SECTION D – EXISTING ENVIRONMENT & IMPACT OF THE DISCHARGE(S)

Attachment D1: WATER QUALITY MODELLING, ECOLOGICAL IMPACT ASSESSMENT, EIA SCREENING

– **Attachment D.1.b: Cæstletownbere Far Field Modelling**

Supplementary Report

– **Attachment D.1.c: Castletownbere Ecological Impact Assessment**

Irish Water

Cork UTAS

Castletownbere Far Field Modelling Supplementary Report – Response to RFI and Additional Modelling

Issue | July 1, 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Ove Arup & Partners Ireland Ltd

50 Ringsend Road
Dublin 4
D04 T6X0
Ireland
www.arup.com

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Appendices

1 Introduction

1.1 Background

Arup has been commissioned by Irish Water to advance an Untreated Agglomerations (UTAS) project for Castletownbere, Co. Cork. A detailed water quality impact assessment was undertaken as part of the project to determine the compliance of the effluent discharges from the proposed wastewater treatment plant on the receiving waters in Bantry Bay. The findings of the study [1] were submitted as part of the planning application for the project on 19th December 2019.

The Planning Authority issued a number of Requests for Further Information (RFI) on the Planning application and one of these relates to the water quality impact assessment. Section 2 of this report addresses the RFI and assesses the impact of the breakwaters that are currently being constructed in Castletownbere Harbour on effluent discharges from the proposed WwTP.

Section 3 of the report presents an assessment of Section 4 licensed outfalls in Castletownbere that were not included as part of the original modelling study. It is noted that this analysis is unrelated to the RFI's issued by the Planning Authority.

Section 4 of the report presents further validation of the hydrodynamic model which adds even greater confidence in the accuracy of the model used in study. This work is also unrelated to the RFI's.

1.2 RFI – Water Quality modelling

The RFI relevant to the water quality modelling is RFI number 3. It states:

"Submit studies and analysis of further modelling to determine the impact the breakwaters will have on effluent dispersal and flows in the harbour, taking into account the possible impact of the harbour infrastructure associated with planning reference 17/637 granted on the 1st May 2018 (to the Minister for Agriculture Food and the Marine).

This RFI has been addressed by reconfiguring the water quality model of Bantry Bay that was developed as part of the original study in order to account for the impact of the breakwaters. This work is presented in Section 2 of the report.

1.3 Layout of the report

The layout of this supplementary report is presented in the following table.

Table 1: Report chapters and descriptions

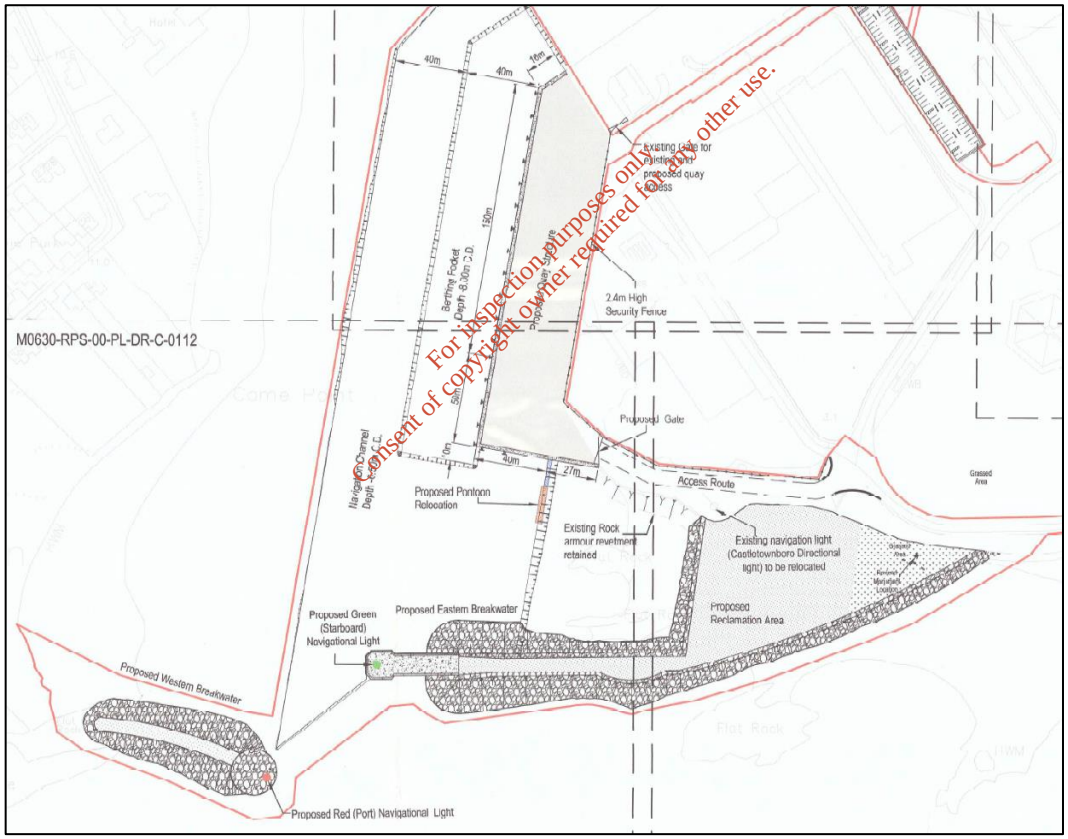
Chapter	Title	Description
1	Introduction	Details the background to the report
2	RFI Response - Dinish Wharf Expansion model run	Examines the impact that the completed Dinish Wharf Expansion Breakwaters will have on water quality in Bantry Bay
3	Section 4 Outfalls model run	Assesses the influence of including three additional Section 4 discharges on nutrient concentrations within the study area
4	Further validation of the Hydrodynamic model	Details the additional validation results for the hydrodynamic model

2 RFI Response - Dinish Wharf Expansion Modelling

2.1 Introduction

The Minister for Agriculture Food and the Marine submitted a planning application to Cork County Council by for a wharf extension and associated development at Dinish Island in Castletownbere (hereafter referred to as the Dinish Wharf Expansion). The development was granted planning permission in May 2018 and comprises of an extension to the Dinish Island wharf and the construction of two new breakwaters at the entrance to the harbour. Figure 1 presents an extract of an engineering drawing of the development.

Figure 1: Extract from the Key Site Layout Plan



The extension was not considered as part of the original modelling study and the Planning Authority have therefore requested further information on the impact that the development will have on effluent dispersal in the harbour. This chapter details our response and presents the findings of additional modelling work which has considered the impact of the breakwaters.

2.2 Modelling the Dinish Wharf Expansion

The construction of the Dinish Wharf Expansion will alter the hydrodynamics in Castletownbere harbour in the immediate vicinity of the engineering works. This in turn will alter the dispersion patterns in the harbour which will result in changes to the water quality. By accounting for the expansion development in the Castletownbere model, the impact of the engineering works on water quality can be assessed.

Six different WQ parameters were considered in the original Castletownbere study:

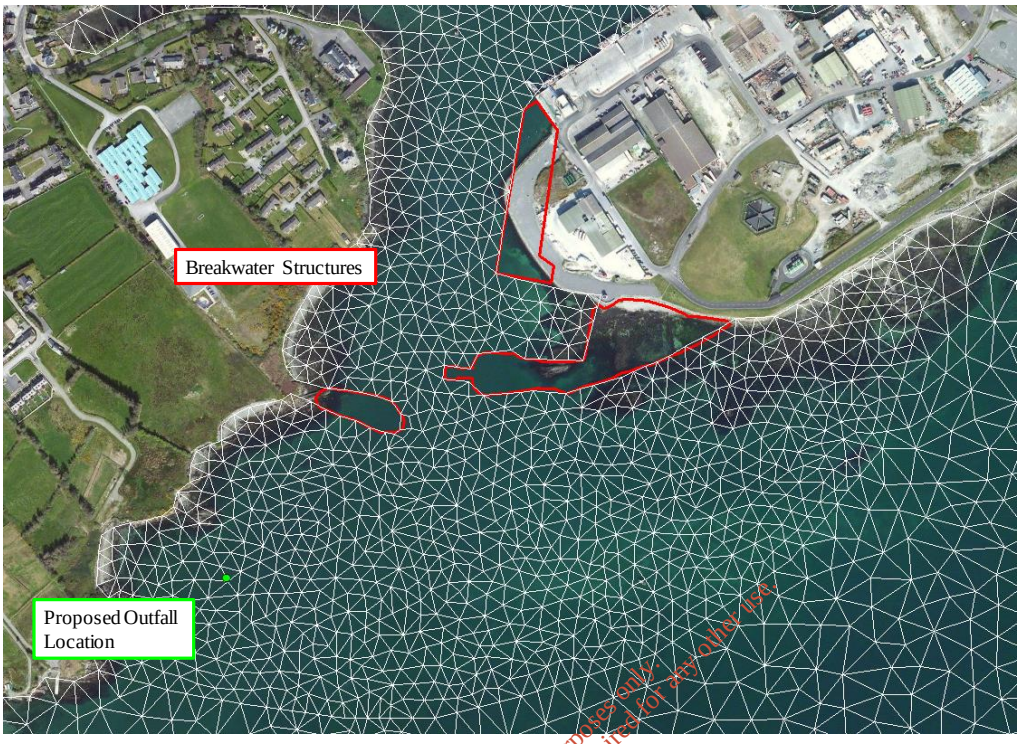
- E. Coli/Faecal Coliforms;
- Intestinal Enterococci;
- DIN;
- MRP;
- Total Ammonia (TA);
- Unionised Ammonia (UiA)

The assessment of the Dinish Wharf Expansion has been undertaken using one of these parameters: E. Coli /Faecal Coliforms. Using this WQ parameter is justified given that the original study clearly demonstrated that E. Coli is the most critical parameter in Castletownbere Harbour in terms of its concentration relative to its EQS i.e. of the six parameters assessed, E. Coli is the closest to exceeding its EQS limit. Should the findings of the Dinish Wharf Expansion impact assessment therefore conclude that the concentrations of E. Coli remain below their EQS limit at each of the monitoring points with the engineering works in place, it can be concluded that all the WQ parameters considered in the original study will also remain below their EQS limit.

2.3 Modification to the Hydrodynamic model

The computational mesh of the original model was edited to account for the geometry of the Dinish Warf Expansion. All other model parameters and inputs remain unchanged. A close-up view of the updated mesh in the vicinity of the development is presented in Figure 2. The mesh cell size is smallest around the outfall and in the vicinity of the breakwaters (circa 30m^2) and largest near the model boundary (circa 150,000m^2).

Figure 2: Updated computational mesh showing breakwaters and proposed outfall location



2.4 Proposed scenario with breakwaters

2.4.1 Overview

Two separate model runs have been simulated and compared against each other in order to allow for the impact of the breakwaters on water quality to be assessed:

- The *'proposed scenario without breakwaters'* – the proposed Castletownbere WwTP is included in the model but the Dinish Wharf Expansion is not. This model run was previously considered as part of the original Castletownbere report.
- The *'proposed scenario with breakwaters'* model run - both the proposed Castletownbere WwTP and Dinish Wharf Expansion are included;

The EQS for E.Coli for both scenarios are also presented in order to assess the cumulative effect of both the proposed WwTP and the Dinish Wharf Extension result and to determine of the concentrations exceed the relevant EQS limits that are set out in the relevant EU regulations.

2.4.2 Results – E. Coli 95%ile plots

The Bathing Water Quality Regulations 2008 (S.I. No. 79/2008), 95%ile E-coli concentrations of 250cfu/100ml or less in coastal/ transitional waters are considered "Excellent", and below 500cfu/100ml is considered "Good", as indicated in Table 2.

Table 2: Bathing Water Classification

Water Type	Parameter	Excellent	Good	Sufficient
Coastal/Transitional	E-Coli cfu/100ml	250 (*)	500 (*)	500 (**)

(*) based on a 95-percentile evaluation; (**) based on a 90-percentile evaluation

The spatially varying 95%ile plot for E. Coli for both scenarios is presented in Figure 3. The difference between them in the key area of interest is presented in Figure 4.

It can be seen from the results that with the breakwaters in place the 95%ile concentrations of E. Coli in the vicinity of the breakwaters are increased. As the breakwaters narrow the entrance into the inner harbour, they will reduce the volume of water that can pass that point on both the ebb and flood tide. This in turn will reduce the dispersion of any material suspended in the water column and lead to higher concentrations in the immediate vicinity of the breakwater. The amount by which the concentrations are increased varies; in the inner harbour they are increased by less than 100 cfu/100ml. To the south-west of the breakwaters, concentrations are increased by up to 250 cfu/100ml.

There are also areas where the concentrations are reduced with the structures in place. In the outer harbour area the 95%ile concentrations are reduced by as much as 50 cfu/100ml.

It is evident however that the increase in concentration are relatively localised to the structures and the majority of the harbour area still retains "Excellent" status as the E. Coli concentrations are largely less than 250 cfu/100ml outside the immediate mixing zone of the outfall.

Figure 3: E. Coli 95%ile concentration plots for both scenarios.

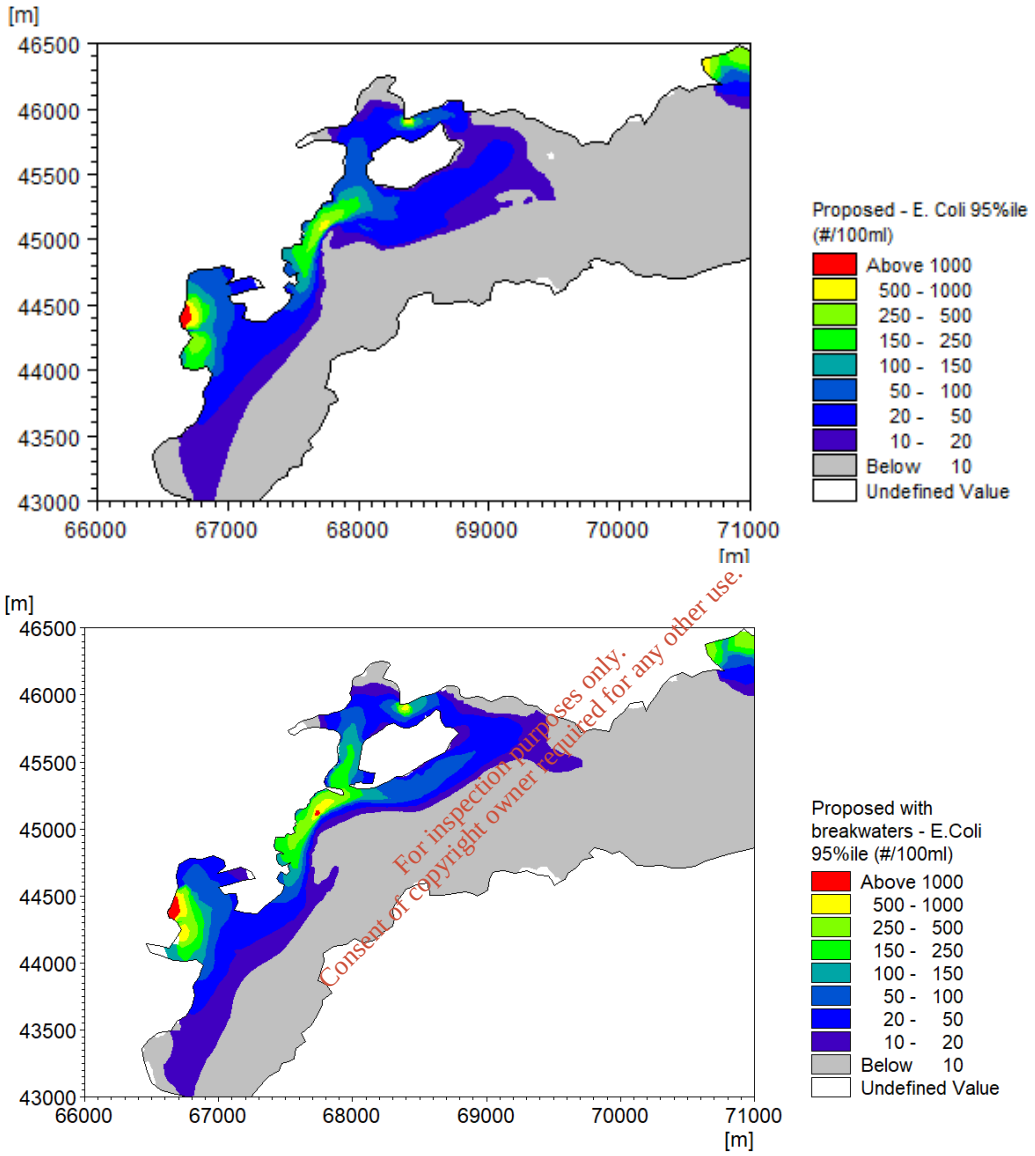
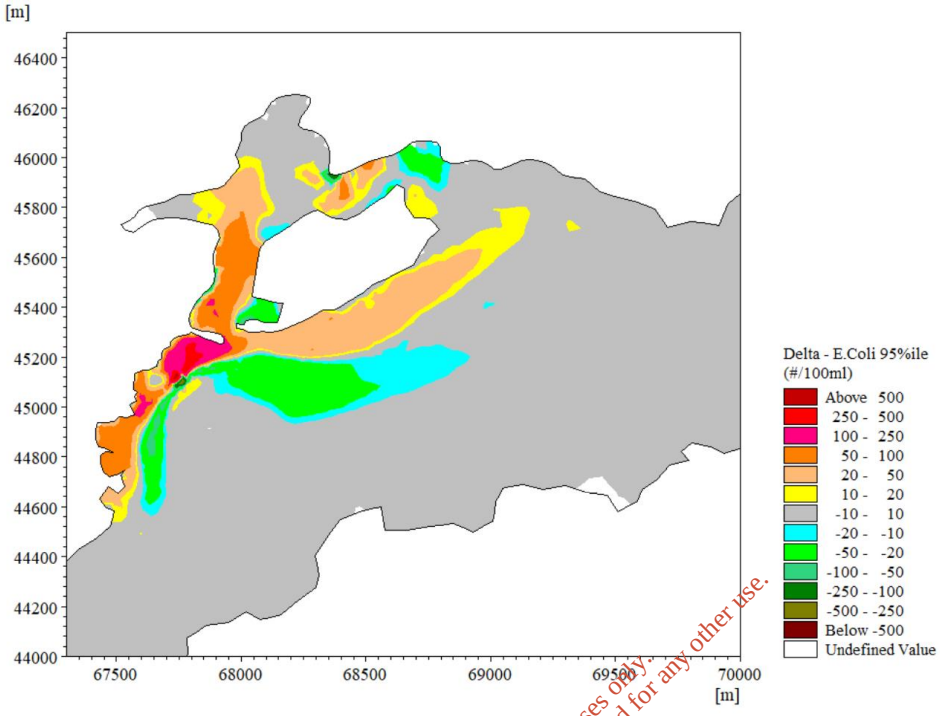


Figure 4: The Delta Plot (difference between both sceanrios)



2.4.3 Results – E. Coli 95%ile concentrations at monitoring points

As per the original report, the E. Coli 95%ile concentrations have been calculated at a number of designated monitoring points in Bantry Bay which are an amalgamation of points from the EPA's National Water Monitoring Stations as well as sampling points from the bathing water and shellfish water directives, and other points of interest. The location of the points are presented in Figure 5.

Figure 5: Location of monitoring points

Table 3 presents the 95%ile E. Coli concentrations at each of the points for both scenarios.

It can be seen from the results that the construction of the Dinish Wharf Expansion will not have any impact at the points located furthest away from the outfall as the concentrations of E. Coli remain zero.

In the inner harbour, the increases in the 95%ile concentration at the monitoring points are very minor and less than 10 cfu/100ml. Closer to the outfall the increases in concentration are still minor and do not result in any of the EQS's being exceeded. At a number of locations there is a very minor decrease in concentration with the Dinish Wharf Expansion in place.

The Hornet Rock Buoy monitoring point is the closest monitoring point to the proposed outfall that is situated in Shellfish Waters. With the Dinish Wharf Expansion in place the concentration at this location is decreased to 2cfu/100ml which is deemed very minor.

Table 3: E. Coli (95%ile) concentrations at monitoring points for proposed scenarios with and without breakwaters

Monitoring Point	95%ile Escherichia Coliforms (cfu/100ml)		
	Proposed WWTP - No Breakwaters	Proposed WWTP - With Breakwaters	Delta
RSL Dunboy Castle	56	75	19
Piper's Point, Bullig Bay	9	5	-3
Dunboy Castle	200	234	35
Walter Scott Rock Buoy	11	8	-4
Castletownbere Harbour	28	36	8
RSL Opp. Minane Island	3	6	2
Hornet Rock Buoy	7	2	-5
Rossmackowen	29	31	2
RSL Carraiglee Point	0	1	1
Mouth of Berehaven	0	0	0
South of Shee Head	0	0	0
Mouth of Bantry Bay	0	0	0
Roancarrigmore	0	0	0
South of Mehal Head	0	0	0
South of Shealane Island	0	0	0
Proposed Outfall Mixing Zone**	567	534	-34
CTB Gauge	27	47	20
Castletownbere AER Monitoring Point	98	168	70
Bantry AER Monitoring Point	0	0	0
Glengarriff AER Monitoring Point	4	4	0
** Not a monitoring point. Included for information purposes only.			

It can be seen from the table that an 'Excellent' water quality (<250cfu/100ml) status is achieved at each of the designated monitoring points with both the proposed WWTP in place and with the Dinish Wharf Expansion constructed.

