APPENDIX A5(Bundle2)

[redacted]

From: Dara White <dwhite@water.ie>
Sent: 15 March 2019 15:41
To: Gerry O'Donoghue
Subject: FW: Confidential - Ecoli levels in discharge
Attachments: 20190315_Statistical Analysis of predicted Ecoli concentrations_ver2.docx

Importance: High

From: O'Keeffe, Ciaran [mailto:Ciaran.OKeeffe@jacobs.com]
Sent: 15 March 2019 14:25
To: Dara White <dwhite@water.ie>
Subject: Confidential - Ecoli levels in discharge
Importance: High

Dara,

As discussed

From: Alan Berry <alan@marcon.ie>
Sent: 15 March 2019 11:19
To: O'Keeffe, Ciaran <Ciaran.OKeeffe@jacobs.com>
Cc: McGlynn, Stephanie <Stephanie.McGlynn@jacobs.com>
Subject: [EXTERNAL] Re: FW: Shellfish expert [ALG-MAIN.FID2334887]
Importance: High

Ciaran,

Updated version of document, containing additional comparison against Oysters and Mussels.

Alan Berry
Managing Director
MarCon Computations International

[redacted]

On 2019-03-15 10:34, Alan Berry wrote:

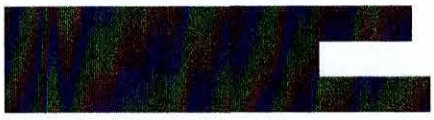
> Ciaran,

Find attached.

Not good.

Alan Berry

Managing Director
MarCon Computations International



On 2019-03-14 08:25, O'Keeffe, Ciaran wrote:

Alan,

See email below from ALG which is raising two questions that FCC are concerned about. We have a meeting with FCC this afternoon to discuss these concerns. In light of the memo from our shellfish expert that Sarah circulated yesterday do we have a problem with our assessment? Could you give me a call to discuss please.

Regards

Ciarán

From: Alison Fanagan <afanagan@algoodbody.com>
Sent: 13 March 2019 08:47
To: O'Keeffe, Ciaran <Ciaran.OKeeffe@jacobs.com>
Cc: Noeleen McHenry (nmchenry@water.ie) <nmchenry@water.ie>; Olwyn James <ojames@water.ie>; Kristen Read <kread@algoodbody.com>; Brendan Curran <bcurran@algoodbody.com>; Chris Stynes <cstynes@algoodbody.com>
Subject: [EXTERNAL] RE: Shellfish expert [ALG-MAIN.FID2334887]
Importance: High

[redacted]

[redacted]

[redacted]

[redacted]

Alison Fanagan | Consultant

A&L Goodbody

[redacted]

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From: O'Keeffe, Ciaran [mailto:Ciaran.OKeeffe@jacobs.com]
Sent: 13 March 2019 08:30
To: Alison Fanagan
Subject: RE: Shellfish expert [ALG-MAIN.FID2334887]

Expecting a memo from her today with phone call to follow.

From: Alison Fanagan <afanagan@algoodbody.com>
Sent: 13 March 2019 08:29
To: O'Keeffe, Ciaran <Ciaran.OKeeffe@jacobs.com>
Subject: [EXTERNAL] Shellfish expert [ALG-MAIN.FID2334887]

Hi Ciaran

How are you getting on with this expert, is he or she on board yet?

Regards

Alison Fanagan | Consultant

A&L Goodbody

[redacted]

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[redacted]

From: Jane Chambers
Sent: 19 March 2019 22:23
To: Callista Brien
Cc: Geoff OSullivan
Subject: RE: [EXTERNAL] Re: GDD - Wording re modelling background. [ALG-MAIN.301850.01416521]

Follow Up Flag: Follow up
Flag Status: Flagged

project manager did not know about UV addition! what?

Callista

Can you let me know where tertiary treatment has come from?
I have just briefed RTE and Morning Ireland on 2nd treatment at 6:30pm and 8:45pm this evening respectively.

Regards

Jane

From: Callista Brien
Date: 19 March 2019 at 21:59:19 GMT
To: Dan O'Boyle , O'Keeffe, Ciaran
Cc: Jane Chambers , Geoff OSullivan
Subject: RE: [EXTERNAL] Re: GDD - Wording re modelling background. [ALG-MAIN.301850.01416521]

Thanks Dan. I think that reads well.

Copying Jane and Geoff as Jane May need final messaging for any media interviews.

C

From: Dan O'Boyle
Date: 19 March 2019 at 21:56:09 GMT
To: O'Keeffe, Ciaran , Callista Brien
Subject: RE: [EXTERNAL] Re: GDD - Wording re modelling background. [ALG-MAIN.301850.01416521]

Hi folks,
Please see suggested FAQs/responses below:
Q. Why is tertiary treatment now being proposed?
Having regard to the submissions made by Fingal County Council and members of the public including fishermen, further analysis by a specialist shellfish ecologist was undertaken over recent months. The advice was to the effect that, as a precautionary measure, to ensure the protection of the shellfish, additional treatment should be applied to the effluent. Irish Water has responded and confirmed that Ultraviolet (UV) disinfection, which is a tertiary treatment, will be applied to all effluent discharges from the new GDD treatment plant.

Q. Does this mean significant changes to the GDD planning application?
No. The utilisation of UV treatment does not require any additional structures or changes to planned structures.
Q. What is UV treatment?
UV disinfection is a tertiary treatment process. UV treatment instantaneously neutralises microorganisms as they pass by ultraviolet lamps submerged in the effluent. It results in a higher quality effluent.
Best regards,
Dan
Dan O'Boyle
Technical Director, Project Communications
[redacted]

From: O'Keeffe, Ciaran
Sent: Tuesday 19 March 2019 20:42
To: Callista Brien
Cc: Dan O'Boyle
Subject: RE: [EXTERNAL] Re: GDD - Wording re modelling background. [ALG-MAIN.301850.01416521]

Callista,
Text as agreed with Allison set out below

shes legal counsel - is the facts/narrative being managed?

1 The modelling studies have also confirmed that:

- The Proposed Project will assist in achieving the goals of the WFD (i.e. reaching good status in all water bodies);
- The proposed discharge location will not negatively impact any designated bathing waters;
- The Proposed Project will have a negligible impact on the quality the coastal waters off County Dublin

1 In its report on the application, Fingal County Council raised issues in relation to the modelling of ecoli concentrations in the treated effluent. In response to those submissions, MarCon carried out revised modelling, assuming a higher level of coliform concentrations in the effluent than modelled in the original application (300,000cfu/100ml instead of 39,000 cfu/100ml for the flow to full treatment scenario). That modelling, which Alan Berry of Marcon will give evidence on this afternoon, showed that the level of concentration fluctuated with the ebb and flow of tides, providing equal time for uptake/accumulation and subsequent clearance/removal of any coliforms by the shellfish and on that basis concluded that there was not predicted to be any impact on the shellfish water quality as a result of the Proposed Project. This is detailed in the Response.

1 Subsequent to the Response and having regard to the submissions made by Fingal County Council and members of the public including fishermen, Irish Water asked us to carry out some further analysis, which my colleague Marja Aberson, who is a marine ecologist specialising in shellfish, completed. 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. The utilisation of UV treatment does not require any additional structures or changes to planned structures.

Regards
Ciarán

From: Callista Brien <Callista.Brien@ervia.ie>
Sent: 19 March 2019 19:00
To: Alison Fanagan <afanagan@algoodbody.com>; O'Keeffe, Ciaran <Ciaran.OKeeffe@jacobs.com>
Cc: Chris Stynes <cstynes@algoodbody.com>; Kristen Read <kread@algoodbody.com>; Brendan Curran <bcurran@algoodbody.com>
Subject: Re: [EXTERNAL] Re: GDD - Wording re modelling background. [ALG-MAIN.301850.01416521]
Ciarán
Can you send myself and Dan the final language so we can draft the FAQ.
Thanks
Callista

From: Alison Fanagan <afanagan@algoodbody.com>
Date: 19 March 2019 at 17:32:44 GMT
To: Ciaran O'Keeffe <Ciaran.OKeeffe@jacobs.com>
Cc: Chris Stynes <cstynes@algoodbody.com>, Kristen Read <kread@algoodbody.com>, Brendan Curran <bcurran@algoodbody.com>, Callista Brien <Callista.Brien@ervia.ie>
Subject: [EXTERNAL] Re: GDD - Wording re modelling background. [ALG-MAIN.301850.01416521]

[redacted]

Alison

On 19 Mar 2019, at 15:50, Brendan Curran <bcurran@algoodbody.com> wrote:

Ciaran

[redacted]

We can discuss when we meet later.
Kind regards
Brendan
Brendan Curran | Associate
A&L Goodbody
[redacted]
IFSC, 25-28 North Wall Quay, Dublin 1, D01 H104 | www.algoodbody.com

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Thank you for your attention.

Is don té nó an t-eintiteas chuig a seoltar an fhaisnéis atá an fhaisnéis seo beartaithe agus d'fhéadfadh ábhar faoi rún, atá íogair ó thaobh tráchtála agus/nó faoi phribléid a bheith mar chuid de. Tá cosc ar dhuine ar bith nó ar eintiteas ar bith seachas an té chuig a raibh sí beartaithe, an fhaisnéis seo a athbhreithniú, a athsheoladh, a scaipeadh nó aon úsáid eile a bhaint aisti, nó gníomh a ghlacadh bunaithe uirthi agus d'fhéadfadh sin a bheith in aghaidh an dlí. Ní ghlacfaidh Ervia aon fhreagracht maidir le gníomhartha nó iarmhairtí a bheadh bunaithe ar úsáid thoirmiscthe na faisnéise seo. Ní bheidh Ervia freagrach maidir le seachadadh cuí ná iomlán na faisnéise atá sa chumarsáid seo ná maidir le haon mhoill a bhainfeadh lena fáil. Má fuair tú an teachtaireacht seo trí dhearmad, déan teagmháil le do thoil leis an té a sheol í agus scrios an t-ábhar de gach ríomhaire.

D'fhéadfadh truailliú sonraí, idircheapadh agus leasú neamhúdaraithe tarlú do ríomhphost. Ní ghlacfaidh Ervia aon fhreagracht maidir le hathruithe nó idirghabháil a dhéantar ar an ríomhphost ó bheidh sé seolta nó maidir le haon damáiste a dhéanfadh an teachtaireacht seo nó na ceangaltáin leis do chórais nó do shonraí an té a fhaigheann é. Tabhair ar aird le do thoil go bhféadfadh monatóireacht a bheith á déanamh ar theachtaireachtaí chuig Ervia nó uaidh chun a chinntiú go bhfuiltear ag comhlíonadh caighdeáin agus beartais Ervia agus chun ár ngnó a chosaint. Is comhlacht corparáideach é Ervia (Bord Gáis Éireann roimhe seo) a bunaíodh faoin Acht Gáis 1976.

Go raibh maith agat as d'aird a thabhairt.

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[redacted]

From: O'Keeffe, Ciaran
Sent: 25 March 2019 18:22
To: Aberson, Marja
Cc: Kiernan, Sarah; McGlynn, Stephanie
Subject: GDD - Ecoli Levels in Discharge
Attachments: GDD - Ecoli document.docx

Follow Up Flag: Follow up
Flag Status: Completed

Hi Marja,

Many thanks for making the time to attend our Oral Hearing, in case we get questions on the ecoli. I am hoping that with the commitment to provide UV treatment on the discharge the extent of these questions will have diminished somewhat.

Apologies also for interrupting your holiday.

I attach a short document explaining where we are in relation to the ecoli levels in the discharge and how we got here. If you have any questions do not hesitate to call me at [redacted].

Again many thanks and looking forward to meeting you on Wednesday.

Best Regards

Ciarán

B

[redacted]

From: Marja Aberson [redacted] >
Sent: 25 March 2019 20:37
To: Kiernan, Sarah
Cc: McGlynn, Stephanie; O'Keeffe, Ciaran
Subject: [EXTERNAL] Re: FW: GDD - Ecoli Levels in Discharge

Follow Up Flag: Follow up
Flag Status: Completed

Hi

Many thanks for sending through and no apologies needed as often these things cannot be helped . I will likely only be able to re iterate the information I have already sourced to date for razor clams

I hope to be at hotel by 9am on the Wednesday if flights run on time . I'll be continuing to read up again on all the notes tomorrow as I travel back.
Hope tomorrow goes well. I will read this info attached tomorrow if ok.

One thing I wanted to check, as in what an appropriate answer would be if asked..

" what is your opinion on...."

may I answer that I will not provide an opinion but to state what we understand currently and from that an assessment of risk has been made (which looks to be one based on precautionary approach) woudk thus suffice or be inappropriate ?

I do not feel comfortable to state that the risk is one way or the other on the razor clam beds given the level of uncertainty at the species specific level . But going on relevant research both university led and government funded projects we can understand x, y, z (eg uptake can follow increase in concentrations in water column but a rapid deputation period following cessation of exposure will likely follow in razor clams also .).

There seems to be a natural dead end at the moment as we've identified the limitations of our knowledge for the target species in question and from that appropriate measures by Irish water has been taken (UV treatment)

Will this be a suitable stance to take .

Many thanks
Marja

On Mon, 25 Mar 2019 at 21:01 Kiernan, Sarah [redacted] wrote:

> Hi Marja,
>
> Please see below.
>
> Kind Regards,
>
> Sarah

Sarah Kiernan BSc. MSc. MCIWEM C.WEM CEnv | Jacobs | Technical Director - Environment | Environment, Maritime & Resilience | [redacted] www.jacobs.com

From: O'Keeffe, Ciaran
Sent: 25 March 2019 18:22
To: Aberson, Marja <Marja.Aberson@jacobs.com>
Cc: Kiernan, Sarah <Sarah.Kiernan@jacobs.com>; McGlynn, Stephanie <Stephanie.McGlynn@jacobs.com>
Subject: GDD - Ecoli Levels in Discharge

Hi Marja,

Many thanks for making the time to attend our Oral Hearing, in case we get questions on the ecoli. I am hoping that with the commitment to provide UV treatment on the discharge the extent of these questions will have diminished somewhat.

M.A. was there but not made available for questions) why? she is the xpert.

Apologies also for interrupting your holiday.

I attach a short document explaining where we are in relation to the ecoli levels in the discharge and how we got here. If you have any questions do not hesitate to call me a [redacted].

Again many thanks and looking forward to meeting you on Wednesday.

Best Regards

Ciarán

--
Sent from Gmail Mobile

From: Dara White <dwhite@water.ie>
Sent: 25 April 2019 12:46
To: Ronan Kane
Subject: FW: Confidential: GDD - Ecoli levels in Discharge
Attachments: 20190324_GDD_20k_cfu_v3.docx

From: O'Keeffe, Ciaran [mailto:Ciaran.OKeeffe@jacobs.com]
Sent: 25 March 2019 18:27
To: Dara White <dwhite@water.ie>
Subject: Confidential: GDD - Ecoli levels in Discharge

Dara,

Amended document on the 20,000 cfu/100ml discharge run which includes analysis of the ecoli concentrations in the water column along the southern boundary of the designated shellfish area.

Regards

Not at outfall location.

Ciarán

Summary of UV disinfection runs

Two scenarios were simulated to assess the impacts of discharging UV treated effluent with a coliform concentration of 20,000 cfu/100ml.

Scenario #1: Synthesised flow @ 20,000 cfu/100ml, no wind

The model commenced the simulation on 18/04/2015 at 00:00hrs with the proposed GDD Project discharging at the synthesised flow profile presented in Figure 1 (below). The Average Daily Flow (ADF) is included in Figure 1 for reference. The concentrations of coliforms in the effluent was 20,000 cfu/100ml. No wind field was specified.

Scenario #2: Synthesised flow @ 20,000 cfu/100ml, recorded wind field

The model commenced the simulation on 18/04/2015 at 00:00hrs with the proposed GDD Project discharging at the synthesised flow profile presented in Figure 1 (below). The concentrations of coliforms in the effluent was 20,000 cfu/100ml. Recorded wind speed and direction data from Dublin Airport was defined and presented in Figure 6 below..

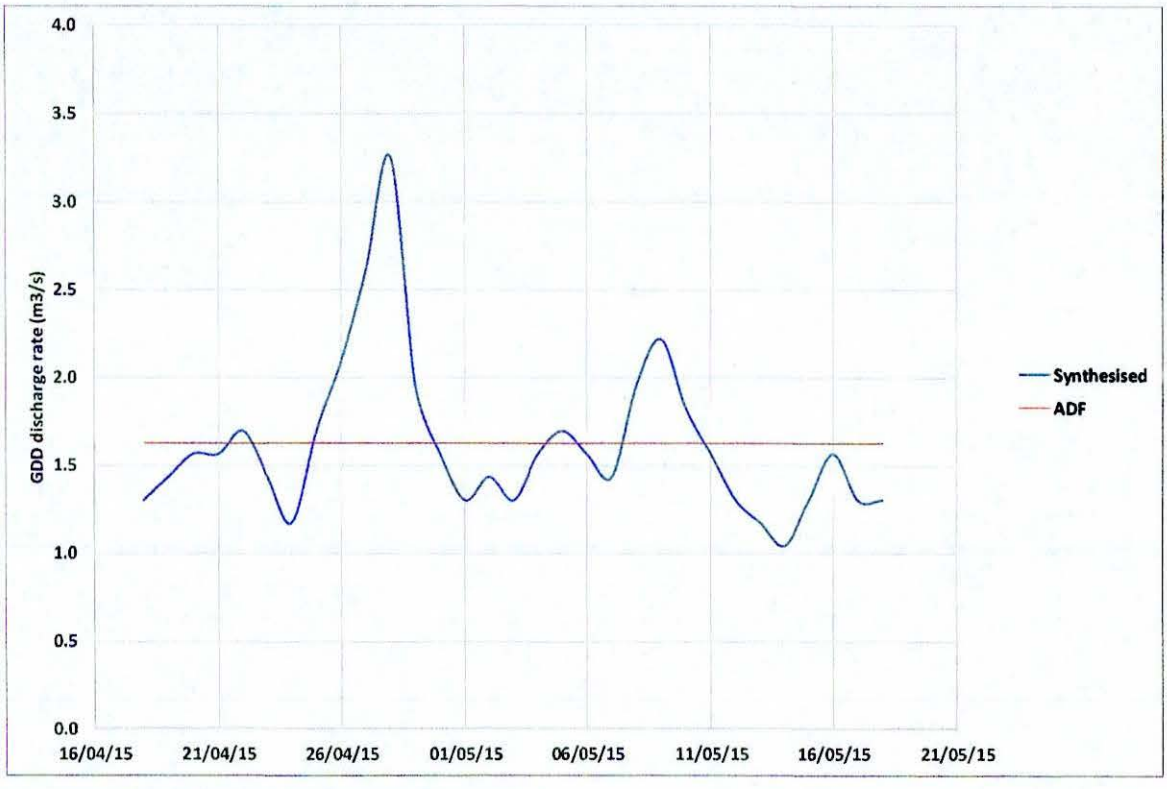


Figure 1: Synthesised GDD discharge rate

The results were analysed at the designated Malahide Shellfishery sampling point. The concentration of coliforms over the course of the simulation for both scenarios (No Wind, and Wind) are presented in Figure 2 below.

This is at entrance to Malahide estuary. Misleading to sample here

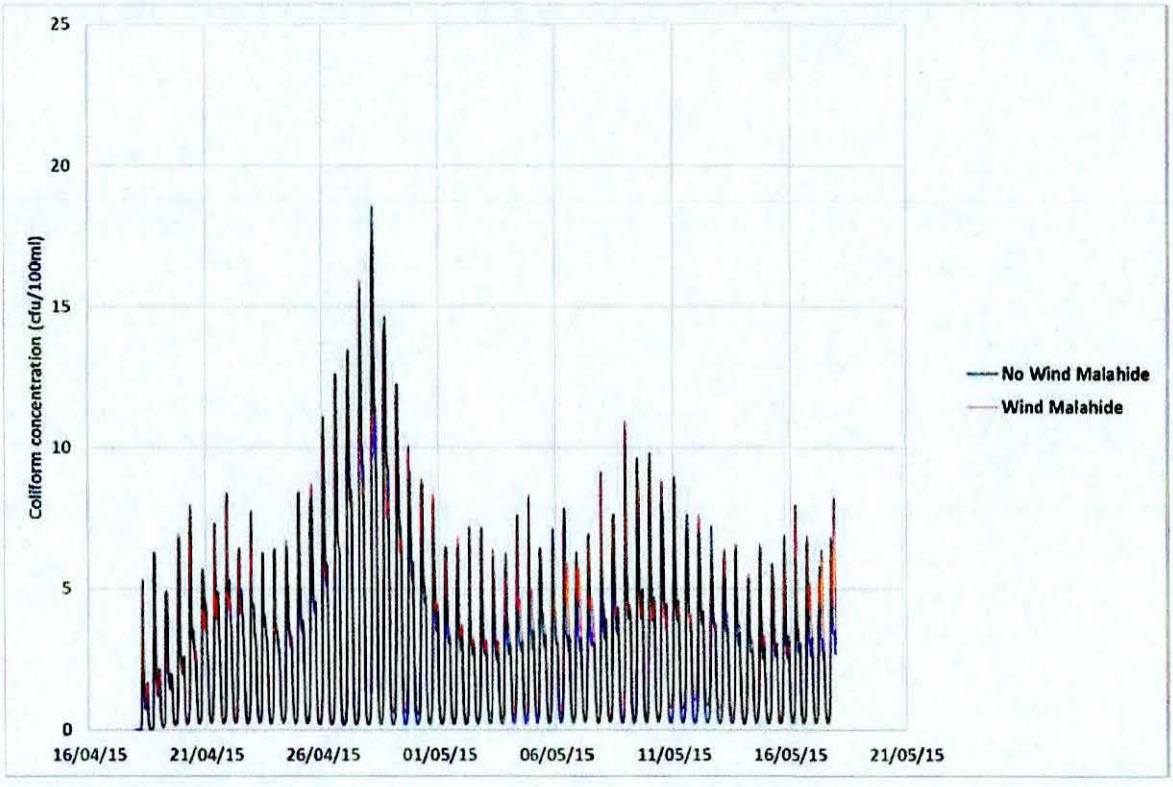


Figure 2: Predicted coliform concentrations at Malahide shellfish sampling point for No Wind and Wind scenarios.

There is no appreciable difference in predicted coliform concentrations between the No Wind, and Wind scenarios. The predicted concentrations were analysed statistically to determine compliance with the proposed "All Species" geometric mean concentration on coliforms in the water column of 1.4. The results from the statistical analysis for the two scenarios are presented in the table below, along with the estimated statistics for a discharge at constant ADF of 1.63 m3/s with no wind defined.

	No Wind	Wind	ADF No Wind	
Geometric Mean	1.49	1.76	1.16	*
90%ile	6.46	6.60	6.32	*

The geometric means calculated for both scenarios (No Wind [1.49], and Wind [1.76]) are greater than the "All Species" value of 1.4. It is suggested the reason for this is the character of the synthesised flow rate shown in Figure 1 with peak flows at Flow to Full Treatment levels resulting in increased mass of coliforms discharging through the outfall.

Five locations along the southern edge of the designated shellfish waters were also examined, both statistically and as a timeseries plots. The position of the five locations are presented in Figure 3, below.

Tested ?

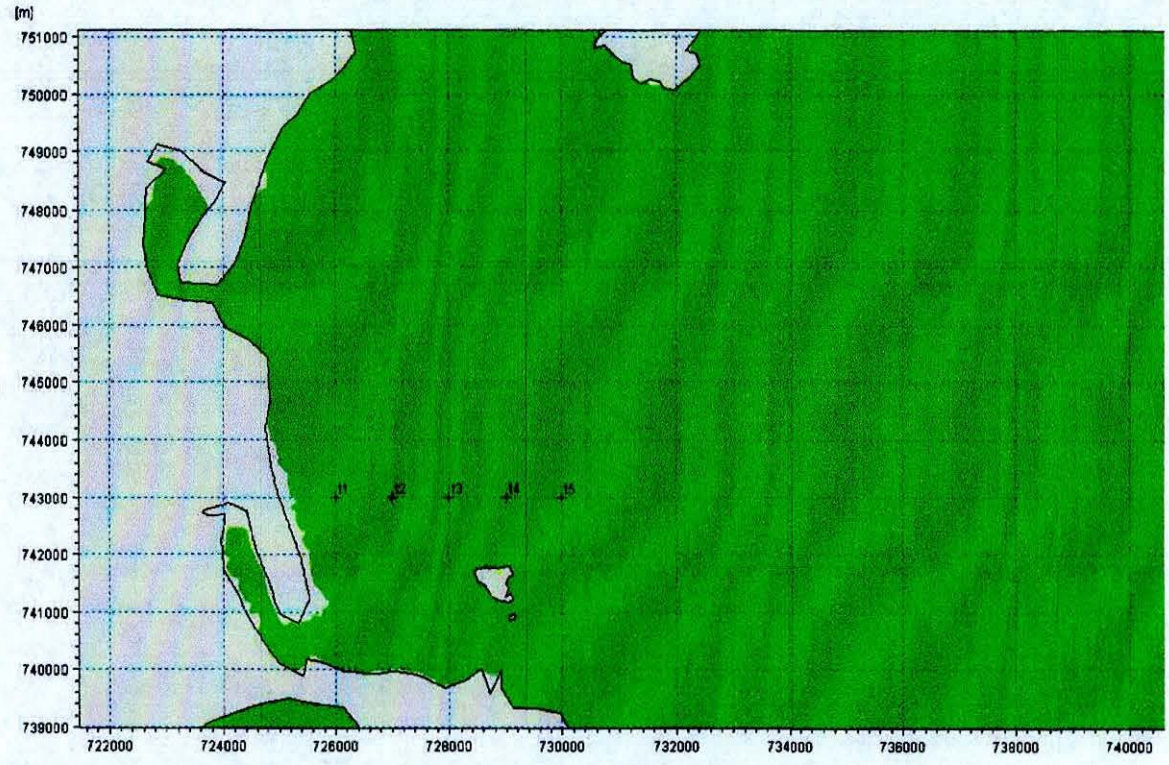


Figure 3: Position of the 5 locations across southern shellfish boundary.

The evolution over time of the predicted coliform concentrations is presented in Figure 4 and Figure 5 for the No Wind, and Wind scenarios respectively.

