# An Bord Pleanála Oral Hearing

## Irish Water

## Greater Dublin Drainage

## Brief of Evidence

## Marine Water Quality

**Alan Berry**

**GDD Oral Hearing**
**Witness Statement of Alan Berry**
**Marine Water Quality**

## QUALIFICATIONS AND ROLE ON THE PROJECT

1 My name is Alan Berry and I am the Managing Director and Senior Modeller of MarCon Computations. I have been with MarCon since its foundation and have worked to date on projects in Ireland, the UK and Asia. I have been involved in the modelling of rivers, estuaries, coasts and open seas for the past twenty years, having authored / co-authored over sixty professional reports for various clients and co-authored six peer-reviewed articles. I am a Chartered Engineer with Engineers Ireland and hold an honours degree, (B.A., B.A.I.), in Civil, Structural and Environmental Engineering from the University of Dublin, Trinity College, and a Masters degree, (M.Eng.Sc.) in Civil Engineering from the National University of Ireland, Galway.

2 In 2011, at an early stage of the Proposed Project's development, MarCon Computations were commissioned to undertake mathematical modelling studies of the coastal waters off north County Dublin to determine the preferable location(s) for a marine outfall. MarCon Computations were subsequently commissioned to undertake further studies for the purposes of the planning application in relation to the possible impacts on the receiving waters of discharging treated wastewater through the proposed outfall pipeline route (marine section), pursuant to the Proposed Project. I undertook the modelling work, analysis of results, and preparation of the text for Chapter 8: Marine Water Quality which is contained within Volume 3 Part A of the Environmental Impact Assessment Report (EIAR).

## SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

3 MarCon Computations' first involvement in the Project was in 2011. At that stage, a number of alternative locations for the Project, orbital sewer route and outfall pipeline route (land based and marine sections) were under consideration and were shortly to be the subject of public consultation. In that context, MarCon Computations International were commissioned to undertake a mathematical modelling study of the coastal waters off north Co. Dublin for the Project to assess the discharge of treated wastewater on the receiving waters.

4 Therefore, in 2011, a preliminary modelling study was undertaken to identify a range of potential outfall locations along the north Dublin coastline. That study showed that, by locating the proposed outfall in one of two discrete areas within the Project study area, the impact of the treated wastewater discharge on the receiving marine environment could be minimised. That conclusion was supported by the results of the preliminary modelling study, which identified the preferable locations for the proposed outfall. The results and conclusion were subject to public consultation in 2011 as part of the Alternative Site Assessment Phase One - Preliminary Screening Outcomes Report, which contains the feedback from the public consultation on the potential northern and southern outfall locations.

5 Subsequently, in 2013, MarCon International carried out a near-field modelling study to determine the relative environmental merits of those two locations. The 2013 study showed that the southern outfall study area exhibited more favourable coastal hydrodynamic characteristics than the northern outfall study area, (i.e. larger current speeds and greater water depths), which allow for faster and greater dilution of treated wastewater. The study was subject to public consultation as part of the *Alternate Site Assessment and Route Selection Report (Phase 4): Final Preferred Site and Routes*.

6 Following publication of the Alternate Site Assessment and Route Selection Report (Phase 4): Final Preferred Site and Routes, a detailed hydrodynamic and water quality model was developed and calibrated in 2015 to assess in detail both the Construction Phase and Operational Phase likely significant impacts of the proposed outfall pipeline route (marine section) on the marine environment for the purposes of the application for development consent. EIAR Chapter 8: Marine Water Quality contains a detailed assessment of the impact of the proposed outfall pipeline route (marine section) on the water quality of the receiving marine environment by reference to that model.

7 In that regard, a Mike-by-DHI 3D Flexible Mesh (Mike3-FM) hydrodynamic, solute and sediment transport model (**the Model**) was developed to predict:

a) tidal circulation patterns in the region;

b) the advection, dispersion and settling of sediment arising from dredge operations associated with construction of the proposed outfall pipeline route (marine section); and

c) treated wastewater dispersion and plume trajectories associated with the operation of the Proposed Project.

8 The MIKE software suite has been the preferred choice for water professionals worldwide for more than 25 years. The modelling software is used worldwide by governmental agencies and authorities, water utilities companies, professional engineering companies and consultants. Notable projects employing the Mike-by-DHI software include “The World” and “The Palm Jumeirah” in Dubai, the “Deepwater Horizon” oil spill modelling, and most of the Irish coastal Flood Risk Assessment and Management Studies.

9 The hydrodynamic component of the Model was calibrated against field survey data collected in July and August 2012. As the tides, and the dominant tidal circulation patterns, are caused by the gravitational interaction between the Earth and the Moon occurring over a 28-day lunar period, two months field survey data was more than sufficient against which to calibrate the hydrodynamic model. The comparison of the modelled and measured datasets, both statistically and visually, provided a robust calibration agreement. Thereafter, the hydrodynamic calibration coefficients remained unchanged within the Model.

10 The solute transport component of the Model, which sits on top of the hydrodynamic model, was calibrated against survey data collected in March, April and June 2015. Again, the comparison of the modelled and recorded datasets provided good agreement. The solute transport calibration coefficients thereafter remained unchanged within the Model.

11 The calibration results presented in Appendix 8.1 of the EIAR showed that the Model had been successfully calibrated and validated against field measurements, thus providing an accurate representation of the hydrodynamics and transport patterns within the study region.

12 When assessing the potential impacts of the Proposed Project the calibrated Model took account of:

a) the hydraulic flows from all Wastewater Treatment Plants (WwTPs) and rivers;

b) pollutant loads from WwTPs and rivers; and

c) background concentrations within the coastal waters and bed sediment composition.