The increase in the 95%ile concentration of E Coli associated with the Dinish Wharf Expansion does not therefore result in any changes in the water quality classification when compared against the findings of the original modelling report for Castletownbere.

2.5 Discussion and conclusions

With the proposed WWTP in place, the Dinish Wharf Expansion will lead to increases in the 95%ile concentrations of E. Coli in Castletownbere Harbour and in the western channel of Dinish Island when compared to the scenario without the Expansion in place. These increases are relatively minor for most of the area of the harbour. Each of the designated monitoring points in the harbour all retain 'Excellent' water quality (<250cfu/100ml) status with the works in place as the 95%ile E. Coli concentration remains below the EQS threshold at each point.

Of the six parameters assessed in the original study, E. Coli is the closest to exceeding its EQS limit in Castletownbere Harbour. From the results presented in this chapter it can therefore be concluded that each of the six WQ parameters will also remain below their respective EQS limit as the relative increase in E Coli concentrations with the Dinish Wharf Expansion can be applied to the concentrations of the other parameters.

It can therefore be concluded that the key findings of the original Castletownbere Far Field Modelling report remains valid with the Dinish Wharf Expansion in place: discharges from the proposed WwTP for Castletownbere are in full compliance with all the various EU water regulations.

3 Section 4 Outfalls model run

3.1 Introduction

A Section 4 outfall is a discharge from a private entity that is licensed by the local authority. Castletownbere Harbour has three Section 4 outfalls that were not considered as part of the original study as they only impact on the background concentrations in the harbour.

In order to assess the influence of the Section 4 outfalls on Castletownbere Harbour, a revised model has been simulated which includes the Section 4 discharges. The purpose of the revised run is to assess if any of the nutrient EQS's are exceeded when the Section 4 outfalls are considered along with the proposed WwTP scheme.

3.2 Additional outfall discharges

For the purpose of this simulation run, the only change made to the original Castletownbere Water Quality model was the inclusion of the three additional Section 4 discharges which are presented in Figure 6. All other model inputs and parameters remain the same.

Figure 6: Section 4 outfall discharges

Two of the Section 4 outfalls are located on the south side of Dinish Island, while the third outfall discharges into the receiving coastal waters at Ballynakilla, Bere Island. No monitoring data was available for these outfalls. It was therefore conservatively assumed that the Dinish Island and Bere Island outfalls were operating at their licensed limit for both flow and concentration which are specified in their respective discharge licenses.

Of the WQ parameters considered in the original study, the Section 4 discharge licenses only provides a limit value on Dissolved Inorganic Nitrogen (DIN) for the

Dinish Island outfalls, and Total Ammonia (TA) for the Bere Island discharge. As a result, only these two parameters were included in the additional model run. The flows and concentrations applied to these discharges in the model are presented in Table 4 below.

Table 4: Additional outfall flows and concentrations

Source Type	Source Name	Flow Rate (m^3/s)	WQ Parameter	
			DIN (mg/l)	TA (mg/l)
Outfall	Dinish Island outfall 1	0.009	25	–
Outfall	Dinish Island outfall 2	0.0021	25	–
Outfall	Bere Island outfall	0.188	–	1

3.3 Model results

The impact of including the Section 4 discharges on water quality is assessed by examining the 50%ile concentrations of DIN and TA at each of the designated monitoring points in Castletownbere for both the with and without Section 4 discharges scenarios. In both cases it is assumed that the proposed WWTP for Castletownbere is operating.

The results are presented in Table 5. It can be seen that for both scenarios the 50%ile concentrations of both DIN and TA are very low. The modelled TA values are in fact below the EPA's stated Limit of Detection (LoD) of 0.02mg/l. (It is noted that a LoD for DIN is not generally reported as it is the combination of Ammonia, Nitrate and Nitrite).

While the inclusion of the Dinish Island Section 4 discharges increases 50%ile concentrations of DIN and TA as monitoring points close to the discharges, it can be seen from the table that the increases are insignificant.

The target level of DIN as specified in the Surface Water Regulations is 0.25mg/l. 50%ile DIN concentrations are well below this EQS at each of the monitoring points with both the proposed WWTP and Section 4 discharges in place. The target level of TA as defined in the Salmonid Water Regulations is 1mg/l. TA concentrations are also well below this EQS at each of the monitoring points.

It can therefore be concluded that when the Section 4 discharges are accounted for in the model the key finding of the original report as regards nutrients remains valid: discharges from the proposed WwTP for Castletownbere are in full compliance with the relevant EU water regulations.

Table 5: Nutrient (50%ile) concentrations at monitoring points

Monitoring point	50%ile Dissolved Inorganic Nitrogen (mg/l)			50%ile Total Ammonia (mg/l)		
	Proposed (Excluding Section 4s)	Proposed (Including Section 4s)	Delta	Proposed (Excluding Section 4s)	Proposed (Including Section 4s)	Delta
RSL Dunboy Castle	0.0406	0.0432	0.0026	0.0023	0.0023	0
Piper's Point, Bullig Bay	0.0072	0.0083	0.0011	0.0007	0.0007	0
Dunboy Castle	0.1845	0.1805	-0.0040	0.0045	0.0045	-0.0001
Walter Scott Rock Buoy	0.0172	0.0200	0.0028	0.0016	0.0016	0
Castletownbere Harbour	0.0538	0.0553	0.0015	0.0034	0.0034	0
RSL Opp. Minane Island	0.0148	0.0170	0.0022	0.0019	0.0019	0
Hornet Rock Buoy	0.0120	0.0139	0.0019	0.0016	0.0022	0.0006
Lawrence Cove	0.0063	0.0072	0.0009	0.0006	0.0019	0.0013
Rossmackowen	0.0432	0.0428	-0.0003	0.0011	0.0015	0.0005
RSL Carraiglee Point	0.0065	0.0061	-0.0004	0.0002	0.0006	0.0004
Mouth of Berehaven	0.0024	0.0027	0.0003	0.0001	0.0001	0
South of Shee Head	0.0000	0.0000	0	0.0000	0.0000	0
Mouth of Bantry Bay	0.0011	0.0015	0.0003	0.0000	0.0000	0
Roancarrigmore	0.0026	0.0024	-0.0001	0.0001	0.0001	0
South of Mehal Head	0.0005	0.0005	0.0001	0.0000	0.0000	0
South of Shealane Island	0.0006	0.0006	0	0.0001	0.0001	0
Proposed Outfall	0.0232	0.0264	0.0033	0.0049	0.0053	0.0004
CTB Gauge	0.0447	0.0472	0.0025	0.0030	0.0030	0
Castletownbere AER Monitoring Point	0.0208	0.0230	0.0022	0.0056	0.0058	0.0002
Bantry AER Monitoring Point	0.0530	0.0500	-0.0031	0.0014	0.0014	0
Glengarriff AER Monitoring Point	0.1380	0.1038	-0.0342	0.0043	0.0035	-0.0008

4 Further validation of the Hydrodynamic model

4.1 Introduction

As part of this supplementary report, additional validation model runs were undertaken on the hydrodynamic model of Castletownbere that was developed for the original study. The work was undertaken using additional survey field data which was recorded in August 2019. The purpose of undertaking additional model validation is to all further confidence in the model.

4.2 Data acquisition

A marine survey was commissioned in 2018 as part of the original far-field modelling study of Castletownbere. The 2018 survey, which is detailed in the main report, collected hydrographic data at the proposed outfall location for a single spring and neap tidal cycle. To facilitate additional validation of the Castletownbere model, a new marine survey was commissioned by Arup. As detailed in the following section, the new survey collected data at two separate locations over a longer period and was undertaken in August 2019 by Hydrographic Surveys Ltd.

Hindcast water level data was procured from Deltares to provide an open sea boundary condition for these additional validation model runs and publicly available datasets have also been collected as detailed below.

All other data used in these additional validation model runs remained unchanged from that used in the original study.

4.2.1 Marine Survey 2019

As part of the 2019 marine survey, hydrographic data was collected from both the vicinity of the proposed outfall and also within the deeper channel between Castletownbere and Bere Island as indicated in Figure 7.

Figure 7: Survey locations

Current speed and direction data was collected at 3 points in the water column:

(1) near the surface;

(2) at mid-depth;

(3) near the bed.

Continuous measurements of water level, current speeds and current directions were collected at 10-minute intervals for a number of spring-neap tidal cycles for the following durations:

- Near Outfall – 06/08/2019 11:20 – 20/08/2019 11:30
- Deep Channel – 02/08/2019 15:30 – 20/08/2019 12:10

The survey dataset is presented in Appendix A.

4.2.2 Water levels from the Castletownbere Port Gauge

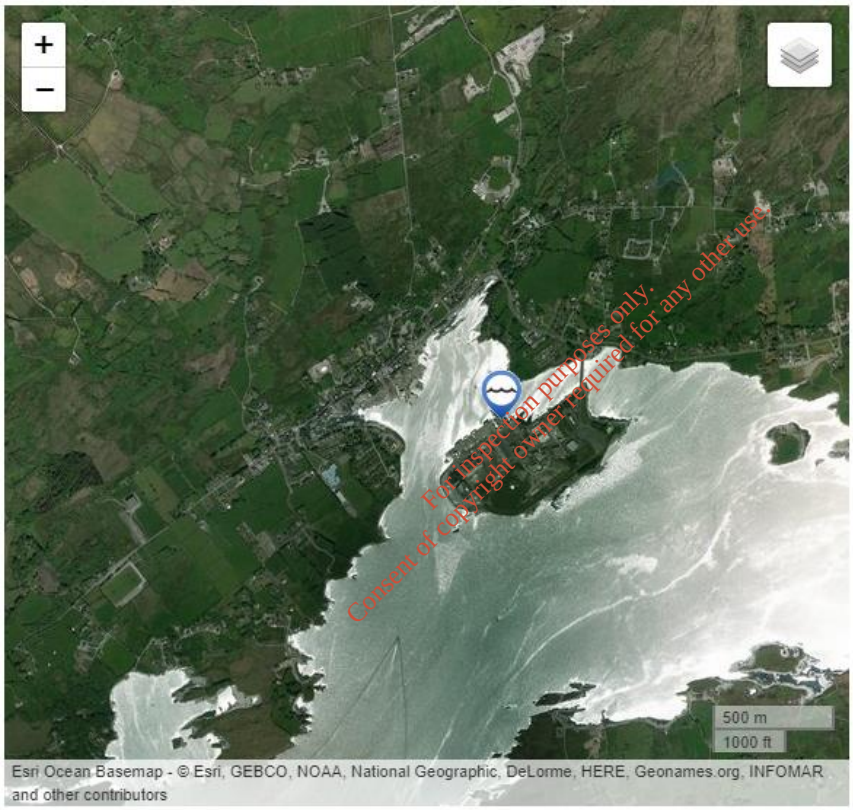
The surveyed water levels for both spring and neap tides were validated against measured data from the Castletownbere Port gauge which is maintained by the Marine Institute (Refer to Table 6 and Figure 8). The surveyed water levels collected as part of the Marine Survey had some discrepancies associated with it and was therefore not used as part of the study.

The modelled water level was instead validated against the data from the Castletownbere Port gauge which we note is available to download from the Marine Institute website.

Table 6: Castletownbere Port tide gauge details

Co-ordinates	Station ID	WL above LAT (m)	WL to OD Malin Head (mOD)
Lat: 51.6496, Long: -9.9034	Castletownbere Port	1.731	-0.7

Figure 8: Location of gauge in Castletownbere



4.2.3 Hindcast data from Deltares

Hindcast water level data was procured from Deltares for the same period as the 2019 marine survey was undertaken. This dataset provides a definition of the boundary conditions for the additional validation model runs. This approach is the same one taken for the original calibration and validation runs. Water level data at 10-minute intervals for seven points over a three-week period were obtained. The location of these points is presented in Figure 9. The points represent locations on the open sea boundary of the hydrodynamic model.

Figure 9: Hindcast water level data points

4.2.4 Fluvial source inflows

Fluvial (river) flows from watercourses discharging into Bantry Bay have been included in the validation model runs. The approach taken is the same as the original model validations runs. As flow gauge data was unavailable for the rivers, data from a pivot site gauge was obtained from the OPW (waterlevel.ie) for the time period corresponding to the validation model runs and scaled based on catchment size.

4.2.5 Summary of additional data acquired

A summary of the data acquired for this additional validation study of the Castletownbere far field model is presented in Table 7.

Table 7: Summary of the additional data acquired

Data	Location	Source	Used	How data is used
Water level	Near outfall location	August 2019 survey	X	Quality checked and deemed to be erroneous. Data from Castletownbere Port used instead.
Water level	Deep channel location	August 2019 survey	X	Quality checked and deemed to be erroneous. Data from Castletownbere Port used instead.
Water level	Castletownbere Port	Marine Institute	√	Used to validate model

Data	Location	Source	Used	How data is used
Water level	Outer Bay	Deltares DCSM Model	√	Used to derive model boundary for validation runs
Current Speeds	Near outfall location, at 3 depths	August 2019 survey	√	Use to inform validation
Current Speeds	Deep channel location, at 3 depths	August 2019 survey	√	Use to inform validation
Current Directions	Near outfall location, at 3 depths	August 2019 survey	√	Use to inform validation
Current Directions	Deep channel location, at 3 depths	August 2019 survey	√	Use to inform validation

4.3 Hydrodynamic model validation

4.3.1 Overview

This section details the results of additional validation model runs for the Castletownbere hydrodynamic model. Please refer to the main report for a full description of the model build as well as the original model calibration and validation results. It should be noted that all the original model parameters remain unchanged with the exception of the tidal boundary conditions and fluvial inflows.

The model was simulated for two separate 7-day spring and neap periods, each with a model warm-up time of 12 hours.

The 2D hydrodynamic model was validated for the following measured parameters:

- Water levels
- Current speeds
- Current directions

Current speeds and directions were validated against measured data recorded as part of the 2019 marine survey for the Near Outfall and Deep Channel locations.

The findings for the spring tide validation are presented in Section 4.3.3, while Section 4.3.4 details the neap tide validation results.

4.3.2 Irish Water validation guidance

Following the guidance outlined in the Irish Water Technical Standards for Marine Modelling, the model validation has been undertaken in two ways:

- A visual interpretation of the goodness of fit of the modelled data to the recorded data;
- A statistical analysis of the modelled data against the recorded data.

The Irish Water Technical Standards for Marine Modelling state that the hydrodynamic performance of a model should be validated for the following parameters and their associated statistical performance targets as set out in the main Castletownbere Far-field Modelling Report and repeated here:

- Water level: ±15% and ±20% of measured levels during Spring and Neap tides respectively. ±0.1m of measured levels as an absolute difference. A Root Mean Squared Error of below 0.1m;
- Current velocity: ±10% of measured peak velocities at Mid tide, ±20% of measured velocities at high and low water. ±0.1m/s of measured velocities as an absolute difference;
- Current direction: ±20 degrees of measured directions;
- Timing of high water: ±15 minutes at estuary mouth; ±25 minutes at estuary head.

Statistical targets should not be used in isolation when assessing the performance and acceptability of a model and it is necessary for the experienced modeller to offer a critical assessment of model's performance taking all of the available information and validation data into account.

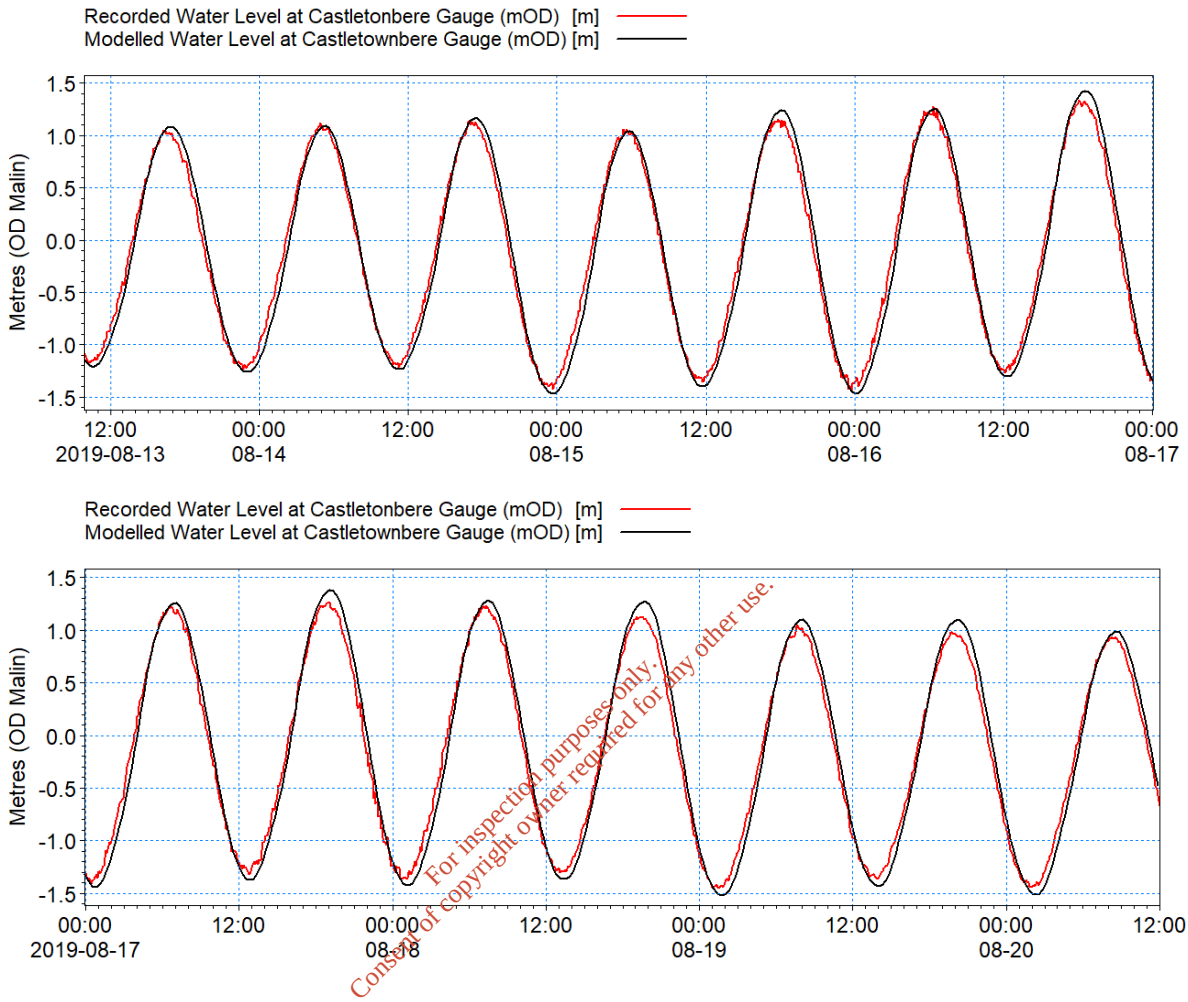
4.3.3 Spring Tide Validation

4.3.3.1 Water Level

The spring water level validation at the Castletownbere Gauge location is presented in Figure 10. The figure shows the full 7-day model simulation and is presented as two separate plots in order to aid the reader. Each plot presents 3.5 days. It is noted that this presentation format is applied to all subsequent plots in this section.

It can be seen from the plot that there is a very good match between the modelled and recorded data. Both the tidal magnitude and tidal phase are very well reproduced by the model over the full 7-day period.

Figure 10: Spring tide water level validation at the Deep Channel location – visual analysis



The statistical analysis of the water level validation at the Castletownbere Gauge is presented in Table 8. It is presented for a full spring tidal cycle and the cells highlighted in green are those that meet the performance targets.

There is a difference of circa 15 minutes between the model and recorded data for the time of occurrence of high water. The difference for the time of low water is also circa 15 minutes. This performance is in keeping with the performance target of 15 minutes as set by the Irish Water Technical Standards.

For the absolute difference it can be seen that the model is within the performance target circa 62% of the time. The Root Mean Squared Error (RMSE) between the modelled and recorded is 0.099m. These results represent a good statistical match.