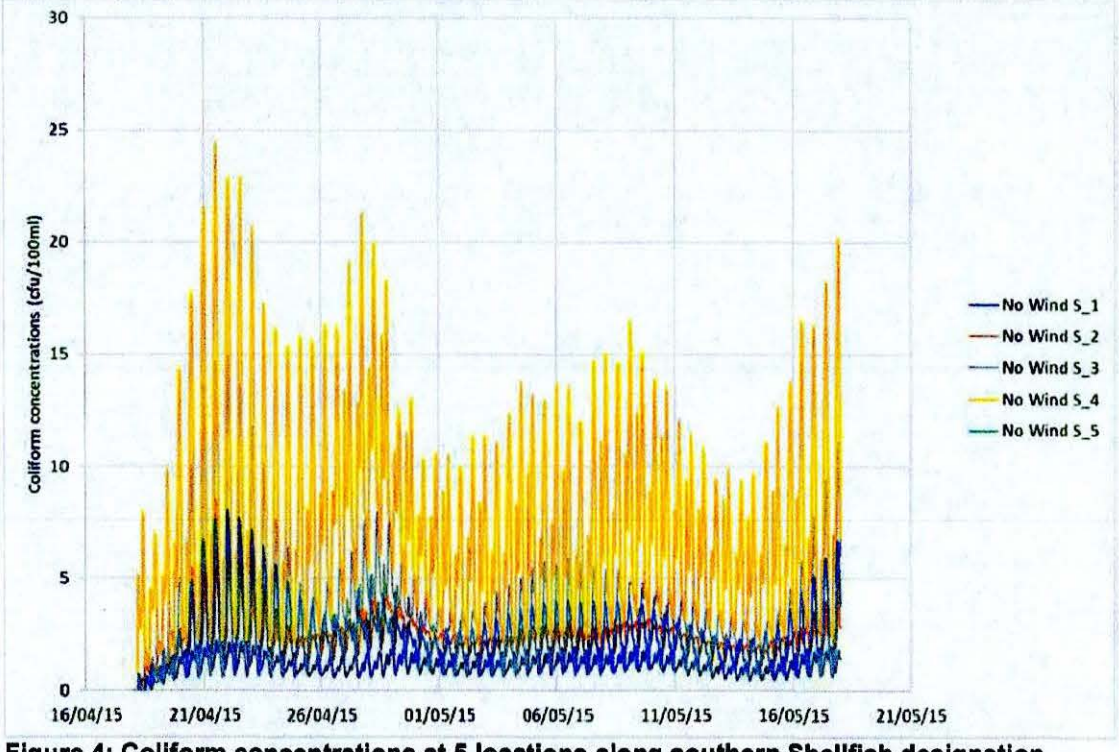


Figure 4: Coliform concentrations at 5 locations along southern Shellfish designation (No Wind)

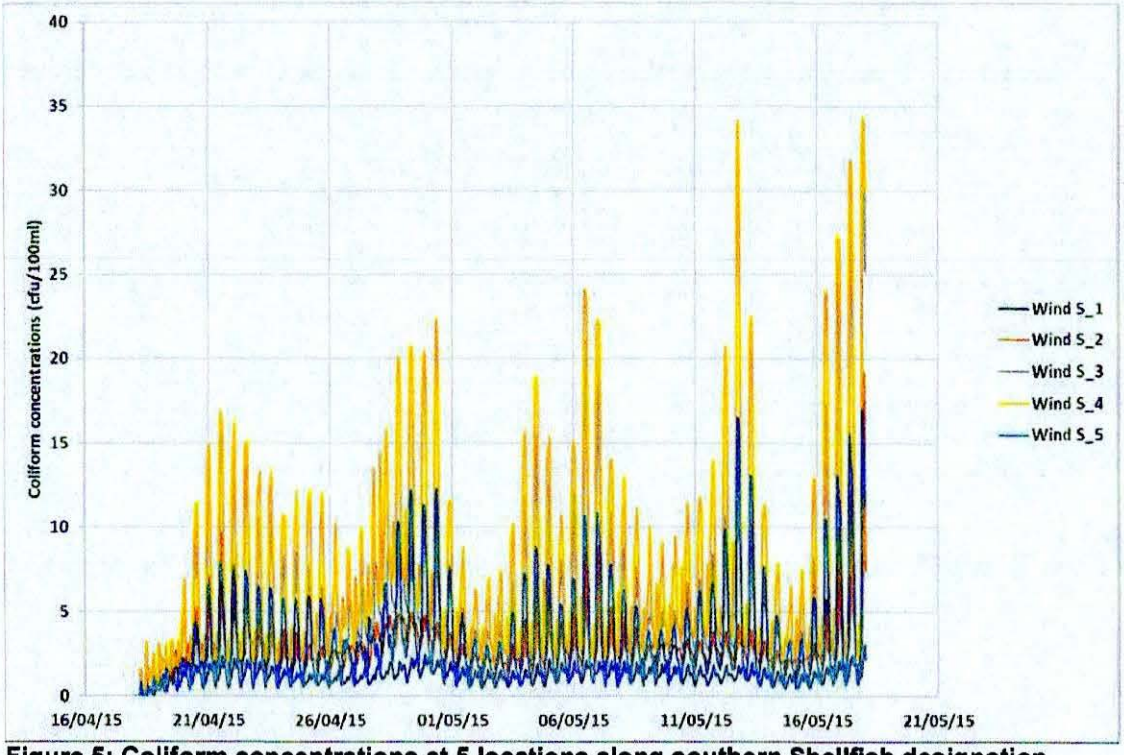


Figure 5: Coliform concentrations at 5 locations along southern Shellfish designation (No Wind)

Both the above Figures show that highest coliform concentrations predicted at Location S_4 just to the northwest of the outfall. During the Wind scenario, locations S3 and S_5 are also predicted to experience higher than normal concentrations.

The statistical assessment of both scenarios at the 5 locations along the southern boundary of the designated shellfish waters are presented in the tables below.

	Synthesised Flows @20,000 cfu/100ml (No Wind)					
	SMP	S_1	S_2	S_3	S_4	S_5
Geometric Mean	1.49	1.22	2.41	3.49	6.03	2.01
90%ile	6.46	1.79	3.14	5.48	12.97	3.89

	Synthesised Flows @20,000 cfu/100ml (with Wind)					
	SMP	S_1	S_2	S_3	S_4	S_5
Geometric Mean	1.76	1.34	2.76	4.35	5.78	2.65
90%ile	6.60	1.99	4.31	8.88	14.86	7.57

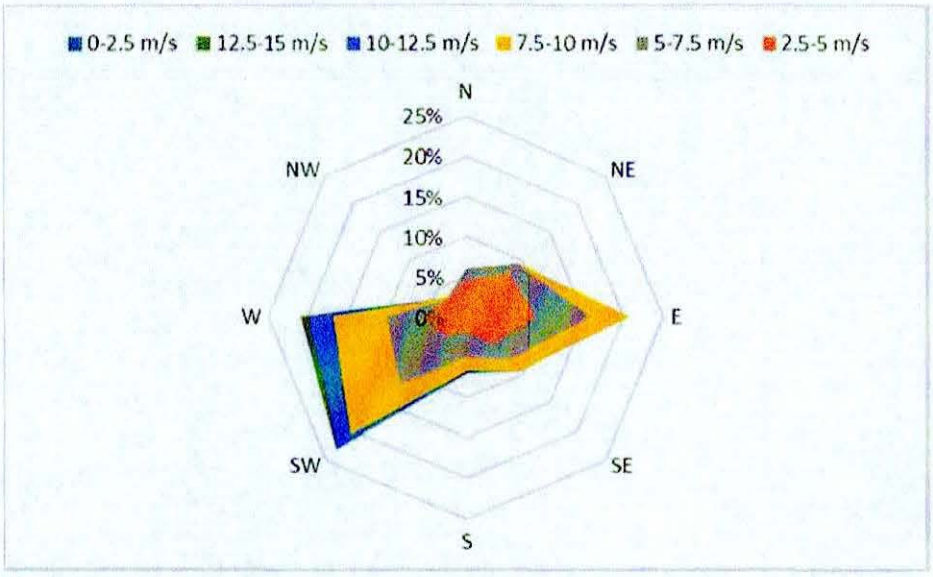


Figure 6: Dublin Airport windrose (18/04/2015 – 18/05/2015)

Impact on Bathing Waters

The results were analysed at the designated bathing water sampling points on Portmarnock Velvet Strand and Claremont Beach and presented in Figure 7 and Figure 8 respectively.

Predicted concentrations of coliforms at Portmarnock Velvet Strand were very low and show little variation between the NoWind and Wind scenarios.

Predicted concentrations of coliforms at Claremont were low and but showed significant variation between the NoWind and Wind scenarios, with the Wind scenario predicting increased coliform concentrations following periods of easterly winds. This would be expected given the beach's location with respect to the proposed outfall location.

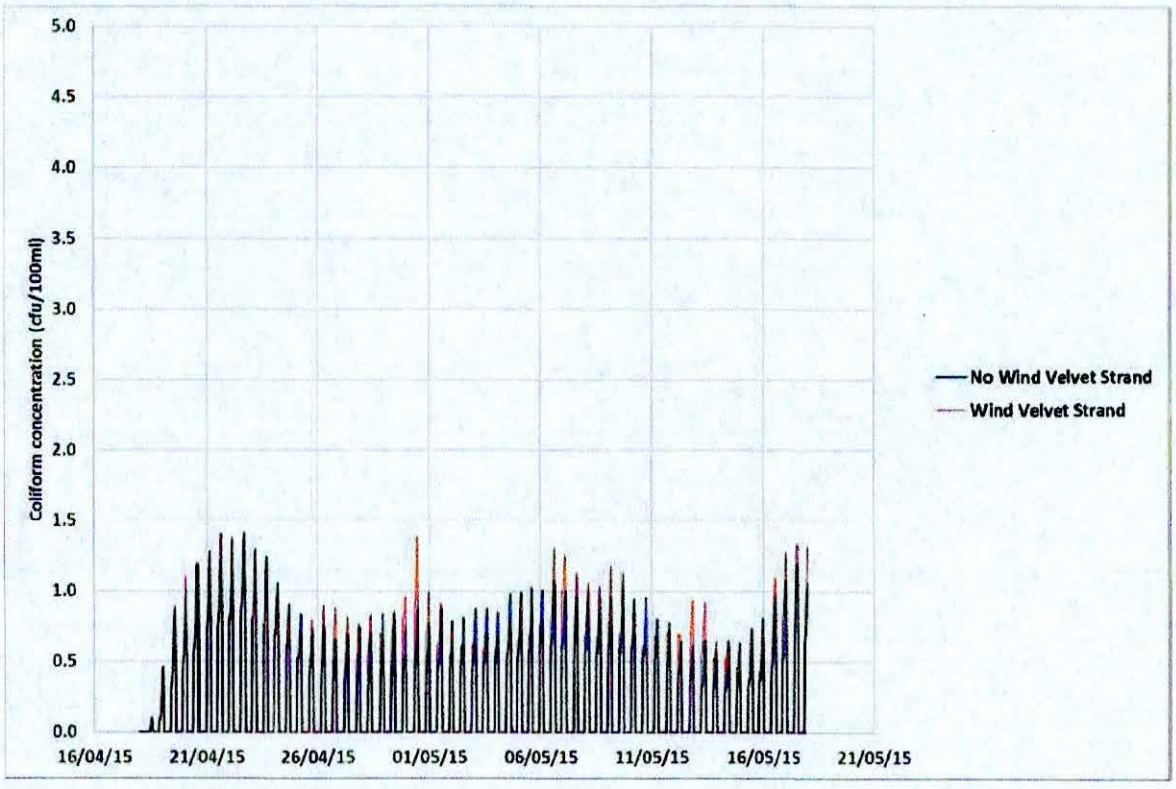


Figure 7: Predicted coliform concentrations at Portmarnock Velvet Strand for both scenarios.

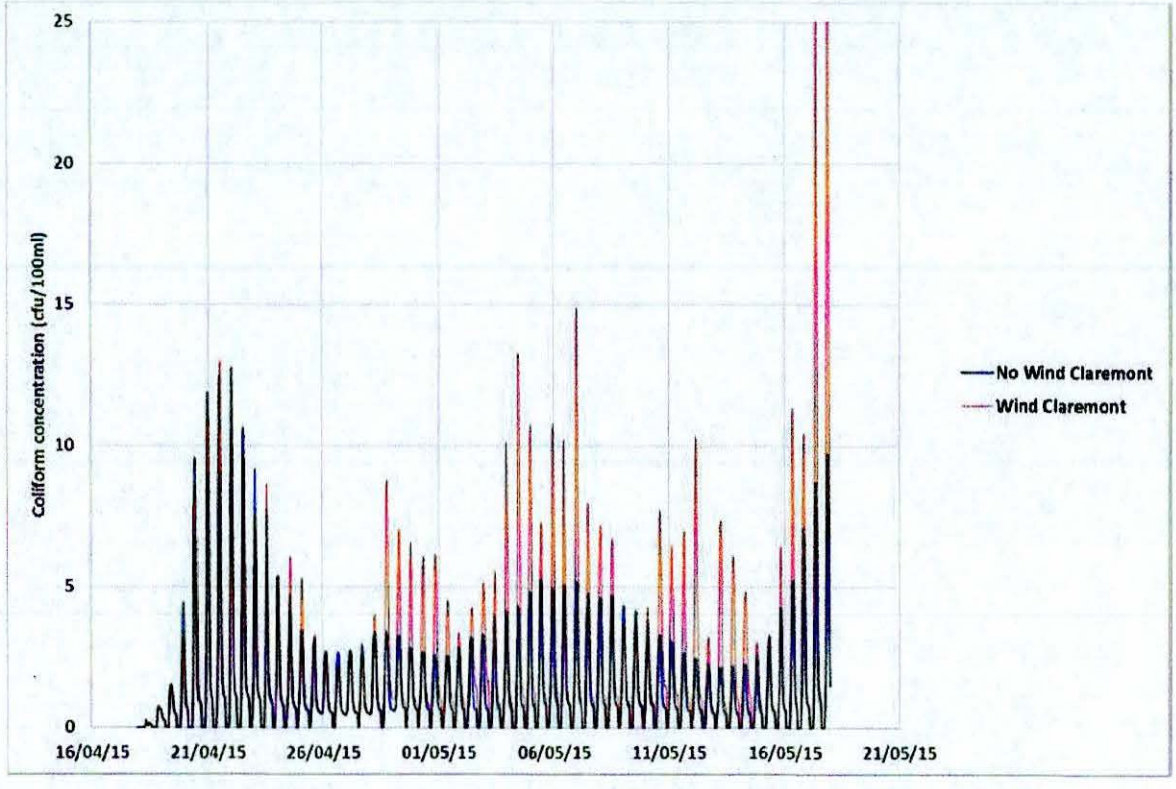


Figure 8: Predicted coliform concentrations at Claremont Beach for both scenarios.

JACOBS

Memorandum

Kenneth Dibben House
Enterprise Road, Southampton Science Park
Chilworth, Southampton SO16 7NS
United Kingdom
T +44 (0)23 8011 1250
F +44 (0)23 8011 1251

Subject	**Literature review *E. coli***	**Project Name**	Dublin Drainage Project
Attention	<Name>		
From	Marja Aberson		
Date	13 March 2019		
Copies to	<Name>		

1. Aim

This short literature review of accumulation of the bacteria *Escherichia coli* in shellfish, encompasses the following:

Section 2: Summary of data and literature sources used.

Section 3: Potential limitations and important considerations identified.

Section 4: A high-level summary of the sensitivity of targeted commercial shellfish to potential pressures from the proposed discharge during operation (of the marine section).

Section 5: Background summary information of factors affecting concentrations of *E. coli* in the environment, in shellfish, and current understanding of the relationship between these parameters.

Section 6: Additional text to supplement 'The Applicant's response to consultees concerns of potential impact on shellfish waters and shellfish from the proposed discharge (of the marine section), as documented in Jacobs (2019).

2. Methods

Peer and non-peer reviewed literature has been sourced, and these have included the following:

- Cefas Project Reports to DEFRA (2006 --2013).
- Cefas Shellfish Water Quality Investigation Reports (2012)
- Scientific peer-reviewed literature (1984-2018).
- Marine Life Information Network (MarLin): Biology and Sensitivity Key Information Reviews. [Accessed On-Line March 2019]. The reviews are cited from the MarLIN sensitivity assessment process, which is currently being superseded by the MarESA approach to assessment for species and biotopes.

Much of the information summarised in this document, is cited from reports submitted by Cefas to DEFRA as part of the Projects WT1001 ('*Factors affecting the microbial quality of shellfish*') and WT0923 ('*Impact of chronic microbial pollution on shellfish*'). These technical reports themselves provided a comprehensive overview of scientific literature, and report upon results of experimental work that investigate the relationship between concentrations of *E. coli* in ambient waters and in the tissues of shellfish.

3. Limitations and considerations

- **The MarLin sensitivity review data is not available for all commercial shellfish species of interest, and with low level of associated evidence and/confidence in assessments made.**
- **Significant bias in studies of commercial shellfish species (e.g. *Mytilus edulis*) over others (*e.g. Ensis* sp.).**
- **Likely high inter-species variation in accumulation and depuration rates.**
- **Difficulty in assessment of mobile species (e.g. *Cancer pagurus* and *H. gammarus*) due to life history and lack of data.**
- **Assessments of rate of uptake and clearance are often undertaken under a microcosm laboratory condition where expected variations in environmental conditions will not be incorporated.**

4. Sensitivity Review

Table 4 1 summarises the sensitivity review of key commercial species harvested in the area, in response to all key potential pressures of the proposed discharge. Although *Pecten maximus* and *Mytilus edulis* are not listed as a targeted species in Northern Fingal (Table 9.17, EIAR) they are listed as a principal shellfish species in the area (Table 9.16, EIAR).

Potential pressures may encompass physical (smothering, increased sediment deposition and turbidity), chemical (changes in nutrient and oxygenation levels), and biological (increase in pathogens). No sensitivity review data was available for the following commercial species of interest: *Necora. puber, Homarus gammarus, Palaemon serratus* and *Buccinum undatum.*

Except *M. edulis*, all species are assessed to have a low level of intolerance and high recoverability to any potential physical disturbances, and with all species (except *P. maximus*) being of low sensitivity to such pressures overall. All species are assessed to have low level of sensitivity to chemical pressures overall, but with the bivalves *P. maximus, Ensis* sp. and *M. edulis* exhibiting an intermediate level of intolerance to one or both potential chemical pressures listed in Table 4 1. Responses to an increase in microbial pathogens/parasites had only been assessed in *Cancer pagurus* and *M. edulis*; with both species assessed as being of low sensitivity.

M no info for Razor clam in relation to pathogens/parasites

JACOBS

Memorandum

Kenneth Dibben House
Enterprise Road, Southampton Science
Park
Chilworth, Southampton SO16 7NS
United Kingdom
T +44 (0)23 8011 1250
F +44 (0)23 8011 1251

Table 4 1: Sensitivity of commercial shellfish species, as reviewed under the Marlin sensitivity assessment process.

Common name	Scientific name	Pressure	Pressure Type	Intolerance	Recoverability	Sensitivity	Evidence/ Confidence	Source
Brown crab	***Cancer pagurus***	Physical	Smothering	Low	Very high	Very low	High	Neal and Wilson (2008)
			Increase in suspended sediment	Low	High	Low	Very low	
			Increase in turbidity	Tolerant	Not relevant ?	Not sensitive	Very low	
		Chemical	Changes in nutrient level	Tolerant	Not relevant ?	Not sensitive	Very low	
			Changes in oxygenation	Tolerant	Very high	Not sensitive	High	
		Biological	Introduction of microbial pathogens/parasites	Intermediate	Moderate	Moderate	High	
Velvet swimming crab	***Necora puber***	**No data available**						Wilson (2008a)
European lobster	***Homarus gammarus***	**No data available**						Wilson (2008b)
Shrimp	***Palaemon serratus***	**No data available**						Neal (2008)
Whelk	***Buccinum undatum***	**No data available**						Ager (2008)
Great scallop	***Pecten maximus***	Physical	Smothering	Low	High	Moderate	Moderate	Marshall and Wilson (2008)
			Increase in suspended sediment	Low	High	Low	Low	
			Increase in turbidity	Tolerant	Not relevant	Not sensitive	Not relevant	
		Chemical	Changes in nutrient level	Intermediate	High	Low	Moderate	
			Changes in oxygenation	Low	High	Very low	Low	
		Biological	Introduction of microbial pathogens/parasites	**No data available**				
Razor clam	***Ensis* sp.**	Physical	Smothering	Tolerant	Not relevant ?	Not sensitive	High	Hill (2006)
			Increase in suspended sediment	Low	High	Low	High	
			Increase in turbidity	Low	High	Low	Moderate	
		Chemical	Changes in nutrient levels	Intermediate	High	Low	Low	
			Changes in oxygenation	Intermediate	High	Low	Moderate	

		Biological	Introduction of microbial pathogens/parasites	**No data available** RAZOR Clam.				
Blue mussel	***Mytilus edulis***	Physical	Smothering	Intermediate	High	Low	Low	Tyler-Walters (2008)
			Increase in suspended sediment	Low	Intermediate	Not sensitive	High	
			Increase in turbidity	Tolerant	Not relevant	Not sensitive	Not relevant	
		Chemical	Changes in nutrient levels	Intermediate	High	Low	Low	
			Changes in oxygenation	Low	Very high	Very low	High	
		Biological	Introduction of microbial pathogens/parasites	Intermediate	High	Low	High	

Kenneth Dibben House
Enterprise Road, Southampton Science Park
Chilworth, Southampton SO16 7NS
United Kingdom
T +44 (0)23 8011 1250
F +44 (0)23 8011 1251

5. Accumulation of *E. coli* in commercial shellfish

5.1 *E. coli* concentrations in seawater

The degree of *E. coli* contamination of a receiving water body by a Waste Water Treatment Works (WwTW) will be primarily influenced by the level operational activity of the plant itself, but in addition to this the potential risk of accidental release from sewage overflows or plant failure. Heavy rainfall and increased fluvial inputs may also increase the loading and subsequent *E. coli* contamination of a receiving water body (Craig *et al.*, 2008; Cefas, 2012a; Cefas, 2012b).

WAS THIS a parameter in process Faime modelling?

The concentration of the bacteria *E. coli* within crude sewage itself will not exhibit a clear normal distribution pattern (curve) with often skewed abundances as bacteria often occurs in clumps. Following dilution with the receiving waters, the distribution curve of bacteria will be expected to flatten across its range of concentrations, thereby also increasing its variation in levels (Cefas, 2013). The fate and transport of faecal bacterial once released into ambient waters will be influenced by a number of complex and interacting processes where concentrations may be further affected by temperature, salinity, tidal conditions, current velocities and geomorphological features of the water body itself. Discharges into shallow tidal inlets with constricted entrances may create complex tidal currents and flow patterns restricting the potential mixing and dilution of any contaminants in the water column (e.g. Portsmouth Harbour, UK (Cefas, 2012a)). Discharges into an open coastal system subject to strong tidal currents may promote rapid diffusion and dilution of faecal bacteria levels in the plume. Hydrodynamic modelling of the narrow, Dart Estuary (Devon, UK) were simulated across five days in January for a sewage overflow of untreated sewage discharge of 200 m^3 (Garcia *et al.*, 2018). It was computed that overall, the largest area of *E. coli* contamination (>10 cfu/100ml) occurred during periods of neap tides and low river discharges, but also with a maximum value obtained during neap tide and high river discharges; these both representing the worse-case scenarios.

NO geomorph Survey Complete.

The exponential decay (die-off) rates of *E. coli* in the environment will be a function of natural factors including temperate, salinity and irradiation (Garcia *et al.*, 2018). A review by Craig *et al.*, (2004) concludes that in general, within the water column, there is a positive relationship with rates of decay and temperature and sunlight. However, an increase in turbidity of the water may restrict any solar penetration through the water column. An *in-situ* study by Craig *et al*, (2004), further showed that *E. coli* can persist in coastal sediments even after any rapid decline of levels in the overlying water. Within contaminated sediments, particle size has also been shown to be important factor with an increase in *E. coli* decay rates in those sediments comprised of larger particles and containing low organic carbon. It may be that increased nutrient availability in those finer sediment may provide an important food source for bacteria.

TECHWORKS survey for turbidity but Report was Seen in application

Could it impact UV degrading of E.coli.

5.2 *E. coli* concentrations in shellfish (review by Cefas, 2012c)

Accumulation of *E. coli* bacteria in bivalves will occur during filter-feeding (process of water pumping and filtration). This process can be limited by the physical properties of the filter pump and concentration of food in the water. Filter feeding has been shown to be autonomous and not regulated at the organism level with processes kept open and operating at a constant rate during optimal conditions. The efficiency of accumulation can naturally vary with external environmental conditions such as concentration and composition of particulates, temperature, current speed, and in part viscosity of the water.

Pumping rates are shown to increase with increasing temperature and also with a decrease in viscosity; of which is in itself temperature dependant. Effects of changes in salinity have not been

shown to be as important as temperature but with a general pattern of delayed valve opening with a decrease in salinity. Euryhaline bivalves can tolerate and thus feed in lower saline conditions (e.g. *M. edulis*) than others (e.g. *Ostrea edulis* and *Ensis* sp.). Species-specific responses to different environmental conditions thus may overall, naturally result in different rates of accumulation.

There has been shown to be wide inter-specific differences in relative levels of accumulation and so contamination in different bivalves. For example, levels of *E. coli* in *M. edulis* and *Cerastoderma edule* have been shown to be approximately 1<2, to 3 times higher than *Magallana gigas* (previously called *Crassostrea gigas*), respectively. Variations in accumulation may be attributable to physiological differences but also due to methods of growth (e.g. in bags on bed verses grown directly on bed itself). Even among shellfish of the same species in any one bed, the distribution of *E. coli* in tissues can be variable both spatially and over time, with levels between monitoring points varying by 2-3 orders of magnitude within just a few hours (Walker *et al.*, 2017; Cefas, 2011).

5.3 Uptake of *E. coli* in shellfish in response to concentrations in seawater

It can be difficult to directly quantify the relationship between *E. coli* concentrations in the water to the uptake and accumulation in the flesh of shellfish. However, recently funded DEFRA projects undertaken by Cefas in the UK sought to: explore the relationship between microbial quality of shellfish flesh and seawater, investigate the dynamics of uptake and clearance of *E. coli* in shellfish subject to chronic contamination, identify water concentrations of *E. coli* which would be compliant with the Shellfish Water Directive (SWD) "guideline" standard (G) of 300 cfu/100g (in 75% of samples), and make recommendations regarding an *E. coli* standard (water column standard verses shellfish flesh) for shellfish protected areas (Cefas, 2011;Cefas, 2012b; Cefas, 2013).

5.3.1 Relationship between concentrations in seawater and shellfish

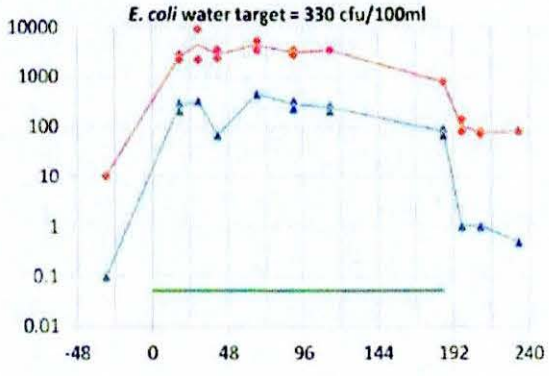
The relationship between *E. coli* counts in sampled seawater and shellfish flesh of three species (*O. edulis, M. gigas* and *Mytilus* spp. (*M. edulis* and *Mytilus galloprovencialis* data not separated)), sampled between 1991-1994 within six different production areas in the UK was analysed (Cefas, 2011). The level of contamination between the three bivalves, as expected was variable with *M. edulis* being more contaminated overall and for all species a greater geometric mean concentration calculated in the tissues than in the seawater. For all data pooled (all three species, n=602) a positive linear relationship between increasing *E. coli* levels in the seawater and in the shellfish was apparent, however, with a wide spread of values around the computed regression line. This wide range in measured values around the predicted values is an expected artefact of data obtained under natural environmental conditions.