13 I used the Model to assess the impact of the Proposed Project (both Construction and Operation Phase) on the receiving waters of Co. Dublin. In particular I examined the following scenarios:

a) the dredging of the trench for the proposed outfall pipeline route (marine section) to a depth of 5m below bed level for a distance of 3.9km;

b) the continuous discharge of treated wastewater into the receiving waters for both

(i) average flow conditions; and

(ii) flow to full treatment conditions; and

c) a hypothetical three-day process failure at the proposed WwTP.

### Scenario (a)

14 The Model results predicted there would be a brief but recurring effect during the course of the dredging operations but that it would be of negligible impact when compared to the natural variability of total suspended solid concentrations in the receiving waters.

15 In line with the predictions from the modelling scenario, I recommended a number of mitigation measures to minimise the of the dredging operations on the receiving waters:

a) disposal of dredged material to take place only on local flooding tides (confirmed by reference to Howth Harbour's tide gauge) to minimise the risk of suspended sediments dispersing to sensitive receptors around Ireland's Eye with the timing of flood tide to be confirmed;

b) monitoring of turbidity and suspended sediment concentrations of the receiving waters during the dredging operations using a buoy-mounted turbidity meter with telemetering back to the dredger to monitor potential impacts from dredging activity; and

c) suspension of the dredging operation if water column concentrations of suspended sediment material exceed 40mg/l above background levels off the northern coastline of Ireland's Eye, according to recommendations in the EIAR Chapter 9: Biodiversity, specifically Section 9.7 Mitigation Measures.

### Scenario (b) (i)

16 The Model results predicted that there would be no impact on the receiving waters in this scenario.

### Scenario (b) (ii)

17 The Model results predicted there would be an imperceptible to slight impact on the receiving waters in the immediate vicinity of the discharge point.

### Scenario (c)

18 The Model results predicted there would be a slight impact on the receiving waters in the immediate vicinity of the discharge point.

19 The extensive modelling undertaken as part of the EIAR has predicted that the Project will have an imperceptible to slight impact on the water quality of the coastal waters off north County Dublin. None of the scenarios examined predicted the likelihood of any significant impact on the receiving waters from the proposed operation of the outfall discharge.

## ASSESSMENT OF EFFLUENT COLIFORM CONCENTRATIONS RESPONSES

20 At Fingal County Council's request, additional modelling of the above scenarios (b) and (c) was undertaken to simulate Ringsend levels of treated wastewater coliform concentrations (300,000 cfu/100ml) discharging through the Proposed Project outfall point

21 Daily recorded coliform levels in the Ringsend effluent discharge for the period January – April 2018 ranged from 1,553 cfu/100ml to 241,960 cfu/100ml with the average coliform levels being 81,396 cfu/100ml.

22 The additional modelling scenarios to simulate a continuous 30-day discharge of coliforms at a concentration of 300,000 cfu/100ml from the Proposed Project outfall point represents an extreme scenario that would not occur in a well-managed plant of the proposed size.

23 Bathing Waters: For the revised scenario (b)(i), average daily flow, the predicted concentrations of coliforms over the course of the 30-day simulation did not exceed the 250 /100ml limit required to achieve 'Excellent' Status at any of the designated bathing waters areas. There was predicted to be no compliance failures at the designated bathing water beaches arising from the proposed discharge of treated wastewater containing higher coliform concentration levels of 300,000 cfu/100ml. The results of the Model predictions of coliform concentrations at the two closest designated bathing waters beaches, Velvet Strand and Claremont, are presented below in Diagram 1 and Diagram 2 respectively.