Table 8: Statistical performance results for spring tide water level validation at Deep Channel location

Time	Recorded Water Level (mOD)	Modelled Water Level (mOD)	Absolute difference between modelled and recorded (m)
16/08/2019 06:20	1.28	1.25	0.02
16/08/2019 06:50	1.13	1.22	0.09
16/08/2019 07:20	0.98	1.08	0.10
16/08/2019 07:50	0.75	0.85	0.11
16/08/2019 08:20	0.42	0.57	0.15
16/08/2019 08:50	0.13	0.24	0.12
16/08/2019 09:20	-0.21	-0.09	0.12
16/08/2019 09:50	-0.48	-0.42	0.06
16/08/2019 10:20	-0.80	-0.72	0.08
16/08/2019 10:50	-0.99	-0.98	0.01
16/08/2019 11:20	-1.16	-1.17	0.00
16/08/2019 11:50	-1.22	-1.28	0.05
16/08/2019 12:20	-1.21	-1.31	0.09
16/08/2019 12:50	-1.14	-1.26	0.12
16/08/2019 13:20	-1.04	-1.13	0.08
16/08/2019 13:50	-0.81	-0.93	0.12
16/08/2019 14:20	-0.60	-0.70	0.10
16/08/2019 14:50	-0.28	-0.44	0.16
16/08/2019 15:20	0.01	-0.13	0.14
16/08/2019 15:50	0.33	0.23	0.10
16/08/2019 16:20	0.63	0.61	0.02
16/08/2019 16:50	0.87	0.94	0.07
16/08/2019 17:20	1.16	1.18	0.02
16/08/2019 17:50	1.28	1.33	0.06
16/08/2019 18:20	1.28	1.41	0.14
16/08/2019 18:50	1.28	1.42	0.14

4.3.3.2 Current Speed

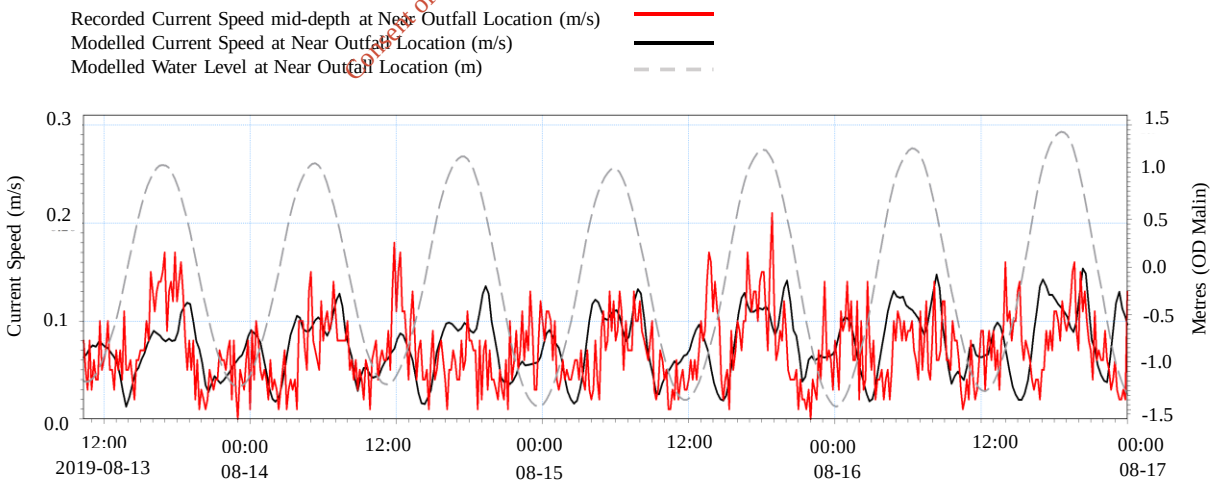
The current speed validation is presented in Figure 11 and Figure 12 for the Near Outfall and Deep Channel locations respectively. The modelled water level is also presented in the plots in order to aid the reader in deciphering the stage of the tide at which the current speeds occur.

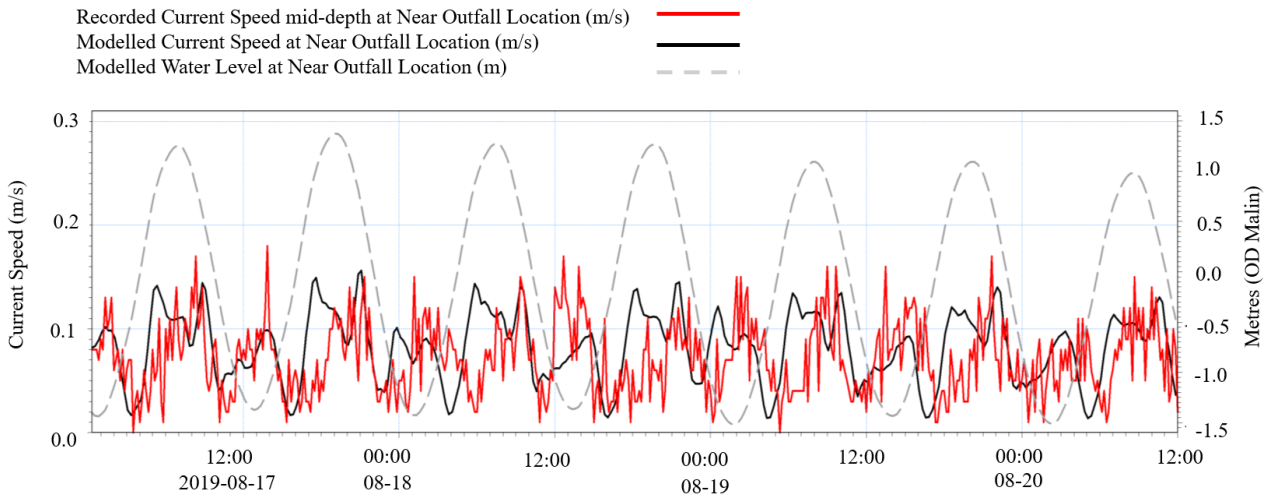
The mid-depth current speeds were considered to be the most appropriate dataset to validate the model against as they best represent the depth averaged values as simulated by a 2D model. Using an average of the data from the three different three points in the water column was not deemed appropriate given that the noise in the data would have led to erroneous averaged values.

It can be seen from the plot that the recorded current speed at the Near Outfall location is noisy due to localised turbulence in the water column. It can also be seen that the current speeds are generally below 0.1m/s which is considered to be very low. The general pattern of current speeds however can be determined from the plot and be used to validate the model. It can also be seen that the peak current speeds occur at high and low tide due to the influence of eddies which develop at certain stages of the tide in this area. The reader is referred to main Castletownbere Far Field modelling report for detailed discussion of this phenomenon.

It can be seen from the plots the model replicates both the magnitude and patterns of the recorded speeds throughout the spring tidal cycle reasonably well. The modelled maximum speeds generally match the recorded maximum speeds. Both the minimum current speeds and the time at which the minimum speeds occur are also well represented by the model. Due to the noise in the recorded data it appears as if the speeds on both the flood and ebb tides are not well represented by the model. It is evident however that the model does in fact match the recorded speeds reasonably well during these periods when the influence of the noise is discounted. It can therefore be concluded that the model well represents the spring tide current speeds at this location.

Figure 11: Spring tide current speed validation at the Near Outfall location – visual analysis



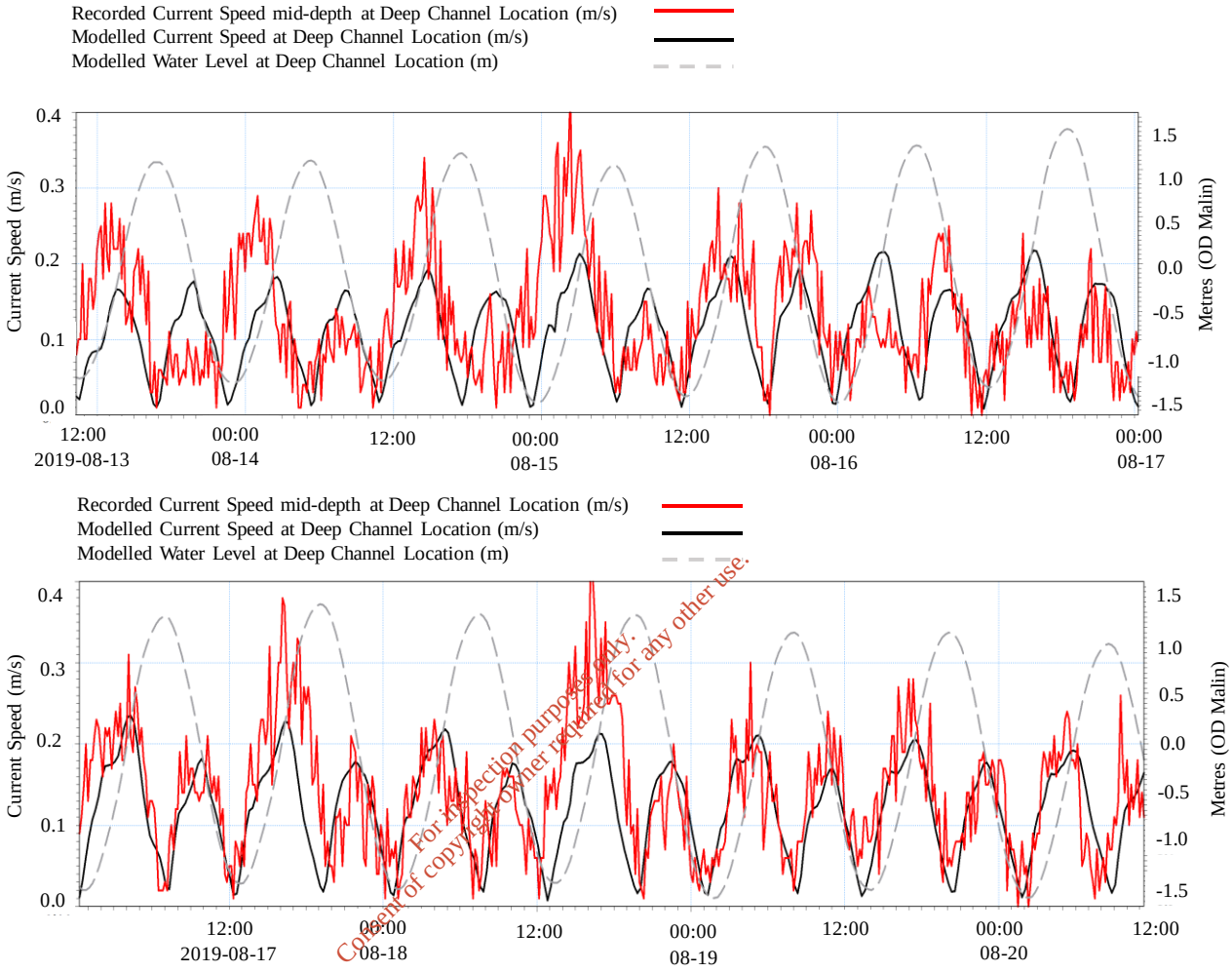


At the Deep Channel location, the recorded current speeds are of slightly greater magnitude then near the outfall. The peaks of the current speeds also occur at mid-tide which is in keeping with typical tidal hydrodynamics in an estuary.

As with the Near Outfall location data, the recorded current speeds are noisy. It can be seen however that the overall current speed magnitudes and general pattern is well captured by the model.

There are a number of instances where the model underpredicts current speeds during a flood tide. For example, at circa 04:00 hours on 15th August, recorded speeds reach circa 0.35m/s - 0.4m/s whilst modelled speeds are circa 0.2m/s. However, for the majority of the time the magnitude of recorded currents are well captured by the model. From the visual analysis of the Deep Channel location it can therefore be concluded that the spring currents are well represented by the model.

Figure 12: Spring tide current speed validation at Deep Channel location – visual analysis



The statistical analysis of the current speed validation is presented in Table 9 and Table 10 for the Near Outfall and Deep Channel locations respectively.

At both locations the model is within the statistical performance target of ±0.1m/s through 96% of the tidal cycle. These results represent a good statistical match.

Table 9: Statistical performance results for spring tide current speed validation at Near Outfall location

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
16/08/2019 06:20	0.10	0.11	0.01
16/08/2019 06:50	0.04	0.10	0.06
16/08/2019 07:20	0.08	0.09	0.01
16/08/2019 07:50	0.04	0.11	0.07
16/08/2019 08:20	0.06	0.15	0.09

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
16/08/2019 08:50	0.12	0.10	0.02
16/08/2019 09:20	0.06	0.05	0.01
16/08/2019 09:50	0.08	0.04	0.04
16/08/2019 10:20	0.03	0.04	0.01
16/08/2019 10:50	0.04	0.05	0.01
16/08/2019 11:20	0.04	0.08	0.04
16/08/2019 11:50	0.06	0.06	0.00
16/08/2019 12:20	0.03	0.07	0.04
16/08/2019 12:50	0.06	0.08	0.02
16/08/2019 13:20	0.07	0.10	0.03
16/08/2019 13:50	0.09	0.08	0.01
16/08/2019 14:20	0.11	0.05	0.06
16/08/2019 14:50	0.10	0.02	0.08
16/08/2019 15:20	0.08	0.02	0.06
16/08/2019 15:50	0.07	0.04	0.03
16/08/2019 16:20	0.03	0.09	0.06
16/08/2019 16:50	0.02	0.14	0.12
16/08/2019 17:20	0.09	0.14	0.05
16/08/2019 17:50	0.07	0.13	0.06
16/08/2019 18:20	0.10	0.12	0.02
16/08/2019 18:50	0.10	0.11	0.01

Table 10: Statistical performance results for spring tide current speed validation at Deep Channel location

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
16/08/2019 06:20	0.08	0.03	0.05
16/08/2019 06:50	0.18	0.02	0.16
16/08/2019 07:20	0.18	0.09	0.09
16/08/2019 07:50	0.21	0.14	0.07
16/08/2019 08:20	0.23	0.16	0.07
16/08/2019 08:50	0.19	0.17	0.02
16/08/2019 09:20	0.14	0.16	0.02
16/08/2019 09:50	0.12	0.14	0.02
16/08/2019 10:20	0.05	0.12	0.07
16/08/2019 10:50	0.00	0.10	0.10
16/08/2019 11:20	0.01	0.05	0.04
16/08/2019 11:50	0.05	0.01	0.04

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
16/08/2019 12:20	0.09	0.05	0.04
16/08/2019 12:50	0.12	0.09	0.03
16/08/2019 13:20	0.11	0.12	0.01
16/08/2019 13:50	0.08	0.14	0.06
16/08/2019 14:20	0.11	0.16	0.05
16/08/2019 14:50	0.17	0.17	0.00
16/08/2019 15:20	0.09	0.19	0.10
16/08/2019 15:50	0.17	0.22	0.05
16/08/2019 16:20	0.18	0.21	0.03
16/08/2019 16:50	0.15	0.16	0.01
16/08/2019 17:20	0.10	0.11	0.01
16/08/2019 17:50	0.10	0.07	0.03
16/08/2019 18:20	0.05	0.04	0.01
16/08/2019 18:50	0.07	0.02	0.05

4.3.3.3 Current Direction

The current direction validation for spring tide is presented in Figure 13 and Figure 14 for the Near Outfall and Deep Channel locations respectively. It can be seen in Figure 13 that the modelled tide turns close to mid-tide at the Near Outfall location which is expected as the hydrodynamics at this location differ in this respect to the Deep Channel. The reader is referred to the original Castletownbere Far-field Modelling report for a description of this phenomenon.

From the plots it can be seen that the model is well validated to the recorded current speed data at both locations as the model captures the general direction of the tide on both the flood and ebb tide. It can also be seen that the recorded data is relatively noisy at both locations which needs to be considered as part of the visual analysis. The turning of the tide is also replicated well by the model.

Figure 13: Spring tide current direction validation at Near Outfall location – visual analysis

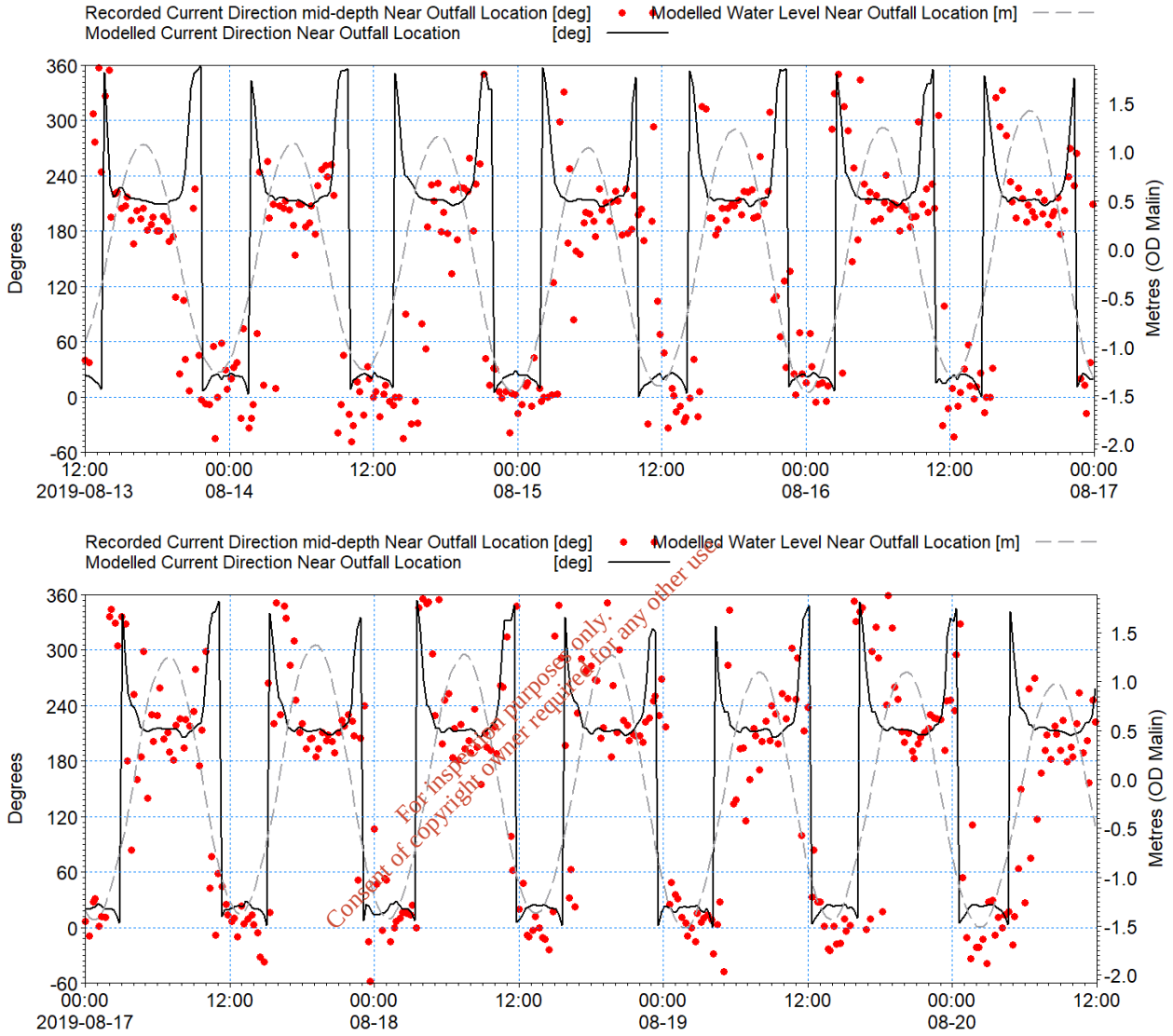
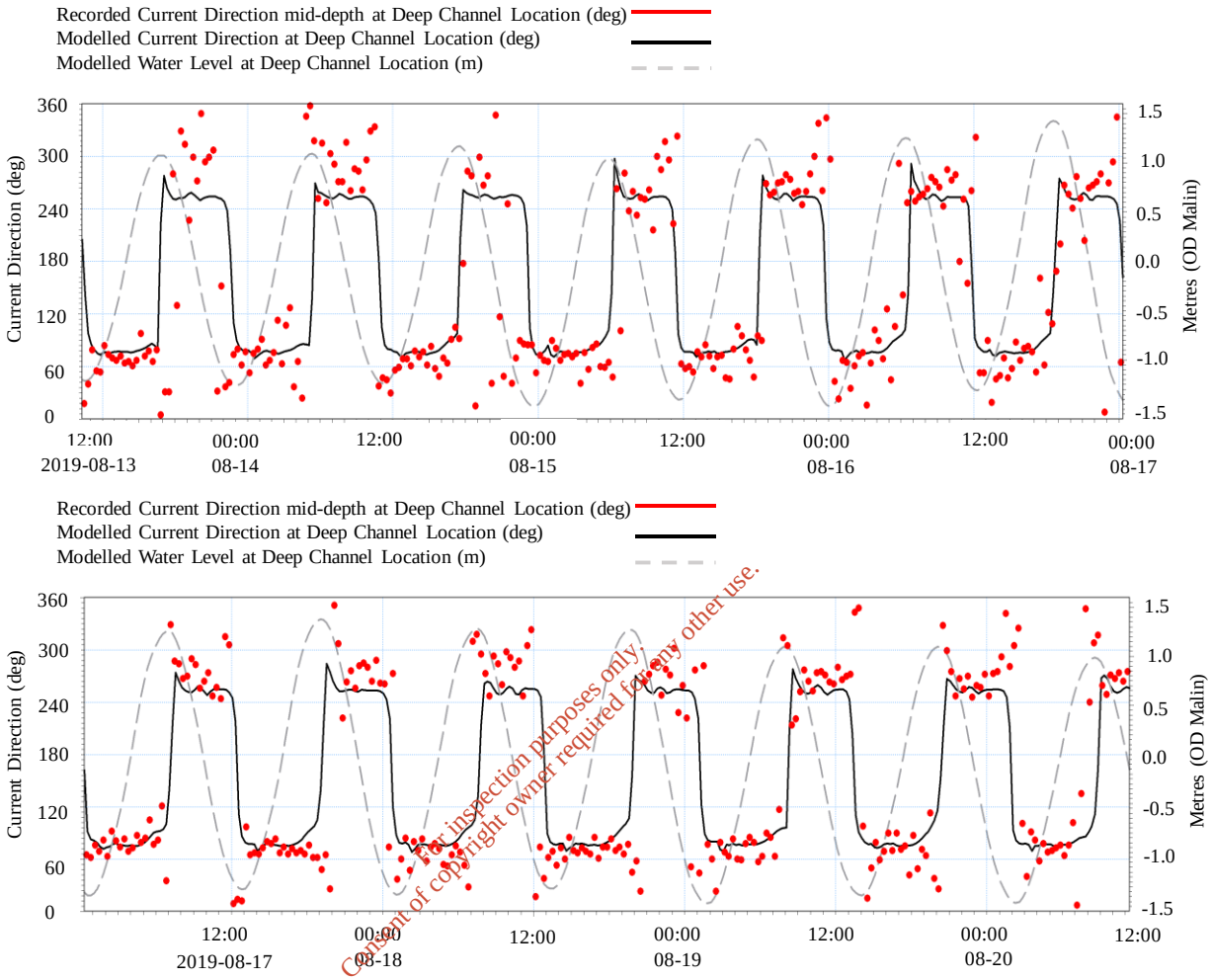


Figure 14: Spring tide current direction validation at Deep Channel location – visual analysis



The statistical analysis of the current direction is presented in Table 11 and Table 12 for the Near Outfall and Deep Channel locations respectively.