Microcosm tank experiments monitored the uptake of *E. coli* in the tissues of the bivalves *M. edulis, M. gigas* and *C. edule* exposed to chronic exposure (continuous dosing for 5 days) to a range of water quality levels (1 cfu/100ml – 330 cfu/100ml) (Cefas, 2013). Across all concentrations, a rapid uptake of *E. coli* was shown for all species to a maximum 'equilibrium' (plateau) state (within 17 hours) and on cessation of dosing, a rapid clearance was also exhibited.Previous studies have shown that there is a threshold for *E. coli* concentrations in the water, above which bivalves are unable to accumulate more bacteria, however this maximum 'equilibrium' state will vary between both individuals and species (Cefas, 2011).

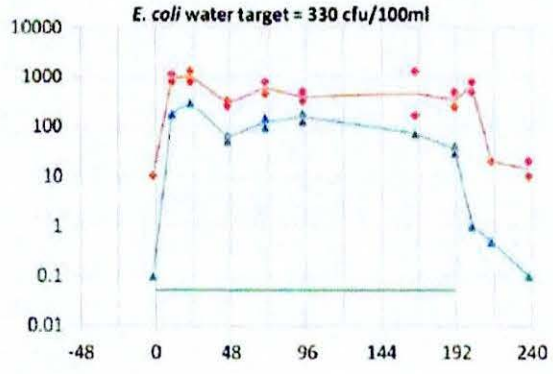
Figure 5.1 shows the time-series data for each species in the microcosm tanks under the maximum target *E. coli* seawater conditions (330 cfu/100ml). Changes in concentrations in the shellfish appear to mirror changes in the ambient seawater for all species during the 10-day experiment. Where only a low percentage (35% overall) of the variation in concentrations of shellfish tissue was explained by concentrations in the water from analysis of historic monitoring data (Cefas, 2011), under these microcosm conditions, this was found to be much higher at 55 – 60%. The overall factorial increase

between seawater and shellfish *E. coli* concentrations (as calculated across all tank concentrations) ranged from 11.7 for *M. gigas,* 15.2 for *M. edulis,* and 330 for *C. edule* with a wider range of accumulation rates found overall for *C. edule* at each seawater tank concentrations. Although flesh concentrations increased linearly with concentrations of the tank seawater, there was no direct association with an increase in seawater concentration of the microcosms and resulting accumulation factor.

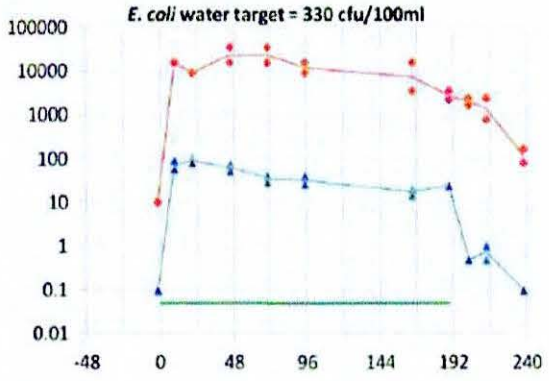
The rate of accumulation in tissues in the study was overall proportionate to the changes in water quality, the rate of clearance following the end of dosing was not as much (Figure 5.1). Bacteria can be rapidly cleared from shellfish when exposed to clean waters, with an initial phase of greatest clearance lasting <10hrs then followed by a less evident phase of 10-30 hrs. Within 24 hours of exposure to un-contaminated waters, clearance rates of approximately 100 times the initial concentrations have been observed in mussels and oysters (Cefas, 2011).



a) ***Mytilus edulis***



b) Magallana gigas



c) ***Cerastoderma edule***

Figure 5.1: Time series of levels of *E. coli* in tank water and tissues of a) *M. edulis,* b) *M. gigas* and c) *C. edule* for the target tank water concentration of 330 cfu/100ml. X-axis is hours relative to start of sewage dosing with Green line = period of sewage dosing. Red line = flesh concentrations and Blue line = tank water concentrations (Cefas, 2013).

Investigations of *E. coli* accumulation in *M. edulis*, *C. edule* and *M. gigas* was also undertaken in Mumbles Bay, UK across 10- day exposure period in September 2011, by attaching specimen bags to the intertidal zone at the site (Cefas, 2013). The relative ordering in inter-species *E. coli* accumulation remained valid with other studies and the microcosm experiment (e.g. greatest uptake in *C. edule*). However, no clear statistically significant difference between mean *E. coli* concentrations between the three species sampled from these environmental investigations was reported; only in comparison with *E. coli* seawater concentrations. Variation recorded in both water and flesh concentration is expected and will reflect variations in the environmental waters.

Direct measurements of water quality in the study area did not significantly correlate with *E. coli* shellfish concentrations. Therefore, a hydrodynamic two-dimensional water quality model (DIVAST) predicted *E. coli* concentrations for Swansea Bay was also done to provide near-real-time prediction of *E. coli* concentrations for where the shellfish bags had been positioned. The results of the model could not find a statistically significant correlation between water quality and the laid shellfish in this study. Diurnal and tidal patterns in concentrations have been found to be important, indicating a ubiquitous and high 'natural' variability in *E. coli* concentrations with differences exceeding 2 $\log_{10}$ orders diurnally even under dry conditions (review by Cefas, 2013). Such short term variability in bacterial concentrations may now be considered the 'normal' condition

5.3.2 Predicting compliance using *E. coli* seawater concentrations

Using the historic data collected in 1991-1994, models were computed for the three shellfish species *O. gigas*, *M. gigas* and *Mytilus* spp., to predict compliance with the SWD G value of 300 cfu/100g against a range of *E. coli* water quality concentrations (Cefas, 2011). The greatest proportion of samples compliant was shown to be for the Pacific oyster *M. gigas*. Assessing all three species together, indicated that a geometric mean threshold of 9.6 cfu/100ml and a 90th percentile of 55 cfu/100ml in seawater would be equivalent to the current SWD G standard.

The indicative thresholds for *E. coli* water concentrations for each species to meet the SWD G based on this study is listed in Table 5 1, and for 90% compliance with thresholds for Class B (<4,600 cfu/100g) is listed in Table 5 2. However, in terms of compliance with Class A threshold (<230 cfu/100m) none of the samples in this study met the criteria.

Later studies by Cefas (2013) also calculated indicative water quality standard values, to meet both the SWG G and Class A thresholds for concentration of *E. coli* in shellfish. Estimations were semi-quantitative (pass/fail), based either on samples taken quarterly, or monthly per annuum looking at overall distribution of readings to derive parameters. It is assumed that samples are taken equally spaced through the year and are independent; excluding any risk-based or biased sampled. Table 5 1 and Table 5 3 lists the indicative standards estimated for meeting the SWD G and Class A thresholds based on monthly sampling per annum. The indicative *E. coli* seawater concentrations for individual species are more conservative when compared to values calculated based on monitoring data (Cefas, 2011).

As the thresholds determined in the Cefas (2011) study were based on historic data (1991-1994), it has been recommended that these are validated with more up to date samples from production areas to draw more accurate comparisons and be comparable with the microcosm experiments of project WT0923 (Cefas, 2013).

Table 5 1: Indicative concentrations of *E. coli* in seawater (geometric mean and 90th percentile) to achieve 75%* compliance with SWD G (300 fcu/100g) in shellfish. *Cefas (2013) data predicted for 75% target annual compliance rate.

Species	Study Type	Geometric mean Seawater cfu/100ml	90th percentile seawater cfu/100ml	Sample size	Reference
Mytilus spp.	Natural sampling	8.9	102	313 individuals (pooled sites)	Cefas (2011)
Mytilus edulis	Microcosm	10	38	predicted from 12 samples taken per annum	Cefas (2013)
Magallana gigas	Natural sampling	41	492	111 individuals (pooled sites)	Cefas (2011)
Magallana gigas	Microcosm	13	100	predicted from 12 samples taken per annum	Cefas (2013)
Ostrea. edulis	Natural sampling	8.3	64	178 individuals (pooled sites)	Cefas (2011)
Cerastoderma. edule	Microcosm	0.26	2.5	predicted from 12 samples taken per annum	Cefas (2013)

Table 5 2: Indicative concentrations of *E. coli* in seawater (geometric mean) to achieve target annual 90% compliance with SWD standard for harvesting Classification B (<4,600 cfu/100g) in shellfish (Cefas, 2011).

Species	Study	Geometric mean seawater cfu/100ml	Number of samples
Mytilus spp.	Natural sampling	33	313 individuals (pooled sites)
O. edulis	Natural sampling	177	178 individuals (pooled sites)
M. gigas	Natural sampling	4,200	111 individuals (pooled sites)

Table 5 3: Indicative concentrations of *E. coli* in seawater (geometric mean and 90th percentile) to achieve annual 80% compliance with SWD standard for harvesting Classification A (<230 cfu/100g) in shellfish (Cefas, 2013).

Species	Study	Geometric mean seawater cfu/100ml	90th percentile seawater cfu/100ml	Number of samples/annum
M. edulis	Microcosm	8	30	12
C. edule	Microcosm	0.2	2.0	12
M. gigas	Microcosm	11	79	12

6. The Greater Dublin Drainage Project (GDD)

The below section lists responses from the 'Applicant' to consultee submissions following the lodging of the Planning Application; responses are regarding the impact of Proposed Project on shellfish and shellfish waters during operation. The responses are sourced and numbered, as cited in the *Greater Dublin Drainage Report: Response to Submissions* (Jacobs, 2019).

Succeeding each statement response(s) is further information that aims to support/ or expand upon these given statements.

6.1.1 Concerns regarding impact of Proposed Project on designated shellfish waters

457. In summary the plumes arising…….from the discharge of treated wastewater from the proposed outfall pipeline route (marine section) fall outside the designated shellfish waters. Furthermore, the modelled data for the discharge during the Operational Phase indicates that the impact plume has a limited spatial impact and will disperse significantly into the prevailing oceanography at the site. This fact coupled with the discharge parameters will ensure there will be no impact to shellfish waters.

Response remains valid.
Comparisons with monitoring studies of the dispersal and fate of *E. coli* in water bodies in the UK where they are more restrictive in tidal flow and exposure, would support conclusions that the outcome of the model for the GDD project has a plume with a restricted impact on any surrounding areas, such as the designated shellfish waters at Malahide.

6.1.2 Concerns regarding impact of Proposed Project on shellfish

364. Schedule 2 of S.I. No. 268/2006 does not set values for the coliform concentrations in the water column. Schedule 4 of S.I. No. 268/2006 sets a guide value for coliform concentrations equal to or less than 300 faecal coliforms per 100 millilitres in the shellfish flesh and intervalvular liquid but does not set values for coliform concentrations in the water column.

Response remains valid.
There is at present no agreed upon *E. coli* seawater concentration guideline value in which to monitor against. Recent studies have shown that for compliance with the current SWD G, there can be a wide range in predicted *E. coli* water concentrations calculated, that primarily depend on the targeted species in question and methods of assessment (e.g. microcosms vs. environmental studies). As such these studies have not support the application of a single guideline value for water quality standard, where more than one species is harvested.

Such studies done to date have focussed on only a few commercial species, primarily the blue mussel *Mytilus edulis,* the Pacific oyster *Magallana gigas (*previously known as *Crassostrea gigas)* and the common cockle *Cerastoderma edule.* There is no data available for those commercial bivalve species known to be harvested within the study area (razor clam *Ensis* sp), whelks (*Buccinum undatum*) and large mobile crustaceans (*Homarus gammarus* and *Cancer pagurus*).

366. There is no direct relationship between the concentration of coliforms in overlying water and the concentration of coliforms in 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. temperature, food availability, salinity, shellfish age, season, reproductive state, health of the shellfish and the impacts of toxins and other contaminants.

Statement may require further validation if questioned further on.
Although there is still a high level of variance in the data that remains unexplained when paired values of concentrations of *E. coli* in seawater verses shellfish are analysed; there is still a clear linear relationship between these two measured parameters. However, differences in the strength of this relationship has been shown to vary between species and between artificial microcosm conditions to *in situ* studies in the field, where natural fluxes in environmental conditions may mask any patterned responses or reduce any predicted effects.

It will be important to acknowledge that following exposure that there will be likely rapid increase (within 1 hour) in uptake and assimilation of *E. coli* in tissues of bivalves, with 'equilibrium' reached within 17 hours (in these tested cases), and clearance following end of exposure. Microcosm studies done to date have looked at chronic exposure, with aim of continuous contamination over a period of 5 days. In this data set, declines and subsequent increases in tissue concentration occurred during this dosing period when there had been a short-term fault in equipment, reducing the flow of diluted sewage into the test tanks. The patterned decline with decline in water concentration bears evidence that under natural conditions when these fluxes occur it will instantly result in a reduction in tissues of shellfish, and as likely to occur regularly and over longer periods this will naturally allow clearance to occur (e.g. during tidal periods). However, it also highlights the rapid physiological response by bivalves to uptake, which may occur following heavy rainfall for example which may for the short term increase uptake in tissue of resident shellfish.

Variations in uptake and maximum concentrations at 'equilibrium' state between species has been shown, with an agreed ranking of greater concentration accumulated in cockles compared to mussels and oysters. The literature suggests that there is a maximum accumulation level a species can reach, independent of any further increase concentrations in the ambient waters. The duration of exposure will be of importance, for allowing full clearance from the tissues. It is unlikely that bivalve shellfish of the study area will be subject to prolonged exposure periods comparable with these experimental studies (e.g. 5-10 days) and

367. The potential impacts on the Malahide shellfishery were examined using a revised modelling simulation examining the discharge of coliforms at a concentration of 300,000 cfu/100ml for both the proposed Average Daily Flow and Flow to Full Treatment scenarios.

370. For Flow to Full Treatment scenario, the maximum predicted coliform concentration in the water near the seabed was 327 cfu/100ml. For 80% of the time the predicted concentrations were less than 147 cfu/100ml with the average coliform concentration over the course of the simulation predicted to be 78 cfu/100ml. The coliform concentrations fluctuate between a maximum value on flooding tides and zero concentrations on ebbing tides. This provides equal time for uptake/accumulation and subsequent clearance/removal of any coliforms by shellfish. No impact is predicted on the shellfish water quality as a result of the proposed discharge.

Response may require to be updated
The modelled simulation at 300,000 cfu/100ml for normal operation of the proposed WwTP may be considered to be conservative (C. O'Keeffe *pers. comm.* 12 March 2019). 2018 discharge data from Ringsend WwTP have reported variable levels, with very few data points exceeding 200,000 cfu/100ml, and with an overall average discharge of 79,000 cfu/100ml. The maximum modelled coliform in the water near the seabed of 327 cfu/100ml, will therefore, likely be considerably less than this, as will the concentrations for 80% of a given period, and the overall average.

There will be variation in rate of uptake and rate of clearance between species, as shown in previous studies. This will also be expected to vary across seasons. During winter periods (low temperature and solar irradiation), the natural decay of *E. coli* in the water column may be slower than in the summer months, possibly also further impacted by increased rainfall and fluvial inputs during this

Production Area

Razor Clam fishing is along pipeline route south of the designated area.

period. The lowered values currently sourced for the Ringsend WwTP were taken outside of the bathing season (e.g. the winter months with no UV treatment) and excluding an overflow or plant failure event, may indicate a worst-case chronic exposure scenario for the receiving water body and one that is not as conservative as the modelled scenarios.

Local shellfisheries harvest throughout the year but with specific collection periods for some species. Harvesting of the razor clam *Ensis* sp. (predominantly *Ensis siliqua)* occurs over the winter months in the area. The Malahide production area (site name: DN-ME) has a shellfish harvesting classification of A, and as per the status of the last sample analysed (taken 5 February 2019), remains as 'Open'. Monthly monitoring data for biotoxins over the last 12 months (January 2018 – February 2019) reported on only one occasion (14 June 2018) a failure (status changed to 'Closed pending') but an additional sample taken that month, had a reported status then of 'Open' (Marine Institute, 2019).

Unfortunately, studies to date of *E. coli* accumulation in *Ensis* spp. have not been undertaken, with focus on other commercially important bivalves. Substances within sediments are known to have longer residence time than water-borne contaminants. As bottom dwelling infaunal species, there is the higher risk that they will be exposed to any contaminants within the sediment compared to bivalves that grow above the seabed. *Ensis* spp. tend to inhabit coarser sediments, but with spatial distribution in different sediments between this con-specifics. Such sediments will likely contain a lower organic content and thus support a relatively lower resident population of bacteria than finer sediments.

It will be imprudent to estimate a potential accumulation factor in the tissues of razor clams at Malahide as current work has shown a wide range of uptake rates and maximum concentrations between bivalve species, and with spatio-temporal differences also expected. The distance of the Malahide production area from the point-source (outfall pipe), and consideration of the predicted plume in the far field zones, and the current data from an existing WwTP in Dublin Bay, reduces the level of assessed risk of contamination to shellfish. It will be important to acknowledge potential increased risks to harvesting post heavy rainfall events and the expected natural tidal and seasonality in water column *E. coli* concentrations when harvesting.

7. References

Include South Portmarnock.

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8. Glossary

Definitions sourced and adapted from: Cefas (2012c),

Accumulation:	Uptake and storage of FIOs within the cells of the living shellfish species.
Accumulation factor:	Measure of the intensity of the accumulation of FIOs in bivalve shellfish. This measure is given by the ration between the concentration of FIOs in shellfish relative to the concentration of FIOs in the overlying water.
Bivalve filter pump:	Group or bands of lateral cilia on filaments arranged in parallel within the mantle cavity of the bivalve.
Chronic exposure:	Contact of shellfish with *E. coli* in the overlying waters that occurs over a long time (e.g. > 5 days).
Clearance:	Process by which shellfish eliminate FIOs (e.g. from filter-feeding in bivalve species).
Microcosm:	Artificial simplified ecosystem up under often laboratory conditions to predict responses to a variation in environmental conditions.

[redacted]

From: Dara White <dwhite@water.ie>
Sent: 25 April 2019 12:29
To: Ronan Kane
Subject: FW: GDD - Ecoli levels in discharge - Shellfish expert memo
Attachments: Memo_GDD E coli.docx

From: O'Keeffe, Ciaran [mailto:Ciaran.OKeeffe@jacobs.com]
Sent: 14 March 2019 11:08
To: Dara White <dwhite@water.ie>
Cc: Geoff OSullivan <Geoff.OSullivan@ervia.ie>; Gerry O'Donoghue <godonoghue@water.ie>
Subject: GDD - Ecoli levels in discharge - Shellfish expert memo

Dara, Geoff,

Tried calling you re above. We received a memo from our inhouse shellfish specialist last night, see attached. In my opinion it is not as strong as I would have hoped for and it leaves some doubt that requires a discussion.

Regards

Ciarán

[redacted]

From: Ronan Kane <rkane@water.ie>
Sent: 25 April 2019 20:27
To: Brian Deegan
Cc: Dara White
Subject: FW: GDD - Ecoli levels in discharge - Shellfish expert memo
Attachments: Memo_GDD E coli.docx

Brian,
As discussed earlier today for your information.
Regards
Ronan

From: Dara White
Sent: 25 April 2019 12:29
To: Ronan Kane
Subject: FW: GDD - Ecoli levels in discharge - Shellfish expert memo

From: O'Keeffe, Ciaran [mailto:Ciaran.OKeeffe@jacobs.com]
Sent: 14 March 2019 11:08
To: Dara White <dwhite@water.ie>
Cc: Geoff OSullivan <Geoff.OSullivan@ervia.ie>; Gerry O'Donoghue <godonoghue@water.ie>
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Dara, Geoff,

Tried calling you re above. We received a memo from our inhouse shellfish specialist last night, see attached. In my opinion it is not as strong as I would have hoped for and it leaves some doubt that requires a discussion.

Regards

Ciarán

Tá an fhaisnéis á seachadadh dírithe ar an duine nó ar an eintiteas chuig a bhfuil sí seolta amháin agus féadfar ábhar faoi rún, faoi phribhléid nó ábhar atá íogair ó thaobh tráchtála de a bheith mar chuid de. Tá aon athsheachadadh nó scaipeadh den fhaisnéis, aon athbhreithniú ar nó aon úsáid eile a bhaint as, nó aon ghníomh a dhéantar ag brath ar an bhfaisnéis seo ag daoine nó ag eintitis nach dóibh siúd an fhaisnéis seo, toirmiscthe agus féadfar é a bheith neamhdhleathach. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh iomlán agus ceart na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Ní ghlacann Uisce Éireann le haon dliteanas faoi ghnímh nó faoi iarmhairtí bunaithe ar úsáid thoirmiscthe na faisnéise seo. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh ceart agus iomlán na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Má fuair tú an teachtaireacht seo in earráid, más é do thoil é, déan teagmháil leis an seoltóir agus scrios an t-ábhar ó gach aon ríomhaire. Féadfar ríomhphost a bheith soghabhálach i leith truaillithe, idircheaptha agus i leith leasaithe neamhúdaraithe. Ní ghlacann Uisce Éireann le haon fhreagracht as athruithe nó as idircheapadh a rinneadh ar an ríomhphost seo i ndiaidh é a sheoladh nó as aon dochar do chórais na bhfaighteoirí déanta ag an teachtaireacht seo nó ag a ceangaltáin. Más é do thoil é, tabhair faoi deara chomh maith go bhféadfar monatóireacht a dhéanamh ar theachtaireachtaí chuig nó ó Uisce Éireann chun comhlíonadh le polasaithe agus le caighdeáin Uisce Éireann a chinntiú agus chun ár ngnó a chosaint. Fochuideachta gníomhaíochta de chuid Ervia is ea Uisce Éireann atá faoi theorainn scaireanna, de bhun fhorálacha an tAcht um Sheirbhísí Uisce 2013, a bhfuil a bpríomh ionad gnó ag 24-26 Teach Colvill, Sráid na Talbóide, BÁC 1.

Go raibh maith agat as d'aird a thabhairt.

From: O'Keeffe, Ciaran <Ciaran.OKeeffe@jacobs.com>
Sent: 29 April 2019 11:48
To: Seamus Ryan
Cc: Alan Berry; Kiernan, Sarah; Geoff OSullivan; Jane Chambers; Edel Casserly
Subject: [EXTERNAL] RE: Updated Marine Water Quality Modelling and Diffuser Design
Attachments: GDD_Ecoli modelling_G1402_doc010_01.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Seamus,

I attach a short summary report from Marcon on the iteration of ecoli modelling on the GDD project.

Please note that the final ecoli levels offered at the Oral Hearing were 20,000 cfu/100ml at the diffuser on the outfall pipe.

Please also note that the Cefas study on ecoli levels in the water column in shellfish waters, as referenced by Marja Aberson and also referenced in Marcon's summary report is an indicative guide only and have not, as yet, been adopted as a standard in the UK.

The model has modelled a virtual diffuser (4 port single riser) which represented a 'worst case' impact scenario. This 4 port single riser diffuser is also shown on the planning drawings. The actual diffuser arrangement is subject to detail design and/or contractor design.

Regards

Ciarán

Actual Diffuser has not been modelled / Cefas study attached
Why did Insp. let this go?

From: Seamus Ryan
Sent: 10 April 2019 08:55
To: O'Keeffe, Ciaran
Cc: Alan Berry ; Kiernan, Sarah ; Geoff OSullivan ; Jane Chambers ; Edel Casserly
Subject: [EXTERNAL] Updated Marine Water Quality Modelling and Diffuser Design

Ciarán,

As per my voicemail yesterday, can you work with Alan Berry and provide a short memo summarising the changes we have made to the marine water quality modelling since the submission of the planning application last June along with the key findings and results. Can you please include the key figures including the eColi cfu's from each iteration. In addition, can you review the diffuser design in line with the final modelling offered to ABP and any efficiencies that can now be achieved as a result.

I got your text this morning noting you are on sick leave all this week. I'm on annual leave next week so can you please liaise with Edel in my absence.

Kind Regards

Seamus Ryan
Project Manager – Major Projects

ervia

Colvill House, 24-26 Talbot St, Dublin 1

[redacted]

Greater Dublin Drainage Project – Ecoli levels in the proposed Discharge and impact on adjacent Designated Malahide Shellfish Waters

Sequence of events.

1. When project started back in 2011 the shellfish from these waters had a Class B classification.

2. Early modelling of the discharge modelled a discharge level of 39,100 cfu/100ml, which indicated no impact on the Class B shellfish.

3. We were loosely applying the ShellSan (Shellfish Classification System) originally from US EPA, but seems to have been adopted by the Department of Marine & Natural Resources here at one point in the early 2000's at least. Not sure if they are still following this. Extract produced hereunder.

1. Approved: No further purification necessary
2. Conditional: Purification necessary by relaying in uncontaminated seawater
3. Restricted: Pressure Cooking essential

The DoMNR's Shellsan classification system is set out in Table 2.5 below:

Table 2.5 – Summary of scheme classification of shellfish production areas operated by the Department of the Marine and Natural Resources under 91/492/EEC

Classification	Geometric Mean of FC /100ml	Compliance FC per 100ml
Approved	<14	90% <46
Conditional:	>14<140	90%<460
Restricted:	>140	>460

4. Note that since we commenced this project the shellfish from the Malahide area have been reclassified as Class A. We somehow missed this, however, the 39,100 cfu level would still meet the approved classification above at the designated sampling point.

5. A submission made by Fingal County Council, in whose area the project will be constructed, queried the level of ecoli modelled in the discharge when compared to the Ringsend model, which modelled 300,000 cfu/100ml.

* Designated Sampling point is not off Portmarnock or Irelands Eye. and is not along route of pipeline

6. For the response document of January 2019 to An Bord Pleannala (the Irish Planning Authority) we ran a 300,000 cfu/100ml constant discharge over a full months tidal cycle. Note that we later found out that Ringsend did not apply their 300,000 cfu model run over the full months tidal cycle. We also received the actual ecoli discharge data for Ringsend for 2018. *NB.

7. 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

8. 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.

9. 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.

10. 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.

11. We have also since run scenarios with 150,000 cfu/100ml. The comments from Alan Berry (the modeller) on these runs are reproduced hereunder:

12. Yes, the average of the ADF_300,000 run was 33 cfu/100ml, but more importantly is the statistical analysis and especially at the five points along the southern boundary of the shellfish designation. See table below.

13. At the designated sampling point, although the geometric mean is fine, the 90%ile is 91.26 much greater than ShellSAN 90%ile limit of 46. 300,000 cfu/100ml in discharge is too high.

Scenario: ADF_300k_NoWind

	ShellSAN	SMP	South_1	South_2	South_3	South_4	South_5
Geometric Mean	14	10.74	11.03	21.89	28.43	58.15	13.58
90%ile	46	91.26	19.73	33.87	50.92	122.81	26.56

– NO wind HS NOT great.

14. For the ADF scenario discharging 150,000 cfu/100ml (and it was with Force 8 wind) you would comply with ShellSAN criteria, except for the geomean at the shellfish water's southern boundary location closest to the outfall. See table below.

Scenario: ADF_150k_Force 8

	ShellSAN	SMP	South_1	South_2	South_3	South_4	South_5
Geometric Mean	14	7.55	5.70	8.44	11.95	19.72	7.79
90%ile	46	45.46	9.13	14.61	18.15	33.92	16.22

15. This is more or less when we sought your advice. On foot of this advice, Irish Water committed, on the opening day of the planning enquiry 'out of abundance of caution' to provide UV treatment on the discharge (95%ile limit of 20,000 cfu/100ml) to ensure protection of the shellfish so that they retain the Class A classification.