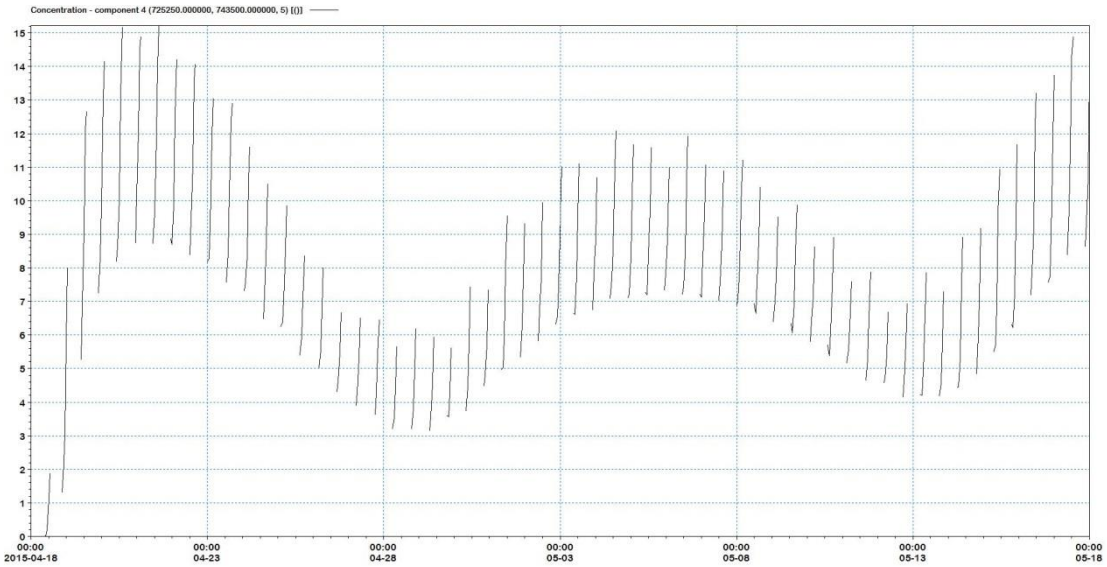


**Diagram 1: Predicted coliform concentrations over time at Velvet Strand bathing water sampling point**

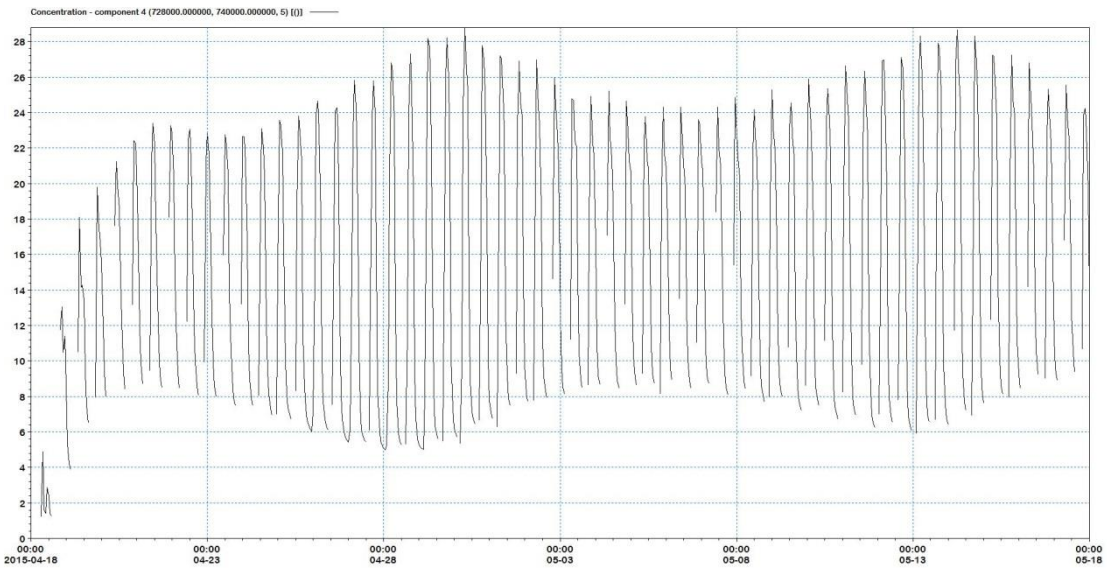


**Diagram 2: Predicted coliform concentrations over time at Claremont bathing water sampling point**

24 Shellfish: For the revised scenario (b)(i), average daily flow, the maximum predicted coliform concentration over the course of the 30-day simulation in the water near the seabed was 142 cfu/100ml with the average coliform concentration predicted to be 33 cfu/100ml.

25 Bathing Waters: For the revised scenario (b)(ii), flow to full treatment, the predicted concentrations of coliforms did not exceed the 250 /100ml limit required to achieve 'Excellent' Status at any of the designated bathing waters areas. There was predicted to be no compliance failures at the designated bathing water beaches arising from the proposed discharge of treated wastewater containing higher coliform concentration levels of 300,000 cfu/100ml. The results of the Model predictions of coliform concentrations at the two closest designated bathing waters beaches, Velvet Strand and Claremont, are presented below in Diagram 3 and Diagram 4 respectively.

