey Estuary 288ha (14.4%)
Dollymount Strand 500ha (25%)

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Appendix B

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Description of the Project	
Description of |Project	A Wastewater Treatment Works discharging to the Liffey Estuary . Discussions with the EPA have indicated that the aspect of concern is the impact of the discharge of treated effluent on the nearby Natura 2000 sites. The discharge outfall is to Designated sensitive waters. No nutrient reduction is incorporated in the treatment process at present. Details of the discharge are summarised below.

Description	
Average Daily Flow (ADF)	5.7 m^3/sec
Flow to Full Treatment	11.1 m^3/sec
Peak Instantaneous Flow	23.0 m^3/sec
Effluent BOD 95 Percentile Not to be Exceeded	 25 mg/L 50 mg/L
Effluent COD 95 Percentile Not to be Exceeded	 125 mg/L 250 mg/L
Effluent TSS 95% Percentile Not to be Exceeded	 35 mg/L 87.5 mg/L
Effluent Ammonia Nitrogen 95% Percentile Not to be Exceeded	 18.75 mg/L 37 mg/L

Location	Ringsend Dublin. Discharge direct to Liffey Estuary at Poolbeg.
Distance from Natura sites	The outfall pipe from the Ringsend WwTW is located in Dublin Bay, approximately 0.7km from Bull Island SPA, and the South Dublin Bay and River Tolka Estuary SPA. It is located approximately 0.5km from South Dublin Bay SAC
Land Take	None from any designated site
Emmission	The works discharges an average of 5.3m^3/sec of treated effluent,
Note	The discharge is occurring presently and and consultants have been appointed to further improve the treatment with particular emphasis on nutrient reduction to ensure compliance with the UWWT regulations

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Description of the Natura 2000 sites		
Name	**Natura 2000 Designation**	**Basis**
North Bull Island	**SPA (SY004006)**	**EU Birds Directive (79/209/EEC)**
Site description	**North Bull Island SPA** This site covers all of the inner part of north Dublin Bay, with the seaward boundary extending from the Bull Wall lighthouse across to Drumleck Point at Howth Head. The North Bull Island sand spit is a relatively recent depositional feature, formed as a result of improvements to Dublin Port during the 18th and 19th centuries. It is almost 5 km long and 1 km wide and runs parallel to the coast between Clontarf and Sutton. Part of the interior of the island has been converted to golf courses. A well-developed and dynamic dune system stretches along the seaward side of the island. Various types of dunes occur, from fixed dune grassland to pioneer communities on foredunes. Marram Grass (Ammophila arenaria) is dominant on the outer dune ridges. A feature of the dune system is a large dune slack with a rich flora, usually referred to as the 'Alder Marsh' because of the presence of Alder (Alnus glutinosa) trees. The water table is very near the surface and is only slightly brackish. Sea Rush (Juncus maritimus) is the dominant species, with Meadowsweet (Filipendula ulmaria) and Devil's-bit Scabious (Succisa pratensis) being frequent. The orchid flora is notably diverse in this area. Saltmarsh extends along the length of the landward side of the island and provides the main roost site for wintering birds in Dublin Bay. The island shelters two intertidal lagoons which are divided by a solid causeway. These lagoons provide the main feeding grounds for the wintering waterfowl. The sediments of the lagoons are mainly sands with a small and varying mixture of silt and clay. Tasselweed (Ruppia maritima) and small amounts of Eelgrass (Zostera spp.) are found in the lagoons. Common Cord-grass (Spartina anglica) occurs in places. Green algal mats (Enteromorpha spp., Ulva lactuca) are a feature of the flats during summer. These sediments have a rich macro-invertebrate fauna, with high densities of Lugworm (Arenicola marina) and Ragworm (Hediste diversicolor). The North Bull Island SPA is of international importance for waterfowl on the basis that it regularly supports in excess of 20,000 waterfowl. It also qualifies for international importance as the numbers of two species exceed the international threshold – Brent Goose and Bar-tailed Godwit. A further 15 species have populations of national importance – Shelduck, Teal, Pintail, Shoveler, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Black-tailed Godwit, Curlew, Redshank and Turnstone. The island is also regular wintering site for Short-eared Owl. The site has five Red Data Book vascular plant species, four rare bryophyte species, and is nationally important for three insect species. The rare liverwort, Petalophyllum ralfsii, was first recorded from the North Bull Island in 1874 and its presence here has recently been re-confirmed. This species is of high conservation value as it is listed on Annex II of the E.U. Habitats Directive. A well-known population of Irish Hare is resident on the island. The main landuses of this site are amenity activities and nature conservation. The North Bull Island is the main recreational beach in Co. Dublin and is used throughout the year. Two separate Statutory Nature Reserves cover much of the island east of the Bull Wall and the surrounding intertidal flats. North Bull Island is also a Wildfowl	