16. This commitment in practice was to achieve the CEFAS 'all species' geo-mean and 90%ile of 1.4 and 20 respectively. We have since modelled a continuous discharge of 20,000 cfu/100ml and Alan has reported on these results today. Refer to separate document. While not quite achieving the Geomean we meet the 90%ile indicative CEFAS guide value at all points analysed.

17. Note that the discharge will never be a constant 20,000 cfu/100ml over the full months tidal cycle and will on average be considerably lower as evidenced from other IW plants with UV treatment.

? . evidence . ?

18. The suppliers of UV treatment equipment when asked to guarantee a 95%ile limit of 20,000 cfu/100ml are likely to provide systems with better performance and if, following further modelling work, it is necessary to reduce the standard even lower than IW will commit to this.

no UV system design.

19. A key question for you is 'what is the status of the CEFAS indicative guide value'? Have they been applied to any discharges in the UK to your knowledge?

Summary of UV disinfection runs

Two scenarios were simulated to assess the impacts of discharging UV treated effluent with a coliform concentration of 20,000 cfu/100ml.

Scenario #1: Synthesised flow @ 20,000 cfu/100ml, no wind

The model commenced the simulation on 18/04/2015 at 00:00hrs with the proposed GDD Project discharging at the synthesised flow profile presented in Figure 1 (below). The Average Daily Flow (ADF) is included in Figure 1 for reference. The concentrations of coliforms in the effluent was 20,000 cfu/100ml. No wind field was specified.

Scenario #2: Synthesised flow @ 20,000 cfu/100ml, recorded wind field

The model commenced the simulation on 18/04/2015 at 00:00hrs with the proposed GDD Project discharging at the synthesised flow profile presented in Figure 1 (below). The concentrations of coliforms in the effluent was 20,000 cfu/100ml. Recorded wind speed and direction data from Dublin Airport was defined and presented in Figure 6 below..

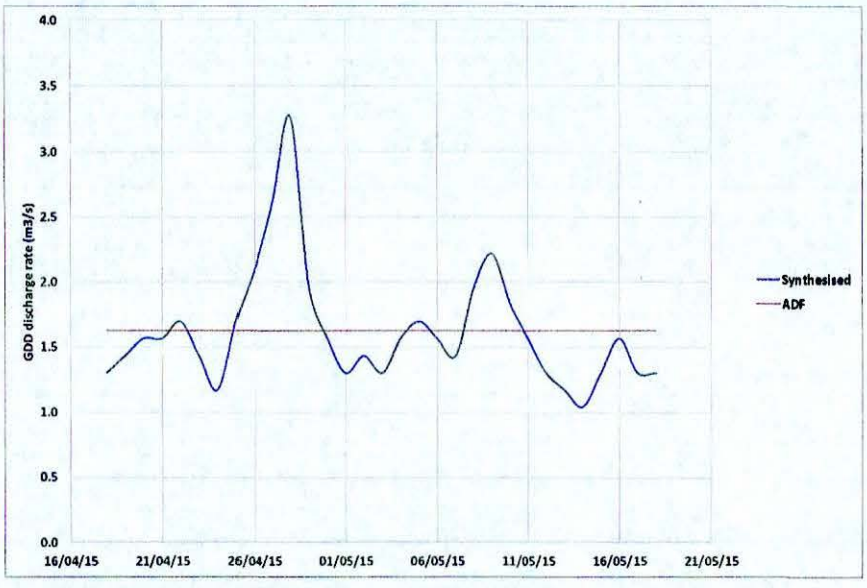


Figure 1: Synthesised GDD discharge rate

The results were analysed at the designated Malahide Shellfishery sampling point. The concentration of coliforms over the course of the simulation for both scenarios (No Wind, and Wind) are presented in Figure 2 below.

Why not analysed at the Designated Shellfish area closest to the GDP outfall. Malahide Sampling point is quite a distance away and is to measure for Malahide WWTP.

Iacunae.

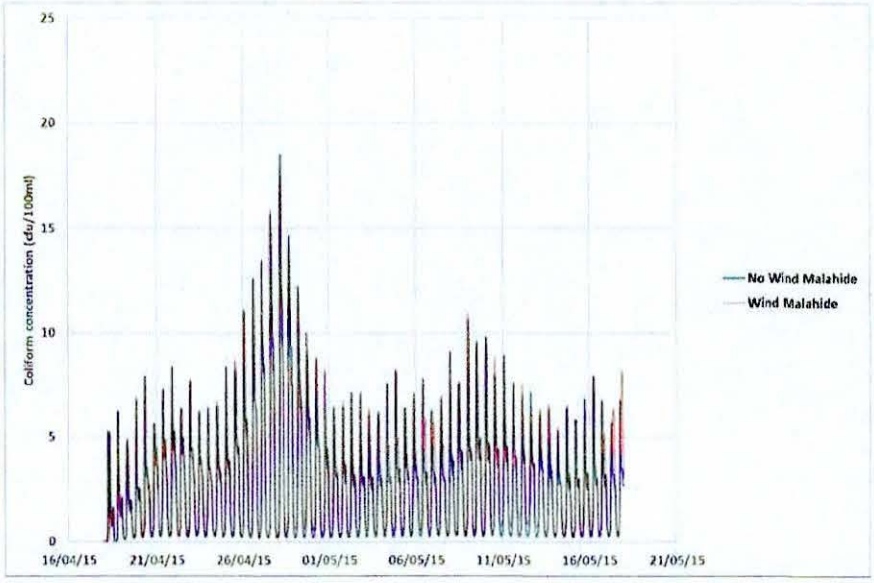


Figure 2: Predicted coliform concentrations at Malahide shellfish sampling point for No Wind and Wind scenarios.

There is no appreciable difference in predicted coliform concentrations between the No Wind, and Wind scenarios. The predicted concentrations were analysed statistically to determine compliance with the proposed "All Species" geometric mean concentration on coliforms in the water column of 1.4. The results from the statistical analysis for the two scenarios are presented in the table below, along with the estimated statistics for a discharge at constant ADF of 1.63 m3/s with no wind defined.

	No Wind	Wind	ADF No Wind	
Geometric Mean	1.49	1.76	1.16	*
90%ile	6.46	6.60	6.32	*

The geometric means calculated for both scenarios (No Wind [1.49], and Wind [1.76]) are greater than the "All Species" value of 1.4. It is suggested the reason for this is the character of the synthesised flow rate shown in Figure 1 with peak flows at Flow to Full Treatment levels resulting in increased mass of coliforms discharging through the outfall.

Five locations along the southern edge of the designated shellfish waters were also examined, both statistically and as a timeseries plots. The position of the five locations are presented in Figure 3, below.

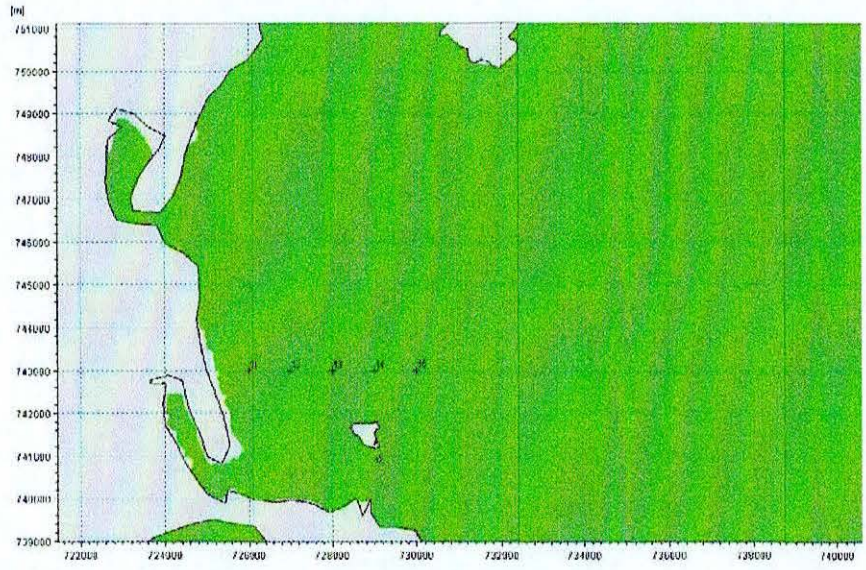


Figure 3: Position of the 5 locations across southern shellfish boundary.

The evolution over time of the predicted coliform concentrations is presented in Figure 4 and Figure 5 for the No Wind, and Wind scenarios respectively.

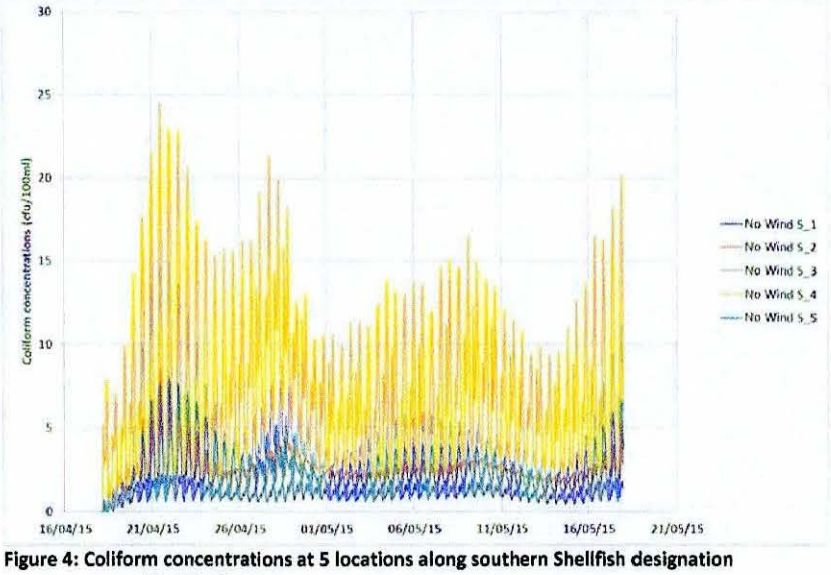


Figure 4: Coliform concentrations at 5 locations along southern Shellfish designation (No Wind)

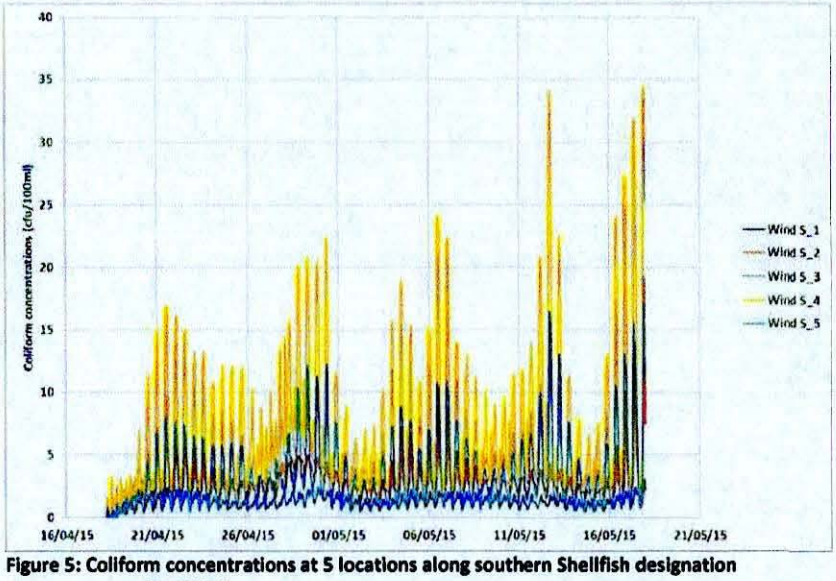


Figure 5: Coliform concentrations at 5 locations along southern Shellfish designation (No Wind)

Both the above Figures show that highest coliform concentrations predicted at Location S_4 just to the northwest of the outfall. During the Wind scenario, locations S3 and S_5 are also predicted to experience higher than normal concentrations.

The statistical assessment of both scenarios at the 5 locations along the southern boundary of the designated shellfish waters are presented in the tables below.

Synthesised Flows @ 200,000 cfu/100ml (No Wind)						
	SMP	S_1	S_2	S_3	S_4	S_5
Geometric Mean	1.49	1.22	2.41	3.49	6.03	2.01
90%ile	6.46	1.79	3.14	5.48	12.97	3.89

Commented [OC1]: This should read 20,000 cfu/100ml

Synthesised Flows @ 200,000 cfu/100ml with Wind						
	SMP	S_1	S_2	S_3	S_4	S_5
Geometric Mean	1.76	1.34	2.76	4.35	5.78	2.65
90%ile	6.60	1.99	4.31	8.88	14.86	7.57

Commented [OC2]: This should read 20,000 cfu/100ml

With the exception of the closest inshore location, S_1, the geometric means calculated for both scenarios (No Wind, and Wind) are greater than the "All Species" value of 1.4.

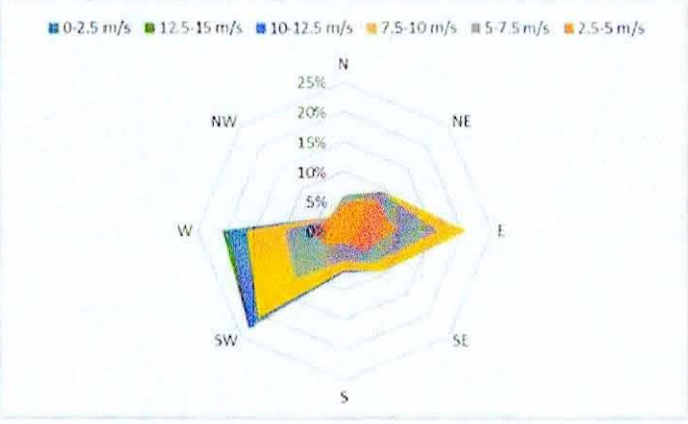


Figure 6: Dublin Airport windrose (18/04/2015 – 18/05/2015)

Impact on Bathing Waters

The results were analysed at the designated bathing water sampling points on Portmarnock Velvet Strand and Claremont Beach and presented in Figure 7 and Figure 8 respectively.

Predicted concentrations of coliforms at Portmarnock Velvet Strand were very low and show little variation between the NoWind and Wind scenarios.

Predicted concentrations of coliforms at Claremont were low and but showed significant variation between the NoWind and Wind scenarios, with the Wind scenario predicting increased coliform concentrations following periods of easterly winds. This would be expected given the beach's location with respect to the proposed outfall location.

Greater Dublin Drainage

Marine Water Quality Model

Summary of E.coli modelling

G1402_doc010_01

Independent expert required..

Document No: G1402_doc010_01
Status: Issue_01
Date: 23 – 04 - 2019

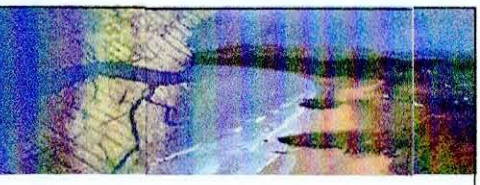


Table of Contents

1. Introduction

This document presents a short summary of the E.coli modelling scenarios since the submission of the EIAR and planning application in June 2018. It provides the input data and results for each scenario, and a summary table of the key findings for both the designated bathing waters and designated shellfish waters in the study area local to the proposed marine outfall.

2. Reporting Requirements

Did not identify Portmarnock South Designated Bathing area.

2.1. Bathing Waters Regulations

S.I. No. 79/2008 - Bathing Water Quality Regulations, 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. The classification criteria are detailed in Table 1.

Table 1: Quality of Bathing Water Regulations, 2008 (S.I. No. 79 of 2008)

Parameter	Excellent	Good	Suffficient
Escherichia coliform (cfu/100ml)	250[1]	500[1]	500[2]
Intestinal enterococci (cfu/100ml)	100[1]	200[1]	185[2]
1 By 95% or more samples 2 By 90% or more samples Poor Quality values are any values worse that the 'Sufficient' quality value			

Blue Flag Status

The Blue Flag Scheme is a voluntary scheme to identify high-quality bathing water areas, administered in Ireland by An Taisce. To receive a blue flag, a bathing site, in addition to maintaining a high standard of water quality, must meet specified objectives with regard to the provision of safety services and facilities, environmental management of the beach area and environmental education. For EU countries implementing the Blue Flag Scheme it is imperative that a beach is classified as being 'Excellent' under the Bathing Water Regulations.

2.2. Shellfish Waters Regulations

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.

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.

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.

what about bioaccumilation in flesh

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).

3. April 2018: EIAR model scenarios

3.1. Model Inputs

The Operational Phase of the proposed outfall modelled the continuous discharge of secondary treated effluent into the receiving waters for

- Average Daily Flow conditions (ADF),
- Flow to Full Treatment conditions (FFT), and,
- Process Failure discharging untreated effluent over a three day period (PF).

The data inputs to the model used in the EIAR model scenarios are detailed in Table 2 below.

WwTP	Flow rate (m^3/s)	COLI (mpn/100ml)
Barnageeragh	0.09	1,000
Portrane	0.06	1,000
Malahide	0.05	1,500
Swords	0.16	100,000
Shanganagh	0.36	100,000
Ringsend (proposed upgrade future average)	6.95	300,000
Proposed Project (ADF)	1.63	39,105
Proposed Project (FFT)	3.78	39,105
Proposed Project (PF)	1.63	39,105 (18th April – 26th April) 100,000 (26th April – 29th April) 39,105 (29th April – 18th May)

Table 2: WwTP flows and loads defined to the EIAR model.

3.2. Model Results

3.2.1. Bathing Waters

The evolution of ecoli concentrations over the period of the simulation at the designated bathing water sampling points on both Velvet Strand and Claremont are presented in Figure 1 to Figure 3 for the Average Daily Flow (ADF), Flow to Full Treatment (FFT) and Process Failure (PF) scenarios respectively.

The model predicted no compliance failures at the designated bathing water beaches, nor blue flag beaches arising from the proposed discharge of treated effluent. None of the scenarios predicted the likelihood of any significant impact on the receiving waters from the proposed operation of the outfall discharge.

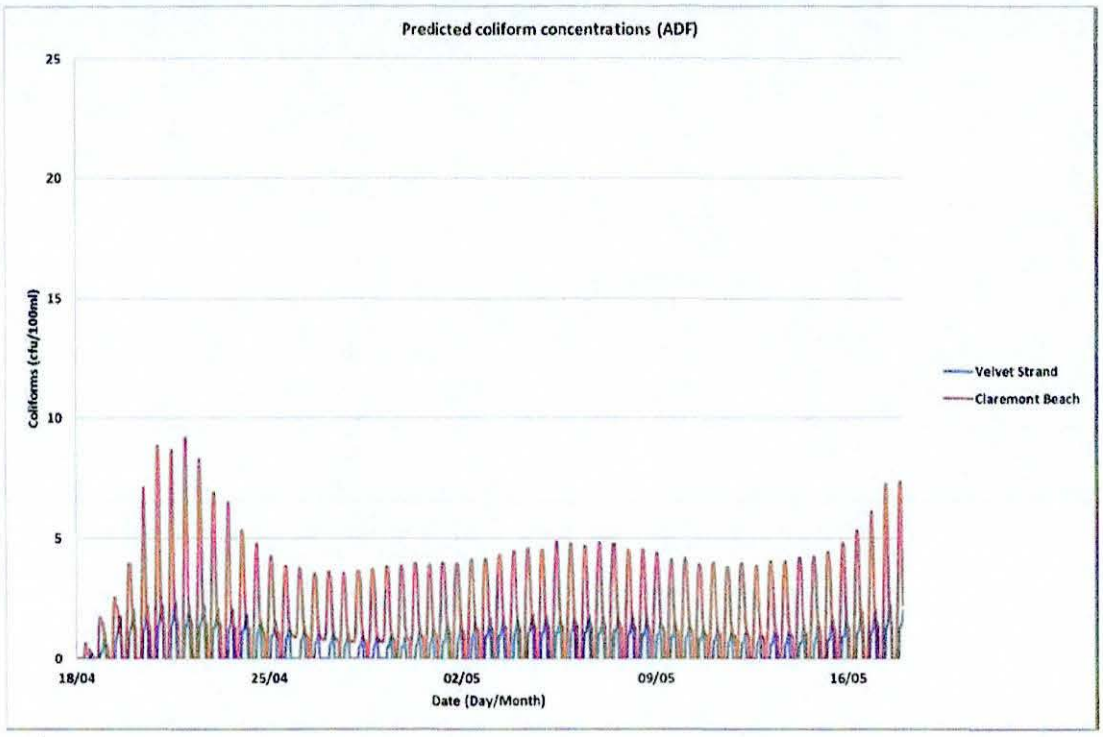


Figure 1: ADF EIAR model predictions of ecoli concentrations at Velvet Strand and Claremont

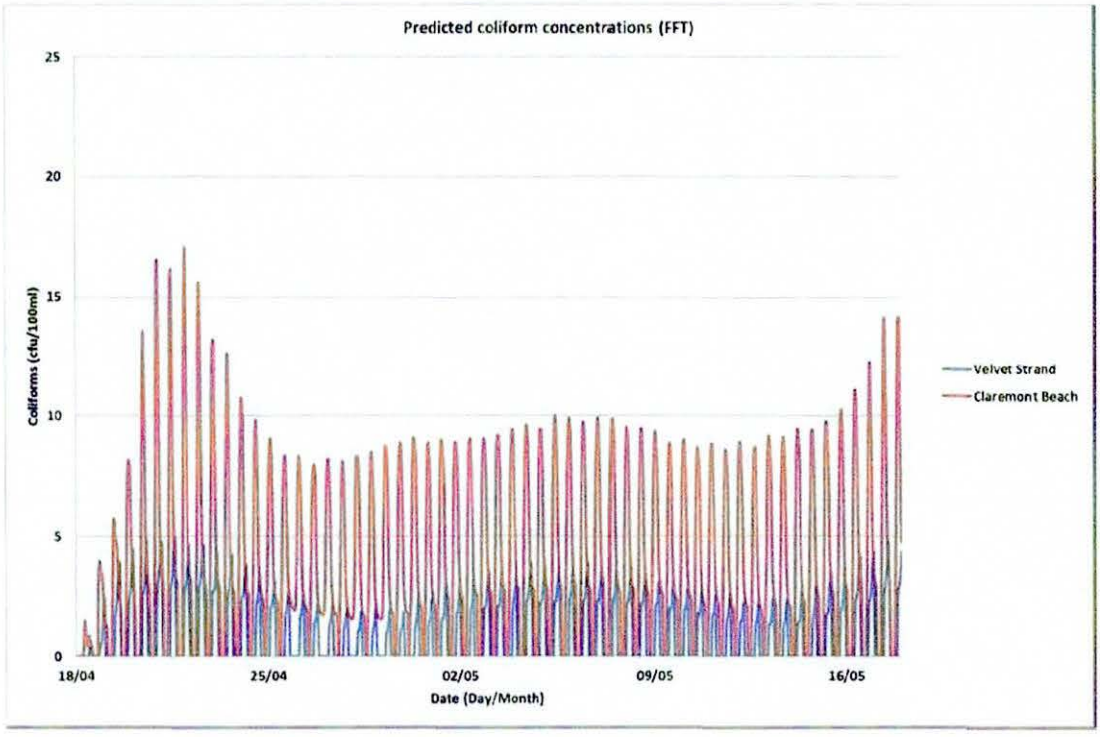


Figure 2: FFT EIAR model predictions of ecoli concentrations at Velvet Strand and Claremont

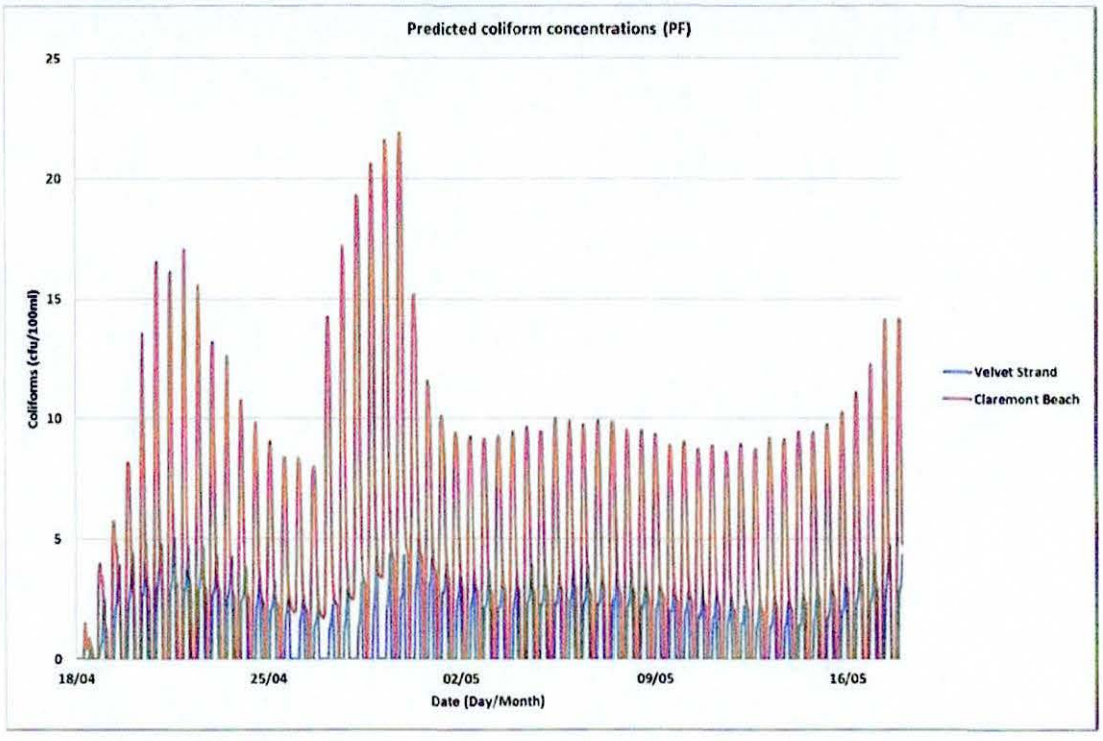


Figure 3: PF EIAR model predictions of ecoli concentrations at Velvet Strand and Claremont

3.2.2. Shellfish Waters

The evolution of ecoli concentrations over the period of the simulation at the designated shellfish monitoring point in the Malahide Shellfishery are presented in Figure 4 to Figure 6 for the Average Daily Flow (ADF), Flow to Full Treatment (FFT) and Process Failure (PF) scenarios respectively.

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.

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.

For Process Failure scenario, the maximum predicted coliform concentration in the water near the seabed was 109 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 12.41 cfu/100ml.