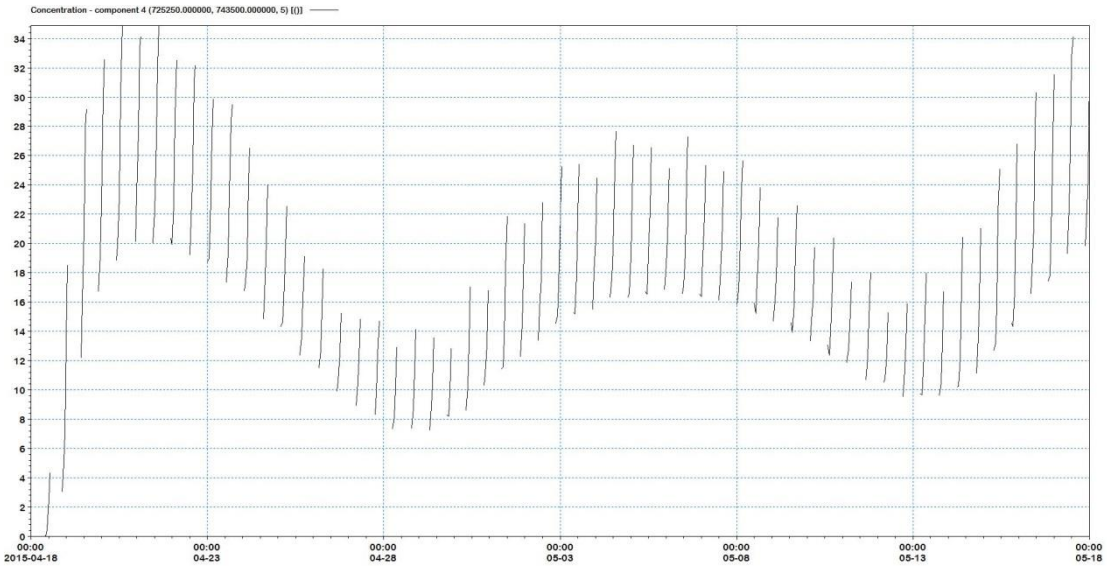


**Diagram 3: Predicted coliform concentrations over time at Velvet Strand bathing water sampling point**

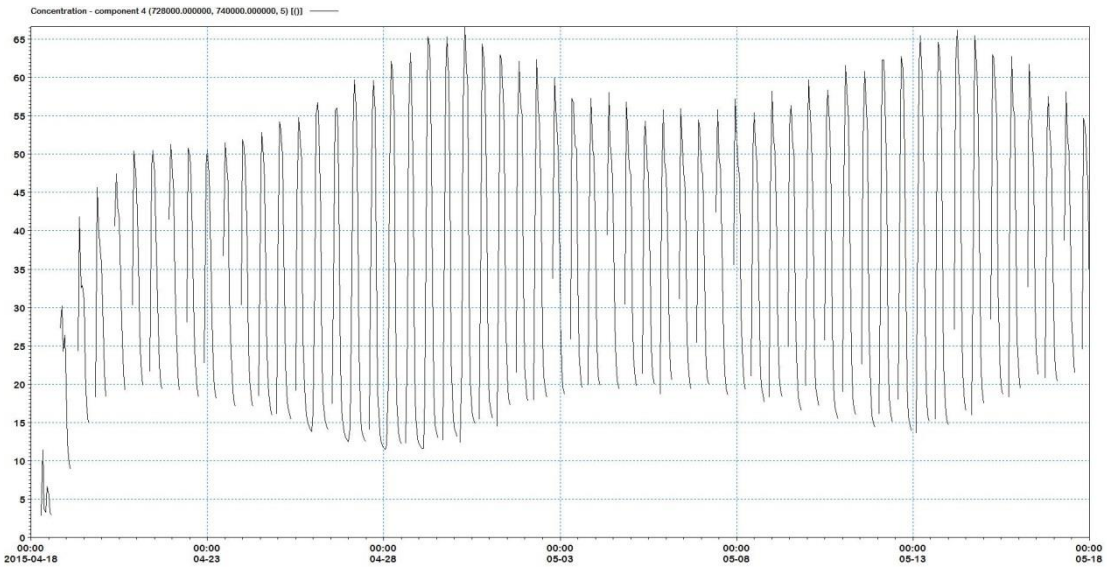


**Diagram 4: Predicted coliform concentrations over time at Claremont bathing water sampling point**

26 Shellfish: For the revised scenario (b)(ii), flow to full treatment, the maximum predicted coliform concentration over the course of the 30-day simulation in the water near the seabed was 147 cfu/100ml with the average coliform concentration predicted to be 78 cfu/100ml.

27 Bathing Waters: For the revised scenario (c), hypothetical 3-day process failure, the predicted concentrations of coliforms over the course of the simulation did not exceed the 250 /100ml limit required to achieve 'Excellent' Status at any of the designated bathing waters areas. There was predicted to be no compliance failures at the designated bathing water beaches arising from the proposed discharge of treated wastewater containing higher coliform concentration levels of 300,000 cfu/100ml. Though elevated coliform levels are predicted during the hypothetical process failure, the predicted coliforms levels return to prior levels three days after the end of the hypothetical process failure event. The results of the Model predictions of coliform concentrations at the two closest designated bathing waters beaches, Velvet Strand and Claremont, are presented below in Diagram 5 and Diagram 6 respectively.