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	Sanctuary, a Ramsar Convention site, a Biogenetic Reserve, a Biosphere Reserve and a Special Area Amenity Order site. Much of the SPA is also a candidate Special Area for Conservation. The site is used regularly for educational purposes and there is a manned interpretative centre on the island. The North Bull Island SPA is an excellent example of an estuarine complex and is one the top sites in Ireland for wintering waterfowl. It is of international importance on account of both the total number of waterfowl and the individual populations of Brent Goose and Bar-tailed Godwit that use it. Also of significance is the regular presence of several species listed on Annex I of the E.U. Birds Directive, notably Golden Plover and Bar-tailed Godwit but also Ruff and Short-eared Owl.	
Qualifying Interests (Species)	**Species**	**Basis**
North Bull Island SPA	Light-bellied Brent Goose Shelduck Pintail Shoveler Oystercatcher Grey Plover Knot Dunlin Black-tailed Godwit Bar-tailed Godwit Redshank Turnstone 20,000 wintering waterbirds	EU Birds Directive
Additional species of interest	Teal Ringed Plover Golden Plover Sanderling Curlew Black-headed Gull Wetland & Waterbirds	EU Birds Directive
Qualifying Interests (Habitats)	**Habitat types (as in Annex I of the Habitats Directive), (Codes)**	
Conservation Objectives	To maintain the special conservation interests for this SPA at favourable conservation status: Light-bellied Brent Goose, Shelduck, Pintail, Shoveler, Oystercatcher, Grey Plover, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Redshank, Turnstone, 20,000 wintering waterbirds, Teal, Ringed Plover, Golden Plover, Sanderling, Curlew, Black-headed Gull, Wetland & Waterbirds.	

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Description of the Natura 2000 sites		
Name		
Natura 2000 Designation	**Designation**	**Basis**
Sandymount Strand and River Tolka Estuary	**Special Protection Area (SY4024)**	**EU Birds Directive (79/409/EEC)**
Site description	This site comprises a substantial part of Dublin Bay. It includes virtually all of the intertidal area in the south bay, as well as much of the estuary of the River Tolka to the north of the River Liffey. A portion of the shallow marine waters of the bay is also included. In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. The landward boundary is now almost entirely artificially embanked. There is a bed of Dwarf Eelgrass (<u>Zostera noltii</u>) below Merrion Gates which is the largest stand on the east coast. Green algae (Enteromorpha spp. and Ulva lactuca) are distributed throughout the area at a low density. The macro-invertebrate fauna is well-developed, and is characterised by annelids such as Lugworm (Arenicola marina), Nephthys spp. and Sand Mason (Lanice conchilega), and bivalves, especially Cockle (Cerastoderma edule) and Baltic Tellin (Macoma balthica). The small gastropod Spire Shell (Hydrobia ulvae) occurs on the muddy sands off Merrion Gates, along with the crustacean Corophium volutator. The site is an important site for wintering waterfowl, being an integral part of the internationally important Dublin Bay complex. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. An internationally important population of Brent Goose occurs regularly and newly arrived birds in the autumn feed on the eelgrass bed at Merrion. The site supports nationally important numbers of a further six species: Oystercatcher Ringed Plover, Knot , Sanderling, Dunlin and Bar-tailed Godwit. Other species which occur in smaller numbers include Great Crested Grebe, Grey Plover, Curlew, Redshank and Turnstone. South Dublin Bay is an important site for wintering gulls, especially Black-headed Gull, Common Gull and Herring Gull. It is also the premier site in Ireland for Mediterranean Gull, with up to 20 birds present at times. These occur through much of the year, but especially in late-winter/spring and again in late summer into winter. The south bay is an important tern roost in the autumn (mostly late July to September). The wintering birds within this site are now well-monitored. The main threat to this site is further reclamation for industrial and/or infra-structural purposes. The intertidal areas receive water that is somewhat polluted though there are no apparent impacts on the associated flora and fauna. Owing to its location in Dublin Bay, pollution such as oil spillages from Dublin Port and shipping is a threat.	