The statistical analysis suggests that the model is preforming relatively poorly, meeting the performance targets 38% of the time for the Near Outfall location and 42% for the Deep Channel location. The statistical analysis however is very sensitive to minor variations in recorded current direction data that can arise from a noisy signal.

The assessment of the validation needs to consider both the visual and statistical aspects and it is evident from the visual comparison that the model replicates recorded current direction data very well. The statistical analysis does not suggest a good validation due to the noise in he recorded data. It can therefore be concluded that the model is well validated to the current direction at both locations.

Table 11: Statistical performance results for spring tide current direction validation at Near Outfall location

Time	Recorded Current Direction (deg)	Modelled Current Direction (deg)	Absolute difference between modelled and recorded (deg)
16/08/2019 06:20	198	214	16
16/08/2019 06:50	244	214	30
16/08/2019 07:20	204	210	6
16/08/2019 07:50	180	209	29
16/08/2019 08:20	203	214	11
16/08/2019 08:50	195	221	26
16/08/2019 09:20	299	238	61
16/08/2019 09:50	190	329	139
16/08/2019 10:20	314	339	25
16/08/2019 10:50	319	15	304
16/08/2019 11:20	329	14	315
16/08/2019 11:50	347	18	329
16/08/2019 12:20	317	24	293
16/08/2019 12:50	5	25	20
16/08/2019 13:20	338	24	314
16/08/2019 13:50	1	20	19
16/08/2019 14:20	13	10	3
16/08/2019 14:50	343	349	6
16/08/2019 15:20	0	295	295
16/08/2019 15:50	325	245	80
16/08/2019 16:20	333	218	115
16/08/2019 16:50	0	212	212
16/08/2019 17:20	203	217	14
16/08/2019 17:50	223	213	10
16/08/2019 18:20	190	213	23
16/08/2019 18:50	201	214	13

Table 12: Statistical performance results for spring tide current direction validation at Deep Channel location

Time	Recorded Current Direction (deg)	Modelled Current Direction (deg)	Absolute difference between modelled and recorded (deg)
16/08/2019 06:20	258	102	156
16/08/2019 06:50	260	291	31
16/08/2019 07:20	265	265	0
16/08/2019 07:50	257	253	4

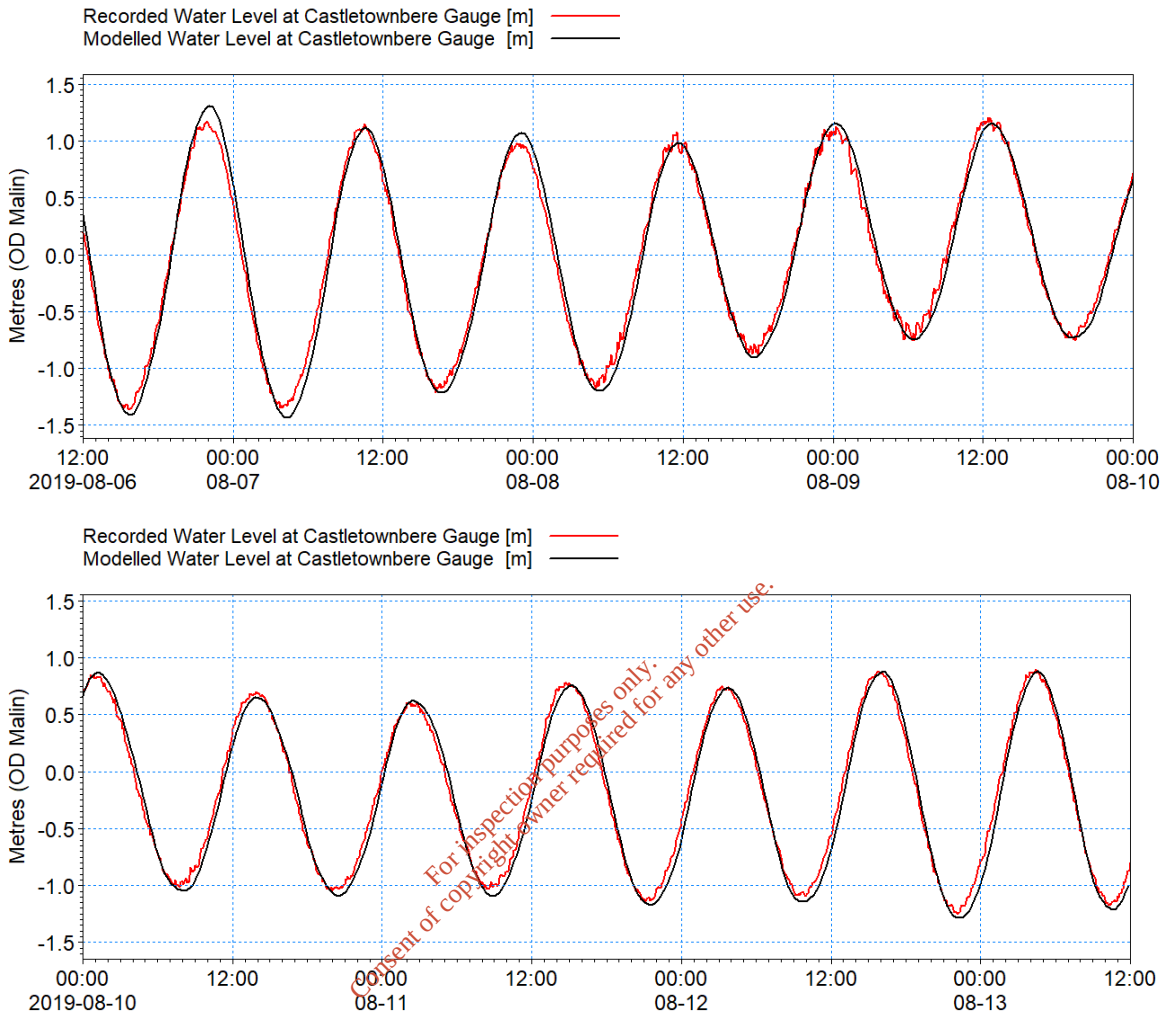
Time	Recorded Current Direction (deg)	Modelled Current Direction (deg)	Absolute difference between modelled and recorded (deg)
16/08/2019 08:20	257	253	4
16/08/2019 08:50	271	256	15
16/08/2019 09:20	272	249	23
16/08/2019 09:50	285	254	31
16/08/2019 10:20	274	253	21
16/08/2019 10:50	180	254	74
16/08/2019 11:20	257	252	5
16/08/2019 11:50	261	178	83
16/08/2019 12:20	67	83	16
16/08/2019 12:50	53	77	24
16/08/2019 13:20	51	79	28
16/08/2019 13:50	46	72	26
16/08/2019 14:20	62	77	15
16/08/2019 14:50	47	76	29
16/08/2019 15:20	47	75	28
16/08/2019 15:50	67	76	9
16/08/2019 16:20	76	76	0
16/08/2019 16:50	77	78	1
16/08/2019 17:20	64	84	20
16/08/2019 17:50	62	92	30
16/08/2019 18:20	273	98	175
16/08/2019 18:50	169	211	42

4.3.4 Neap Tide Validation

4.3.4.1 Water level

The neap water level validation at the Castletownbere Gauge location is presented in Figure 15. It can be seen that the model replicates both the phase and magnitude of the recorded neap tidal data very well over the full 7-day period.

Figure 15: Neap tide water level validation at the Castletownbere Gauge – visual analysis



The statistical analysis of the neap water level validation at the Castletownbere Gauge is presented in Table 13. It can be seen that the model performs very well against the recorded data.

The absolute levels at high and low water are within the targets of ±0.1m tolerance. The modelled water level is within the absolute tolerance 88% of the time. The Root Mean Squared Error (RMSE) between the modelled and recorded for this tidal cycle is 0.074m. These results represent a good statistical match.

The results of both the spring and neap validation provide further confidence in the hydrodynamic model's capability of simulating accurate water levels.

Table 13: Statistical performance results for neap tide water level validation at Deep Channel location

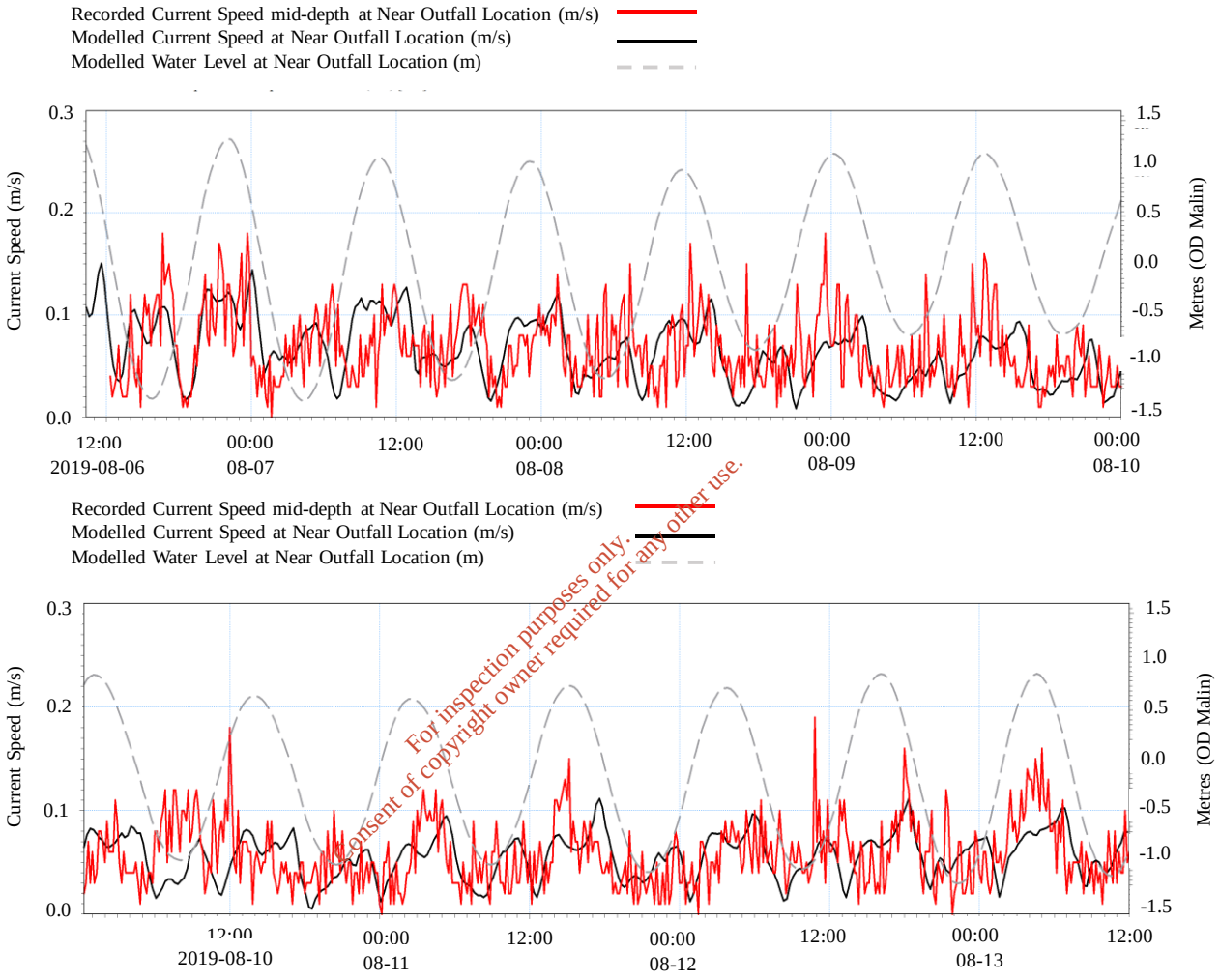
Time	Recorded Water Level (mOD)	Modelled Water Level (mOD)	Absolute difference between modelled and recorded (m)
08/08/2019 11:20	1.05	0.97	0.08
08/08/2019 11:50	0.89	0.98	0.09
08/08/2019 12:20	0.91	0.91	0.01
08/08/2019 12:50	0.80	0.79	0.01
08/08/2019 13:20	0.54	0.62	0.08
08/08/2019 13:50	0.34	0.40	0.07
08/08/2019 14:20	0.09	0.16	0.07
08/08/2019 14:50	-0.15	-0.08	0.07
08/08/2019 15:20	-0.34	-0.31	0.03
08/08/2019 15:50	-0.57	-0.51	0.06
08/08/2019 16:20	-0.68	-0.68	0.01
08/08/2019 16:50	-0.70	-0.80	0.10
08/08/2019 17:20	-0.83	-0.88	0.05
08/08/2019 17:50	-0.85	-0.90	0.05
08/08/2019 18:20	-0.78	-0.85	0.06
08/08/2019 18:50	-0.64	-0.75	0.11
08/08/2019 19:20	-0.52	-0.64	0.12
08/08/2019 19:50	-0.39	-0.49	0.09
08/08/2019 20:20	-0.14	-0.27	0.13
08/08/2019 20:50	0.08	-0.02	0.09
08/08/2019 21:20	0.25	0.24	0.00
08/08/2019 21:50	0.59	0.49	0.09
08/08/2019 22:20	0.71	0.72	0.02
08/08/2019 22:50	0.95	0.91	0.03
08/08/2019 23:20	1.11	1.05	0.05
08/08/2019 23:50	1.04	1.13	0.10

4.3.4.2 Current Speed

The neap current speed validation results are presented in Figure 16 and Figure 17 for the Near Outfall and Deep Channel locations respectively. At the Near Outfall location (Figure 16), the recorded current speeds are below 0.1m/s which is considered to be low. It also has a considerable amount of noise. Despite these issues it can be seen that the modelled current speed follows the general pattern of the recorded data quite well. The modelled maximum current speeds across the period are also representative of the recorded maximum values when the influence of the

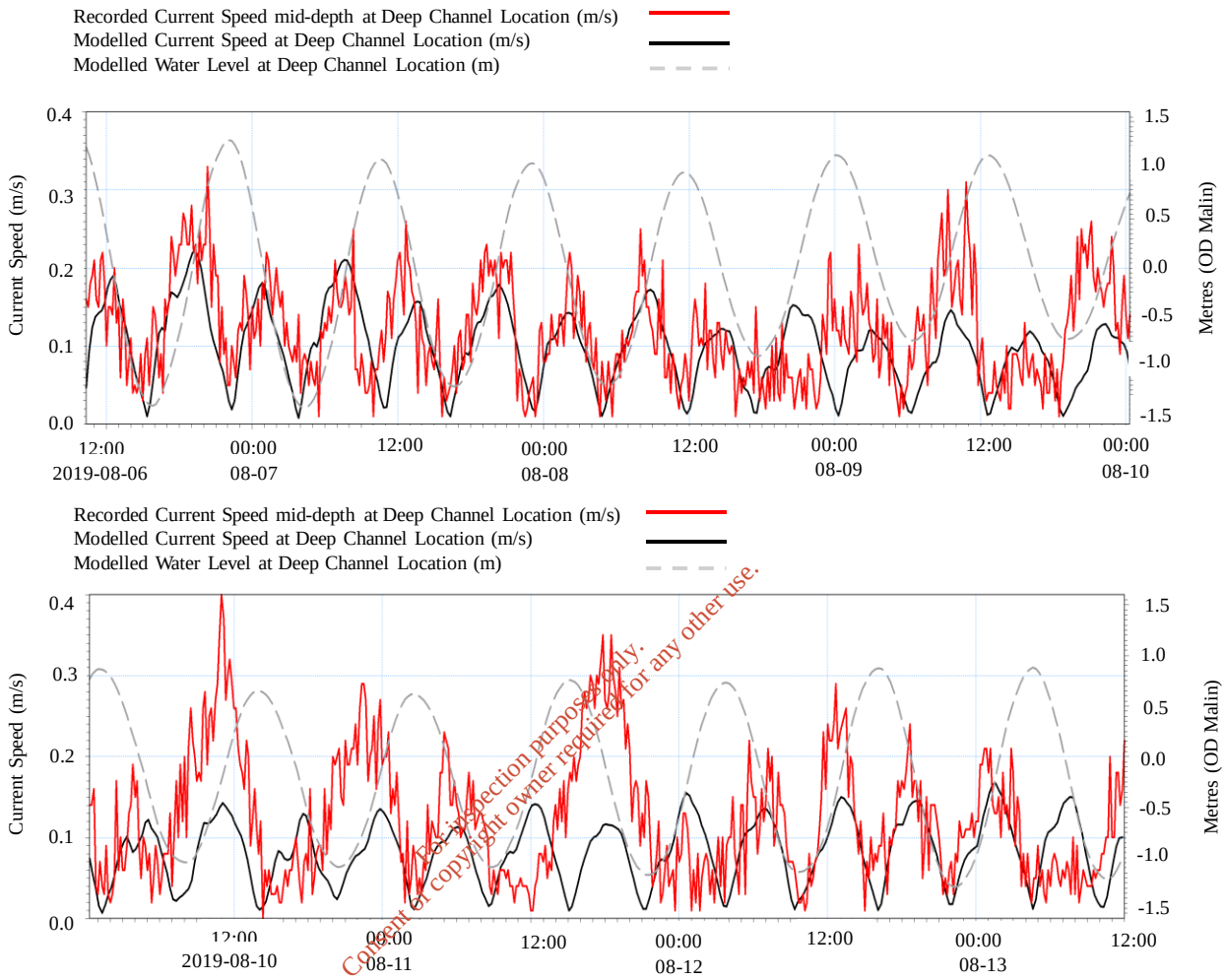
noise is discounted. The modelled data is therefore considered to be a good match to the recorded data.

Figure 16: Neap tide current speed validation at Near Outfall location – visual analysis



From Figure 17 it can be seen that there is a very good match between the modelled and recorded data at the Deep Channel location for the first 3.5 day period. During the 2nd 3.5-day period there are a number instances where the model under predicts the recorded data. Overall however the visual analysis indicates a good match between modelled and recorded data.

Figure 17: Neap tide current speed validation at Deep Channel location – visual analysis



The statistical analysis of the neap current speed validation is presented in Table 14 and Table 15 respectively. The absolute performance targets are below the IW target at every time-step throughout the tidal cycle. A good statistical match is found at both locations.

The results of both the spring and neap visual and statistical validations are very good for current speeds. This provides confidence in the hydrodynamic model's capability of simulating accurate current speeds in the area of interest.

Table 14: Statistical performance results for neap tide current speed validation at Near Outfall location

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
08/08/2019 11:20	0.04	0.03	0.01
08/08/2019 11:50	0.04	0.01	0.03

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
08/08/2019 12:20	0.17	0.04	0.13
08/08/2019 12:50	0.08	0.08	0.00
08/08/2019 13:20	0.11	0.10	0.01
08/08/2019 13:50	0.12	0.11	0.01
08/08/2019 14:20	0.04	0.12	0.08
08/08/2019 14:50	0.08	0.12	0.04
08/08/2019 15:20	0.04	0.12	0.08
08/08/2019 15:50	0.02	0.09	0.07
08/08/2019 16:20	0.06	0.06	0.00
08/08/2019 16:50	0.03	0.04	0.01
08/08/2019 17:20	0.06	0.02	0.04
08/08/2019 17:50	0.08	0.04	0.04
08/08/2019 18:20	0.03	0.07	0.04
08/08/2019 18:50	0.09	0.07	0.02
08/08/2019 19:20	0.09	0.08	0.01
08/08/2019 19:50	0.02	0.11	0.09
08/08/2019 20:20	0.06	0.15	0.09
08/08/2019 20:50	0.04	0.15	0.11
08/08/2019 21:20	0.10	0.14	0.04
08/08/2019 21:50	0.03	0.14	0.11
08/08/2019 22:20	0.06	0.13	0.07
08/08/2019 22:50	0.10	0.09	0.01
08/08/2019 23:20	0.13	0.06	0.07
08/08/2019 23:50	0.09	0.04	0.05

Table 15: Statistical performance results for neap tide current speed validation at Deep Channel location

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
08/08/2019 11:20	0.05	0.09	0.04
08/08/2019 11:50	0.07	0.10	0.03
08/08/2019 12:20	0.13	0.08	0.05
08/08/2019 12:50	0.10	0.07	0.03
08/08/2019 13:20	0.18	0.08	0.10
08/08/2019 13:50	0.12	0.11	0.01
08/08/2019 14:20	0.13	0.10	0.03
08/08/2019 14:50	0.07	0.06	0.01

Time	Recorded Current Speed (m/s)	Modelled Current Speed (m/s)	Absolute difference between modelled and recorded (m/s)
08/08/2019 15:20	0.09	0.04	0.05
08/08/2019 15:50	0.01	0.02	0.01
08/08/2019 16:20	0.04	0.01	0.03
08/08/2019 16:50	0.08	0.01	0.07
08/08/2019 17:20	0.04	0.02	0.02
08/08/2019 17:50	0.03	0.04	0.01
08/08/2019 18:20	0.02	0.06	0.04
08/08/2019 18:50	0.10	0.06	0.04
08/08/2019 19:20	0.04	0.05	0.01
08/08/2019 19:50	0.04	0.07	0.03
08/08/2019 20:20	0.06	0.06	0.00
08/08/2019 20:50	0.04	0.02	0.02
08/08/2019 21:20	0.03	0.02	0.01
08/08/2019 21:50	0.09	0.03	0.06
08/08/2019 22:20	0.04	0.05	0.01
08/08/2019 22:50	0.06	0.06	0.00
08/08/2019 23:20	0.09	0.07	0.02
08/08/2019 23:50	0.12	0.07	0.05

4.3.4.3 Current Direction

The neap tide current direction validation is presented in Figure 18 and Figure 19 for the Near Outfall and Deep Channel locations respectively.