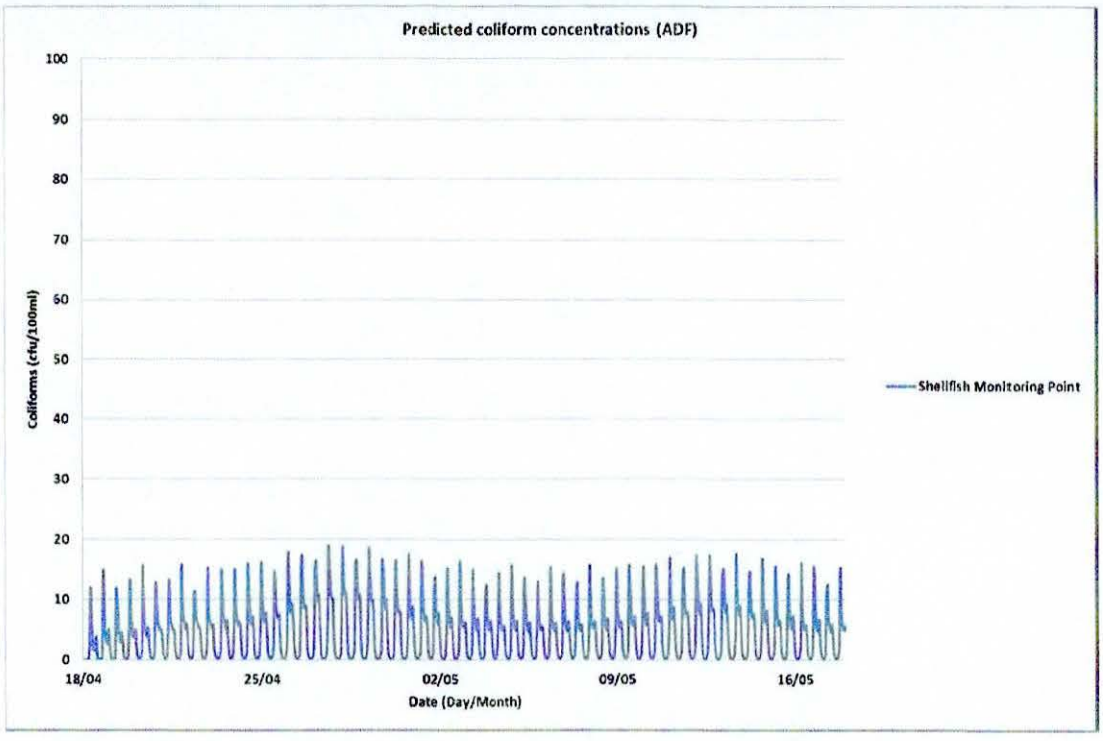


Figure 4: ADF EIAR model predictions of ecoli concentrations at Malahide Shellfish Monitoring Point.

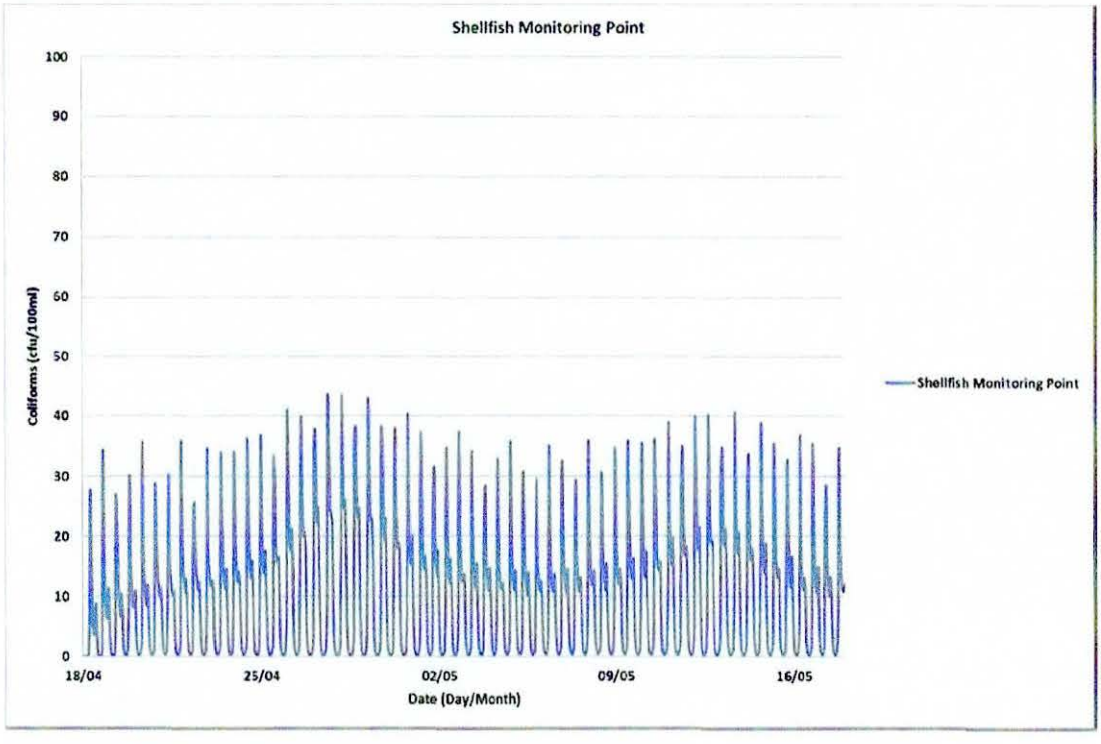


Figure 5: FFT EIAR model predictions of ecoli concentrations at Malahide Shellfish Monitoring Point.

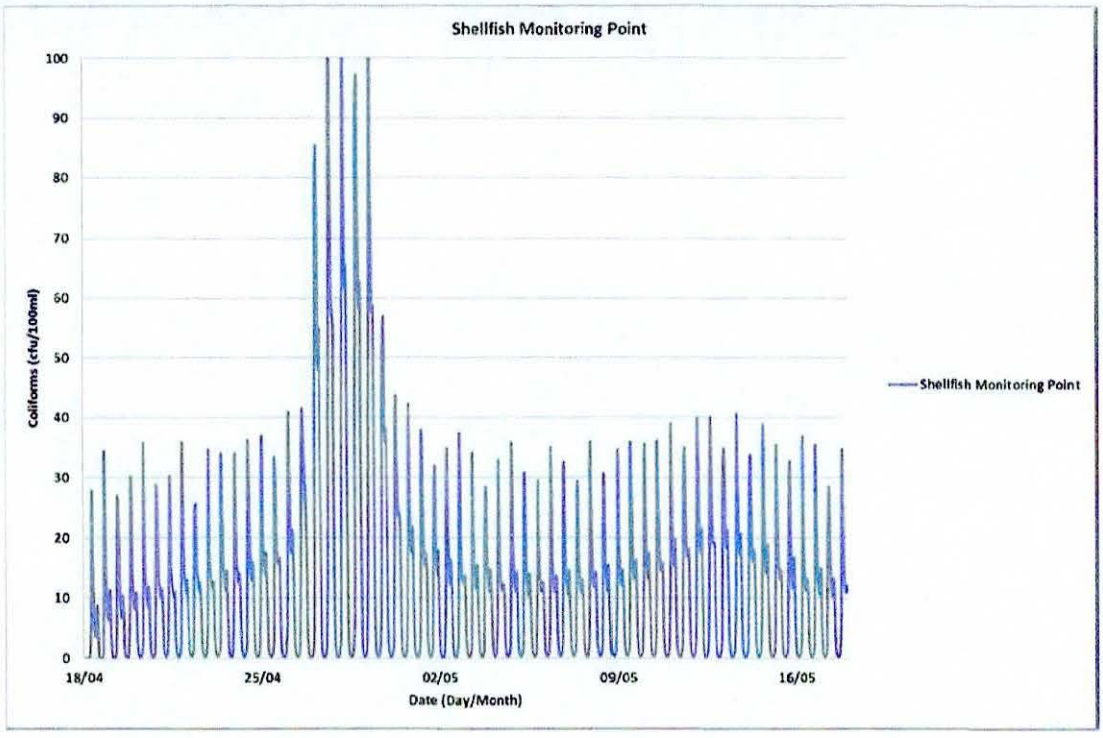


Figure 6: PF EIAR model predictions of ecoli concentrations at Malahide Shellfish Monitoring Point.

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 there will be no impact on the shellfish water quality as a result of the Proposed Project.

4. December 2018: "Fingal Co. Co." model scenarios

Following the Strategic Infrastructure Development (SID) application, issues were raised in the subsequent submissions and observations received by ABP. In particular, and at Fingal County Council's request, additional modelling of the above scenarios was undertaken to simulate "Ringsend levels" of treated wastewater coliform concentrations (300,000 cfu/100ml) discharging through the Proposed Project outfall.

4.1. Model Inputs

The proposed outfall modelled the continuous discharge of secondary treated effluent into the receiving waters for

- Average Daily Flow conditions (ADF),
- Flow to Full Treatment conditions (FFT), and,
- Process Failure discharging untreated effluent over a three day period (PF).

The data inputs to the model used in the "Fingal Co. Co." model scenarios are detailed in Table 3 below.

WwTP	Flow rate (m^3/s)	COLI (mpn/100ml)
Barnageeragh	0.09	1,000
Portrane	0.06	1,000
Malahide	0.05	1,500
Swords	0.16	100,000
Shanganagh	0.36	100,000
Ringsend (proposed upgrade future average)	6.95	300,000
Proposed Project (ADF)	1.63	300,000
Proposed Project (FFT)	3.78	300,000
Proposed Project (PF)	1.63	300,000 (18th April – 26th April) 1,000,000 (26th April – 29th April) 300,000 (29th April – 18th May)

Table 3: WwTP flows and loads defined to the "Fingal Co. Co." model.

4.2. Model Results

4.2.1. Bathing Waters

The evolution of ecoli concentrations over the period of the simulation at the designated bathing water sampling points on both Velvet Strand and Claremont are presented in Figure 7 to Figure 9

for the Average Daily Flow (ADF), Flow to Full Treatment (FFT) and Process Failure (PF) scenarios respectively.

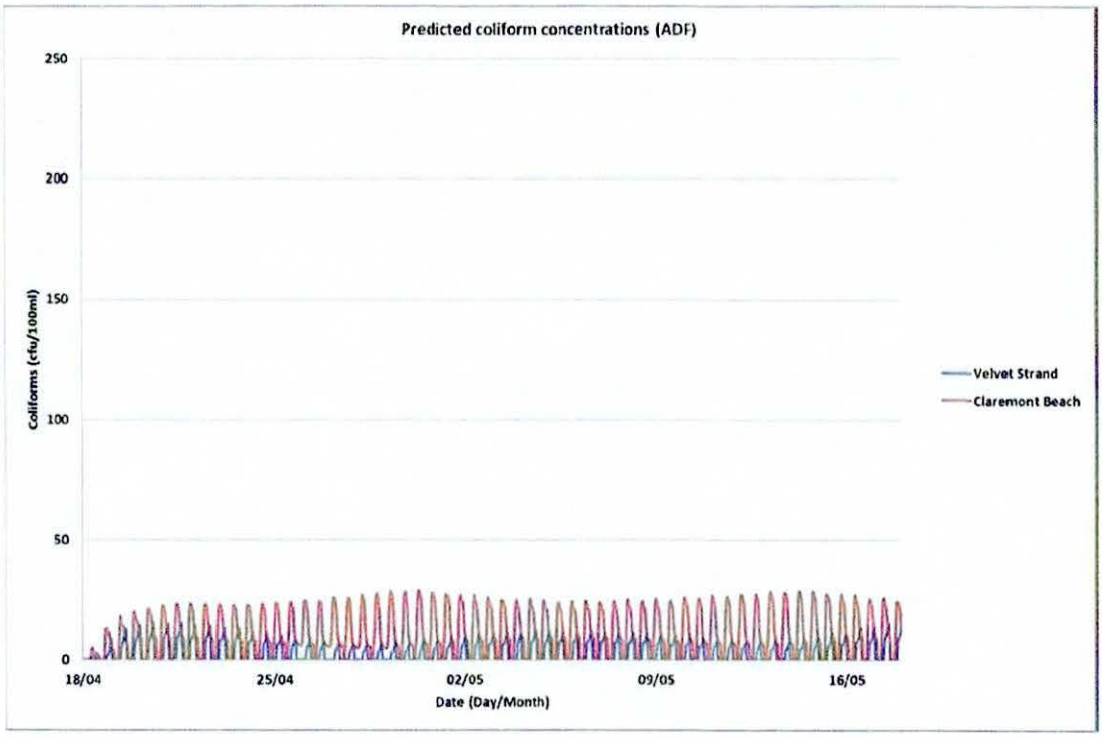


Figure 7: ADF "Fingal" model predictions of ecoli concentrations at Velvet Strand and Claremont

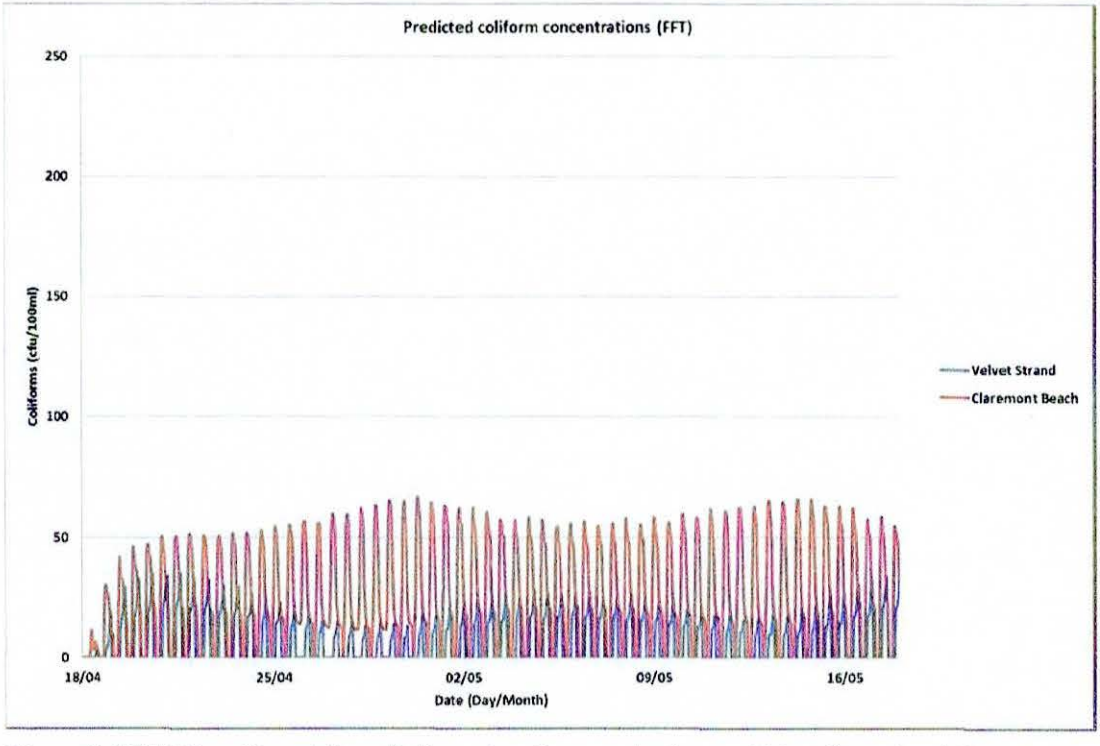


Figure 8: FFT "Fingal" model predictions of ecoli concentrations at Velvet Strand and Claremont

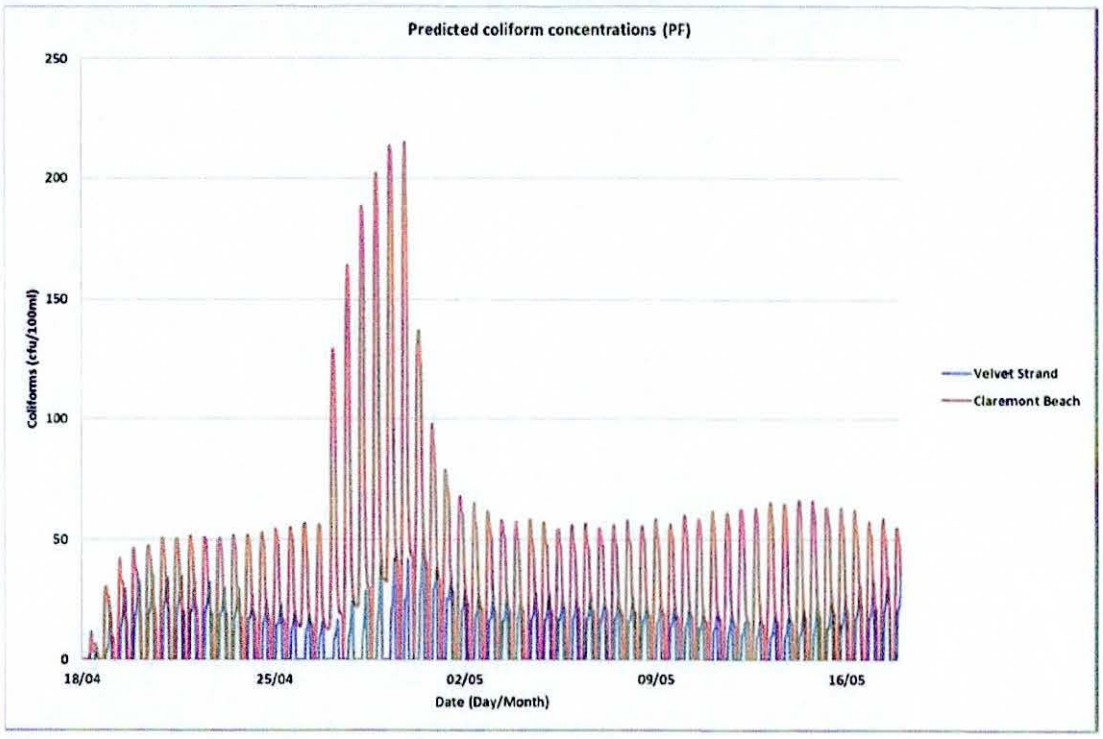


Figure 9: PF "Fingal" model predictions of ecoli concentrations at Velvet Strand and Claremont

The model predicted no compliance failures at the designated bathing water beaches, nor blue flag beaches arising from the proposed discharge of treated effluent. None of the scenarios predicted the likelihood of any significant impact on the receiving waters from the proposed operation of the outfall discharge.

4.2.2. Shellfish Waters

The evolution of ecoli concentrations over the period of the simulation at the designated shellfish monitoring point in the Malahide Shellfishery are presented in Figure 4 to Figure 6 for the Average Daily Flow (ADF), Flow to Full Treatment (FFT) and Process Failure (PF) scenarios respectively.

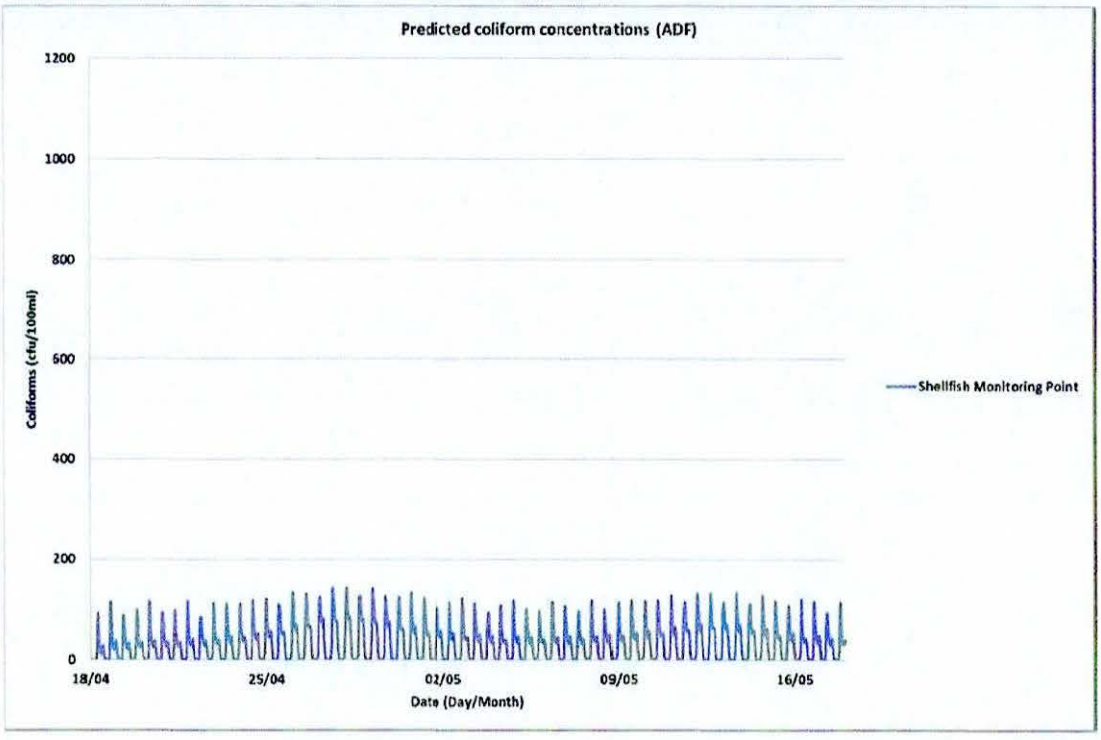


Figure 10: ADF "Fingal" model predictions of ecoli concentrations at Malahide Shellfish Monitoring Point.

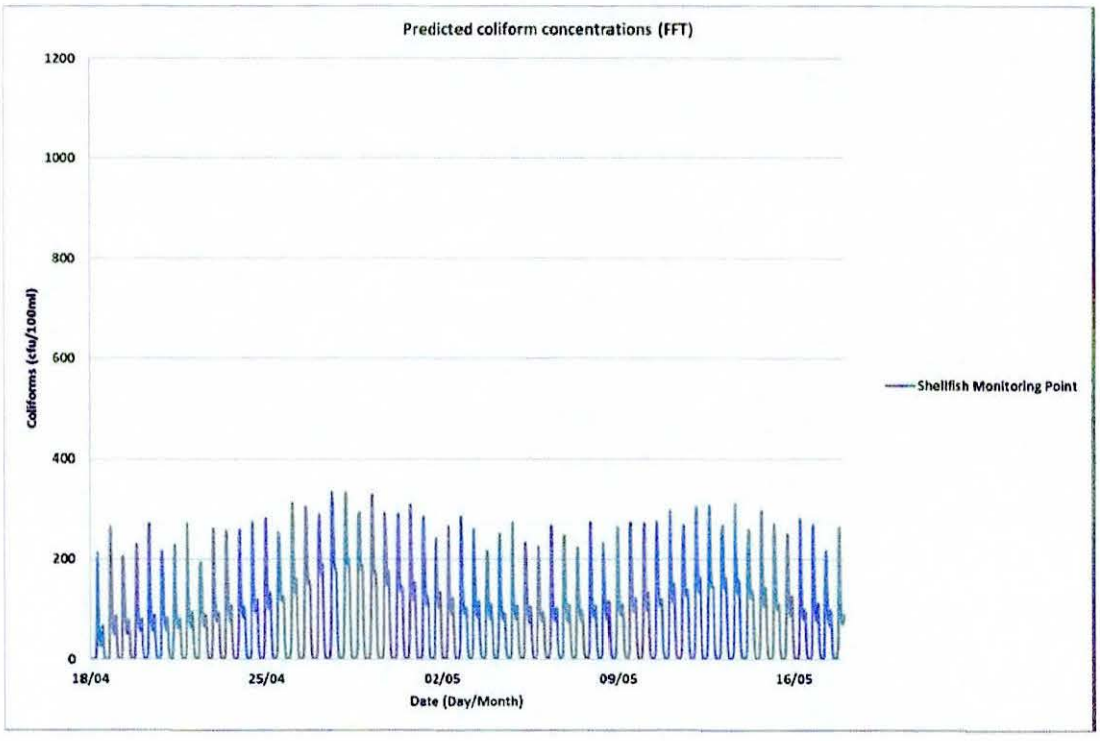


Figure 11: FFT "Fingal" model predictions of ecoli concentrations at Malahide Shellfish Monitoring Point.

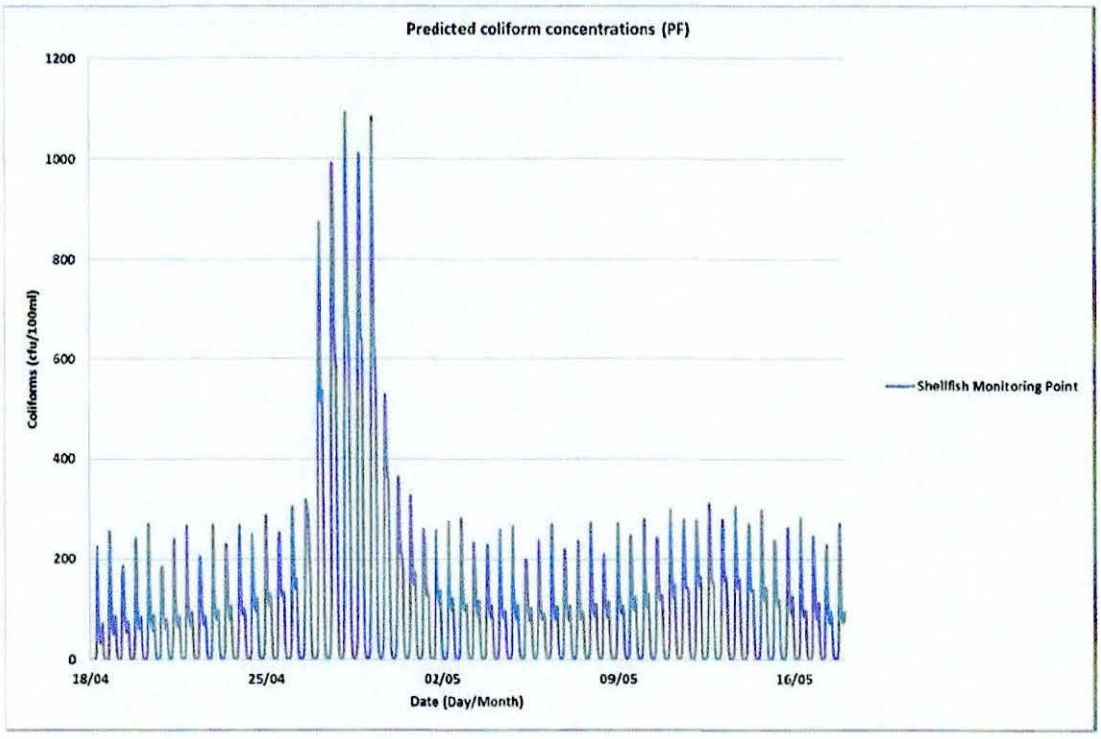


Figure 12: PF "Fingal" model predictions of ecoli concentrations at Malahide Shellfish Monitoring Point.

For Average Daily Flow scenario, the maximum predicted coliform concentration in the water near the seabed was 142 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 33.6 cfu/100ml.

For Flow to Full Treatment scenario, the maximum predicted coliform concentration in the water near the seabed was 330 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 77.4 cfu/100ml.

For Process Failure scenario, the maximum predicted coliform concentration in the water near the seabed was 1077 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 101.4 cfu/100ml.

2019 ?

5. March 2018: Revised "Fingal Co. Co." model scenarios

The "Fingal" 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 represented an extreme scenario that would not occur in a well-managed plant of the proposed size as 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.

Therefore, revised modelling of the above scenarios were undertaken to simulate "Ringsend levels" of treated wastewater coliform concentrations at 150,000 cfu/100ml discharging through the Proposed Project outfall.

5.1. Model Inputs

The proposed outfall modelled the continuous discharge of secondary treated effluent into the receiving waters for

- Average Daily Flow conditions (ADF),
- Flow to Full Treatment conditions (FFT), and,
- Process Failure discharging untreated effluent over a three day period (PF).