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	Commercial bait digging may be a problem - this causes disturbance to wintering birds. Disturbance to birds is also caused by walkers and dogs. Sandymount Strand/Tolka Estuary SPA is of high ornithological importance, being of international importance for Brent Goose and of national importance for six waterfowl species. As an autumn tern roost, it is also classified as of international importance. All of the tern species using the site are listed on Annex I of the E.U. Birds Directive, as are Bar-tailed Godwit and Mediterranean Gull.	
Qualifying Interests (Species)	**Species**	**Basis**
	Light-bellied Brent Goose Knot Sanderling Bar-tailed Godwit Redshank Roseate Tern Common Tern Arctic Tern	EU Birds Directive
Additional Special Conservation Interests	Oystercatcher Ringed Plover Golden Plover Grey Plover Dunlin Black-headed Gull Wetland & Waterbirds	EU Birds Directive
Qualifying Interests (Habitats)	**Habitat types (as in Annex I of the Habitats Directive), (Codes)**	
	Tidal Mudflats / Sandflats	1140
Conservation Objectives	To maintain the special conservation interests for this SPA at favourable conservation status: Light-bellied Brent Goose, Knot, Sanderling, Bar-tailed Godwit, Redshank, Roseate Tern, Common Tern, Arctic Tern, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Dunlin, Black-headed Gull, Wetland & Waterbirds.	

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Description of the Natura 2000 sites		
Name	North Dublin Bay SAC	
Natura 2000 Designation	Designation	Basis
North Dublin Bay	Special Area of Conservation (SY0206)	EU Habitats Directive (92/32/EEC)
Site description	This site covers the inner part of north Dublin Bay, the seaward boundary extending from the Bull Wall lighthouse across to the Martello Tower at Howth Head. The North Bull Island is the focal point of this site. The island is a sandy spit which formed after the building of the South Wall and Bull Wall in the 18th and 19th centuries. It now extends for about 5 km in length and is up to 1 km wide in places. A well-developed and dynamic dune system stretches along the seaward side of the island. Various types of dunes occur, from fixed dune grassland to pioneer communities on foredunes. Marram Grass (Ammophila arenaria) is dominant on the outer dune ridges, with Lyme Grass (Leymus arenarius) and Sea Couchgrass (Elymus farctus) on the foredunes. Behind the first dune ridge, plant diversity increases with the appearance of such species as Wild Pansy (Viola tricolor), Kidney Vetch (Anthyllis vulneraria), Bird's-foot Trefoil (Lotus corniculatus), Rest Harrow (Ononis repens), Yellow Rattle (Rhinanthus minor) and Pyramidal Orchid (Anacamptis pyramidalis). In these grassy areas and slacks, the scarce Bee Orchid (Ophrys apifera) occurs. About 1 km from the tip of the island, a large dune slack with a rich flora occurs, usually referred to as the 'Alder Marsh' because of the presence of Alder trees (Alnus spp). The water table is very near the surface and is only slightly brackish. Saltmarsh Rush (Juncus maritimus) is the dominant species, with Meadow Sweet (Filipendula ulmaria) and Devil's-bit (Succisa pratensis) being frequent. The orchid flora is notable and includes Marsh Helleborine (Epipactis palustris), Common Twayblade (Listera ovata), Autumn Lady's-tresses (Spiranthes spiralis) and Marsh orchids (Dactylorhiza spp.). Saltmarsh extends along the length of the landward side of the island. The edge of the marsh is marked by an eroding edge which varies from 20 cm to 60 cm high. The marsh can be zoned into different levels according to the vegetation types present. Towards the tip of the island, the saltmarsh grades naturally into fixed dune vegetation. The island shelters two intertidal lagoons which are divided by a solid causeway. The sediments of the lagoons are mainly sands with a small and varying mixture of silt and clay. The north lagoon has an area known as the "Salicornia flat", which is dominated by Salicornia dolichostachya, a pioneer Glasswort species, and covers about 25 ha. Tassel Weed (Ruppia maritima) occurs in this area, along with some Eelgrass (Zostera angustifolia). Eelgrass (Z. noltii) also occurs in Sutton Creek. Cordgrass (Spartina anglica) occurs in places but its growth is controlled by management. Three Rare plant species legally protected under the Flora Protection Order 1987 have been recorded on the North Bull Island. These are Lesser Centaury (Centaurium pulchellum), Hemp Nettle (Galeopsis angustifolia) and Meadow Saxifrage (Saxifraga granulata). Two further species listed as threatened in the Red Data Book, Wild Sage (Salvia verbenaca) and Spring Vetch (Vicia	