It can be seen that the recorded current direction values are quite scattered, particularly at the Near Outfall location where water depths are shallow and eddies occur. The model however does capture the general recorded current directions well at both locations across the 7-day period. The turning of the tide during the 7-day neap period is also well replicated at both locations.

Figure 18: Neap tide current direction validation at Near Outfall location – visual analysis

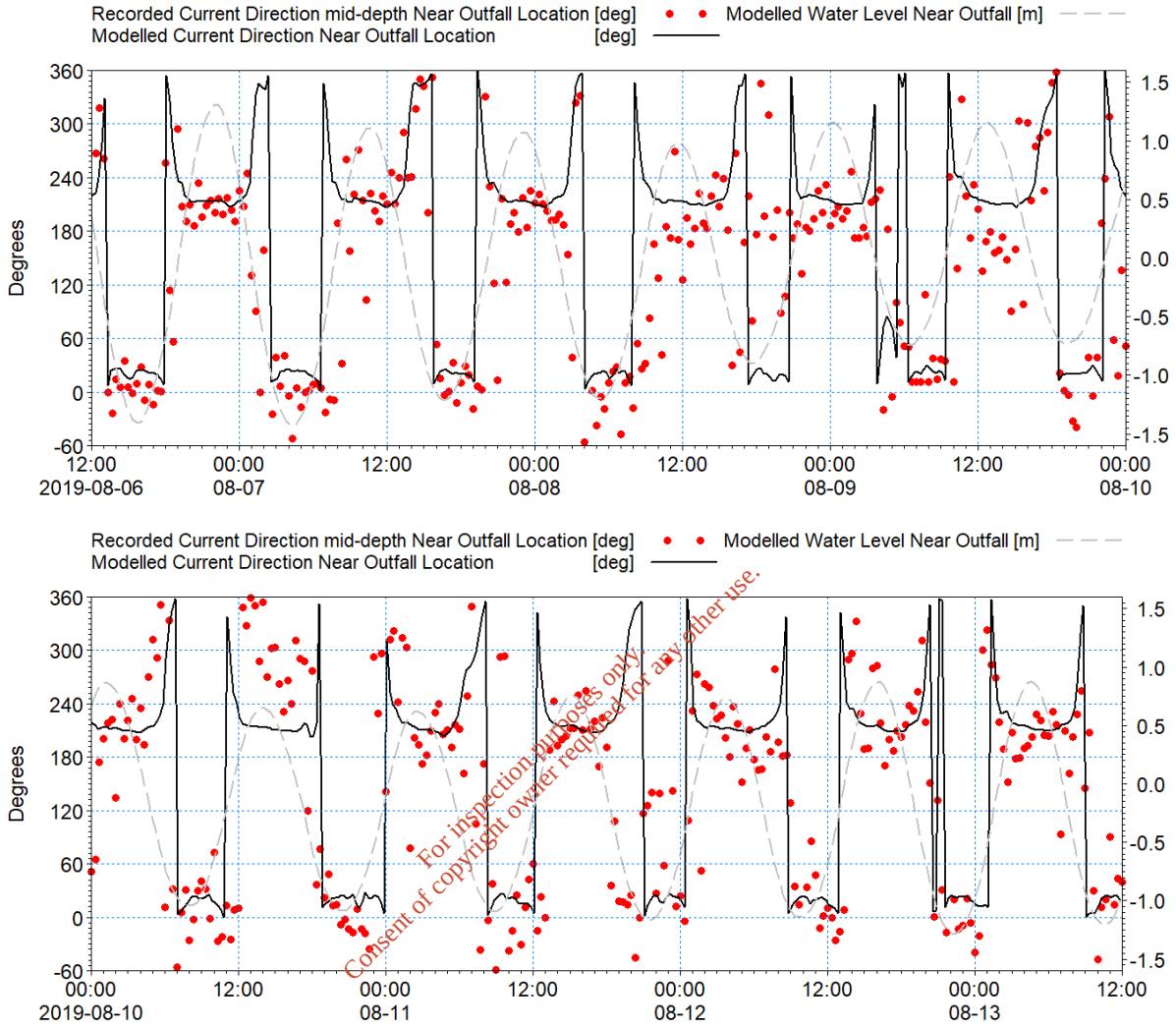
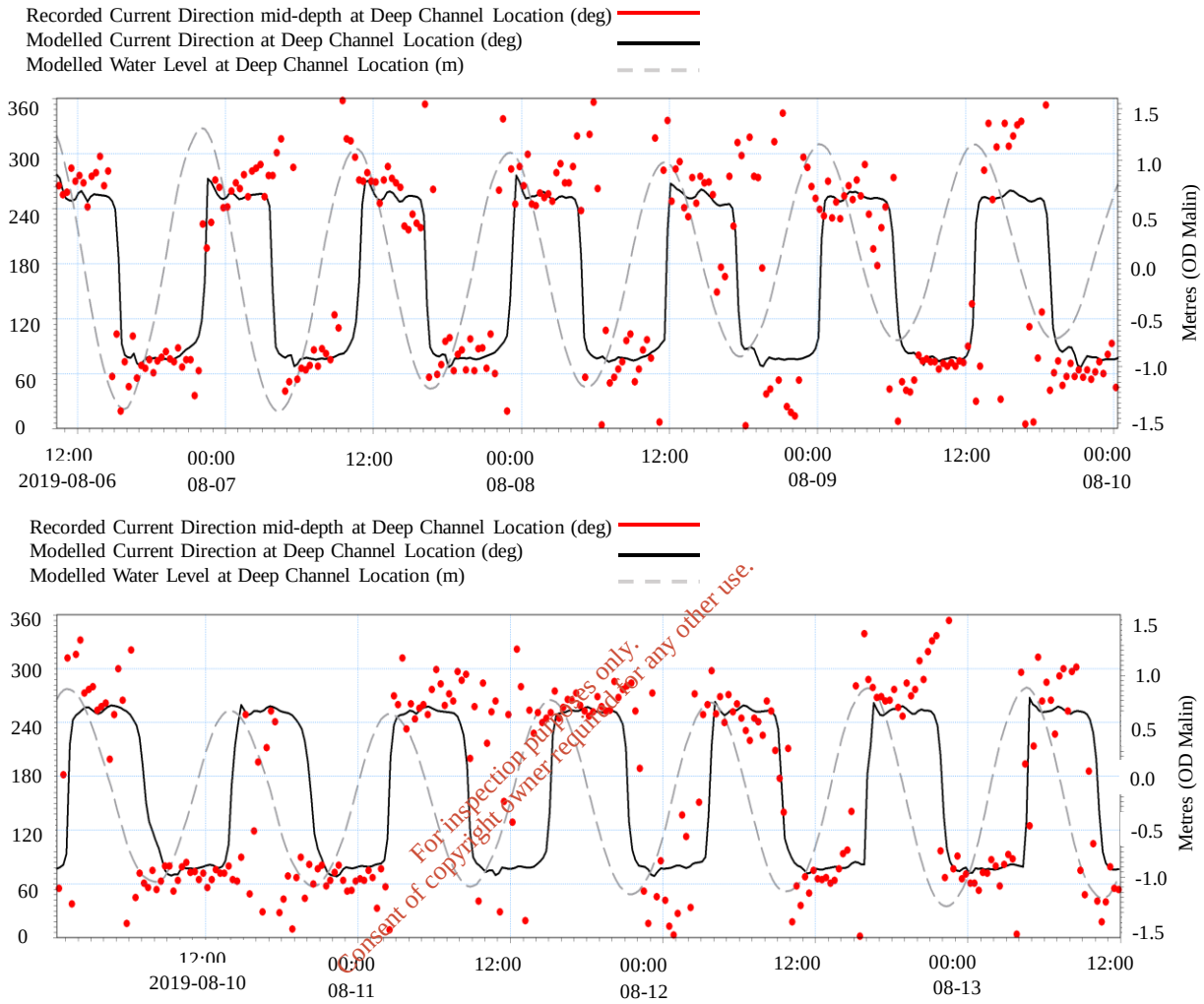


Figure 19: Neap tide current direction validation at Deep Channel location – visual analysis



The statistical analysis for the neap current direction validation at the Near Outfall and Deep Channel locations are presented in Table 16 and Table 17.

At the Near Outfall location, the performance target is achieved 38% of the time and at the Deep Channel location they are met 19% of the time during the tidal cycle. The statistical analysis results are relatively poor and this is a reflection of the scattered nature of recorded direction readings. Despite this, the visual analysis indicates that the model is capturing the turning and direction of the neap tide well.

Overall, the results of both the spring and neap validation are good for current direction, particularly in the region near the outfall. This provides confidence in the hydrodynamic model's capability of realistically simulating current directions in the area of interest.

Table 16: Statistical performance results for neap tide current direction validation at Near Outfall location

Time	Recorded Current Direction (deg)	Modelled Current Direction (deg)	Absolute difference between modelled and recorded (deg)
08/08/2019 11:20	269	214	55
08/08/2019 11:50	212	213	1
08/08/2019 12:20	195	213	18
08/08/2019 12:50	188	210	22
08/08/2019 13:20	222	211	11
08/08/2019 13:50	204	209	5
08/08/2019 14:20	219	211	8
08/08/2019 14:50	195	215	20
08/08/2019 15:20	239	217	22
08/08/2019 15:50	255	239	16
08/08/2019 16:20	267	321	54
08/08/2019 16:50	245	343	98
08/08/2019 17:20	219	8	211
08/08/2019 17:50	194	22	172
08/08/2019 18:20	345	26	319
08/08/2019 18:50	196	20	176
08/08/2019 19:20	173	12	161
08/08/2019 19:50	23	20	3
08/08/2019 20:20	107	18	89
08/08/2019 20:50	204	353	149
08/08/2019 21:20	188	225	37
08/08/2019 21:50	170	218	48
08/08/2019 22:20	180	221	41
08/08/2019 22:50	185	219	34
08/08/2019 23:20	201	217	16
08/08/2019 23:50	196	215	19

Table 17: Statistical performance results for neap tide current direction validation at Deep Channel location

Time	Recorded Current Direction (deg)	Modelled Current Direction (deg)	Absolute difference between modelled and recorded (deg)
08/08/2019 11:20	28	93	65
08/08/2019 11:50	336	216	120
08/08/2019 12:20	271	265	6
08/08/2019 12:50	291	260	31
08/08/2019 13:20	229	253	24

Time	Recorded Current Direction (deg)	Modelled Current Direction (deg)	Absolute difference between modelled and recorded (deg)
08/08/2019 13:50	274	251	23
08/08/2019 14:20	252	258	6
08/08/2019 14:50	268	259	9
08/08/2019 15:20	254	252	2
08/08/2019 15:50	149	244	95
08/08/2019 16:20	193	244	51
08/08/2019 16:50	275	245	30
08/08/2019 17:20	196	214	18
08/08/2019 17:50	298	92	206
08/08/2019 18:20	273	87	186
08/08/2019 18:50	275	87	188
08/08/2019 19:20	328	69	259
08/08/2019 19:50	38	74	36
08/08/2019 20:20	306	76	230
08/08/2019 20:50	53	76	23
08/08/2019 21:20	258	75	183
08/08/2019 21:50	18	76	58
08/08/2019 22:20	333	75	258
08/08/2019 22:50	296	77	219
08/08/2019 23:20	259	79	180
08/08/2019 23:50	251	87	164

4.4 Discussion and conclusion

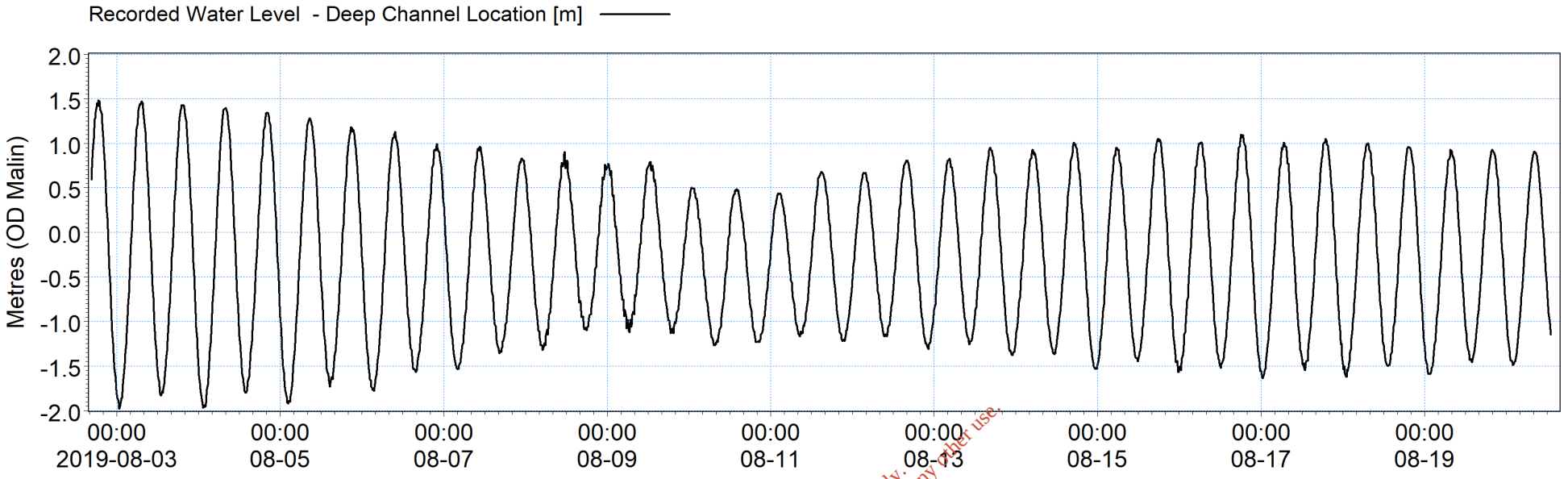
Additional validation runs of the Castletownbere model have been undertaken against survey data from 2019. Results from the model have been compared against current speed and directional data at two locations in the area of interest. Water levels from the model have also been compared with data from Castletownbere Port. The model was simulated for two 7-day periods, covering spring and neap tidal cycles separately.

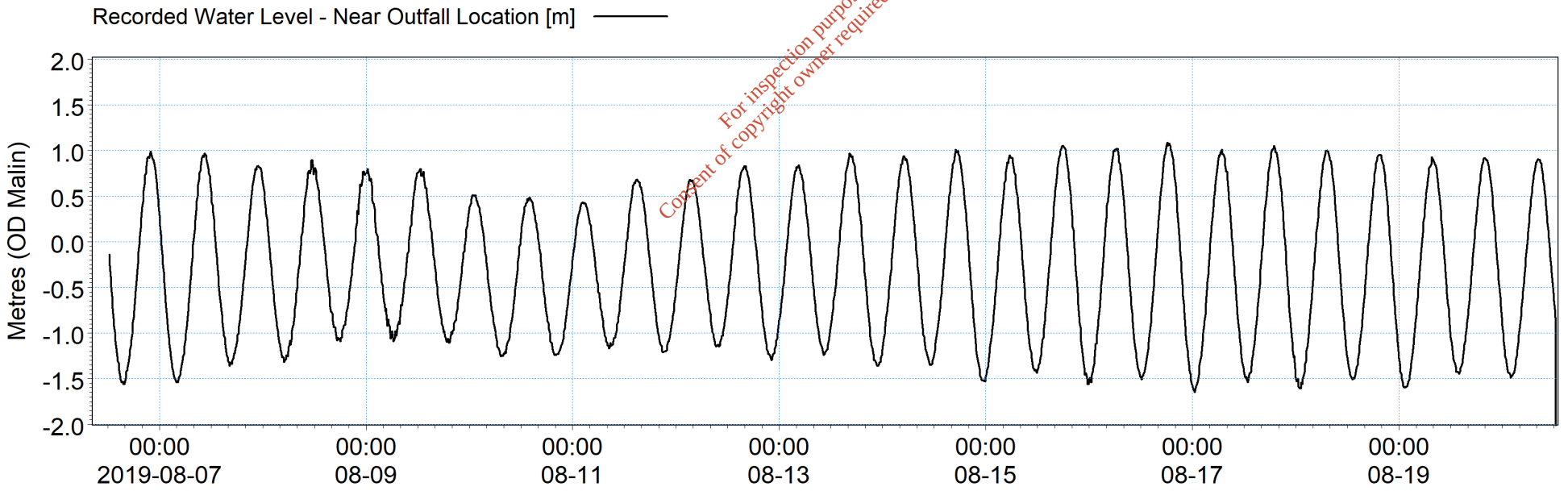
It has been seen that the modelled water levels are very well matched to the recorded data from the gauge at Castletownbere Port for both spring and neap tides. The recorded current speeds are also well matched by the model at both survey locations with a small number of instances where the model deviates from the recorded data. The model is also well matched to the recorded current speed at both locations.

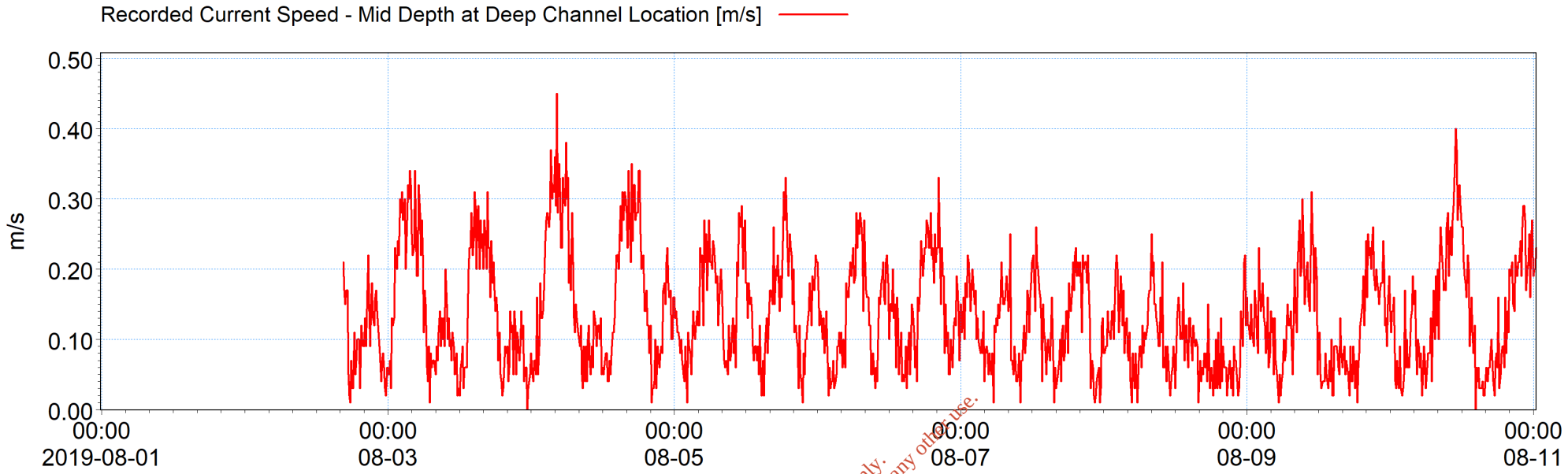
These additional validation model runs have provided an even greater level of confidence in the Castletownbere hydrodynamic model and its suitability for assessing the impact of the discharges from the proposed WwTP outfall for Castletownbere.