The data inputs to the model used in the "Fingal Co. Co." model scenarios are detailed in Table 4 below.

WwTP	Flow rate (m^3/s)	COLI (mpn/100ml)
Barnageeragh	0.09	1,000
Portrane	0.06	1,000
Malahide	0.05	1,500
Swords	0.16	100,000
Shanganagh	0.36	100,000
Ringsend (proposed upgrade future average)	6.95	300,000
Proposed Project (ADF)	1.63	150,000
Proposed Project (FFT)	3.78	150,000
Proposed Project (PF)	1.63	150,000 (18th April – 26th April) 750,000 (26th April – 29th April) 150,000 (29th April – 18th May)

Table 4: WwTP flows and loads defined to the "Fingal Co. Co." model.

5.2. Model Results

5.2.1. Bathing Waters

The model predicted no compliance failures at the designated bathing water beaches, nor blue flag beaches arising from the original "Fingal Co. Co." proposed discharge of 300,000 cfu/100ml treated effluent, and therefore there was predicted no compliance failures at the designated bathing water beaches, nor blue flag beaches arising from the revised "Fingal Co. Co." proposed discharge of 150,000 cfu/100ml treated effluent. None of the scenarios predicted the likelihood of any significant impact on the receiving waters from the proposed operation of the outfall discharge.

5.2.1. Shellfish Waters

For Average Daily Flow scenario, the maximum predicted coliform concentration in the water near the seabed was 61.5 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 16.7 cfu/100ml.

For Flow to Full Treatment scenario, the maximum predicted coliform concentration in the water near the seabed was 142 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 38.4 cfu/100ml.

For Process Failure scenario, the maximum predicted coliform concentration in the water near the seabed was 302 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 24.5 cfu/100ml. THIS breaches 230cf/100ml for Shellfish?

Subsequent to the above results 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. This further analysis is presented in Section 7: Statistical Analysis. 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.

she did not say this.

6. March 2018: Irish Water model scenarios

Irish Water requested two scenarios to be simulated to assess the impacts of discharging UV treated effluent with a coliform concentration of 20,000 cfu/100ml.

Scenario #1: Synthesised flow @ 20,000 cfu/100ml, no wind

The model commenced the simulation on 18/04/2015 at 00:00hrs with the proposed GDD Project discharging at the synthesised flow profile presented in Figure 13 (below). The Average Daily Flow (ADF) is included in Figure 13 for reference. The concentrations of coliforms in the effluent was 20,000 cfu/100ml. No wind field was specified.

Scenario #2: Synthesised flow @ 20,000 cfu/100ml, recorded wind field

The model commenced the simulation on 18/04/2015 at 00:00hrs with the proposed GDD Project discharging at the synthesised flow profile presented in Figure 13 (below). The concentrations of coliforms in the effluent was 20,000 cfu/100ml. Recorded wind speed and direction data from Dublin Airport was defined and presented in Figure 14 below.

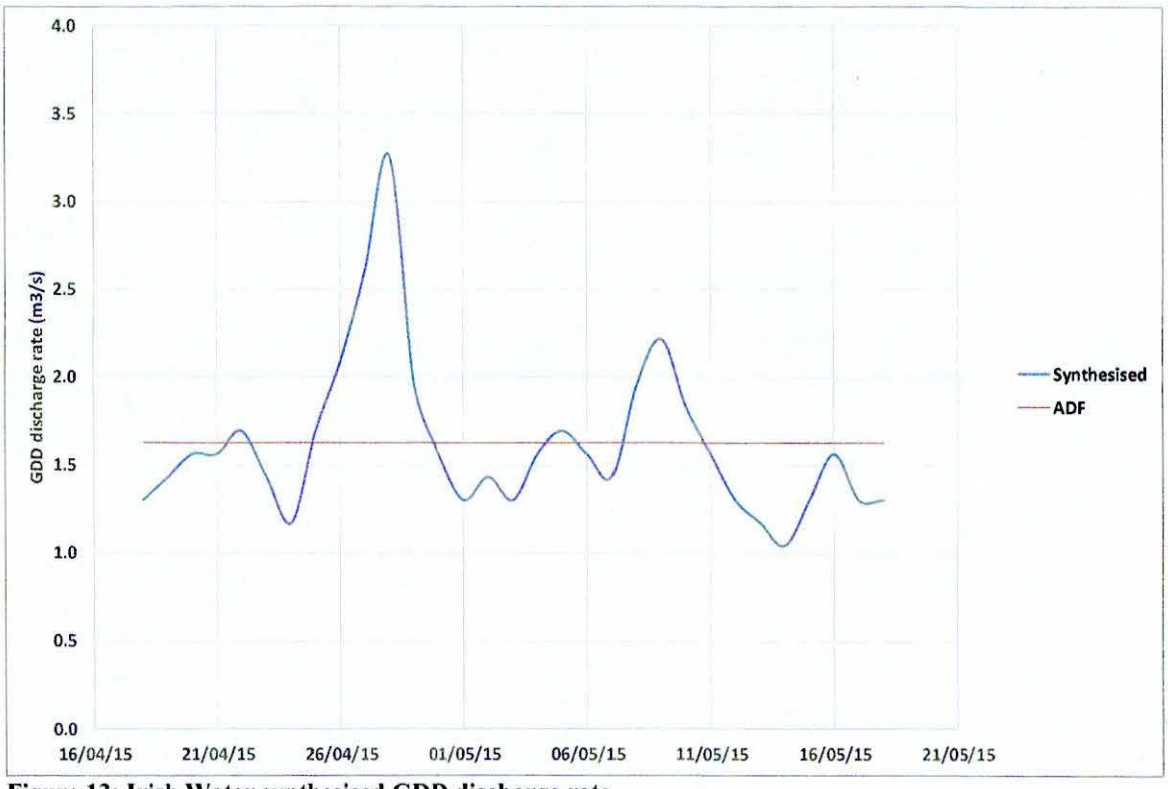


Figure 13: Irish Water synthesised GDD discharge rate.

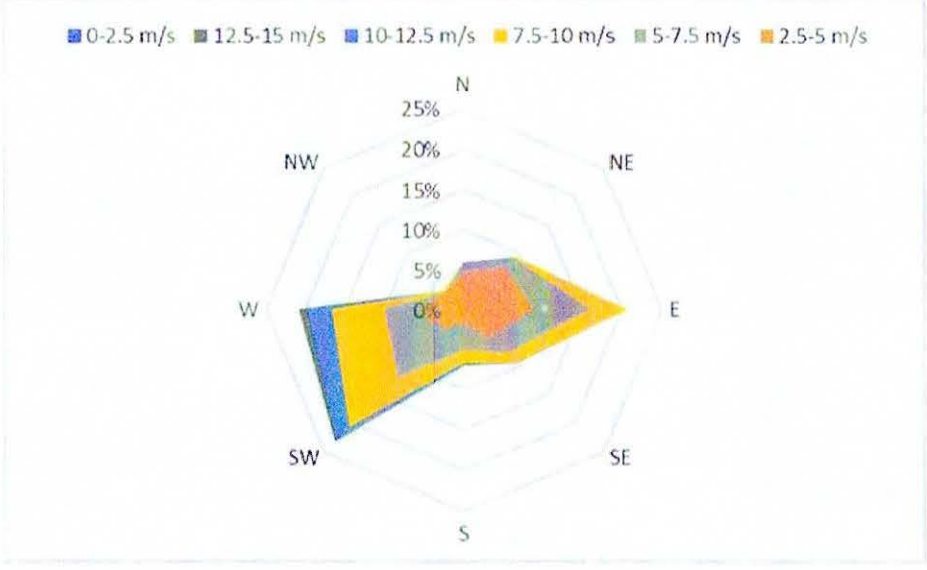


Figure 14: Dublin Airport windrose (18/04/2015 – 18/05/2015)

6.1. Model Results

6.1.1. Bathing Waters

The model predicted no compliance failures at the designated bathing water beaches, nor blue flag beaches arising from the original EIAR proposed discharge of 39,000 cfu/100ml treated effluent, and therefore there was predicted no compliance failures at the designated bathing water beaches, nor blue flag beaches arising from the synthesised Irish Water proposed discharge of 20,000 cfu/100ml treated effluent. None of the scenarios predicted the likelihood of any significant impact on the receiving waters from the proposed operation of the outfall discharge.

6.1.2. Shellfish Waters

The evolution of ecoli concentrations over the period of the simulation at the designated shellfish monitoring point in the Malahide Shellfishery are presented in Figure 15 to Figure 16 for the Average Daily Flow (ADF) scenario with and without wind respectively.

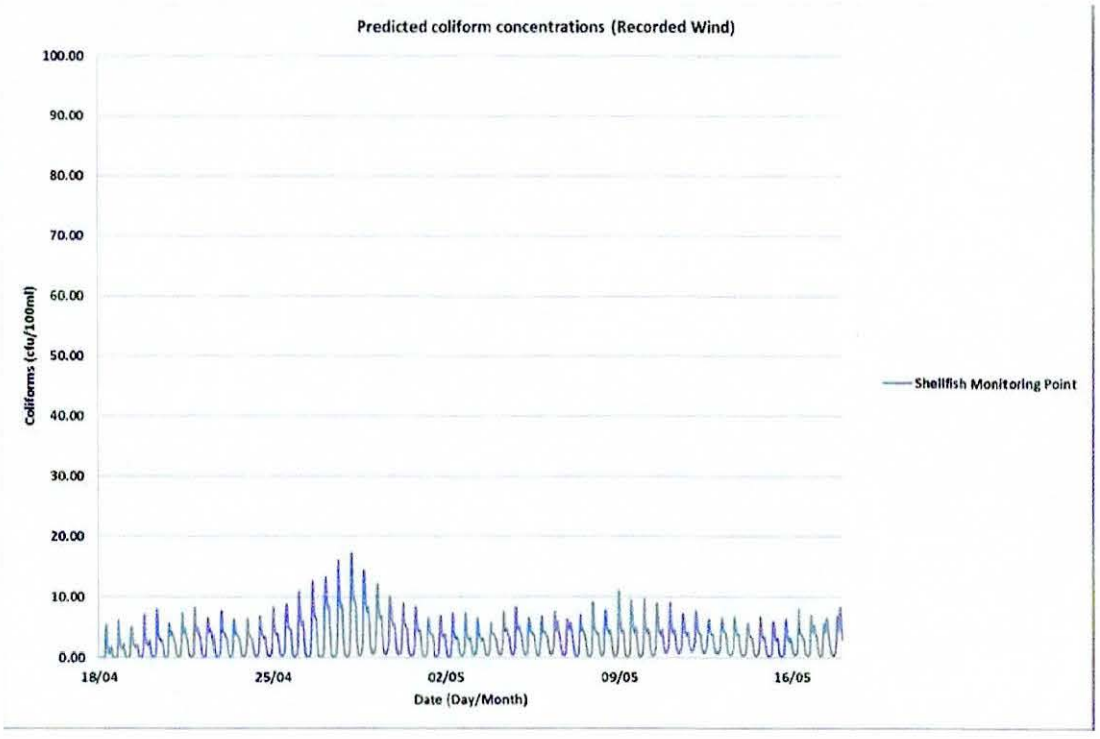


Figure 15: Irish Water (recorded wind) predictions of ecoli concentrations at Malahide Shellfish Monitoring Point

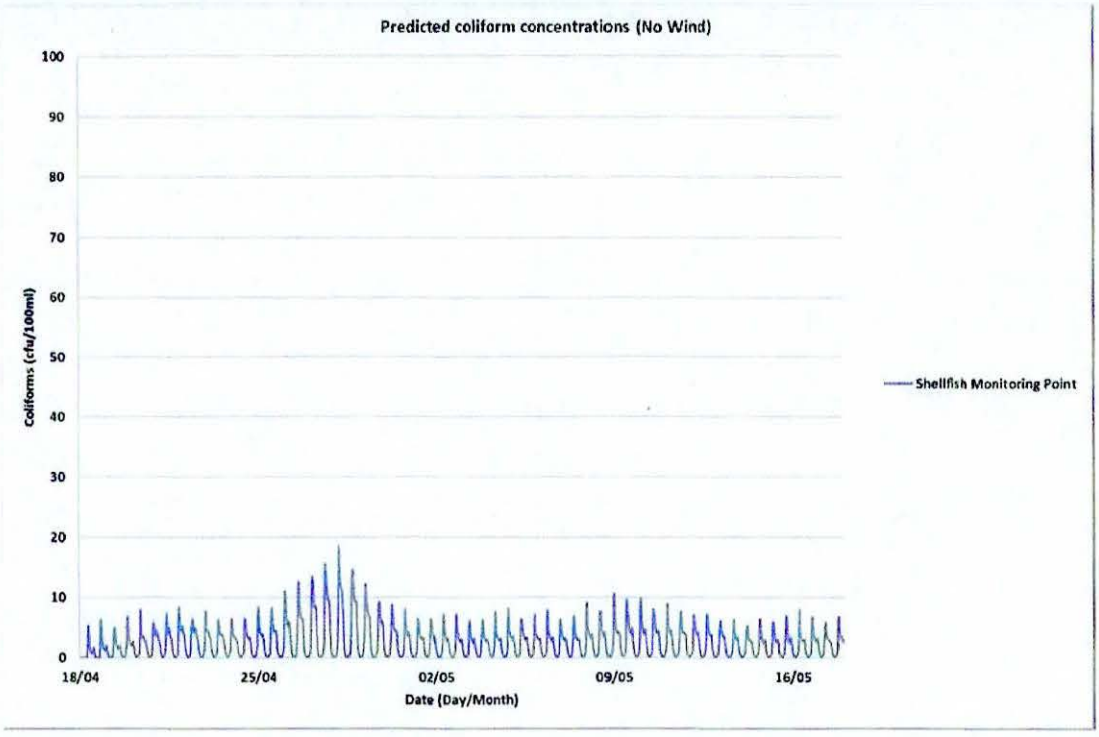


Figure 16: Irish Water (no wind) predictions of ecoli concentrations at Malahide Shellfish Monitoring Point

For Average Daily Flow (no wind) scenario, the maximum predicted coliform concentration in the water near the seabed was 18.3 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 2.7 cfu/100ml.

For Average Daily Flow (recorded wind) scenario, the maximum predicted coliform concentration in the water near the seabed was 17.2 cfu/100ml with the average coliform concentration over the course of the 30-day simulation predicted to be 2.9 cfu/100ml.

7. Statistical Analysis

Statistical analysis was undertaken on the concentrations of e.coli predicted by the model at the designated Malahide Shellfish Waters sampling point (53° 27.394'N, 6° 4.457'W) and at five points along the southern boundary (South_t2 to South_t6) of the designated Malahide Shellfishery for each of the model scenarios detailed above. These locations are designated t1, t2, t3, t4, t5 and t6 in Figure 17.

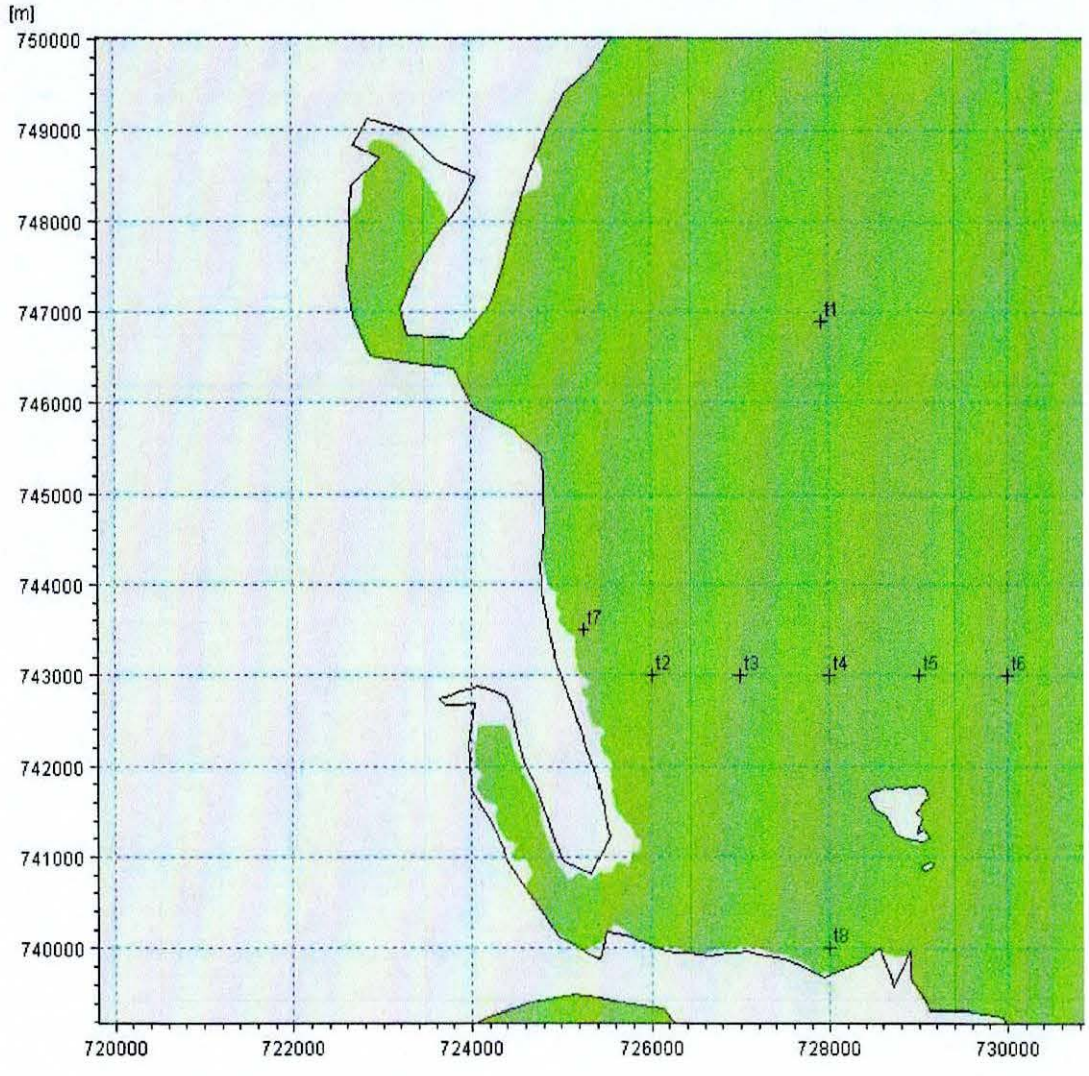


Figure 17: Locations t1 – t6 for statistical analysis

The results of the analysis are presented with reference to *Table 6: Indicative water standards required to achieve shellfish flesh standard of 230 E.coli mpn/100g* in "Impact of chronic microbial

pollution on shellfish". *Project WT093.* Cefas/CREH report to DEFRA. 88 pp., Cefas, 2013. The table is reproduced below.

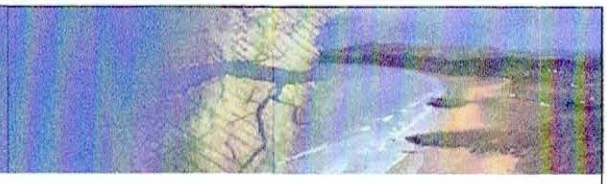
Table 6 - Indicative water standards required to achieve shellfish flesh standard of 230 *E. coli* MPN/100g

Species	No. samples /annum	Target annual compliance rate (%)	Compliance required in individual samples (%)	Geomean required in flesh (MPN/100g)	Estimated geomean *E. coli* in seawater (cfu/100ml)	Estimated 90%ile *E. coli* in seawater (cfu/100ml)
Mussels	4	95	99	21	1.7	6
	4	90	97	34	2.7	10
	4	80	95	44	3.4	12
	4	75	76	114	8	30
	12	90	95	44	3.4	12
	12	80	87	75	5.5	20
	12	75	76	114	8	30
Pacific oysters	4	95	99	11	1.7	12
	4	90	97	20	2.9	21
	4	80	95	28	3.8	28
	4	75	76	94	11	85
	12	90	95	28	3.8	28
	12	80	87	55	7	52
	12	75	78	86	11	79
Cockles	4	95	99	5.8	0.02	0.2
	4	90	97	12	0.04	0.4
	4	80	95	18	0.06	0.6
	4	75	76	79	0.22	2.2
	12	90	95	18	0.06	0.6
	12	80	87	41	0.12	1.2
	12	75	78	71	0.2	2.0
All species	4	95	99	2.2	0.33	4.8
	4	90	97	5.4	0.57	8
	4	80	95	8.7	0.75	11
	4	75	76	57	2.3	33
	12	95	99	2.2	0.33	4.8
	12	90	95	8.7	0.75	11
	12	80	87	25	1.4	20
	12	75	78	50	2.1	30

The statistical analysis of the data consisted of calculating both the geometric mean and the 90th percentile value of the predicted e.coli concentration in the water column near the seabed.

No data exists for the species of interest in the Malahide Shellfishery; the razor clam (*ensis spp*). Therefore indicative water standards required to achieve shellfish flesh standards of 230 ecoli/100mg of flesh for "All Species" are used in the analysis. The target compliance rate of 80% required in individual samples has been adopted.

Therefore, the target values to be met by the predictions of e.coli concentrations in the water column are a geometric mean value <1.4 cfu/100ml, and/or an estimated 90th percentile value <20 cfu/100ml.



The summary results from the statistical analysis are presented in Table 5 for the geometric mean comparisons, and in Table 6 for the 90th percentile comparisons for each of the Malahide Shellfish Monitoring Point and points South_t2 to South_t6, for each scenario detailed previously.

Parameter	Scenario		Malahide Shellfish Monitoring Point	South_t2	South_t3	South_t4	South_t5	South_t6	Target Value
Geometric Mean	EIAR	ADF	2.13	2.11	4.01	5.33	6.41	2.59	1.4
		FFT	4.00	4.54	8.67	11.53	13.95	5.56	
		PF	4.33	4.99	9.57	12.76	15.43	6.14	
	Fingal	ADF	11.03	14.24	26.71	33.71	39.95	15.39	
		FFT	24.22	32.65	61.26	77.18	91.68	35.18	
		PF	28.97	36.63	69.93	89.15	174.77	43.15	
	Revised Fingal	ADF	7.36	7.29	10.72	14.62	19.97	7.82	
		FFT	16.00	16.57	24.08	33.08	45.74	17.78	
		PF	8.69	8.96	12.92	17.75	24.39	9.70	
	Irish Water	No Wind	1.46	1.21	2.38	3.45	5.91	1.95	
		Wind	1.70	1.32	2.71	4.23	5.54	2.51	

Table 5: Comparison of geometric mean of model scenario predictions against the target value of 1.4

Parameter	Scenario		Malahide Shellfish Monitoring Point	South_t2	South_t3	South_t4	South_t5	South_t6	Target Value
90th Percentile	EIAR	ADF	11.77	3.03	4.78	7.66	10.09	4.07	20
		FFT	27.09	6.49	10.64	16.80	21.96	8.77	
		PF	32.28	7.08	13.51	22.23	28.14	10.86	
	Fingal	ADF	89.31	20.32	34.10	51.58	67.46	26.64	
		FFT	206.91	46.84	78.89	119.08	156.32	61.58	
		PF	243.96	53.83	123.01	193.95	370.39	95.50	
	Revised Fingal	ADF	43.61	9.81	15.04	19.34	32.27	14.23	
		FFT	100.85	22.55	34.72	44.64	74.56	32.90	
		PF	52.15	22.42	23.51	40.37	65.51	25.32	
	Irish Water	No Wind	6.38	1.79	3.16	5.49	13.00	3.90	
		Wind	6.47	1.98	4.23	8.76	14.65	7.40	

Table 6: Comparison of 90th percentile values from model predictions against the target value of 20.

Any combination of scenario and monitoring location that is less than the target value has been highlighted in green.

The results show that for the EIAR Average Daily Flow scenario, the Irish Water (wind) scenario, and the Irish Water (no wind) scenario the model predicted that the 90th percentile concentration of e.coli (20cfu/100ml) would not be exceeded at any of the monitoring points assessed.

[redacted]

From: Aberson, Marja
Sent: 21 May 2019 09:10
To: Kiernan, Sarah
Cc: Wilson, Rachel
Subject: RE: GDD - Shellfish Note from Marja

Hi Sarah,

Yes that's no problem.
Many thanks

Marja.

Dr Marja Aberson CBiol | Jacobs | Senior Marine Ecologist | Environment, Maritime & Resilience | +[redacted] | www.jacobs.com

From: Kiernan, Sarah
Sent: 20 May 2019 20:56
To: Aberson, Marja <Marja.Aberson@jacobs.com>
Cc: Wilson, Rachel <Rachel.Wilson@jacobs.com>
Subject: RE: GDD - Shellfish Note from Marja

Hi Marja,

We would really like to get the memo to Legal this week, would COB Wednesday include the CRAV by Victor? If not and Victor could look at it Thursday morning that's would still work.

Very happy for Victor to check Review the Memo, but given the intended purpose of the memo I wouldn't be keen to bring in additional names in at this stage.

Kind Regards,
Sarah

Sarah Kiernan BSc. MSc. MCIWEM C.WEM CEnv | Jacobs | Technical Director - Environment | Environment, Maritime & Resilience | [redacted] | www.jacobs.com

From: Aberson, Marja
Sent: 20 May 2019 17:10
To: Kiernan, Sarah <Sarah.Kiernan@jacobs.com>
Cc: Wilson, Rachel <Rachel.Wilson@jacobs.com>
Subject: RE: GDD - Shellfish Note from Marja

Hi Sarah,

Hope you had a good weekend.

Thank you for forwarding on that information, and apologies I had picked up the email earlier, but not had the chance to reply.

When do you need this by? I may not get it done till COP of Wednesday? Is that too late? Do let me know and I can shuffle stuff around.

Would you also like a couple of lines detailing the Jacobs staff member who will do the technical check of the memo, as it is also an important part of the of the technical writing process for us here in the Aquatics team.

Victor Guerra in our team, is a senior scientist who specialises in water quality so I have asked him to do the CRAV on the edited memo once ready this week for me. As an ecologist myself, it would be useful to have him to check it.

Many thanks

Marja.

Dr Marja Aberson CBiol | Jacobs | Senior Marine Ecologist | Environment, Maritime & Resilience | +[redacted] | www.jacobs.com

From: Kiernan, Sarah
Sent: 20 May 2019 08:33
To: Aberson, Marja <Marja.Aberson@jacobs.com>
Cc: Wilson, Rachel <Rachel.Wilson@jacobs.com>
Subject: FW: GDD - Shellfish Note from Marja

Hi Marja,

Please see below.

Kind Regards,
Sarah

Sarah Kiernan BSc. MSc. MCIWEM C.WEM CEnv | Jacobs | Technical Director - Environment | Environment, Maritime & Resilience | [redacted] | www.jacobs.com

From: O'Keeffe, Ciaran
Sent: 19 May 2019 10:57
To: Kiernan, Sarah <Sarah.Kiernan@jacobs.com>
Cc: McGlynn, Stephanie <Stephanie.McGlynn@jacobs.com>
Subject: GDD - Shellfish Note from Marja

We only received this summary after the OH on request to Dan.