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lathyroides), have also been recorded. A rare liverwort, Petalophyllum ralfsii, was first recorded from the North Bull Island in 1874 and has recently been confirmed as being still present there. This species is of high conservation value as it is listed on Annex II of the E.U. Habitats Directive. The North Bull is the only known extant site for the species in Ireland away from the western seaboard.

North Dublin Bay is of international importance for waterfowl, the following species occurred in internationally important numbers: Brent Geese; Knot ; Bar-tailed Godwit. A further 14 species occurred in nationally important concentrations - Shelduck; Wigeon; Teal; Pintail; Shoveler; Oystercatcher; Ringed Plover; Grey Plover; Sanderling; Dunlin; Blacktailed Godwit; Curlew; Turnstone and Redshank. Some of these species frequent South Dublin Bay and the River Tolka Estuary for feeding and/or roosting purposes
.

The tip of the North Bull Island is a traditional nesting site for Little Tern. However, nesting attempts have not been successful since the early 1990s. Ringed Plover, Shelduck, Mallard, Skylark, Meadow Pipit and Stonechat also nest. A well-known population of Irish Hare is resident on the island. The invertebrates of the North Bull Island have been studied and the island has been shown to contain at least seven species of regional or national importance in Ireland (Orders Diptera, Hymenoptera, Hemiptera).

The main landuses of this site are amenity activities and nature conservation. The North Bull Island is the main recreational beach in Co Dublin and is used throughout the year. Much of the land surface of the island is taken up by two golf courses. Two separate Statutory Nature Reserves cover much of the island east of the Bull Wall and the surrounding intertidal flats. The site is used regularly for educational purposes.

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North Bull Island has been designated a Special Protection Area under the E.U. Birds Directive and it is also a statutory Wildfowl Sanctuary, a Ramsar Convention site, a Biogenetic Reserve, a Biosphere Reserve and a Special Area Amenity Order site.

This site is an excellent example of a coastal site with all the main habitats
represented. The holds good examples of ten habitats that are listed on Annex I of the E.U. Habitats Directive; one of these is listed with priority status. Several of the wintering bird species have populations of international importance, while some of the invertebrates are of national importance. The site contains a numbers of rare and scarce plants including some which are legally protected. Its proximity to the capital city makes North Dublin Bay an excellent site for educational studies and research.

Qualifying Interests (Species)	**Species**	**Basis**
	Petalwort (Petalophyllum ralfsii)	Annex II EU Habitats Directive
Qualifying Interests (Habitats)	**Habitat types (as in Annex I of the Habitats Directive), (Codes)**	
	Fixed dunes	2130 *
	Marram dunes	2120
	Embryonic shifting dunes	2110
	Dune slack	2190
	Vegetation Drift lines	1210
	Salicornia mud	1310

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	Atlantic salt meadows Mediterranean salt meadows Tidal mudflats	1330 1410 1140 * indicates priority Habitat
Conservation Objectives	**Objective 1:** To maintain the Annex I habitats for which the cSAC has been selected at favourable conservation status: Mudflats and sandflats not covered by seawater at low tide; Annual vegetation of drift lines; Salicornia and other annuals colonizing mud and sand; Atlantic salt meadows (Glauco-Puccinellietalia maritimae); Mediterranean salt meadows (Juncetalia maritimi); Embryonic shifting dunes; Shifting dunes along the shoreline with Ammophila arenaria (white dunes); Fixed coastal dunes with herbaceous vegetation (grey dunes); Humid dune slacks. **Objective 2:** To maintain the Annex II species for which the cSAC has been selected at favourable conservation status: Petalophyllum ralfsii. **Objective 3:** To maintain the extent, species richness and biodiversity of the entire site **Objective 4:** To establish effective liaison and co-operation with landowners, legal users and relevant authorities.	