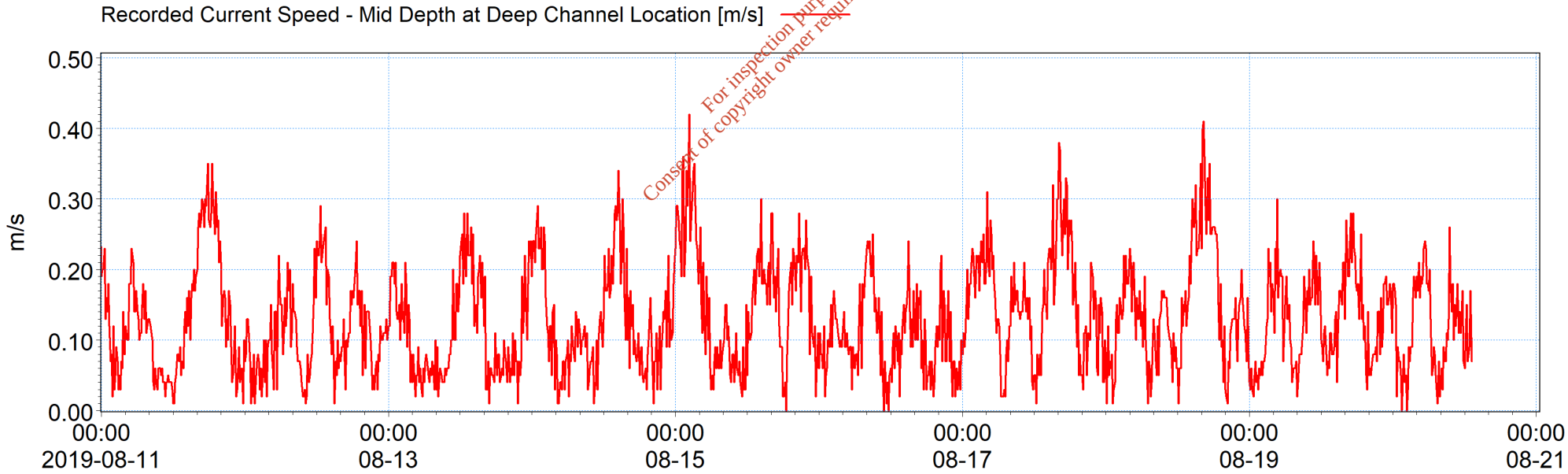
Appendix A

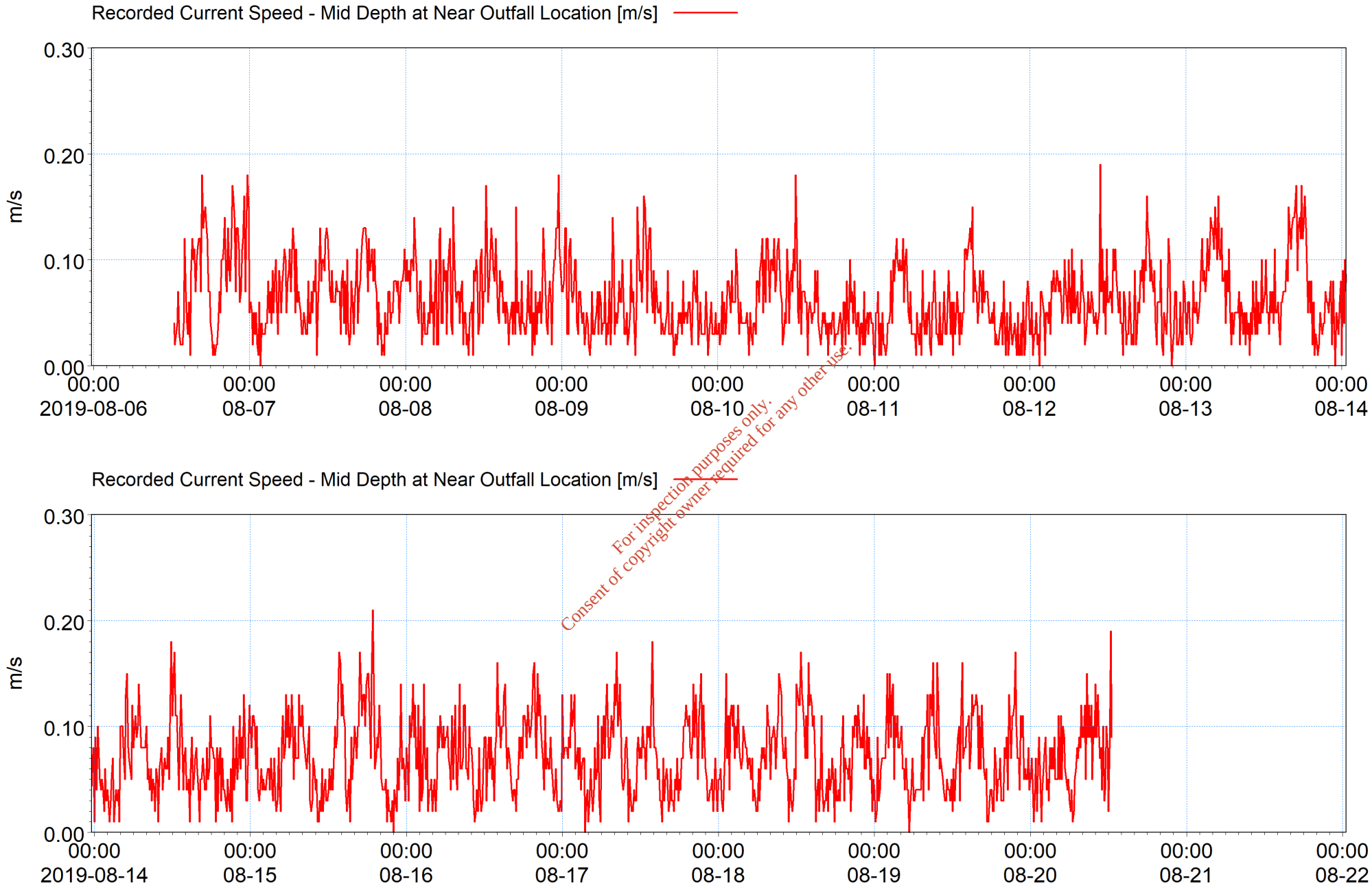
Survey data

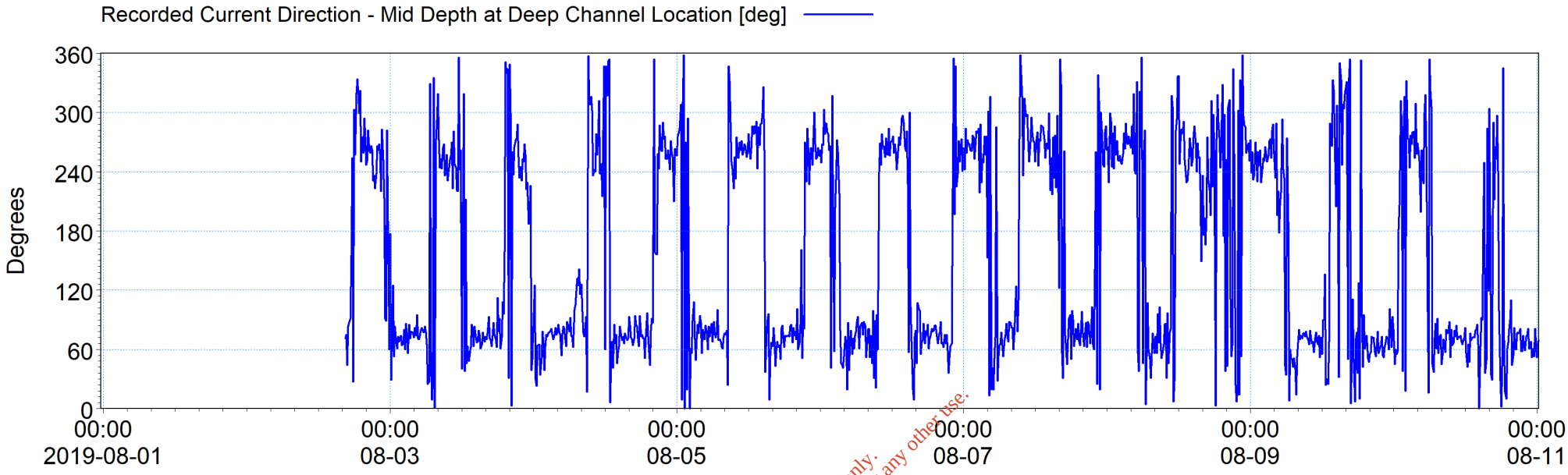


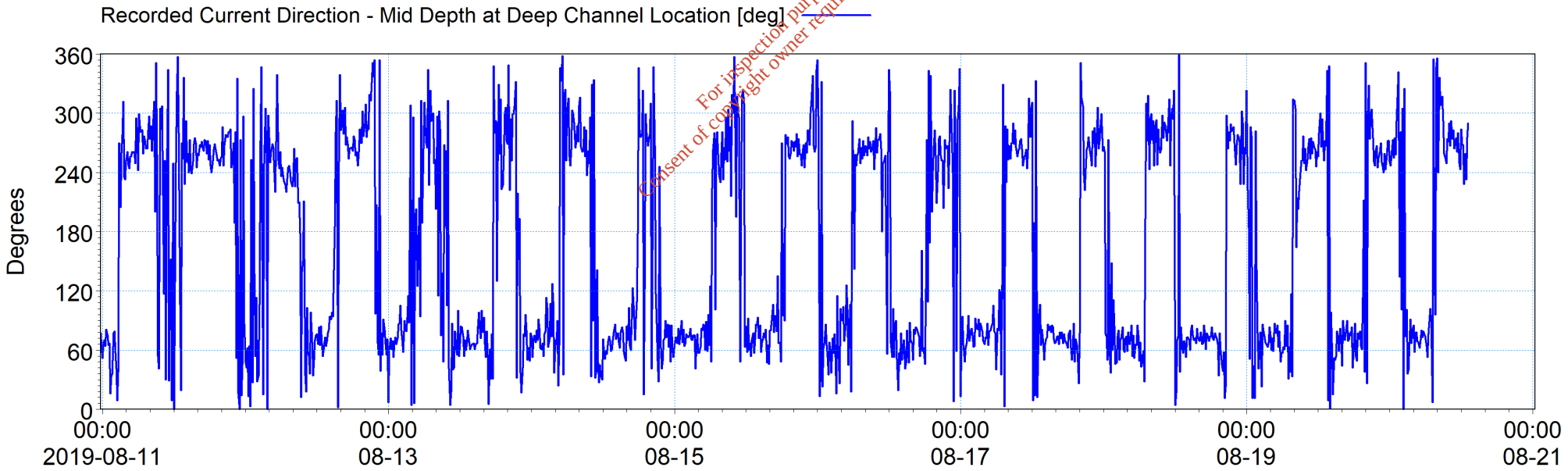


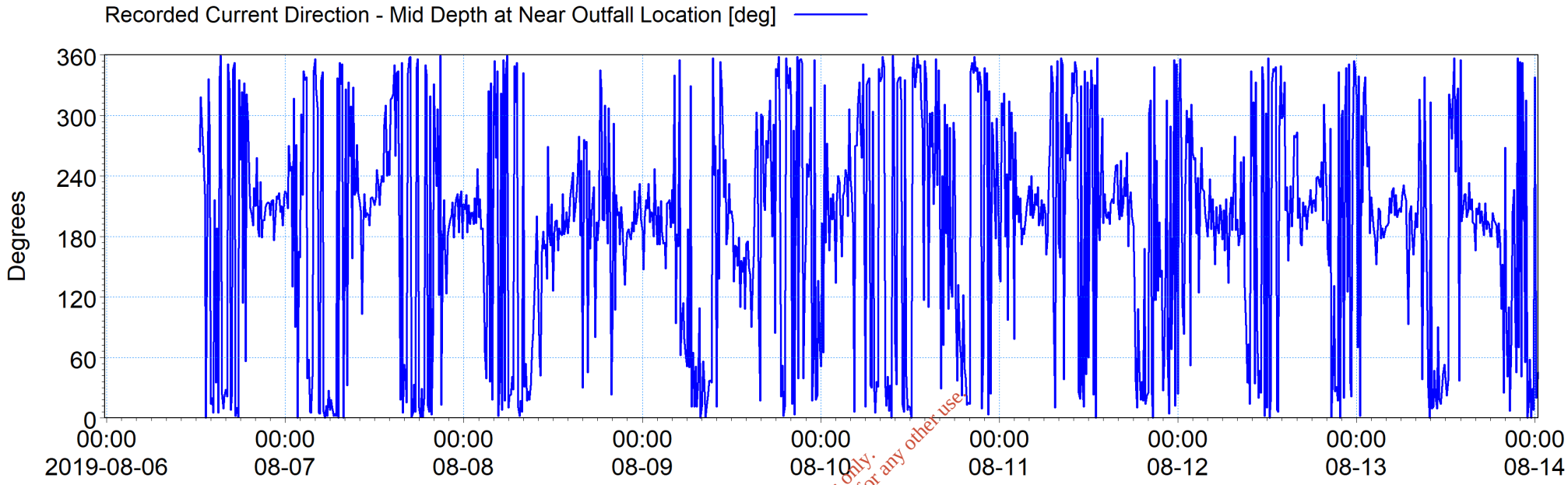


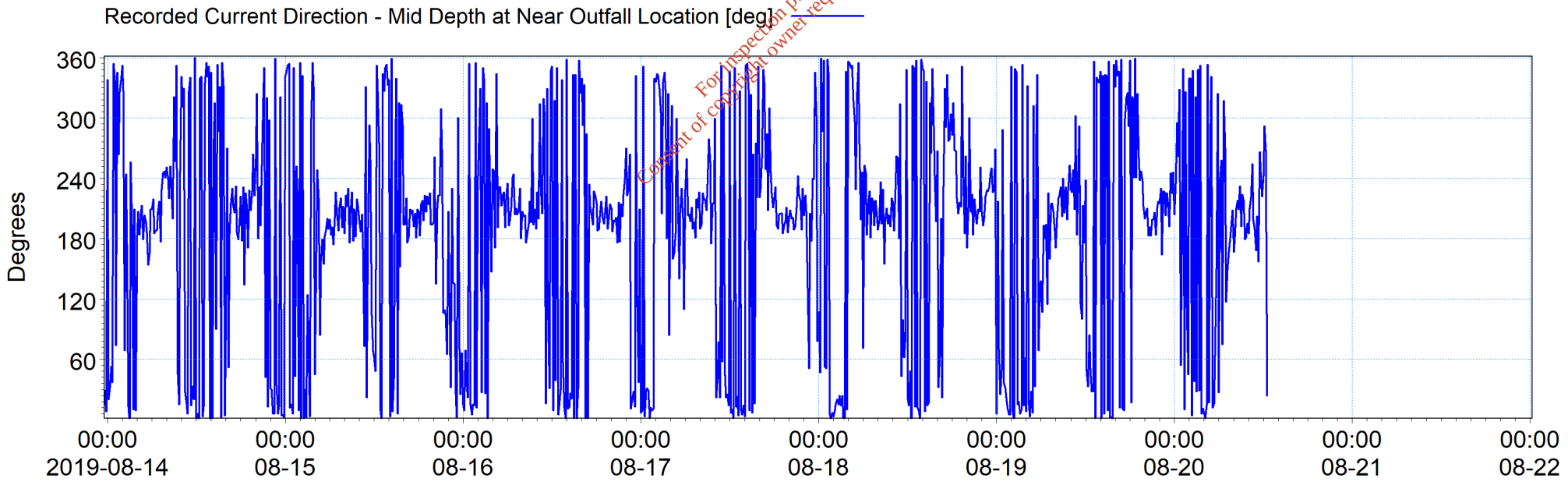












DixonBrosnan

environmental consultants

Project	**Ecological Assessment - Untreated Agglomerations Study – Cork Project (Castletownbere)**
Client	**Arup (on behalf of Irish Water)**

Project ref	Report no	Client ref	
1807	1807	-	

DixonBrosnan 12 Steam Packet House, Railway Street, Passage West, Cork.
Tel 086 851 1437| carl@dixonbrosnan.com | www.dixonbrosnan.com

Date	Rev	Status	Prepared by	
06/12/19	0	Issue to client	Carl Dixon M.Sc.	
			Sorcha Sheehy PhD	
			Ian McDermott	

v180907

1. Introduction

Irish Water proposes to provide a number of new wastewater treatment services for the Untreated Agglomerations Study (UTAS) site at Castletownbere, County Cork in order to ensure compliance with the Urban Wastewater Treatment Directive (91/271/EEC). A new WWTP, pumping stations and modifications to the existing collection network are proposed. Treated water will be discharged via a new 100m effluent outfall pipeline which will discharge outside the inner harbour.

Dixon.Brosnan Environmental Consultants carried out an ecological survey of the location of the proposed development in order to inform the impact assessment on terrestrial and aquatic flora and fauna. This report describes and evaluates the habitats with their representative flora and fauna and addresses the potential ecological impacts of the development on the ecology of the site and the surrounding area.

2. Methodology

2.1 Introduction

This appraisal is based on surveys of the proposed site and surrounding area and a review of desktop data. Although not part of an environmental impact assessment this report follows the structure and protocols detailed in Advice notes for preparing Environmental Impact Statements (EPA Draft, 2015) and Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, May 2017).

2.2 Desktop study

A desktop study was carried out to identify features of ecological value occurring within the proposed development site and those occurring in close proximity to it. A desktop review also allows the key ecological issues to be identified early in the appraisal process and facilitates the planning of appropriate surveys. Sources of information utilised for this report include the following:

- National Parks & Wildlife Service (NPWS) - www.npws.ie
- Environmental Protection Agency (EPA) – www.epa.ie
- National Biodiversity Data Centre – www.biodiversityireland.ie
- Bat Conservation Ireland - http://www.batconservationireland.org
- BirdWatch Ireland - http://www.birdwatchireland.ie/
- British Trust for Ornithology (BTO)-www.BTO.ie
- Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011)
- Guidance on integrating climate changes and biodiversity into environmental impact assessment (EU Commission, 2013)
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (National Roads Authority, 2009).

The appraisal of impacts follows the protocols outlined in guidelines for Assessment of Ecological Impacts of National Road Schemes (National Roads Authority, 2009) and CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland Terrestrial,

Freshwater and Coastal. Potential impacts on designated Natura 2000 sites (SAC/cSAC/SPA) are specifically addressed in an Appropriate Assessment (AA) Screening Report.

2.3 Survey Overview

An ecological survey was carried out on the 15th of January 2018 and a second survey was carried out on 22 November, 2019. Although neither survey date is considered optimal from an ecological viewpoint, the habitats to be affected are highly modified and common and the likelihood of significant ecological receptors not being identified is unlikely. The following surveys were carried out.

- Terrestrial and intertidal habitats were mapped according to the classification scheme outlined in the Heritage Council publication *A Guide to Habitats in Ireland (Fossitt, 2000)* and following the guidelines contained in *Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011).*
- The proposed development area was surveyed for invasive species (See **Appendix 2** Invasive Species Report).
- All bird species recorded during the walkover survey and habitat survey were recorded.
- No roosting habitat, high value commuting or feeding habitat for bats will be affected by the proposed development and therefore no specialised bat surveys were considered necessary.
- A survey for otters and badgers was carried out. No surface watercourses with the exception of drainage ditches were located within or in proximity to the proposed development site and thus no aquatic surveys were considered necessary.
- Given that the rocky shore/sedimentary habitats within this area are common a subtidal survey was not considered necessary.

This report was prepared by Carl Dixon MSc (Ecological Monitoring) and Ian McDermott MSc (Ecological Monitoring).

3. Proposed development

3.1 Existing Scenario

Castletownbere is a coastal town in West Cork. It is approximately 33km south-west of the town of Glengarriff along the R572. As of the 2016 census, Castletownbere has a population of 860.

Currently, wastewater is collected in ten separate drainage sub-catchments and released back into the environment with little or no treatment. The majority of the Castletownbere agglomeration, including the town centre, is served by a collection network which discharges untreated wastewater into Berehaven Harbour. There are a number of septic tanks and package plants within the agglomeration that provide some level of treatment to the wastewater prior to being discharged to the Harbour including:

- 5 no. public septic tanks (3 of which discharge into Berehaven Harbour and 2 of which discharge to a percolation fields);
- 1 no. privately-owned septic tank; and

- 3 no. wastewater treatment package plants (2 private and one public).

The practice of discharging untreated wastewater into the local environment is unsustainable and no longer acceptable. The objective of this Irish Water project is to deliver wastewater treatment to ensure that the water quality standards set down by regulatory bodies will be achieved, as per both European and National legislation.

Delivering a solution for Castletownbere within a complex statutory and regulatory process involves defining the project scope, site selection, planning permission, site purchase and construction, while optimising value for money.

In order to ensure compliance with the Urban Wastewater Treatment Directive (91/271/EEC), the provision of a number of new wastewater treatment services have been proposed by Irish Water. These services will also be required to provide for sufficient wastewater treatment capacity to cater for the expected future population growth in Castletownbere. The West Cork Municipal District Local Area Plan (LAP) 2017 gives the following as an objective for Castletownbere:

"The existing sewer network in the town is limited. It is a combined system which discharges directly to the sea at a number of locations. There is no wastewater treatment plant in Castletownbere. The provision of sewer collection network and Wastewater Treatment Plant is required to accommodate proposed growth in the town. The Castletownbere Sewerage Scheme Network Upgrade and Wastewater Treatment Plant are under review by Irish Water."

Hence, the proposed scheme is in line with the above objective and is critical to facilitate future development in the area.

3.2 Overview of the Proposed Development

The objective of the proposed development is to provide a wastewater treatment plant (WWTP) capable of primary treatment in compliance with the Urban Waste Water Treatment Directive. Four new wastewater pump stations will be required to transfer wastewater to the WWTP, each of which will incorporate stormwater storage facilities.

The proposed Hospital wastewater pump station will be located within the grounds of St. Joseph's Hospital to the south of the R572, adjacent to an existing septic tank which collects flows from a number of properties towards the east of Castletownbere. From this pump station, the wastewater will be pumped to a proposed discharge manhole on the R572, approximately 160m north-west of the hospital entrance, from which it will flow by gravity to the existing foul sewer network, and onwards to the proposed Brandyhall Bridge wastewater pump station.