Hi Sarah,

As discussed we require a 'brief of Evidence' style note from Marja summarising (stressed) the advice provided to us to address the concerns raised by FCC re the shellfish. Marja's previous memo should be used as a basis from which the summary is to be drawn from. Suggested items include the following:

- Name & Qualifications
- Involvement with the project i.e. from when we asked her to undertake some research to address FCC concerns (this relates to how we responded to their original concerns re the level of ecoli in the discharge – Response to Submissions document – and relying on the flushing mechanism of the tides. See attached email from ALG)
- Brief summary of the Malahide shellfishery, map of area, indicate sampling point, classification, main type of shellfish harvested and any other info Marja found in her search;
- Statement that the shellfish standards relate to ecoli levels in the shellfish flesh and not the water column

- Summary of desktop search for shellfish standards in the water column
- Summary of CEFAS studies, attach table of indicative guide values as an appendix
- Statement that no research on razor clams was found
- Statement on status of these CEFAS guide values (e.g not adopted as a 'standard' only indicative guide values)
- Statement providing Marja's final advice to us along the lines that due to the closeness of the shellfish area to the outfall pipe and the Class A classification of the shellfishery and the CEFAS research we should apply the precautionary principle and seek to meet the 80%ile CEFAS indicative guide value for 'all species' throughout the shellfishery.

ALG will review/comment on this similar to the Brief's of Evidence. If you have any questions you can get me up to 10.30am on Monday morning. I am going silent thereafter.

Regards

Ciarán

[redacted]

OH MARCH 2019.

From: Aberson, Marja
Sent: 22 May 2019 16:20
To: Kiernan, Sarah; O'Keeffe, Ciaran
Subject: RE: Brief of evidence - Shellfish
Attachments: Brief of Evidence_Shellfish_21.5.19_for review.docx

Follow Up Flag: Follow up
Flag Status: Completed

HI Sarah

Please find attached a CRAV'd memo for shellfish, shortened to ~ 2 ½ pages (+ ref list + tables in appendix) and in the style of a defence brief as requested.

Many thanks

Marja.

Dr Marja Aberson CBiol | Jacobs | Senior Marine Ecologist [redacted]

JACOBS

An Bord Pleanála Oral Hearing

Irish Water

Greater Dublin Drainage

Brief of Evidence

Shellfish

Dr Marja Aberson

Qualifications and Role on the Proposed Project

1. My name is Dr Marja Aberson and I am a Senior Marine Ecologist at Jacobs where I have over eight years professional experience in marine environmental consultancy. I have been involved with delivering marine environmental projects for a wide range of infrastructure projects in the UK, offering specialist advice on benthic ecology. I am a Chartered Biologist with the Royal Society of Biology and I have a combined Bachelor of Science honours degree in Marine Biology and Zoology from the University of Wales Bangor, a Master of Science in Coastal Zone Management from Bournemouth University and a Doctorate from Queen Mary University of London in Marine Ecology.

2. I have been involved in the Proposed Project since March 2019. Back then, I undertook desk-based research to address Fingal County Council's (FCC) concerns on the potential impact of the discharge on the classification status of the Malahide shellfishery (razor clams). The study also focused on understanding how the levels of faecal coliforms (as measured by counts of the bacteria *Escherichia coli*) can be related to the uptake and concentration in shellfish. The findings are summarised in this Brief of Evidence.

The Malahide Shellfishery

3. Of the shellfish waters in the area, the Malahide production area (site name: DN-ME) is the closest one to the proposed outfall pipeline route. Here, harvesting for the razor clam *Ensis* sp. (predominantly *Ensis siliqua*) occurs over the winter months in the area. At the start of the project in 2011, the Malahide Shellfish fishery was assigned a 'Class B' on the harvesting classification, but since then currently holds an 'A Status'. The classifications criteria is outlined in Table 1~~Table 1~~, Appendix A.

4. At the time of conducting the research (March 2019) the Malahide production area had a status of 'Open', as determined by the result of the last sample of *E. siliqua* analysed (5 February 2019). The sample was collected as part of the HABs (Harmful Algal Blooms) Shellfish Monitoring Programme. However, the current status, set by the last sample taken (12 April 2019), is 'Closed – expired'. This is defined as *'sample frequency for the species listed has expired and the area is now Closed for the listed species'*. At present, a further clear test is required before harvesting for direct consumption resumes at Malahide for *E. siliqua* as mentioned in the Marine Institute Report 19-15g, published on 16 April 2019 (Marine Institute, 2019).

INSERT MAP HERE?

Commented [AM1]: I don't have a map of DN-ME, only sourced one from MI website, not downloadable and of poor quality.

Is there a GIS file of proposed pipeline along with the shellfish boundary for Malahide? And with the DN-ME sampling point?

Shellfish Hygiene Standards in live bivalve molluscs

5. At present hygiene standards for live bivalve molluscs (LBM) (hereafter referred to as 'shellfish') are applied to concentrations of the bacteria *Escherichia coli* (*E. coli*) in the flesh of the organism and not the water column. Under Directive 2006/113/EC (repealed and incorporated in Directive 2000/60/EC, the EU's Water Framework Directive, since 2013) on the quality required of shellfish waters, there is a statutory guideline microbiological standard (SWD G) of 300 faecal coliforms per 100ml in shellfish flesh and intravalvular liquid (in 75% of shellfish samples). Concentrations of *E. coli* in flesh will also determine the classification of a production areas as either A, B or C. This regulates the treatment required before shellfish can be marketed for human consumption (Table 1~~Table 1~~, Appendix A).

***E. coli* uptake in shellfish in response to concentrations in seawater**

6. It can be difficult to directly quantify the relationship between *E. coli* concentrations in the water to the uptake and accumulation in the flesh of shellfish. Recent projects, undertaken by Cefas (Centre for Environment Fisheries and Aquaculture Science) in the UK have sought to:

   - explore the relationship between the microbial quality of shellfish flesh and seawater;
   - understand the dynamics of uptake and clearance of *E. coli* in shellfish subject to chronic contamination; and
   - identify water concentrations of *E. coli* which would be compliant with the current standards in the flesh of bivalve molluscs.

   This was done through desk-based assessments, microcosm laboratory studies and *in situ* environmental investigations coupled with hydrodynamic modelling, and the results of which are summarised below (paragraphs 7 to 12~~14~~11).

7. Concentrations of *E. coli* in seawater and in the flesh of mussels (*Mytilus* spp.) and oysters (*Ostrea edulis* and *Magallana gigas*) sampled across production areas in the UK by Cefas reported a positive linear relationship between increasing *E. coli* concentrations in the water and flesh. The level of contamination between the species was variable indicating inter-specific differences in uptake. The overall high variability found in the data may be expected in the naturally variable environmental conditions in which these samples had been sourced (*Project WT1001* Cefas, 2011).

8. Cefas microcosm experiments monitored uptake in the mussel *Mytilus edulis*, the oyster *M. gigas*, and the cockle *Cerastoderma edule*, exposed to chronic exposure (continuous dosing for five days) to a range of water quality levels (1 cfu/100ml – 330 cfu/100ml). A rapid uptake of *E. coli* was shown for all species to a maximum 'equilibrium' (plateau state) within 17 hours, and on cessation of dosing, a rapid clearance was also exhibited (*Project WT093* Cefas, 2013). There is a threshold for *E. coli* concentrations in the water above which bivalves are unable to accumulate more bacteria, however, this maximum 'equilibrium' state will vary between both individuals and species (*Project WT1001* Cefas, 2011).

9. These microcosm experiments found that although flesh concentrations increased linearly with concentrations of the tank seawater, there was no direct association with an increase in seawater concentrations of the microcosms and resulting accumulation factor. Accumulation rates ranged from 11.7 for *M. gigas*, 15.2 for *M. edulis* and 330 for *C. edule*. The rate of clearance following the end of dosing was not as proportionate to the changes in water column and rate of accumulation in tissues. Bacteria can be rapidly cleared from shellfish when exposed to clean waters, with an initial phase of greatest clearance lasting <10hrs (*Project WT093* Cefas, 2013).

10. Environmental investigations were undertaken to verify whether the results implied by the microcosm experiments could be confirmed in shellfish waters (*Project WT093* Cefas,2013). It was found that the relative ordering in inter-species *E. coli* accumulation remained valid with other studies and the microcosms. However, no clear statistically significant difference between mean *E. coli* concentrations between the three species sampled from these environmental investigations were reported, only in comparison with *E. coli* seawater concentrations. The wide variation in concentrations recorded in these waters and flesh supported the wide variability also reported from naturally sampled concentrations under *Project WT1001* (Cefas, 2011).

11. As direct measurements of water quality in those environmental investigations did not significantly correlate with *E. coli* shellfish concentrations, hydrodynamic modelling for predicted *E. coli* concentrations was done for near-real-time predictions for where the shellfish bags had been positioned. No statistically significant correlation between water quality and the laid shellfish was found. However, diurnal and tidal patterns in concentrations had been found to be important, indicating a ubiquitous and high 'natural' variability in *E. coli* concentrations, with differences exceeding 2 10-base logarithm orders diurnally even under dry conditions. It was concluded that such short-term variability in bacterial concentrations may now be considered the 'normal' condition (Cefas, 2013).

Indicative water quality standards

12. Based on the results of these Cefas projects, indicative thresholds for *E. coli* water concentrations for mussels, oysters and cockles were predicted, so to meet compliance with SWD G (≤300 cfu/100g) and the harvesting classifications A (<230 cfu/100g) and B (<4,600 cfu/100g). Indicative water concentrations for each of the three types of bivalves and 'all species combined' to meet the SWD G and class A standards for flesh concentrations are shown in

Species	Study type	Geometric mean Seawater cfu/100ml	90th percentile Seawater cfu/100ml	Sample size	Reference
Mussels *Mytilus* spp.	Natural sampling	8.9	102	313 individuals (pooled sites)	Cefas (2011)
Mussel *M. edulis*	Microcosm	10	38	predicted from 12 samples taken per annum	Cefas (2013)
Oyster *M. gigas*	Natural sampling	41	492	111 individuals (pooled sites)	Cefas (2011)

Commented [AM2]: Suggest don't include, keep high level and not include too much detail on concentrations used,but state overall findings

Commented [GV3R2]: I would keep it

Commented [AM4R2]: Please could ALG review this here

Commented [AM5]: As above , suggest removal of time to avoid being too prescriptive at this stage .

Commented [GV6R5]: Still I would keep it

Commented [AM7R5]: Please could ALG review this here

Commented [AM8]: If you need more details. The hydrodynamic model was a two-dimensional water quality model called DIVAST

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~~1.1~~ Species	Study Type	Geometric mean Seawater cfu/100ml	90th per centile Seawater cfu/100ml	Sample size	Reference
Oyster *M. gigas*	Microcosm	13	100	predicted from 12 samples taken per annum	Cefas (2013)
Oyster *O. edulis*	Natural sampling	8.3	64	178 individuals (pooled sites)	Cefas (2011)
Cockle *C. edule*	Microcosm	0.26	2.5	predicted from 12 samples taken per annum	Cefas (2013)

~~13.~~ Table 3

14. ~~Table 2~~ and Table 3~~Table 3~~, respectively (Appendix B). On examination of the indicative standard values it is apparent that there are a wide range of predicted thresholds for concentrations of *E. coli* in seawater in order to meet compliance.

***E. coli* uptake in razor clams**

15. There has been very little research undertaken on the uptake of *E. coli* in razor clams in comparison to other commercial species (e.g. the mussel *M. edulis*), and sensitivity assessments of this bivalve group to environmental pressures, currently has a paucity of evidence on responses to biological pressures (Hill, 2006). An important knowledge gap was identified by Cefas for *Ensis* spp. (Cefas, 2014) which was further validated in this recent research exercise.

Conclusions

16. Although there is often a clear linear relationship between concentrations of *E. coli* in seawater versus shellfish, at present there remains no agreed upon *E. coli* seawater concentration guideline value in which to monitor against. Studies have shown that for compliance there can be wide range in predicted *E. coli* concentrations calculated, that is primarily dependent upon the targeted species in question and methods of assessment (artificial microcosm verses natural environment). As such these studies have not supported the application of a single guideline value for water quality where research has focussed on only a few commercial species, which currently has not included the razor clam *Ensis* spp.

17. A review by Cefas (2014) has attempted to assess the evidence for potential use of indicator species to classify shellfish production areas. It was concluded that the mussel *Mytilus* spp. may be used as an indicator in many situations, but an indicator approach may not be recommended at this stage for representation of *Ensis* spp. due to no supporting data available. Due to the paucity of data, it will be imprudent to estimate a potential accumulation factor in the tissues of razor clams as current work has shown a wide range of uptake rates and maximum concentrations between bivalve species, and with spatial-temporal differences also expected.

18. In consideration of the proximity of the proposed outfall pipe, the current classification of A and the scarcity scarcity of data on *Ensis* spp., a precautionary principle should be applied for assessing the risk to the Malahide razor clam fishery. It is therefore recommended that Irish Water should seek to meet the Cefas indicative threshold value for 'all species' throughout the shellfishery (Table 3~~Table 3~~, Appendix 2).

The Shellfishery extends to South Portmarnock

References

Cefas, 2011. Relationship between the microbial quality of shellfish flesh and seawater in UK harvesting areas. *Project WT1001 Factors affecting the microbial quality of shellfish.* Cefas report to Defra. 33 pp.

Cefas, 2013. Impact of chronic microbial pollutions on shellfish. *Project WT093.* Cefas/CREH report to Defra. 88 pp.

Cefas, 2014. A critical review of the current evidence for the potential use of indicator species to classify UK shellfish production areas. Report No. FS512006. 83 pp.

Hill, J.M., 2006. *Ensis ensis* A razor shell. In Tyler-Walters H., and Hiscock, K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 07-03-2019]. Available from: https://www.marlin.ac.uk/species/detail/1419.

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Marine Institute, 2019. HABs Shellfish Monitoring Programme. InShore (Classified) Production Area. Malahide (DN-ME). https://webapps.marine.ie/HABs/AreaStatus/AreaStatusSummary?locationId=44&locationNameCode=Malahide%20%20(DN-ME)&locationType=Onshore&isFinfish=false [Accessed 21.05.19]

Sea-Fisheries Protection Authority (SFPA), 2017. Code of Practice for the Microbiological Monitoring of Bivalve Mollusc Production Areas (COP SH01) Version 6 May 2017.

Appendix A

Table 1: Criteria for the classification of bivalve mollusc harvesting areas under Regulation (EC) no 854/2004, Regulation (EC) 853/2004 and Regulation (EC) 2073/2005. Table extracted from Code of Practice for the Microbiological Monitoring of Bivalve Mollusc Production Areas (SFPA, 2017)

Classification	Standard per 100g of LBM flesh and intravalvular fluid	Treatment required
A	<230 *E. coli* per 100g of flesh and intravalvular liquid (*)	None
B	Must not exceed the limits of a five-tube, three dilution. Most Probably Number (MPN) test of 4,600 *E. coli* per 100g of flesh and intravalvular liquid (**).	Purification, relaying in class A or cooking by an approved method.
C	Must not exceed the limits of a five-tube, three dilution MPN test of 46,000 *E. coli* per 100g of flesh and intravalvular liquid.	Relaying for a long period or cooking by an approved method.
Prohibited	>46,000 *E. coli* per 100g of flesh and intravalvular fluid.	Harvesting not permitted.

(*) Samples must not exceed, in 80% of samples collected during the review period, 230 *E. coli* per 100g of flesh and intravalvular liquid. Remaining 20% must not exceed 700 *E. coli* per 100g of flesh and intravalvular liquid.

(**) Area may remain classification B for which relevant limits of 4,600 *E. coli* per 100g are not exceeded in 90% of samples.

Appendix B

Table 2: Indicative concentrations of *E. coli* in seawater (geometric mean and 90th percentile) to achieve annual 75% compliance with standard for SWD G (500 cfu/100g) in shellfish

Species	Study Type	Geometric mean Seawater cfu/100ml	90th percentile seawater cfu/100ml	Sample size	Reference
Mussels *Mytilus* spp.	Natural sampling	8.9	102	313 individuals (pooled sites)	Cefas (2011)
Mussel *M. edulis*	Microcosm	10	38	predicted from 12 samples taken per annum	Cefas (2013)
Oyster *M. gigas*	Natural sampling	41	492	111 individuals (pooled sites)	Cefas (2011)
Oyster *M. gigas*	Microcosm	13	100	predicted from 12 samples taken per annum	Cefas (2013)
Oyster *O. edulis*	Natural sampling	8.3	64	178 individuals (pooled sites)	Cefas (2011)
Cockle *C. edule*	Microcosm	0.26	2.5	predicted from 12 samples taken per annum	Cefas (2013)

Table 3: Indicative concentrations of *E. coli* in seawater (geometric mean and 90th percentile) to achieve annual 80% compliance with standard for harvesting Classification A (Cefas, 2013).

Species	Study Type	Geometric mean seawater cfu/100ml)	90th percentile seawater cfu/100ml	Number of samples / annum
Mussels (*Mytilus* spp.)	Microcosm	5.5	20	12
Pacific oysters (*M. gigas*)	Microcosm	7	52	12
Cockles (*C. edule*)	Microcosm	0.12	1.2	12
All species	Microcosm	1.4	20	12

[redacted]

From: O'Keeffe, Ciaran <Ciaran.OKeeffe@jacobs.com>
Sent: 30 July 2019 09:52
To: Callista Brien
Cc: Jane Chambers; Seamus Ryan; Geoff OSullivan
Subject: RE: [EXTERNAL] [redacted]
Attachments: [redacted]

Follow Up Flag: Follow up
Flag Status: Flagged

Callista,

My comments are as per attached. Call me if you require further clarification.

Regards

Ciarán

From: Callista Brien
Sent: 25 July 2019 21:03
To: O'Keeffe, Ciaran
Cc: Jane Chambers ; Seamus Ryan ; Geoff OSullivan
Subject: Fwd: [EXTERNAL] [redacted]

Hi Ciaran

We have been requested for a specific response to the issues raised by [redacted] in his submissions to the GDD planning process.

A draft response is attached, the majority of which is taken from the response report.

I would be grateful if you could review to ensure the content is technically correct and revert with any comments/ amends.

Ideally we need to issue a response by Tuesday next week so if you could advise if that is achievable.

Many thanks
Callista

From: Dan O'Boyle <dan.oboyle@rpsgroup.com>
Date: 25 July 2019 at 11:23:11 IST
To: Callista Brien <Callista.Brien@ervia.ie>
Cc: Geoff OSullivan <Geoff.OSullivan@ervia.ie>, Jane Chambers <Jane.Chambers@ervia.ie>, Seamus Ryan <Seamus.Ryan@ervia.ie>, David Conneran <david.conneran@rpsgroup.com>, Joanne Frehill <joanne.frehill@rpsgroup.com>
Subject: RE: [EXTERNAL] [redacted]

Hi Callista,

As requested, please find attached a draft response to [redacted].

The attached letter collates the responses to the issues raised by [redacted] in his written and oral submissions to the statutory consultation process (copies attached for reference).

In preparing the detailed response, we reviewed the Response to Submissions Report and researched all the relevant oral hearing Briefs of Evidence and Response Statements.

For ease of reference when reviewing the draft response, I have included the issues raised by [redacted] as comments.

Best regards,

Dan

Dan O'Boyle
Technical Director, Project Communications
[redacted]

From: Callista Brien <Callista.Brien@ervia.ie>
Sent: Wednesday 24 July 2019 12:30
To: Dan O'Boyle <dan.oboyle@rpsgroup.com>
Cc: Geoff OSullivan <Geoff.OSullivan@ervia.ie>; David Conneran <david.conneran@rpsgroup.com>
Subject: [redacted]

Hi Dan

[redacted] has asked us to respond directly on the issues he raised at the oral hearing. Could you prepare a draft response ?

Many thanks,
Callista

From: Dan O'Boyle [mailto:dan.oboyle@rpsgroup.com]
Sent: 12 July 2019 13:33
To: Callista Brien <Callista.Brien@ervia.ie>
Cc: Geoff OSullivan <Geoff.OSullivan@ervia.ie>; David Conneran <david.conneran@rpsgroup.com>
Subject: [redacted]

Hi Callista,

As requested, please find attached a short memo to inform your internal discussions in relation to the recent engagement [redacted].

Please let me know if you have any questions or would like us to develop a written response [redacted].

Best regards,

Dan

Dan O'Boyle
Technical Director, Project Communications
[redacted]

From: Callista Brien <Callista.Brien@ervia.ie>
Sent: Wednesday 10 July 2019 17:42
To: Dan O'Boyle <dan.oboyle@rpsgroup.com>
Cc: Geoff OSullivan <Geoff.OSullivan@ervia.ie>; David Conneran <david.conneran@rpsgroup.com>
Subject: [redacted]

Dan

Further to our conversation if you could pull together the following please

1. History of engagement [redacted], whatever we had pulled together for the response report is perfect- also perhaps where we responded to his submission in the report, there is a matrix I think included?

2. Where we responded to the issues he raised at the OH - the plant failure overall was dealt with in Ciaran statement I think he also raised the issues of the assessment of the outfall?

It doesn't need to be formatted for issue - but I need to brief internally before we prepare a response.

Many thanks
Callista

RPS Group Plc web link: http://www.rpsgroup.com

RPS Group Plc web link: http://www.rpsgroup.com

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Thank you for your attention.

Is don té nó an t-eintiteas chuig a seoltar an fhaisnéis atá an fhaisnéis seo beartaithe agus d'fhéadfadh ábhar faoi rún, atá íogair ó thaobh tráchtála agus/nó faoi phribléid a bheith mar chuid de. Tá cosc ar dhuine ar bith nó ar eintiteas ar bith seachas an té chuig a raibh sí beartaithe, an fhaisnéis seo a athbhreithniú, a athsheoladh, a scaipeadh nó aon úsáid eile a bhaint aisti, nó gníomh a ghlacadh bunaithe uirthi agus d'fhéadfadh sin a bheith in aghaidh an dlí. Ní ghlacfaidh Ervia aon fhreagracht maidir le gníomhartha nó iarmhairtí a bheadh bunaithe ar úsáid thoirmiscthe na faisnéise seo. Ní bheidh Ervia freagrach maidir le seachadadh cuí ná iomlán na faisnéise atá sa chumarsáid seo ná maidir le haon mhoill a bhainfeadh lena fáil. Má fuair tú an teachtaireacht seo trí dhearmad, déan teagmháil le do thoil leis an té a sheol í agus scrios an t-ábhar de gach ríomhaire.

Uisce Éireann
Teach Colvill
24-26 Sráid Thalbóid
Baile Átha Cliath 1
Éire

Irish Water
Colvill House
24-26 Talbot Street
Dublin 1
Ireland

[redacted]

25 July 2019

Re: Response to issues raised regarding the Greater Dublin Drainage Project

Dear [redacted]

Thank you for attending the recent meeting with our Public Affairs team.

Commented [DO1]: Callista – can we update with correct meeting details please.

We noted your query concerning the Greater Dublin Drainage (GDD) project and Irish Water's response to the issues raised in your written submission to the statutory consultation process including the recent oral hearing as held by An Bord Pleanála.

We are pleased to provide you with a written compilation of the responses to the issues raised in your written and oral hearing submissions. The responses were presented in the Irish Water - Greater Dublin Drainage Project: Response to Submissions Report (January 2019) as published on the GDD Planning Application Website and in the expert witness testimony as delivered to the oral hearing held by An Bord Pleanála held in March-April 2019. We trust that the responses, as collated in this document, confirm that the issues which you raised were considered and responded to in full.

Greater Dublin Drainage Project Planning Update

Continued population growth and increased commercial activity means the volume of wastewater generated in greater Dublin is projected to increase by more than 50% in the next 30 years.

Greater Dublin Drainage (GDD) is the development of a new regional wastewater treatment facility and associated infrastructure to serve the Greater Dublin Area, in particular, the population of north Dublin along with small parts of the surrounding counties of Kildare and Meath.

A new regional plant is required to provide the additional treatment capacity needed once the country's largest wastewater treatment facility at Ringsend reaches its ~~upgraded its~~ maximum upgraded capacity by the mid-2020s.

Following detailed site investigations, extensive environmental assessments and wide-ranging public consultations over a seven-year period, on 20th June 2018, Irish Water made an application for strategic infrastructure development to An Bord Pleanála for the GDD project. An oral hearing was held by An Bord Pleanála, from March-April 2019. The application is now undergoing adjudication by the planning authority. An Bord Pleanála has indicated a decision timeframe of 27th September 2019.

It is vital that we have adequate wastewater treatment capacity in place when needed in order to protect public health, to safeguard our environment and to support the sustainable social and economic growth of communities across the Dublin area into the future. An additional regional wastewater treatment facility – capable of providing advanced wastewater treatment for up to half a million people – has been found to be the most environmentally, technically and economically advantageous solution to meeting the long-term wastewater needs of the north Dublin area.

Commented [CO2]: The WwTP capacity is expressed in 'population equivalents'. Approx 3/5ths of load is from the non-domestic sector (includes headroom allowance).

This GDD project will help to ensure that the wastewater generated every day in our homes and workplaces will continue to be treated safely in compliance with the EU and national wastewater treatment regulations.

Responses to the issues raised in written submission by Cllr. D Healy to An Bord Pleanála received on 17/08/18.

The references contained in the responses below are to the Irish Water - Greater Dublin Drainage Project: Response to Submissions Report (January 2019).

1. Site Notices at Howth and Ireland's Eye

Commented [DO3]: [redacted] issue:

There were no site notices at the land locations nearest to the outfall nor at the locations where people take boats to get to the waters into which the effluent will be discharged. Clearly there should have been site notices on Ireland's Eye and Howth Harbour.

The issue raised is responded to in Section 3.3.4 Paragraphs 161-165: "Site notices were erected at locations where infrastructure is planned, either where proposed temporary construction compounds will be located or where the proposed orbital sewer route will cross road/rail corridors or where tunnelling is proposed to take place. As no works are planned at Ireland's Eye or at Howth, it was not necessary to erect site notices at these locations. Public Information Notices (advertisements) were placed in national and local media to announce the planning application statutory consultation period for the Proposed Project in June 2018."

2. Impact on Water Users

Commented [DO4]: [redacted] issue

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Relevant Extract from Section 6.3.7 of Chapter 6 Population in Volume 3 Part A of the EIAR: "Beaches and Associated Water Based Activities - Velvet Strand Beach at Portmarnock is a Blue Flag Beach and, as a result, is a popular bathing area. The Burrow Beach, Sutton, is situated to the south of the study area. These beaches are popular for water based recreational activities such as swimming, sailing and other

water related activities. Sea angling and fishing are also popular activities along the Fingal coastline, with angling and fishing carried out from beaches, harbours, piers and boats close to the shore and offshore. Sailing is a popular activity in the locality. A popular sailing area for members of Howth Yacht Club and other sailing enthusiasts is the area between Ireland's Eye and Lambay Island. Local regattas, national sailing championships and other international sailing events take place in this area.

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In summary, the modelling studies have confirmed that:

- The Proposed Project will have a negligible impact on the water quality of the coastal waters off County Dublin;
- The Proposed Project will not negatively impact the achievement of the Water Framework Directive goals;
- The proposed discharge location will not negatively impact any designated bathing waters; and
- The Proposed Project will have a negligible impact on the quality of shellfish waters.