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Description of the Natura 2000 sites		
Name	**South Dublin Bay and River Tolka Estuary SPA**	
Natura 2000 Designation	**Designation**	**Basis**
South Dublin Bay	**Special Area of Conservation (SY00210)**	**EU Habitats Directive (92/32/EEC)**
Site description	This site lies south of the River Liffey and extends from the South Wall to the west pier at Dun Laoghaire. It is an intertidal site with extensive areas of sand and mudflats, a habitat listed on Annex I of the E.U. Habitats Directive. The sediments are predominantly sands but grade to sandy muds near the shore at Merrion gates. The main channel which drains the area is Cockle Lake. There is a bed of Eelgrass (Zostera noltii) below Merrion Gates which is the largest stand on the east coast. Green algae (Enteromorpha spp. and Ulva lactuca) are distributed throughout the area at a low density. Fucoid algae occur on the rocky shore in the Maretimo to Dún Laoghaire area. Several small, sandy beaches with incipient dune formation occur in the northern and western sectors of the site, notably at Poolbeg, Irishtown and Merrion/Booterstown. The formation at Booterstown is very recent. Driftline vegetation occurs in association with the embryonic and incipient fore dunes. Typically drift lines occur in a band approximately 5 m wide, though at Booterstown this zone is wider in places. The habitat occurs just above the High Water Mark and below the area of embryonic dune. A small area of pioneer salt marsh now occurs in the lee of an embryonic sand dune just north of Booterstown Station. This early stage of salt marsh development is here characterised by the presence of pioneer stands of Glasswort (Salicornia spp.) occurring below an area of drift line vegetation. As this is of very recent origin, it covers a small area but ample areas of substrate and shelter are available for the further development of this habitat. South Dublin Bay is an important site for waterfowl. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. The principal species are Oystercatcher, Ringed Plover, Sanderling and Dunlin, Redshank. Up to 100 Turnstones are usual in the south bay during winter. Brent Geese regularly occur in numbers of international importance. Bar-tailed Godwit, a species listed on Annex I of the EU Birds Directive, also occur. Large numbers of gulls roost in South Dublin Bay. It is also an important tern roost in the autumn, regularly holding 2000-3000 terns including Roseate Terns, a species listed on Annex I of the E.U. Birds Directive. South Dublin Bay is largely protected as a Special Protection Area. At low tide the inner parts of the south bay are used for amenity purposes. Baitdigging is a regular activity on the sandy flats. At high tide some areas have windsurfing and jet-skiing. This site is a fine example of a coastal system with extensive sand and mudflats, a habitat listed on Annex I of the E.U. Habitats Directive. South Dublin Bay is also an internationally important bird site.	
Qualifying Interests (Species)	**Species**	**Basis**
	Light-bellied Brent Goose	EU Birds Directive

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	Knot Sanderling Bar-tailed Godwit Redshank Roseate Tern Common Tern Arctic Tern	
Additional Special Conservation Interests	Oystercatcher Ringed Plover Golden Plover Grey Plover Dunlin Black-headed Gull Wetland & Waterbirds	EU Birds Directive
	Petalwort (Petalophyllum ralfsii)	Annex II, EU Habitats Directive.
Qualifying Interests (Habitats)	**Habitat types (as in Annex I of the Habitats Directive), (Codes)**	
	Tidal Mudflats / Sandflats	1140
Conservation Objectives	**Objective 1:** To maintain the Annex I habitat for which the cSAC has been selected at favourable conservation status: Mudflats and sandflats not covered by seawater at low tide. **Objective 2:** To maintain the extent, species richness and biodiversity of the entire site. **Objective 3:** To establish effective liaison and co-operation with landowners, legal users and relevant authorities.	