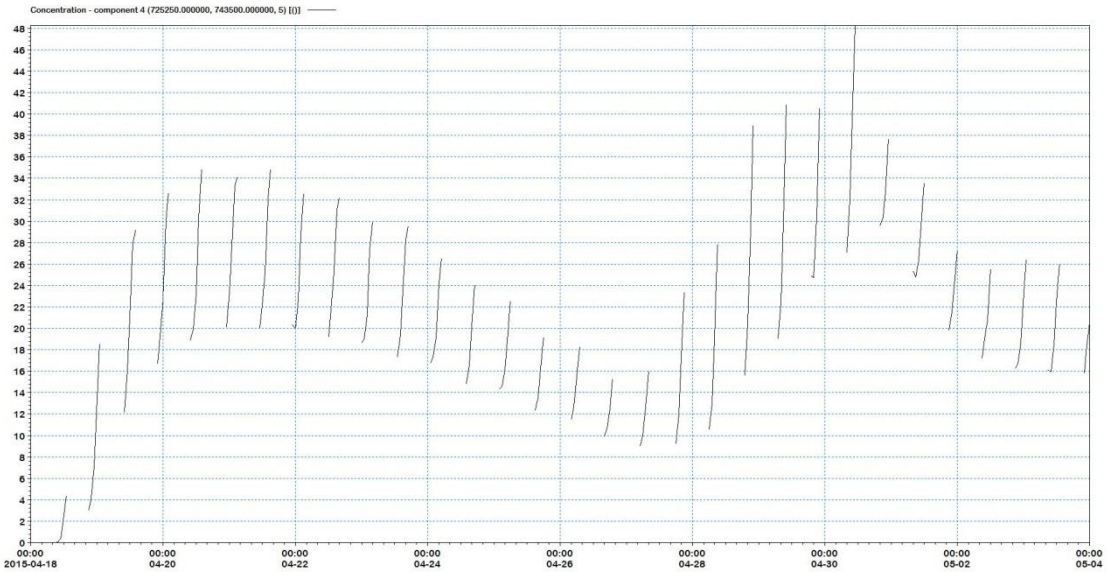


**Diagram 5: Predicted coliform concentrations over time at Velvet Strand bathing water sampling point**

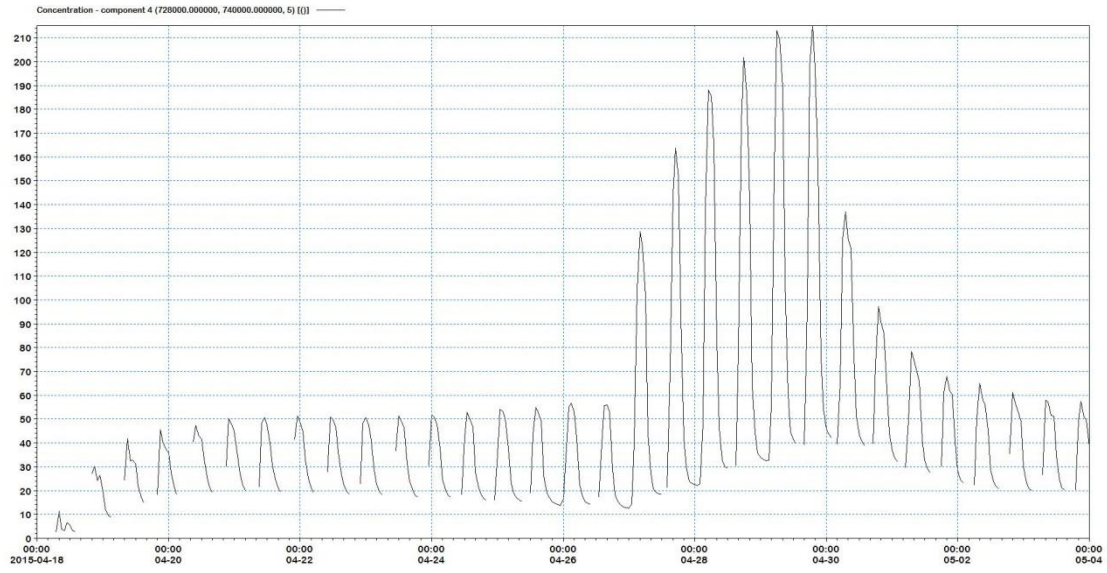


**Diagram 6: Predicted coliform concentrations over time at Claremont bathing water sampling point**

28 Shellfish: For the revised scenario (c), hypothetical 3-day process failure, the maximum predicted coliform concentration over the course of the simulation in the water near the seabed was 965 cfu/100ml during the process failure event with the average coliform concentration predicted to be 98 cfu/100ml. Comprehensive measures are proposed to minimise the risk of a process failure, and evidence previously presented by Ciarán O'Keeffe, has confirmed that there would be no marine discharge during a process failure.

29 Subsequent to the Response and having regard to the submissions made by Fingal County Council and members of the public including fishermen, Irish Water requested some further analysis to be undertaken, which was completed by Marja Aberson, who is a marine ecologist specialising in shellfish. Her advice was to the effect that as an abundance of caution to ensure the protection of the shellfish, additional treatment should be applied to the effluent. Irish Water has determined that it will apply UV treatment to all effluent discharges.

**SUBMISSIONS/OBJECTIONS RECEIVED AND RESPONSES**

30 104 submissions raised the issue of marine water quality in relation to the Proposed Project.

Issue #1 - Impact of the Project on local beaches / coastal water quality

31 The Bathing Water Quality Regulations 2008 (S.I. No. 79 of 2008), as amended, transposed the Bathing Water Directive into Irish Law on 24 March 2008. It established a new classification system for bathing water quality based on four classifications: 'Poor', 'Sufficient', 'Good' and 'Excellent'. The Regulations generally require that a classification of 'Sufficient' be achieved by 2015 for all bathing waters.

32 The Regulations require that the maximum values of Escherichia coliforms should not exceed the mandatory value of 500 cfu/100ml in 95% or more of the samples taken in the season to ensure a 'Good' classification of bathing water beaches. The Regulations require that the maximum values of Escherichia coliforms should not exceed the mandatory value of 250 colony forming units (cfu)/100ml in 95% or more of the samples taken in the season to ensure an 'Excellent" classification of bathing water beaches.

33 Under the Quality of Bathing Waters Regulations, the stretches of beach designated as bathing water protected areas along the north County Dublin coastline include:

- Balbriggan (excellent)
- Skerries (excellent)
- Claremont Beach (excellent)
- Sutton Burrow Beach (excellent)
- Portmarnock, Velvet Strand Beach (excellent)
- Donabate, Balcarrick Beach (excellent)
- Portrane, Brook Beach (restricted)
- Rush, South Beach (restricted)
- Rush, North Beach (excellent)
- Loughshinny Beach (restricted)

34 Submissions also raised the impact of the Proposed Project on Balscadden Beach and Ireland's Eye.

35 The Blue Flag programme is a programme to identify high-quality bathing water areas, administered in Ireland by An Taisce. Only beaches that meet the criteria for 'Excellent' status under the Bathing Water Directive are eligible for a Blue Flag. Only one beach in north Dublin was awarded a Blue Flag Award for 2017, that being Portmarnock Velvet Strand Beach.

36 Issues relating to the quality of bathing water beaches and Blue Flag beaches have been addressed in the Chapter 8 Marine Water Quality in Volume 3 Part A of the EIAR, specifically Section 8.4.2: Impact of the Proposed Project (pages 32-78). The Model results predict that the discharge of treated wastewater from the Project would have no impact on any designated bathing waters or Blue Flag beaches.

37 The Model included results for the continuous discharge of treated wastewater into the receiving waters for average flow conditions and flow to full treatment conditions.