4. Outfall Location

The issue raised is responded to in Section 9.3.8 Paragraphs 394 and 395 which state: "The location of the proposed outfall pipeline route (marine section) discharge point to the north east of Ireland's Eye was proposed following an Alternate Sites Assessment Study, a preliminary modelling study undertaken (MarCon 2011) to identify a range of potential outfall locations along the north Dublin coastline. That study showed that two discrete areas existed within the Proposed Project area where locating a proposed outfall would minimise the impact on the receiving marine environment.

A subsequent near-field modelling study (MarCon 2013) to determine the relative merits between the two locations off the coast of north Dublin for a new proposed outfall pipeline route (marine section) discharge point was undertaken. That study showed that the southern outfall study area exhibited more favourable coastal hydrodynamic characteristics (larger current speeds and greater water depths), which allows for faster and greater dilution of treated wastewater than the northern outfall study area."

Commented [CO6]: Alan's Brief of Evidence included a number of diagrams illustrating coliform concentration over time at Velvet Starnd and Claremont Beach for the various scenarios modelled. All showed coliform concentrations significantly lower than 250cfu/100ml.

Commented [DO7]: [redacted] issue:

The modelling demonstrates that putting the outfall west of Ireland's Eye would be significantly polluting. (Chapter 5 Consideration of Alternatives, https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-2a/Cha pter%205%20Consideratio n%20of%20Alternatives.pdf)
However what Irish Water apparently haven't considered is putting it further east. In public communications, they repeatedly described the location as 6km east of Portmarnock as if Ireland's Eye and Howth didn't exist at all. Irish Water are obliged to consider alternatives in a reasonable manner. In considering alternatives it is not sufficient to merely show that they could have picked a more polluting location for the outfall. To carry out a credible EIA, Irish Water need to demonstrate that the location they have picked is the optimal location and that, combined with the selected treatment methods, it will not lead to any reduction in water quality.
When an analysis of the alternative of locating the outfall further east is presented, the public and the Board will have a much better understanding of the impact of the proposal.

Commented [CO8]: No assessment of extending the outfall further east was undertaken. The proposed discharge point lies in some 25m depth of water, and the modelling has confirmed that all water quality standards are met by a discharge at this point. Extending the outfall further east may have necessitated laying the pipe on the sea bed eastward from Ireland's Eye rather than in a trench as the depth of water coupled with the trench depth is on the limit of the type of dredging equipment envisaged.

Commented [DO9]: The key point raised is that no assessment of putting the outfall further east was undertaken. We may need to justify the basis for stopping the outfall at 6kms. I am unable to locate a response to this specific point either in the EIAR or OH evidence. Recommend seeking C'OK advice.

5. Tertiary Treatment

The issue raised was responded to by the applicant in the oral hearing statements presented by Mr. Ciaran O'Keeffe, Mr. Dara White and Mr. Alan Berry.

The decision to propose ultraviolet disinfection treatment was taken following submissions made by Fingal County Council, public representatives, and members of the public including local fishermen. Following receipt of the submissions to the statutory consultation, Irish Water consulted with Ms. Marja Aberson, a marine ecologist specialising in shellfish, who undertook analysis of the available data. 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 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.

Commented [DO10]: [redacted] issue:
The assessment of alternatives does not consider the use of tertiary treatment, in particular disinfection to reduce the risk of pathogens from the sewage effluent affecting water users or consumers of seafood from the vicinity of the outfall. Given that tertiary treatment is standard in many countries, it is very hard to understand why Irish Water haven't considered it for this effluent. (It is referred to in relation to an alternative outfall further west but there's no consideration of it for this outfall.)
When an analysis of the alternative of tertiary treatment, in particular disinfection, is presented, the public and the Board will have a much better understanding of the impact of the proposal.

6. Overflows

As noted in the GDD Planning Report as referenced in the testimony of Ms. Lara Gough on Planning matters (Paragraph 19) of 26th March 2019: "The operational phase of the proposed project, will reduce the extent of overflows from existing sewer networks to local water networks and courses, through the provision of additional wastewater treatment capacity and diversion of a proportion of the wastewater loadings from a number of existing WwTPs into the new WwTP, and therefore improve the water quality of these."

The diversion of the north and north west parts of the Ringsend catchment and the partial diversion of the North Fringe Sewer will alleviate pressure on the collection/sewer network and reduce the flows to Ringsend including via the 9C Sewer and via the Sutton pumping station/submarine pipeline. This will reduce the risk of overflows throughout the network generally. It is not proposed to divert existing overflows to the outfall pipeline as this is a ~~pressurised (pumped)~~ pipeline, acting under gravity pressure, outputting fully treated effluent.

Commented [DO11]: [redacted] issue: "I have searched through both maps and documents and I can't find any specific information on overflows. Therefore, I don't know if existing overflows or any new ones are being diverted into the effluent outfall...The public and the Board are entitled, not to a generalised assurance, but to specific information on which overflows will be reduced in frequency and extent and by how much."

Commented [DO12]: Draft text for technical review and updating.

7. Dredging Sediments

The issue raised is responded to in Section 10.3.1. Paragraphs 431-433 state:

" Section 9.4.3 of Chapter 9 Biodiversity (Marine) in Volume 3 Part A and Figure 9.6 in Volume 5 Part A of the EIAR detail the results of assessment which show that "none of the discharged sediment is predicted to impact the qualifying Annex I habitats of littoral and sublittoral reef features of the Rockabill to Dalkey Island SAC along the north and eastern coastline of Ireland's Eye". To ensure this the following mitigation measures, as presented in Section 9.7.1 of Chapter 9 Biodiversity (Marine) of the EIAR will be put in place: "turbidity will be monitored using a buoy-mounted turbidity meter with telemetering back to the dredger to monitor potential impacts from dredging activity. As the reef is only prone to sedimentation during slack water periods, a slightly elevated level of Total Suspended Solids (TSS) up to 40mg/l (the natural standard deviation for the year) above a daily background will be permitted off

Commented [DO13]: [redacted] issue:

The Marine Biodiversity chapter of the EIA (https://www.gddapplication.ie/planning-sites/greaterÂ-dublin-drainage/docs/environmental-documents/volume-3a/Chapter%209%20Biodiversity%20(Marine).pdf) and the surveys done for it identify that the reefs at Ireland's Eye are already being affected by the deposition of sediments and that the planned dredging will have a further negative impact on these protected reefs.
The consideration of alternatives does not include consideration of continuing the tunnelling along more of, or the entire length of, the outfall pipeline.
This appears to be contrary to the requirement the Habitats Directive.

the northern coastline of Ireland's Eye. If this level increases above this threshold as a result of dredging activity, then the discharge of material will be temporarily halted to allow the resulting plume to disperse. This is particularly important 30 minutes before and after slack water where increased suspended sediments can settle within the SAC."

As presented in Section 9.3.4 in Volume 3 Part A of the EIAR, a detailed assessment of the subtidal reefs was carried out in 2015 and it recorded that "natural siltation levels were high in the sublittoral environment, a fact that has not appeared to have had a significant impact on the biological diversity in this area".

Following a tidal restricted discharge, the modelled impact of the dredging spoil has shown that the plume will not impact these reefs. Further monitoring will also be employed to ensure that this remains the case during the construction works. The overall conclusion is that there will be no impact to the SAC reefs from suspended sediments during dredging."

Further related information in contained at Sections 10.3.3 and 10.3.4.

8. Water Framework Directive Compliance

Commented [DO14]: [redacted] issue:

Much of the missing information identified above is required to determine whether the application is in compliance with the Water Framework Directive (WFD).
The Directive requires that water bodies which are not currently meeting good status be brought up to that level. The rivers and transitional waters in the affected sewage catchments are not at good status. Therefore the proposal must be assessed in terms of whether it is doing what it should to achieve the WFD obligations (e.g. in reducing overflows.)
The Directive also requires that water bodies at high quality be maintained at that status. The proposal must be assessed against this obligation. The information necessary to make this assessment must be provided and made available to the public for comment.

The issue raised is responded to in Section 3 above. 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 Proposed Project will support the achievement of the Water Framework Directive goals.

The water quality will reach standards set out in the Water Framework Directive, European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009) and Directive 2006/7/EC of 15 February 2006 concerning the management of bathing water quality (Bathing Waters Directive) to maintain an 'excellent' water quality status set out for 'coastal' waters and to prevent impact to nearby bathing waters or protected areas (such as shellfish waters).

9. Doldrum Bay

Commented [DO15]: [redacted] issue: Irish Water continue to discharge a mixture of raw sewage and septic tank effluent into the sea at Doldrum Bay in Howth. Their EPA licence requires them to have ended this discharge by the end of 2011.
The maps they have supplied with this application are misleading in that they do not show the outfall (https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-5a/Figure%208.8%20Wastewater%20Treatment%20Plant%20Outfall%20Locations.pdf)
and they do not show the sewer network catchment which leads to this outfall (https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-5a/Figure%203.3%20Potentia l%20Secondary%20Catchments.pdf .)
This lack of compliance with the law and misleading information in the application should be taken into account by the Board.

This issue raised is responded to in Section 27.4 Paragraph's 912-91 state: "39 houses are currently connected to the Doldrum Bay outfall by a 1.7km foul sewer network. Currently the wastewater is not treated. In October 2016, Irish Water completed works to replace the wastewater pipeline at Doldrum Bay as part of a short-term solution to address the discharge of wastewater to the beach. This project included the construction of a replacement pipeline on the beach and upgrade works to the distribution chamber.

Irish Water is currently working towards compliance with Schedule A.3 of the Ringsend Wastewater Discharge Licence to discontinue a discharge of wastewater to the sea at Doldrum Bay, Howth. Irish Water are currently progressing the detailed design and planning phase and will, subject to no planning, environmental or land acquisition issues, issue tender documents to the market in Q4 2019. Following

completion of the tender phase IW expect to appoint a contractor to commence construction in Q2/Q3 2020.

For a project of this scale and complexity, the timeframe for completion is presently early 2021. It is however possible that the timeframe for completion could be late 2021 if there are any delays in statutory approvals.

As the Proposed Project will not have any significant negative effect on water quality in Dublin Bay, it will not give rise to any negative effects cumulatively or in-combination with Doldrum Bay."

10. Biodiversity at Ballymun

Commented [DO16]: [redacted] raised one further item in addition in his oral submission to the OH on 26.03.19 – the potential of impact of the orbital sewer on biodiversity in Ballymun at Silloge. He provided a copy of a Biodiversity Action Plan Report by the Ballymun Wildlife Group to the hearing. He called for a more sensitive routing of the pipeline to avoid biodiversity impacts.

The issue raised concerning potential of impact of the orbital sewer on biodiversity in Ballymun and Silloge was consider and responded to at the oral hearing. In his opening statement on the proposed project description to the hearing on 20th March 2017, Mr. Ciaran O'Keeffe of Jacobs Tobin stated that tunnelling and trenchless construction techniques are proposed at locations to avoid impacts including at Silloge Golf Course. In his detailed Response Statement of 27th March 2017, RPS ornithologist Dr. James McCrory stated that: "Lands identified in the Ballymun Biodiversity Action Plan relate to an area south of the M50 corridor and south of Ikea, more than 500m south of the pipeline wayleave of the Proposed Project."

I trust that the above collated materials clarify that Irish Water has fully responded to the issues raised in your written and oral submissions.

The GDD project is a key part of Irish Water's investment in new wastewater infrastructure in greater Dublin and will protect public health, safeguard our environment and facilitate growth up to 2050 and beyond.

In the event that I can provide any additional information relating to the Greater Dublin Drainage project please don't hesitate to contact me. I look forward to providing you with progress updates as this important project is delivered.

Yours sincerely,

Jane Chambers,
GDD Project Manager,
Irish Water

[redacted]

[redacted]

Uisce Éireann
Teach Colvill
24-26 Sráid Thalbóid
Baile Átha Cliath 1
Éire

Irish Water
Colvill House
24-26 Talbot Street
Dublin 1
Ireland

25 July 2019

Re: Response to issues raised regarding the Greater Dublin Drainage Project

Dear [redacted],

Thank you for attending the recent meeting with our Public Affairs team.

Commented [DO1]: Callista – can we update with correct meeting details please.

We noted your query concerning the Greater Dublin Drainage (GDD) project and Irish Water's response to the issues raised in your written submission to the statutory consultation process including the recent oral hearing as held by An Bord Pleanála.

We are pleased to provide you with a written compilation of the responses to the issues raised in your written and oral hearing submissions. The responses were presented in the Irish Water - Greater Dublin Drainage Project: Response to Submissions Report (January 2019) as published on the GDD Planning Application Website and in the expert witness testimony as delivered to the oral hearing held by An Bord Pleanála held in March-April 2019. We trust that the responses, as collated in this document, confirm that the issues which you raised were considered and responded to in full.

Greater Dublin Drainage Project Planning Update

Continued population growth and increased commercial activity means the volume of wastewater generated in greater Dublin is projected to increase by more than 50% in the next 30 years.

Greater Dublin Drainage (GDD) is the development of a new regional wastewater treatment facility and associated infrastructure to serve the Greater Dublin Area, in particular, the population of north Dublin along with small parts of the surrounding counties of Kildare and Meath.

A new regional plant is required to provide the additional treatment capacity needed once the country's largest wastewater treatment facility at Ringsend reaches its ~~upgraded its~~ maximum upgraded capacity by the mid-2020s.

Following detailed site investigations, extensive environmental assessments and wide-ranging public consultations over a seven-year period, on 20th June 2018, Irish Water made an application for strategic infrastructure development to An Bord Pleanála for the GDD project. An oral hearing was held by An Bord Pleanála, from March-April 2019. The application is now undergoing adjudication by the planning authority. An Bord Pleanála has indicated a decision timeframe of 27th September 2019.

It is vital that we have adequate wastewater treatment capacity in place when needed in order to protect public health, to safeguard our environment and to support the sustainable social and economic growth of communities across the Dublin area into the future. An additional regional wastewater treatment facility – capable of providing advanced wastewater treatment for up to half a million people – has been found to be the most environmentally, technically and economically advantageous solution to meeting the long-term wastewater needs of the north Dublin area.

Commented [CO2]: The WwTP capacity is expressed in 'population equivalents'. Approx 3/5ths of load is from the non-domestic sector (includes headroom allowance).

This GDD project will help to ensure that the wastewater generated every day in our homes and workplaces will continue to be treated safely in compliance with the EU and national wastewater treatment regulations.

Responses to the issues raised in written submission by Cllr. D Healy to An Bord Pleanála received on 17/08/18.

The references contained in the responses below are to the Irish Water - Greater Dublin Drainage Project: Response to Submissions Report (January 2019).

1. Site Notices at Howth and Ireland's Eye

Commented [DO3]: [redacted]

There were no site notices at the land locations nearest to the outfall nor at the locations where people take boats to get to the waters into which the effluent will be discharged. Clearly there should have been site notices on Ireland's Eye and Howth Harbour.

The issue raised is responded to in Section 3.3.4 Paragraphs 161-165: "Site notices were erected at locations where infrastructure is planned, either where proposed temporary construction compounds will be located or where the proposed orbital sewer route will cross road/rail corridors or where tunnelling is proposed to take place. As no works are planned at Ireland's Eye or at Howth, it was not necessary to erect site notices at these locations. Public Information Notices (advertisements) were placed in national and local media to announce the planning application statutory consultation period for the Proposed Project in June 2018."

2. Impact on Water Users

Commented [DO4]: DH issue

I contacted Irish Water some time ago pointing out that the waters around Ireland's Eye are used for a wide range of activities (swimming, sailing, kayaking, scuba diving, lobster and other fishing) and asking that all of these groups be considered and consulted. Despite that I can find no mention of some of these activities in the EIAR (e.g. scuba diving and kayaking). There is no meaningful assessment in the EIAR of the impact of the effluent outfall on the water quality in which these activities take place.
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- The Proposed Project will have a negligible impact on the quality of shellfish waters.

4. Outfall Location

The issue raised is responded to in Section 9.3.8 Paragraphs 394 and 395 which state: "The location of the proposed outfall pipeline route (marine section) discharge point to the north east of Ireland's Eye was proposed following an Alternate Sites Assessment Study, a preliminary modelling study undertaken (MarCon 2011) to identify a range of potential outfall locations along the north Dublin coastline. That study showed that two discrete areas existed within the Proposed Project area where locating a proposed outfall would minimise the impact on the receiving marine environment.

A subsequent near-field modelling study (MarCon 2013) to determine the relative merits between the two locations off the coast of north Dublin for a new proposed outfall pipeline route (marine section) discharge point was undertaken. That study showed that the southern outfall study area exhibited more favourable coastal hydrodynamic characteristics (larger current speeds and greater water depths), which allows for faster and greater dilution of treated wastewater than the northern outfall study area."

Commented [C06]: Alan's Brief of Evidence included a number of diagrams illustrating coliform concentration over time at Velvet Starnd and Claremont Beach for the various scenarios modelled. All showed coliform concentrations significantly lower than 250cfu/100ml.

Commented [D07]: [redacted]

The modelling demonstrates that putting the outfall west of Ireland's Eye would be significantly polluting. (Chapter 5 Consideration of Alternatives, https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-2a/Cha pter%205%20Consideratio n%20of%20Alternatives.pdf)
However what Irish Water apparently haven't considered is putting it further east. In public communications, they repeatedly described the location as 6km east of Portmarnock as if Ireland's Eye and Howth didn't exist at all. Irish Water are obliged to consider alternatives in a reasonable manner. In considering alternatives it is not sufficient to merely show that they could have picked a more polluting location for the outfall. To carry out a credible EIA, Irish Water need to demonstrate that the location they have picked is the optimal location and that, combined with the selected treatment methods, it will not lead to any reduction in water quality.
When an analysis of the alternative of locating the outfall further east is presented, the public and the Board will have a much better understanding of the impact of the proposal.

Commented [C08]: No assessment of extending the outfall further east was undertaken. The proposed discharge point lies in some 25m depth of water, and the modelling has confirmed that all water quality standards are met by a discharge at this point. Extending the outfall further east may have necessitated laying the pipe on the sea bed eastward from Ireland's Eye rather than in a trench as the depth of water coupled with the trench depth is on the limit of the type of dredging equipment envisaged.

Commented [D09]: The key point raised is that no assessment of putting the outfall further east was undertaken. We may need to justify the basis for stopping the outfall at 6kms. I am unable to locate a response to this specific point either in the EIAR or OH evidence. Recommend seeking C'OK advice.

5. Tertiary Treatment

The issue raised was responded to by the applicant in the oral hearing statements presented by Mr. Ciaran O'Keeffe, Mr. Dara White and Mr. Alan Berry.

The decision to propose ultraviolet disinfection treatment was taken following submissions made by Fingal County Council, public representatives, and members of the public including local fishermen. Following receipt of the submissions to the statutory consultation, Irish Water consulted with Ms. Marja Aberson, a marine ecologist specialising in shellfish, who undertook analysis of the available data. 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 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.

Commented [DO10]: [redacted]
The assessment of alternatives does not consider the use of tertiary treatment, in particular disinfection to reduce the risk of pathogens from the sewage effluent affecting water users or consumers of seafood from the vicinity of the outfall. Given that tertiary treatment is standard in many countries, it is very hard to understand why Irish Water haven't considered it for this effluent. (It is referred to in relation to an alternative outfall further west but there's no consideration of it for this outfall.)
When an analysis of the alternative of tertiary treatment, in particular disinfection, is presented, the public and the Board will have a much better understanding of the impact of the proposal.

6. Overflows

As noted in the GDD Planning Report as referenced in the testimony of Ms. Lara Gough on Planning matters (Paragraph 19) of 26th March 2019: "The operational phase of the proposed project, will reduce the extent of overflows from existing sewer networks to local water networks and courses, through the provision of additional wastewater treatment capacity and diversion of a proportion of the wastewater loadings from a number of existing WwTPs into the new WwTP, and therefore improve the water quality of these."

The diversion of the north and north west parts of the Ringsend catchment and the partial diversion of the North Fringe Sewer will alleviate pressure on the collection/sewer network and reduce the flows to Ringsend including via the 9C Sewer and via the Sutton pumping station/submarine pipeline. This will reduce the risk of overflows throughout the network generally. It is not proposed to divert existing overflows to the outfall pipeline as this is a ~~pressurised (pumped)~~ pipeline, acting under gravity pressure, outputting fully treated effluent.

Commented [DO11]: [redacted] "I have searched through both maps and documents and I can't find any specific information on overflows. Therefore, I don't know if existing overflows or any new ones are being diverted into the effluent outfall...The public and the Board are entitled, not to a generalised assurance, but to specific information on which overflows will be reduced in frequency and extent and by how much."

Commented [DO12]: Draft text for technical review and updating.

7. Dredging Sediments

The issue raised is responded to in Section 10.3.1. Paragraphs 431-433 state:

" Section 9.4.3 of Chapter 9 Biodiversity (Marine) in Volume 3 Part A and Figure 9.6 in Volume 5 Part A of the EIAR detail the results of assessment which show that "none of the discharged sediment is predicted to impact the qualifying Annex I habitats of littoral and sublittoral reef features of the Rockabill to Dalkey Island SAC along the north and eastern coastline of Ireland's Eye". To ensure this the following mitigation measures, as presented in Section 9.7.1 of Chapter 9 Biodiversity (Marine) of the EIAR will be put in place: "turbidity will be monitored using a buoy-mounted turbidity meter with telemetering back to the dredger to monitor potential impacts from dredging activity. As the reef is only prone to sedimentation during slack water periods, a slightly elevated level of Total Suspended Solids (TSS) up to 40mg/l (the natural standard deviation for the year) above a daily background will be permitted off

Commented [DO13]: [redacted]

The Marine Biodiversity chapter of the EIA (https://www.gddapplication.ie/planning-sites/greaterÂ-dublin-drainage/docs/environmental-documents/volume-3a/Chapter%209%20Biodiversity%20(Marine).pdf) and the surveys done for it identify that the reefs at Ireland's Eye are already being affected by the deposition of sediments and that the planned dredging will have a further negative impact on these protected reefs.
The consideration of alternatives does not include consideration of continuing the tunnelling along more of, or the entire length of, the outfall pipeline.
This appears to be contrary to the requirement the Habitats Directive.

the northern coastline of Ireland's Eye. If this level increases above this threshold as a result of dredging activity, then the discharge of material will be temporarily halted to allow the resulting plume to disperse. This is particularly important 30 minutes before and after slack water where increased suspended sediments can settle within the SAC."

As presented in Section 9.3.4 in Volume 3 Part A of the EIAR, a detailed assessment of the subtidal reefs was carried out in 2015 and it recorded that "natural siltation levels were high in the sublittoral environment, a fact that has not appeared to have had a significant impact on the biological diversity in this area".

Following a tidal restricted discharge, the modelled impact of the dredging spoil has shown that the plume will not impact these reefs. Further monitoring will also be employed to ensure that this remains the case during the construction works. The overall conclusion is that there will be no impact to the SAC reefs from suspended sediments during dredging."

Further related information in contained at Sections 10.3.3 and 10.3.4.

8. Water Framework Directive Compliance

The issue raised is responded to in Section 3 above. 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 Proposed Project will support the achievement of the Water Framework Directive goals.

The water quality will reach standards set out in the Water Framework Directive, European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009) and Directive 2006/7/EC of 15 February 2006 concerning the management of bathing water quality (Bathing Waters Directive) to maintain an 'excellent' water quality status set out for 'coastal' waters and to prevent impact to nearby bathing waters or protected areas (such as shellfish waters).

Commented [DO14]: [redacted]

Much of the missing information identified above is required to determine whether the application is in compliance with the Water Framework Directive (WFD).
The Directive requires that water bodies which are not currently meeting good status be brought up to that level. The rivers and transitional waters in the affected sewage catchments are not at good status. Therefore the proposal must be assessed in terms of whether it is doing what it should to achieve the WFD obligations (e.g. in reducing overflows.)
The Directive also requires that water bodies at high quality be maintained at that status. The proposal must be assessed against this obligation. The information necessary to make this assessment must be provided and made available to the public for comment.

9. Doldrum Bay

This issue raised is responded to in Section 27.4 Paragraph's 912-91 state: "39 houses are currently connected to the Doldrum Bay outfall by a 1.7km foul sewer network. Currently the wastewater is not treated. In October 2016, Irish Water completed works to replace the wastewater pipeline at Doldrum Bay as part of a short-term solution to address the discharge of wastewater to the beach. This project included the construction of a replacement pipeline on the beach and upgrade works to the distribution chamber.

Irish Water is currently working towards compliance with Schedule A.3 of the Ringsend Wastewater Discharge Licence to discontinue a discharge of wastewater to the sea at Doldrum Bay, Howth. Irish Water are currently progressing the detailed design and planning phase and will, subject to no planning, environmental or land acquisition issues, issue tender documents to the market in Q4 2019. Following

Commented [DO15]: [redacted] Irish Water continue to discharge a mixture of raw sewage and septic tank effluent into the sea at Doldrum Bay in Howth. Their EPA licence requires them to have ended this discharge by the end of 2011.
The maps they have supplied with this application are misleading in that they do not show the outfall (https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-5a/Figure%208.8%20Wastewater%20Treatment%20Plant%20Outfall%20Locations.pdf)
and they do not show the sewer network catchment which leads to this outfall (https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-5a/Figure%203.3%20Potentia l%20Seconda ry%20Catchments.pdf .)
This lack of compliance with the law and misleading information in the application should be taken into account by the Board.

completion of the tender phase IW expect to appoint a contractor to commence construction in Q2/Q3 2020.

For a project of this scale and complexity, the timeframe for completion is presently early 2021. It is however possible that the timeframe for completion could be late 2021 if there are any delays in statutory approvals.

As the Proposed Project will not have any significant negative effect on water quality in Dublin Bay, it will not give rise to any negative effects cumulatively or in-combination with Doldrum Bay."

10. Biodiversity at Ballymun

Commented [DO16]: Cllr. Healy raised one further item in addition in his oral submission to the OH on 26.03.19 – the potential of impact of the orbital sewer on biodiversity in Ballymun at Silloge. He provided a copy of a Biodiversity Action Plan Report by the Ballymun Wildlife Group to the hearing. He called for a more sensitive routing of the pipeline to avoid biodiversity impacts.

The issue raised concerning potential of impact of the orbital sewer on biodiversity in Ballymun and Silloge was consider and responded to at the oral hearing. In his opening statement on the proposed project description to the hearing on 20th March 2017, Mr. Ciaran O'Keeffe of Jacobs Tobin stated that tunnelling and trenchless construction techniques are proposed at locations to avoid impacts including at Silloge Golf Course. In his detailed Response Statement of 27th March 2017, RPS ornithologist Dr. James McCrory stated that: "Lands identified in the Ballymun Biodiversity Action Plan relate to an area south of the M50 corridor and south of Ikea, more than 500m south of the pipeline wayleave of the Proposed Project."

I trust that the above collated materials clarify that Irish Water has fully responded to the issues raised in your written and oral submissions.

The GDD project is a key part of Irish Water's investment in new wastewater infrastructure in greater Dublin and will protect public health, safeguard our environment and facilitate growth up to 2050 and beyond.

In the event that I can provide any additional information relating to the Greater Dublin Drainage project please don't hesitate to contact me. I look forward to providing you with progress updates as this important project is delivered.

Yours sincerely,

Jane Chambers

Jane Chambers,
GDD Project Manager,
Irish Water