The proposed wastewater pump station at Brandyhall Bridge will be located immediately to the south of the R572, approximately 50m south of Brandyhall Bridge. The existing foul sewer network, which currently runs along the R572 to the existing septic tank adjacent to the north-eastern bridge abutment, will be diverted into the proposed pump station. From here, the combined flows from the Hospital and Brandyhall Bridge drainage areas will be pumped to a proposed discharge manhole on the R572, approximately 130m to the west of Brandyhall Bridge and will be conveyed onwards to the proposed Quays wastewater pump station via the existing gravity network. The proposed pump station will also be designed to accommodate flows from the Mariner's View drainage area to the north, although no connecting sewers will be laid under the current scheme.

The proposed wastewater pump station at Came Woods will be located adjacent to the existing public road which leads to the Beara Coast Hotel. Wastewater from this pump station will be pumped to a discharge manhole along the R572, approximately 175m to the west of the pumping station, and will be conveyed onwards to the proposed Quays wastewater pump station via the existing gravity network.

Flows emerging from the Foildarrig drainage area to the north of the town are currently discharged to a percolation area to the rear of a row of council-owned dwellings. Under this scheme, these flows will be conveyed via a proposed gravity sewer to the main gravity network within the town, and onwards to the WWTP via the Quays pump station.

All flows from the agglomerations will arrive, via the existing gravity sewer network, to a proposed manhole on Main Street, at the intersection of the R571 and R572, and will be conveyed via a proposed gravity sewer to the proposed Quays pump station, a terminal pumping station to be located in the towards the western end of the quays area.

From the Quays pump station, all flows emerging from the agglomeration will be pumped to a proposed discharge manhole (67491N, 45351E) located upstream of the proposed WWTP. From this discharge manhole, flows will be conveyed to the proposed WWTP via an existing gravity sewer running along the wastewater treatment plant access road.

The proposed WWTP will be located to the south-west of the town in Drom South. The proposed WWTP will provide primary treatment, appropriate to bring the agglomeration into Urban Wastewater Treatment Directive compliance. Effluent will be discharged into Bearhaven Harbour via a proposed 100m long treated effluent outfall.

The proposed site location is presented in **Figure 1**, while a flow diagram is presented in **Figure 2.**

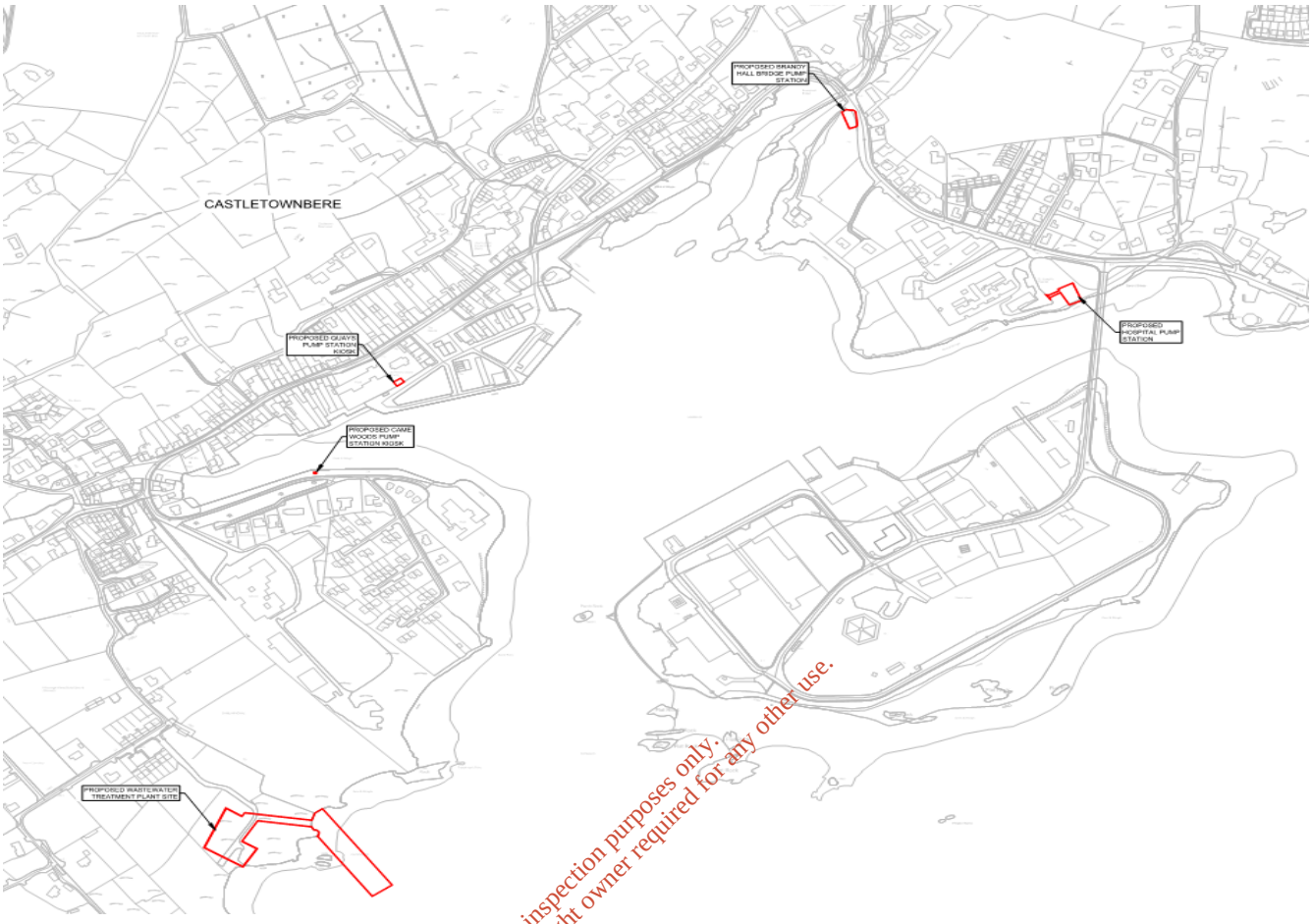


Figure 1: Proposed Development Locations (Red Line Boundary) | Not to Scale.

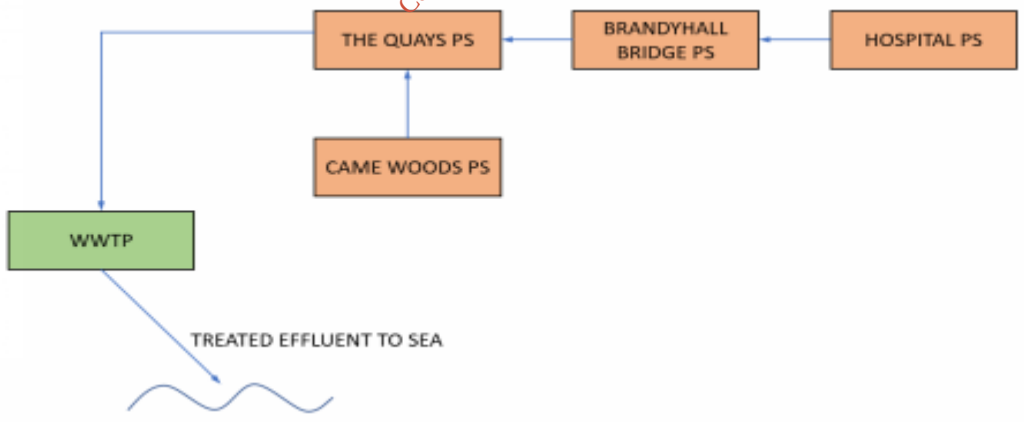


Figure 2: Flow diagram of the Castletownbere Sewerage Scheme

3.3 Main Components of the Proposed Development

The main components of the proposed scheme can be summarised as follows:

- Hospital Pumping Station[1]:
  - 32m long diversion of the existing 150mm diameter gravity sewer;
  - Wastewater Pumping Station incorporating 51.7m³ of stormwater storage and utilising the existing outfall as an overflow facility;
  - 260m long, 110mm OD rising main to convey pumped flows to a proposed discharge manhole on the R572; and
  - Decommissioning of the existing septic tank.
- Brandyhall Bridge Pumping Station:
  - 10m long diversion of the existing 225mm diameter gravity sewer;
  - Wastewater Pumping Station incorporating 50.5m³ of stormwater storage and utilising the existing outfall as an overflow facility;
  - 205m long, 160mm diameter rising main to convey pumped flows to a proposed discharge manhole on the R572;
  - 264m of 225mm diameter existing gravity sewer to transfer flows from proposed discharge manhole on the R572 to Main street; and
  - Decommissioning of the existing septic tank.
- Foildarrig:
  - 170m of 225mm diameter gravity sewer to transfer flows from the Cork County Council owned properties to the existing sewer network at Chapel Lane.
- Came Woods:
  - 24m long diversion of the existing 150mm diameter gravity sewer;
  - Wastewater Pumping Station incorporating 57.2m³ of stormwater storage and utilising the existing outfall as an overflow facility;
  - 210m long, 90mm diameter rising main to convey pumped flows to a proposed discharge manhole on the R572; and
  - Decommissioning of the existing septic tank.
- Quays Pumping Station:
  - 385m of new 810mm diameter gravity sewer to convey flows to the Quays Pumping Station;
  - Wastewater Pumping Station incorporating 135m³ of stormwater storage and utilising the existing outfall as an overflow facility;
  - 1,050m long, 250mm diameter rising main to convey pumped flows to a proposed discharge manhole on Tallon Heights; and

[1] It is intended to submit the Hospital Pumping Station as a separate planning application (refer to cover letter of planning application for details), the remainder of the sewerage scheme is included in another planning application. This EcIA report has assessed the sewerage scheme in its entirety including the overall ecological assessment for the two planning applications.

- 120m of gravity sewer from the discharge point for the rising main to the Wastewater Treatment Plant.

➢ Wastewater Treatment Plant (WWTP):

- Decommissioning and removal of an existing package plant;
- WWTP providing preliminary and primary treatment;
- 85m gravity treated effluent pipe to the launch point at new outfall; and
- 100m new marine outfall.

More detailed drawings are provided in the planning application.

Potential emissions to environmental media from the operation of the proposed development are identified below:

Emissions to Water

Emissions to water from the proposed development during operation will arise from the proposed marine outfall to the south of Castletownbere. Effluent released from this outfall will be treated prior to discharge to Berehaven Harbour and will be required to meet applicable water standards. The effluent discharge plume will be quickly dispersed into the harbour and levels will quickly return to background concentrations such that there will not be a significant impact on water quality. It is noted that in the current scenario, untreated raw sewerage is discharged into the harbour, therefore the proposed scenario will result in an improvement in water quality overall. Refer to the Castletownbere Far Field Modelling report which accompanies the planning application for full details. An extract from the conclusions of this report is provided below:

"*Our model results show that the 95%ile concentrations of both E. Coli and Intestinal Enterococci are significantly reduced in the inner harbour area of Castletownbere with the proposed scheme in place. Our model results also show that the 50%ile concentrations of DIN, MRP, TA and UiA are reduced across large areas of the harbour area. Our results also indicate that the 95%ile concentrations of both E. Coli and Intestinal Enterococci as well as the 50%ile concentrations of the other modelled nutrients are increased in the vicinity of the proposed outfall location. The increases however do not lead to the EQS at any of the designated EPA Surface Water Regulation monitoring points outside the immediate mixing zone to be exceeded.*

The proposed scheme therefore does not cause any of the EQS thresholds in Castletownbere harbour to be exceeded and the discharges from the proposed WwTP for Castletownbere are in full compliance with the relevant EU water regulations."

Emissions to Ground

There will be no direct emissions to ground from the proposed development during operation. The proposed WWTP and pumping stations will be placed on concrete foundations. All surface water drainage during operation at these facilities will be routed to surface water management systems. Effluent streams will be routed to the proposed WWTP. There will be a very low risk of accidental releases or spillages from the proposed WWTP during its operation.

Emissions to Air

There will be no continuous emissions to air from the proposed development during operation.

Noise Emissions

Minor noise emissions will be generated from the operation of the proposed development, in particular from the proposed WWTP and pumping stations. However, noise levels generated will be minimal and in keeping with the current baseline noise environment in Castletownbere town.

3.4 Decommissioning of existing wastewater treatment facilitates

Prior to the commencement of the construction works, some of the current wastewater treatment facilities in Castletownbere will be required to be decommissioned. All old septic tanks will be emptied and washed down, with their contents tankered off site to a separate WWTP for treatment. The tank currently located in the grounds of St. Joseph's Hospital will be demolished and transported offsite to a licenced waste facility for disposal.

3.5 Construction

It is expected that construction will commence in Q3 2020, subject to planning approval. The total duration of all construction works is expected to be 12 months. However, some elements of the works, such as the construction of the individual pumping stations and the laying of the rising mains, will be completed in a considerably shorter duration than others, such as the construction of the WWTP.

. separate pumping stations, rising mains connections, gravity sewer connections, the WWTP and the effluent outfall pipeline. An overview of the construction works required for these elements is presented below.

Pumping Stations

Five separate pumping stations will be constructed as part of the proposed development. These will be located in the grounds of St. Joseph's Hospital, at Brandyhall Bridge, at Foildarrig, in the Main Street car park and at Came Woods. Each pumping station will be located entirely below ground except for their control kiosks. The pumping stations will consist of a shaft which will be installed as a concrete caisson, while the control kiosks above ground will be constructed from Glass Reinforced Plastic (GRP). Typical open cut excavation methodology will be used. All excavated material generated from the development of the pumping stations will be removed from site.

Rising Main Connections

Rising main connections of various lengths will be laid between each of the 5 no. pumping stations and the existing gravity network. These connections will be laid below existing ground levels and, in most locations, within existing roads. Excavations will be open cut with excavated material used for backfill. Any surplus material generated will be removed from site.

Gravity Sewer Connections

Gravity sewer connections of various lengths will be required to divert flows to the new pumping stations. Excavated material generated during the construction of these connections will be returned to the trenches.

WWTP

The elements involved in the construction of the proposed WWTP will include the following:

- *Inlet works* – required earthworks, formwork and concrete, incoming and outgoing pipework and associated chambers, inlet channel, inlet screen, screenings handling unit, bypass channel with screen and associated control, testing and commissioning equipment.
- *Primary settlement* – required earthworks, formwork and concrete, incoming and outgoing pipework and associated chambers, pyramidal prefabricated primary settlement tanks, desludging valves and pipework and associated control, testing and commissioning equipment.
- *Sea outfall* – required earthworks, formwork and concrete, pipework and diffuser(s).
- *Sludge handling* – required earthworks, formwork and concrete, incoming and outgoing pipework and associated chambers, circular storm tank, storm tank mixer and associated testing and commissioning equipment.
- *Miscellaneous* – land purchase (agricultural), site clearance, road to site, road within site, watermain to site, watermain within site and water supply break tank.

Effluent Outfall Pipeline

The outfall pipeline to Berehaven Harbour will discharge treated effluent from the WWTP site. The outfall will consist of a terrestrial section and a marine section. The terrestrial section (85m) will be laid in agricultural fields. The length of the marine section will be 100 metres. The outfall will extend approximately 75m beyond the low water mark discharging in a water depth of approximately 2.5m. The outfall area is calculated to be 0.417 Hectares. Refer to **Figure 3**.

There are several methods by which the sea outfall can be constructed, and the contractor's methodology will ultimately depend on their available plant and equipment as well as their previous experience with laying marine outfalls. For the purposes of this AA Screening report, the likely methods to construct the sea outfall are presented in the following sections, based on current practice and site constraints/characteristics. These are:

- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method
- Temporary Causeway method.

Construction of the outfall will include works from both the land and sea. It is expected that several vessels may be required during the construction of the outfall and that diving support is likely to be required at times.

Horizontal Directional Drilling Method

Construction of the outfall using the horizontal directional drilling (HDD) method would comprise three phases: pilot boring, pre-reaming and pipe positioning, each of which are illustrated in **Figure 4**.

It is assumed that the HDDD process would occur from a drilling rig located close to the beach (as this is the reasonable worst case for the purpose of the assessment).

It is noted that this method would not involve any change in the seabed geometry during construction or operation (as the pipeline would be tunnelled) and therefore there is no need to install scour protection along the route of the outfall.

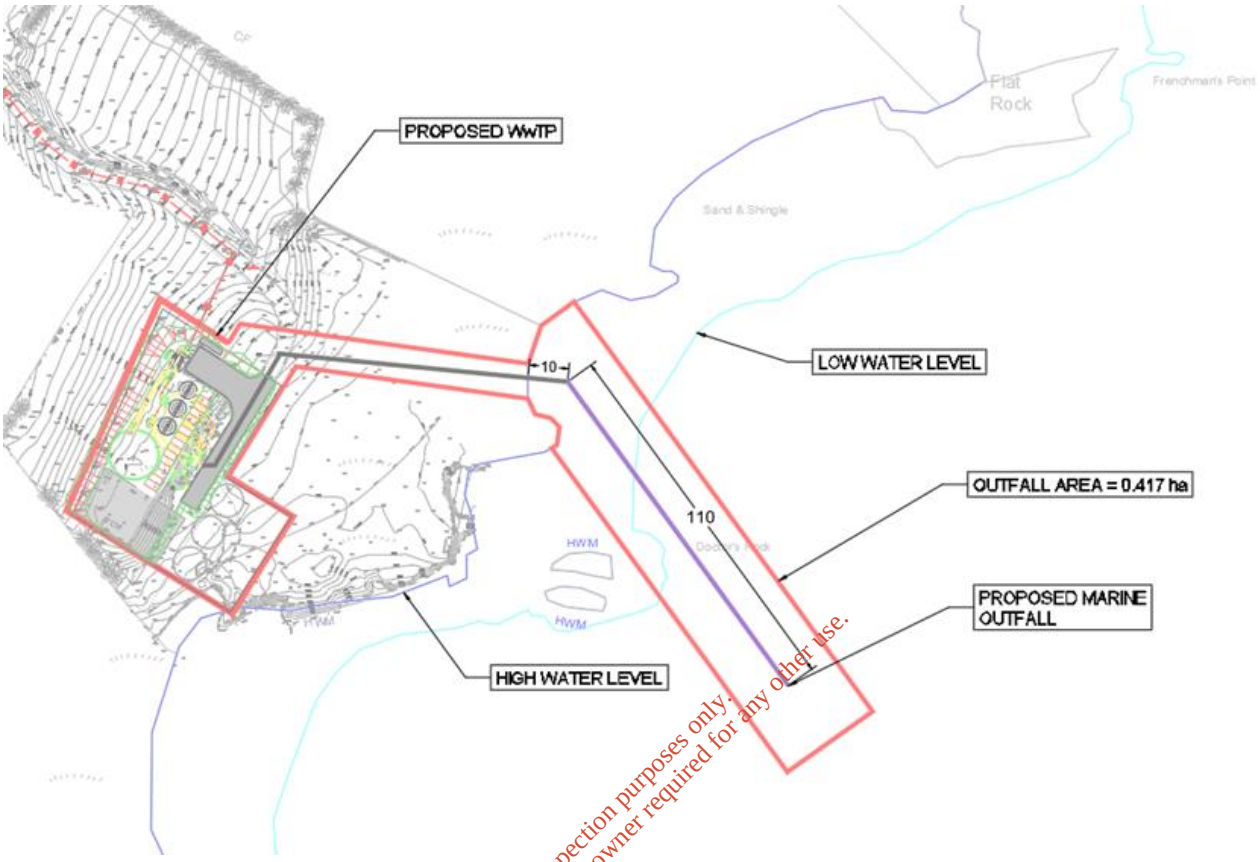


Figure 3: Proposed Marine Outfall

It is noted that the contractor may locate the rig on a suitable barge or jack-up platform (i.e. on the seaward end of the outfall). In this case, pilot boring would be undertaken from the seaward end of the outfall towards the landward end and thus geotechnical risks associated with exiting the seabed would be avoided. This would avoid loose sand material at the exit point and improve support to the hole at the seaward end of the outfall (as the hole can be supported with casing from the platform). The reaming and pull-back stages would be undertaken from the landward side of the outfall.