38 The Model also included results for the impact of the discharge of untreated wastewater over a three-day period to simulate a hypothetical process failure. Comprehensive measures are proposed to minimise the risk of a process failure, and evidence previously presented by Ciarán O'Keeffe, has confirmed that there would be no marine discharge during a process failure so there would be no potential impact from a malfunction.

39 The Model results predicted that plumes from the proposed outfall discharge point would not exceed the 500 cfu/100ml limit required to achieve "Good" status at any of the designated bathing waters beaches, Blue Flag beaches, Ireland's Eye or Balscadden beach.

40 The Model results also predicted that plumes from the proposed outfall discharge point would not exceed the 250 cfu/100ml limit required to achieve "Excellent" status at any of the designated bathing waters beaches, Blue Flag beaches, Ireland's Eye or Balscadden beach.

41 The Model results predicted no failures to comply with the Bathing Water Directive or Regulations standards at any of the designated bathing water beaches, Blue Flag beaches, Balscadden Beach or Ireland's Eye.

Issue #2 – Impacts on General Water Quality

42 The European Union Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009) (as amended) (the Surface Water Regulations) apply to all surface waters and give effect to the measures needed to achieve the environmental objectives established for surface waterbodies by the Water Framework Directive (WFD). Wastewater Discharge Authorisations (WDAs) must set standards (emission limits) that will contribute to the receiving waters complying with the standards for environmental quality laid out in these regulations. Irish Water must apply for and obtain a WDA from the Environmental Protection Agency before it begins to discharge treated wastewater from the Proposed Project.

43 The principal quality standard at issue in relation to wastewater discharges to Coastal Waters is for nutrients in the form of Dissolved Inorganic Nitrogen (DIN). DIN is considered to be the limiting nutrient in coastal waters and a breach of the environmental quality standard may lead to eutrophic conditions (algal blooms, etc.) and consequently the only nutrient standards in place for coastal waters are for DIN. A limiting nutrient is one which, if added to the system, will increase the net rate of primary production thus increasing the potential for eutrophication. Since the 1970s it has been accepted that nitrogen is the key limiting factor in primary production and eutrophication in coastal waters.

44 The Surface Water Regulations set a median concentration limit in coastal and transitional waters for Dissolved Inorganic Nitrogen at ≤0.17mg/l N to achieve high status and at ≤0.25mg/l N to achieve good status.

45 The Model results presented in the Chapter 8 Marine Water Quality in Volume 3 Part A of the EIAR (pages 32-43) predicted:-

a) no impact on the receiving waters for average daily discharge conditions;

b) only a slight impact on the receiving waters, local to the proposed outfall discharge point for flow to full treatment conditions; and

c) only a slight impact on the receiving waters, local to the proposed outfall discharge point, from its operation during a hypothetical three-day process failure at the proposed WwTP.

46 The Model results did not predict any significant impact on the receiving waters from the operation of the Proposed Project.

47 The Surface Water Regulations do not set a limit for molybdate reactive phosphorus in coastal waters. The transitional waters' median concentration limit of ≤0.04mg/l P required to achieve good status has been applied in the absence of a coastal waters limit.

48 The Model results presented in Chapter 8 Marine Water Quality in Volume 3 Part A of the EIAR (pages 44-54) predicted:

a) no impact on the receiving waters for average daily discharge conditions;

b) only a slight impact on the receiving waters, local to the proposed outfall discharge point for flow to full treatment conditions; and

c) only a slight impact on the receiving waters, local to the proposed outfall discharge point, for its operation during a hypothetical three-day process failure in the proposed WwTP.

49 The Model did not predict any significant impact on the receiving waters from the operation of the Proposed Project.

Issue #3 – Impact of the Proposed Project on designated shellfish waters

50 Directive 2006/113/EC of the European Parliament and of the Council of 12 December 2006 on the quality required of shellfish waters (Shellfish Waters Directive) requires Member States to designate waters that need protection to support shellfish life and growth. This legislation also prescribes quality standards for shellfish waters and requires that Member States set limit values corresponding to certain parameters. The European Commission (Quality of Shellfish Waters) Regulations (SI No 268/2006) (the Shellfish Waters Regulations) transpose the Shellfish Waters Directive into Irish law.

51 The Shellfish Waters Regulations do not set values for coliform concentrations in the water column. Instead, Schedule 4 of S.I. No. 268/2006 sets a guide value for coliform concentrations equal to or less than 300 in the shellfish flesh and intervalvular liquid, but does not set values for coliform concentrations in the water column.

52 The criteria for the classification of bivalve mollusc harvesting areas are given under Regulation (EC) No 854/2004. The Malahide razor clam shellfishery has a Class A classification requiring that samples of live bivalve molluscs from these areas must not exceed 230 E. coli per 100 g of flesh and intravalvular liquid.

53 The Model makes predictions for coliform concentrations in the water column, not in the shellfish flesh. There is no direct relationship between the concentration of coliforms in the overlying water and the concentration of coliforms in the shellfish flesh as both the uptake/accumulation and clearance/removal of coliforms by filter-feeding shellfish is a dynamic process affected by many variables (e.g. shellfish species, temperature, turbidity, food availability, salinity, shellfish age, season, reproductive state, health of the shellfish and the impacts of toxins and other contaminants, etc). The potential impacts on the Malahide shellfishery were examined at the designated shellfish sampling point located at 53o 27.394'N, 6o 4.457'W.

54 For Average Daily Flow scenario, the maximum predicted coliform concentration in the water near the seabed was 19 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 4.7 cfu/100ml.

55 For Flow to Full Treatment scenario, the maximum predicted coliform concentration in the water near the seabed was 43 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 10.5 cfu/100ml.