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Assessment Criteria (Also described in main report Section 7)	
Name	
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site.	The Ringsend WwTW treats and discharges effluent to Dublin Bay. The outfall location lies between the North Dublin Bay SAC (site code 00216), South Dublin Bay cSAC (site code 00210), Sandymount Strand and River Tolka Estuary (site code 004024) and the North Bull Island SPA (site code: 004006). No other Natura 2000 sites have the potential to be affected by the works.
Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the Natura 2000 site by virtue of: • **Size and scale;** • **Land-take;** • **Distance from Natura 2000 site or key features of the site;** • **Resource requirements;** • **Emissions;** • **Excavation requirements;** • **Transportation requirements;** • **Duration of construction, operation etc.;** • **Others.**	Due to the fact that the discharge is already taking place the effects of the discharge on water quality were assessed initially and the potential impacts then assessed. Discussions with the EPA indicated that only the discharge as to be assessed. Consequently the only impacts and effects to be considered are by virtue of emissions The RWTW treats and discharges effluent to Dublin Bay. The effect of this discharge is an increase in the nutrient concentration in the receiving waters The outfall is located approximately 0.5 km away from the nearest Natura 2000 site. Without strict adherence to the discharge standards as set out in the discharge licence, there are potential impacts on the Natura 2000 site. These include the eutrophication of waters or contamination of waters, which could cause alterations to the intertidal and littoral habitats and ecosystems. The alteration to the receiving may possibly impact on the lower end of the food chain within the Bay and this would lead to indirect impacts on those qualifying species that feed in the bay. However it is considered that such an impact is unlikely due to the degree of nutrient increase.
Describe any likely changes to the site arising as a result of: • **reduction of habitat area:** • **disturbance to key species;** • **habitat or species fragmentation** • **reduction in species density;** • **changes in key indicators of conservation value (waterquality etc.);** • **climate change.**	There will be no reduction or fragmentation of habitat area within any of the Natura sites. There is the potential for disturbance of plant and algal species sensitive to nutrient enrichment, indirectly affecting habitats and key bird species found in the Natura 2000 site. However there is no evidence that the habiatats and species have been affected to date. While there is still elevated nutrients present in the receiving waters improvements completed in the treatment processes has resulted in an improvement in water quality. Deterioration of water quality resulting from malfunctions in the treatment systems could cause negative impacts on the Natura 2000 sites.
Describe any likely impacts on the Natura 2000 site as a whole in terms of: • **interference with the key relationships that define the structure of the site;**	Without strict adherence to the discharge standards as set out in the discharge licence, there are the following potential impacts on the Natura 2000 site: • A unlikely but potential impact on the structure and function of the intertidal and sub-littoral habitats in and around Dublin Bay that support

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• **Interference with key relationships that define the function of the site.**	wetland bird species. • A risk of degradation in the water quality that support the birds within the Natura 2000 site. • A risk of alteration to ecosystems within the habitats, due to the enrichment of waters in Dublin Bay. However there is no evidence that any such impacts are taking place and proposed improvements to the treatment processes (denitrification) are likely to reduce the potential for impact further.
Provide indicators of significance as a result of the identification of effects set out above in terms of: • **loss;** • **fragmentation;** • **disruption;** • **disturbance;** • **change to key elements of the site (e.g. water quality etc.).**	The prime indicators of significance of those factors which would indirectly impact on the conservation objectives of the sites.. • Water Quality. Continued monitoring of the water quality of the bay and comparison with the draft environmental quality objectives will provide an indication of any deterioration that is likely to lead to an adverse impact on the Qualifying species, habitats and conservation objectives. • Monitoring of Site Conditions. Bird populations and the conditions of the habitats will also indicate whether there is any deterioration in the conservation status
Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale of magnitude of impacts is not known.	There are no significant impacts anticipated on the Natura 2000 sites. However there are elevated dissolved inorganic nitrogen concentrations in the bay and it is unknown whether these concentrations are sufficient to cause eutrophic conditions that would lead to indirect impacts on the protected habitats and species in the future.

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Appropriate Assessment (Also described in main report Section 7)	
Describe the elements of the project or plan (alone or in combination with other projects or plans) that are likely to give rise to significant effects on the site (from screening assessment).	Water quality in and around Dublin Bay is of satisfactory condition at present apart from elevated concentrations of dissolved inorganic nitrogen. The improvements to the works has been in full operation since 2004. Since then there has been no noticeable deterioration in water quality, or alteration to the geomorphological and sedimentological regime within Dublin Bay as a whole. Bird numbers have remained consistent / increasing. While there has been an overall improvement in water quality since the Ringsend WwTW has been commissioned, the works has been operating in a stressed or overcapacity condition. It is therefore necessary that the works be upgraded to ensure that it can continue to meet discharge standards, and contribute to improving water quality in Dublin Bay. There is also a requirement to implement Nutrient reduction in order to Comply with the UWWT regulations on discharges to waters designated as "Sensitive"
Set out the conservation objectives of the site	See above