56 The coliform concentrations fluctuate between the maximum value on flooding tides and zero concentration on ebbing tides. This provides equal time for uptake/accumulation and subsequent clearance/removal of any coliforms by the shellfish. Combined with the predicted low concentration levels and Irish Water's commitment to provide UV treatment to all effluent discharges there will be no impact on the shellfish water quality as a result of the Proposed Project.

Issue #4 - computer modelling simulations

57 Computer modelling has been employed as the Project is at the planning stage. Prior to operation, the only way to assess the predicted impacts of the Project is through computer simulation.

58 Furthermore, as detailed in paragraph 9 to paragraph 11 above, the Model was calibrated using data from surveys of the actual conditions of the study area.

59 Monitoring of the actual discharge will be undertaken in accordance with conditions attached to the WDA required to operate.

Issue #5 - combined effects of Ringsend and GDD Project

60 Ringsend and all other WwTPs along the Dublin coastline were taken into account in the Model (ie Shanganagh, Ringsend, Swords, Malahide, Portrane, Barnageeragh and the Proposed Projects). The WwTPs were included in the modelling studies to assess the potential in-combination effects with the Proposed Project. This was detailed in the EIAR Chapter 8: Marine Water Quality, specifically Section 8.2.6: Model Inputs; "The hydraulic flows defined in the numerical model consisted of the WwTPs at Shanganagh, Ringsend, Swords, Malahide, Portrane, Barnageeragh and the proposed WwTP discharge under consideration in this study. The WwTPs were included in the modelling study to assess the potential in-combination effects with the proposed outfall pipeline route (marine section) discharge point." And later in the same section; "Pollutant loads for both the existing Ringsend WwTP and Ringsend WwTP Upgrade were sourced from Irish Water and confirmed to be consistent with data used in the *Ringsend WwTP Upgrade Project EIAR* (Irish Water 2018)."

Issue #6 - size of marine diffuser to deal with discharge volumes

61 The proposed multi-port diffuser arrangement comprises a single riser pipe with four ports located 2m above the sea bed. The ports are to be positioned concentrically around the proposed outfall pipeline route (marine section), perpendicular to the sea bed. The Model considered the proposed multi-port diffuser as a virtual, single port of similar discharge characteristics in order to ascertain dilution characteristics in the receiving waters at distance from the proposed outfall pipeline route (marine section), and hence the mixing zone extents. The properties of the modelled single-port diffuser were equivalent to the combined area of the individual multi-port diffuser diameters and orientations. The virtual single port diffuser represented a 'maximum adverse scenario'. The actual multi-port diffuser will yield greater initial dilution than the modelled, virtual single port diffuser and is appropriately designed to deal with the proposed discharge volumes.

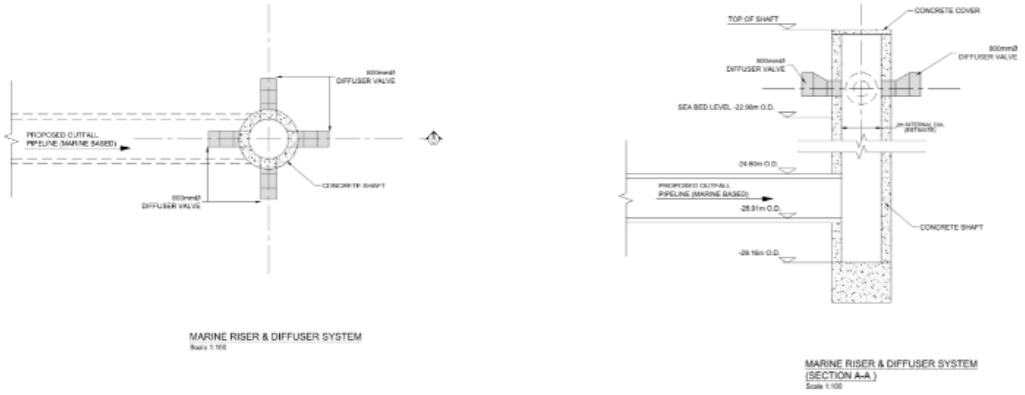


**Diagram 7: Multi-port Diffuser**

Issue #7 - volume of suspended sediments discharged and siltation in Dublin Bay

62 The levels of suspended solids to be discharged through the proposed outfall pipeline route (marine section) are 35mg/l and are standard levels for all WwTPs. Chapter 9 Biodiversity (Marine) in Volume 3 Part A of the EIAR, specifically Section 9.5 Impact of the Proposed Project – Operational Phase cites observations of turbidity recorded at the proposed marine diffuser location throughout 2015 and 2016, indicating a variable existing suspended sediment load ranging from 4mg/l to 120mg/l calculated from converted turbidity measurements or 15mg/l to 160mg/l from sampled water quality measurements taken throughout the same survey period.

63 The proposed discharge of 35mg/l of suspended sediments will not cause Dublin Bay to silt up nor lead to higher water levels.

Issue #8 - dredging operation and alteration of sediment patterns (with impacts on natural beach processes)

64 Chapter 9 Biodiversity (Marine) in Volume 3 Part A of the EIAR, and specifically Section 9.4 Impact of the Proposed Project – Construction Phase, describes that dredging will be undertaken using a combination of backhoe dredger in the shallower areas and trailer suction hopper dredger (TSHD) where the water depths are beyond the limits of the backhoe dredger. Excavated material from the backhoe dredger will be placed in a barge and subsequently deposited and stockpiled parallel to the proposed outfall pipeline route (marine section) trench, within the 250m wide proposed construction corridor. Where the TSHD is used it will deposit and stockpile the excavated material parallel to the proposed outfall pipeline route (marine section) trench, within the 250m wide proposed construction corridor. The stockpiled material will be subsequently reused to

refill the trench over and around the pipe once it is installed in the trench resulting in no net removal of sediment or alteration of sediment transport patterns. Therefore, the dredging operation will not alter sediment patterns, nor will it have any impact on the natural beach nourishment processes.

Issue #9 - considered of local knowledge when deciding on the proposed outfall location

65 The process of deciding on the proposed outfall pipeline route (marine section) location is described in paragraphs 6 and 7 above. Local knowledge was taken into account in that process, which included rounds of public consultation at every stage.

66 Submissions referred to tidal maps from Howth Yacht Club as a form of local knowledge that was not adequately taken into account. It was submitted that the maps from Howth Yacht Club indicated that wastewater would be washed ashore to Portmarnock and Baldoyle on flooding tides.

67 However, those maps do not account for the dispersion or dilution of wastewater, nor the ever-changing direction and the strength of the tidal currents over the course of a tidal cycle. In contrast, the Model is a dynamic model that does take account of the dispersion and dilution of wastewater and changes in direction and strength of tidal currents over the course of the tidal cycle. The Model calculates changes in water surface level, tidal currents, water quality concentrations on a second by second basis as the dynamics of the system change. The Model does not predict any significant impacts on Portmarnock or Baldoyle beaches.

68 As regards the direction of tidal current appearing on the Howth Yacht Club maps, they and the Model show a high level of agreement. This agreement between model predictions and local knowledge contributes additional evidence that the Model as detailed in the Chapter 8 Marine Water Quality in Volume 3 Part A of the EIAR (specifically Section 8.2.3 Hydrodynamic Calibration) provides an accurate representation of the hydrodynamics within the study area for the Proposed Project.

69 Section 8.2.3 Hydrodynamic Calibration, referred to above, stated that the comparison of the modelled and measured datasets, both statistically and visually, would suggest a robust calibration agreement. Overall … the model is providing an ‘excellent’ representation of water levels and, at the ADCP location closest to the proposed outfall pipeline route (marine section), a 'good' representation. The results show that the numerical model has been successfully calibrated and validated against field measurements to provide an accurate representation of the hydrodynamics within the study region.

**CONCLUSION**

70 Issues relating to the quality of bathing water beaches and Blue Flag beaches have been addressed in the Chapter 8 Marine Water Quality in Volume 3 Part A of the EIAR, specifically Section 8.4.2: Impact of the Proposed Project (pages 32-78).

71 Results from the model simulations predicted that plumes from the proposed outfall discharge point would not exceed the 250 cfu/100ml limit required to achieve “Excellent” status at any of the designated bathing waters beaches, Blue Flag beaches, Ireland’s Eye or Balscadden beach. No compliance failures at the designated bathing water beaches arising from the proposed discharge of treated wastewater were predicted.

72 No impact on the shellfish water quality arising from the proposed discharge of treated wastewater were predicted. The concerns raised would not lead to a revision of the conclusion reached in the EIAR.

73 Issues relating to general water quality have been addressed in the Chapter 8 Marine Water Quality in Volume 3 Part A of the EIAR (pages 32-54). None of the scenarios examined predicted the likelihood of any significant impact on nutrient levels in the receiving waters from the operation of the proposed outfall pipeline

route (marine section) and the concerns raised would not lead to a revision of the conclusion reached in the EIAR.

74 Issues relating to the dredging of the proposed outfall pipeline route (marine section) and impacts of suspended sediments have been addressed in Chapter 9 Biodiversity (Marine) in Volume 3 Part A of the EIAR, specifically Section 9.4 Impact of the Proposed Project – Construction Phase, and Section 9.5 Impact of the Proposed Project – Operational Phase. Issued raised in the various submissions would not lead to a revision of the conclusion reached in the EIAR.

75 Concerns that local knowledge was not considered when deciding on the proposed outfall pipeline route (marine section) location were addressed with additional analysis in comparing the calibrated hydrodynamic model's prediction of the circulation patterns against sailing maps provided by Howth Yacht Club. The computer model predictions show a high level of agreement with the Howth Yacht Club maps confirming that the model provides an accurate representation of the hydrodynamics within the study are for the Proposed Project.

76 The submissions received have all been addressed and would not lead to a revision of the conclusion reached in the EIAR for the following reasons;

- The Model has been successfully calibrated and validated against field measurements to provide an accurate representation of the hydrodynamics within the study region and reproduces the complex advection and the dispersion of the dye release surveys very well.

- Irish Water have committed to implementing UV treatment on the effluent discharge to ensure coliform concentrations in the effluent discharge do not impact on the designated shellfish waters of Malahide.

- The extensive modelling undertaken as part of the EIAR has predicted that the proposed project will have an imperceptible to slight impact on the nutrient water quality of the coastal waters off north County Dublin.

- None of the Model scenarios predicted the likelihood of any significant impact from the operation of the proposed outfall on the general nutrient water quality of the receiving waters.

- The Model results predicted that plumes from the proposed outfall discharge point would not exceed the 250 cfu/100ml limit required to achieve "Excellent" status at any of the designated bathing waters beaches, Blue Flag beaches, Ireland's Eye or Balscadden beach.

- The Model predicted that there would be no compliance failures at the designated bathing water beaches, Blue Flag beaches, Ireland's Eye or Balscadden beach arising from the proposed discharge of treated wastewater.