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Acknowledge uncertainties and any gaps in information	
Describe how the integrity of the site (determined by structure and function and conservation objectives) is likely to be affected by the project or plan (e.g. loss of habitat, disturbance, disruption, chemical changes, hydrological changes and geological changes, etc.). Acknowledge uncertainties and any gaps in information	The habitats and species for which the Natura 2000 sites are designated are partially dependent on water quality. The current discharge from the Ringsend WwTW has demonstrated no deterioration in water quality, and resulted in no significant impact on the habitats and species found within the Natura 2000 sites. In upgrading the works, the Natura 2000 sites will not be adversely affected by the works. There may be uncertainties in the effect the present nutrient content may have may have on the biological r regime within Dublin Bay.
Describe what mitigation measures are to be introduced to avoid or reduce the adverse effects on the integrity of the site. Acknowledge uncertainties and any gaps in information	There are no discernible adverse impacts at present. However further mitigation of any risk of potential adverse effects will result from the proposed improvements to the treatment system (denitrification) to reduce the nutrient load and to ensure compliance with the UWWT regulations.

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Mitigation Measures.	
	Nitrogen and phosphorus control is required for discharge into the Liffey Estuary in accordance with the Water Frame Work Directive (2000/60/EC) specifically nitrogen in all of its forms shall be reduced to an annual average concentration of not more than 10 mg/l and Total Phosphorus shall be reduced to an annual average concentration of not more than 1 mg/L. If DCC decides to continue its discharge to the estuary, plans will be made to bring nutrients under control as an early step in the Ringsend Extension project. This decision is crucial to the determination of process selection for nutrients and cannot be made in the absence of the long term plan, which will be determined in the summer of 2009. Bringing phosphorus under control is reasonably straightforward and can be done independent of any other improvements at the Works. Metal salts can be added to the wastewater upstream of the primary clarifiers as well as to the recycle streams from solids processes. The phosphorus would be removed by enhance precipitation in the primary clarifiers. The necessary chemical storage and feed facilities will not require very large areas and can be integrated onto the site without precluding the construction of other facilities. Nitrogen control will be far more difficult to implement. Nitrogen species must first be oxidized to nitrite and/or nitrate. Then the oxidized species must be reduced to nitrogen gas (de-nitrification), which is then released to the atmosphere. Studies to date have shown that the existing facilities are limited in the degree to which they can nitrify, with a current estimate of between 1.2 to 1.3 million population equivalent (PE) as the maximum achievable during the winter months. The current average day loading to the Works is approximately 1.8 million PE, leaving 0.5 to 0.6 million PE untreated with regard to nitrogen species. Thus, adding denitrification facilities as an interim measure without also upgrading the nitrification facilities is risky. The Ringsend Extension project will examine the requirements for nitrogen control in the context of the overall Works upgrade and specify early compliance with those standards, assuming that the Works will continue to discharge to the estuary.
Explain how the measures will avoid the adverse effects on the integrity of the site	
Explain how the measures will reduce the adverse effects on the integrity of the site	The quality of the discharged effluent will improve and the nutrient concentration will be reduced. This will reduce the risk of eutrophication and the possible indirect impacts that could conceivably result.
Provide evidence of how they will be implemented and by	Consultants were appointed in 2008 and their brief is to undertake a series of improvements to ensure compliance

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whom.	with the water quality legislation and to quantify the capacity of the works once these improvements are in place. Other elements of the brief include studies on odour and modelling of the discharge for various scenarios.
List measures to be introduced. (as above)	
Provide evidence of the degree of confidence in their likely success	
Provide timescale, relative to the project or plan, when they will be implemented	If DCC decides to continue its discharge to the estuary, plans will be made to bring nutrients under control as an early step in the Ringsend Extension project. This decision is crucial to the determination of process selection for nutrients and cannot be made in the absence of the long term plan, which will be determined in the summer of 2009.
Explain the proposed monitoring scheme	Required monitoring will be carried out to ensure compliance with all relevant legislation

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