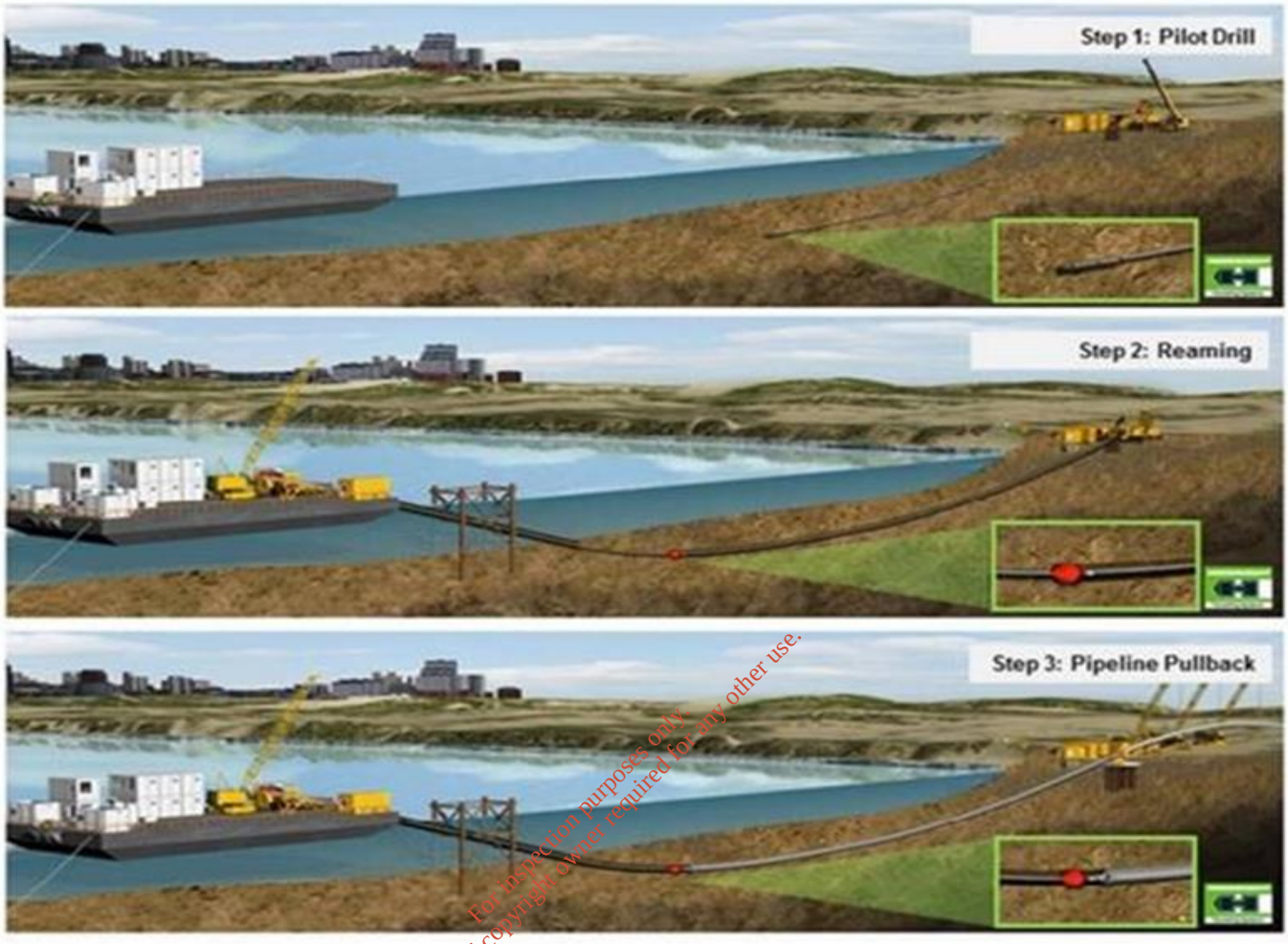


Figure 4: Typical HDD process for a sea outfall (Source: Stevens[2])

Flood and Float Method

The use of the float and flood method would require the formation of trenches and the placement of suitable material to support and protect the sea outfall once it is in position. Refer to **Figure 5** for an overview of the food and float method.

[2] Stevens (2015) Trenchless solutions for sewer networks and sea outfalls. Available from: https://www.imesa.org.za/wp-content/uploads/2015/11/Paper-10-Trenchless-solutions-for-wewer-networks-and-sea-outfalls-Frank-Stevens.pdf [Accessed 30 October 2019]

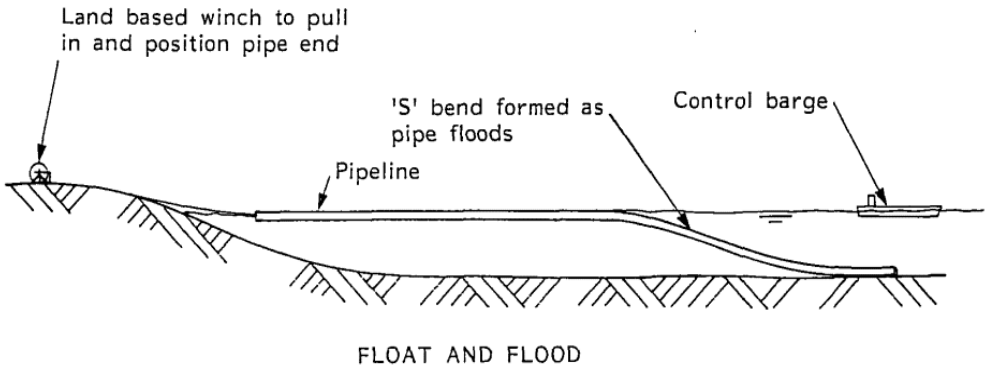


Figure 5: Flood and float method of installing the outfalls (Source: WRC[3])

Bottom Pull Method

The use of the bottom-pull method would, in a similar manner to the flood and float method, require the formation of trenches and the placement of suitable bedding material to support and protect the positioned pipeline. The trenching, placement of the bedding layer, backfilling of the trench, the diffuser assembly and scour protection procedures would also be similar to methods used for the flood and float method.

For the laying of the outfall, the bottom-pull method would involve joining and pulling sections of the outfall pipeline towards the sea by using a barge. The pipes would be pulled into place by the barge as illustrated in **Figure 6**.

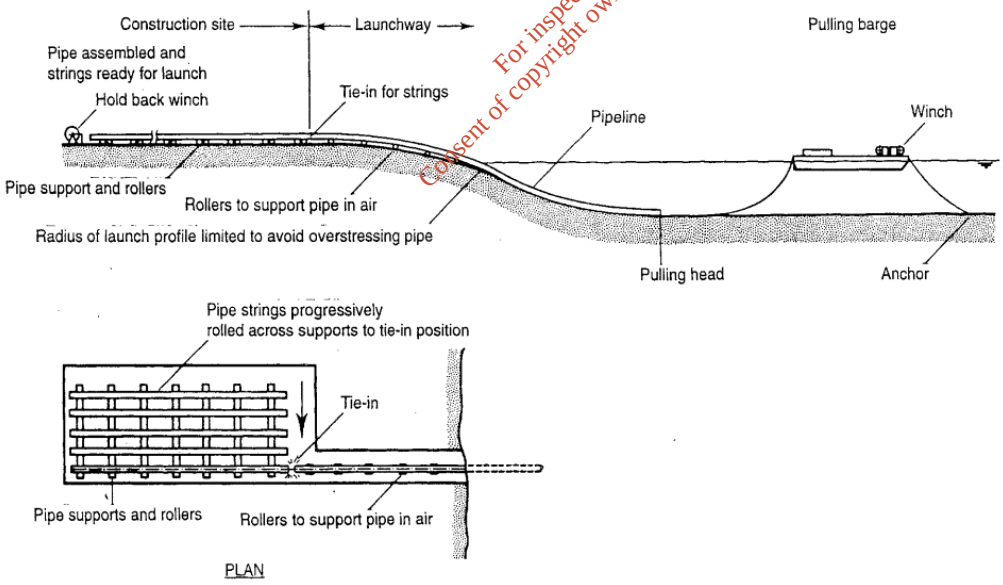


Figure 6: Bottom pull method of installing the outfalls (Source: CIRIA[4])

[3] WRC (1990) Design guide for marine treatment schemes: Volumes I - IV
[4] CIRIA (1996) Sea outfalls - construction, inspection and repair: Report 159.

Temporary Causeway method

This method would entail the temporary construction of a stone causeway into the intertidal area (where depths are too shallow for barge) to facilitate the construction of the outfall. Construction beyond the intertidal area would be via a barge. From the temporary causeway, the Contractor would use excavation machinery to excavate a trench for the outfall pipe. The pipe is then sunk into the trench and covered over. The temporary causeway would be removed once construction is complete.

Potential emissions to environmental media from the construction of the proposed development are identified below:

Emissions to Water

The main emissions to water would be during the construction of the marine outfall. The emissions will consist of a temporary sediment plume which will be generated as a result of the trench excavations. This plume would be centred around the immediate area for the duration of the excavation works. Disturbed sediment would disperse and drop to the seabed on the ebb and flow of the tide. The methodologies for these types of construction works are well understood and the risk for accidental releases or spillages is very low.

Emissions to Ground

There is potential for minor pollution of soils during construction from polluting substances such as hydrocarbons but the construction footprint is quite small and constrained (eg along road width) and any pollution would be confined to the immediate area of the works.

Emissions to Air

Noise generated during the construction would be mainly from construction traffic and excavation activities and would be temporary and short-term. Dust will also be generated during excavations but again would be temporary and short-term.

4. Designated Conservation Areas

Special Areas of Conservation (SACs) and candidate SACs are protected under the Habitats Directive 92/43/EEC and the European Communities (Birds and Natural Habitats) Regulations 2011, as amended. Special Protection Areas (SPAs) are protected under the Birds Directive 2009/147/EC and European Communities (Birds and Natural Habitats) Regulations 2011, as amended. Collectively, these sites are referred to as Natura 2000 or European sites. Natural Heritage Areas (NHAs/pNHAs) are national designations under the Wildlife Act 1976, as amended. A Natural Heritage Area (NHA) is designated for its wildlife value and receives statutory protection. A list of proposed NHAs (pNHAs) was published on a non-statutory basis in 1995, but these have not since been statutorily proposed or designated.

There are no environmental designations located within the study area. Thus, the site of the proposed development does not form part of any Natural Heritage Area (NHA), Special Protection Area (SPA), Special Area of Conservation (SAC) or candidate Special Area of Conservation (cSAC), Nature Reserve, or National Park.

4.1 Nationally Protected Sites - NHAs/pNHAs

Consultation of the NPWS online data identified two NHAs and seven pNHAs within 15km of the proposed development. These are listed in **Table 1** and their distances from the site of the proposed development are also provided. No direct source-pathway-receptor link of significance between the area of the proposed development and any Natura 2000 site, NHA or pNHA has been identified.

None of the NHA and pNHA sites below listed are considered to be of relevance to the proposed development due to their distance from, and lack of connectivity with the proposed development and due to the nature of the proposed development.

Table 1: NHAs and pNHAs within 15km of the Proposed Development

NHAs	**Site Code**	**Distance from closest section of proposed development (km)**
Pulleen Harbour Bog	002416	3.3
Hungry Hill Bog	001059	8.1
pNHAs	**Site Code**	**Distance from closest section of proposed development (km)**
Glanmore Bog	001879	6.0
Eyeries Island	001050	6.9
Cleanderry Wood	001043	9.2
Roancarrigbeg and Roancarrigmor	001073	9.9
Kilcatherine Heath	000593	9.7
Sheep's Head	000102	11.9
Orthon's Island, Adrigole Harbour	001028	12.4

4.2 European sites – SPAs and SACs

The proposed development site is located within 15km of a number of Natura 2000 sites. Designated sites, along with their distance from the site of the proposed development, are listed in **Table 2** and are shown in **Figure 7.**

Potential impacts on designated Natura 2000 sites (SAC/cSAC/SPA) are specifically addressed by the report *Untreated Agglomerations Study (UTAS) – Cork Project (Castletownbere) Report for Screening for Appropriate Assessment (ARUP, December 2019).*

The report concluded that '*Based on the information provided above, and by applying the precautionary principle, it is the opinion of Arup that it is possible to rule out likely significant impacts on any Natura 2000 sites.*

It is the opinion of Arup that a Stage 2 Appropriate Assessment is not considered necessary, but the competent authority, Cork County Council, will make the final determination in this regar".

Table 2: Designated areas and their location relative to the proposed development site

Site	Code	Distance from proposed development
SAC		
Glanmore Bog	001879	6.9 km
Kenmare River	002158	5.7 km
Sheeps Head	000102	11.4 km
Caha Mountains	000093	13.2 km
SPA		
Beara Peninsula	004155	2.3 km
Sheeps Head to Toe Head	004156	11.4 km
NHA		
Pulleen Harbour Bog	002416	3.3 km
Hungry Hill Bog	001059	8.1 km
Glanmore Bog	001879	6.0 km
pNHA		
Eyeries Island	001050	6.9 km
Cleanderry Wood	001043	9.2 km
Roancarrigbeg and Roancarrigmor	001073	9.9 km
Kilcatherine Heath	000593	9.7 km
Sheep's Head	000102	11.9 km
Orthon's Island, Adrigole Harbour	001028	12.4 km

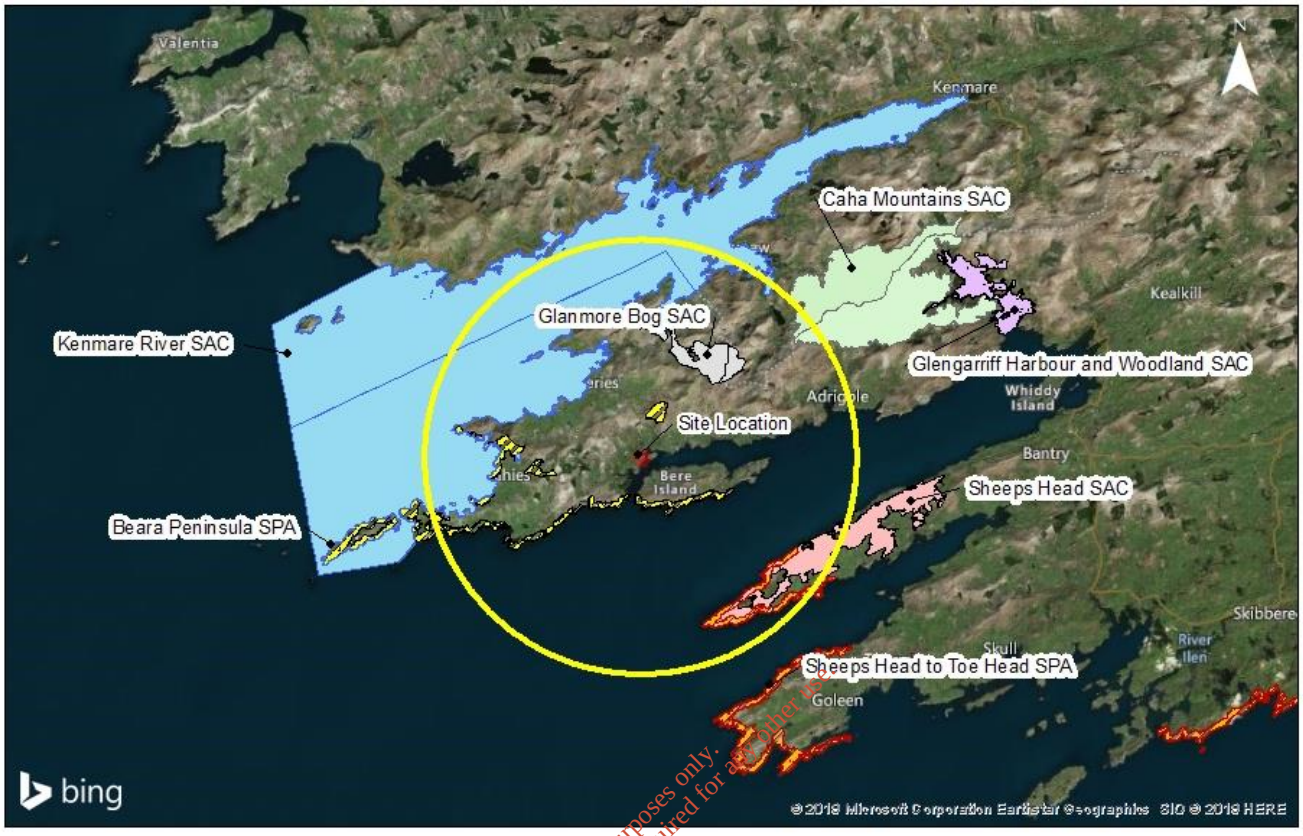


Figure 7: Natura 2000 Sites within 15km of the Proposed Development (Source: ArcMap) Not to Scale

4.3 Important Bird Areas – Beara peninsula

Important Bird and Biodiversity Areas (IBAs) are sites selected as important for bird conservation because they regularly hold significant populations of one or more globally or regionally threatened, endemic or congregator bird species or highly representative bird assemblages. The European IBA programme aims to identify, monitor and protect key sites for birds all over the continent. It aims to ensure that the conservation value of IBAs in Europe (now numbering more than 5,000 sites or about 40% of all IBAs identified globally to date) is maintained, and where possible enhanced. The programme aims to guide the implementation of national conservation strategies, through the promotion and development of national protected-area programmes.

The function of the Important Bird Area (IBA) Programme is to identify, protect and manage a network of sites that are important for the long-term viability of naturally occurring bird populations, across the geographical range of those bird species for which a site-based approach is appropriate. The proposed development site lies in close proximity to the Beara peninsula IBA (Site Code: IE081). The site qualifies for designation under the following IBA Criteria (2000):

- B2 - The site is one of the most important in the country for a species with an unfavourable conservation status in Europe and for which the site-protection approach is thought to be appropriate.

- C6 - The site is one of the five most important in the European region in question for a species or subspecies considered threatened in the European Union.

Table 3: Provides a summary of the Beara peninsula IBA trigger species

Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Red-billed Chough (*Pyrrhocorax pyrrhocorax*)	LC	resident	1992	65 breeding pairs	B2, C6

5. Habitats

An ecological survey was carried out on the 15th of January 2018 and a second survey was carried out on 22 November, 2019.The terrestrial and aquatic habitats potentially affected by the proposed development were classified using the classification scheme outlined in the Heritage council publication *A Guide to Habitats in Ireland* (Fossitt, 2000) and cross referenced with Annex 1 Habitats where required. The ecological value of habitats was defined by the classification scheme outlined in the Guidelines for Assessment of Ecological Impacts of National Road Schemes (National Roads Authority, 2009) which is included in **Appendix 1.**

The new WWTP and associated works will impact on greenfield habitats and intertidal and subtidal habitats will be impacted by the effluent outfall pipeline. Terrestrial habitats and intertidal habitats within or adjoining the proposed development are described below and evaluated in **Table 4**. As shown in **Figure 1** the rising mains will primarily run under existing roads or other highly modified areas and thus the overall ecological impact is predicted to be low.

A description of the habitats within areas considered of local ecological value or where impacts could potentially occur is provided below. Outside of these areas, no potential ecological impacts have been identified as the rising mains will be routed along existing roads through built up areas or there will be no significant ground disturbance.

5.1 Site of WWTP - habitats

A habitat map is provided as **Figure 8**. There is an existing compound and waste water treatment system located within the area within which it is proposed to site the new WWTP. The WWTP compound is surrounded by palisade fencing and supports of a mixture of wet grassland GS4) and scrub (WS1) which has become dense in the absence of grazing. Species noted include bramble and gorse with immature willow also common. Only small remnants of wet grassland remain in situ within the compound.

To the north of the compound and outside the proposed development area, there is an area of wet grassland (GS4) and scrub (WS1) which is currently grazed by cattle. The ground is

waterlogged and heavily poached and dominated by common grass species such as perennial ryegrass and soft rush. Due to grazing pressure, scrub is less developed than within the compound with gorse the most common species noted.

The effluent outfall pipeline will run south from the new WWTP site to the shoreline and will traverse an area of waterlogged wet grassland (GS4). This area is grazed and is poorly drained and dominated by rush species and common agricultural grasses. Small areas of bramble and gorse have developed along the dryer ground which fringes the rocky shoreline.

To the southwest of the development site is a treeline of sitka spruce (WL2) and a small drain (Drainage Ditch FW4) which runs parallel to this treeline before discharging to the bay. This is a small, seasonal drain which does not have the potential to support fish. Both habitats are are of value at a local level.

The intertidal zone was surveyed from mid to high tide on January 15, 2018 and at mid to high tide on November 22 2019. The effluent outfall pipeline will be approximately 100m in length. Although Berehaven Harbour is generally quite sheltered in comparison to the rest of the peninsula there is enough exposure to south westerly winds to ensure that the shoreline experiences moderate levels of swell during storm events.

The upper shoreline is characterised by small sections of red fescue grassland. The main habitat within the upper shore is a large beach of coarse material classified as shingle and gravel shores LS1. Rock armour, which supports very little vegetation, is in place along parts of the upper shoreline (Sea walls, piers and jetties CC1). There are some areas of the Moderately Exposed Rocky Shore (LR2) in the intertidal zone in the lower shore with Fucoid species Channel Wrack (Pelvetia canaliculata), Bladder Wrack (*Fucus vesiculosus*) and Spiral Wrack (*Fucus spiralis*) common and with some red algae (*Corallina officinalis*) also noted. Typical species includeperiwinkle (Littorina littorea), Worm Pipefish (*Nerophis lumbriciformis*), Shore Crab (*Carcinus maenas*), Ballan Wrasse (*Labrus bergylta*), Ragworm (*Hediste diversicolor*) and Painted Top Shell (*Calliostoma zizyphinum*).

Immediately to the north east of the proposed pipeline route are two rocky outcrops which are contiguous with the shoreline at low tide but form a small island at high tide (CS2 Sea stacks and islets). As such it provides habitat for roosting birds such as oystercatcher and cormorant at high tide. Overall the intertidal habitats potentially affected by the pipeline route are considered typical of the types of habitats that occur in the south west along moderately exposed shorelines.

Figure 8 Habitat Map WWTP/outfall. Yellow - treeline WL2, Purple - wet grassland GS4, Orange - Sea walls, piers and jetties CC1/ shingle and gravel shores LS1/ (upper shore), Green - Moderately Exposed Rocky Shore (LR2)/ shingle and gravel shores LS1 Dark blue -drainage ditch FW4, White - CS2 Sea stacks and islets

Photograph 1 showing wet grassland between the shoreline and existing compound which is dominated by scrub. Patchy hedgerow and treeline also evident.

Photo 2 showing gorse scrub within the existing compound.

Photo 3 showing rocky islands and sedimentary shore

5.2 Brandyhall Bridge

Brandyhall Bridge is an old stone arch bridge which spans a tidal section of a small river (Tidal River CW2) which discharges into the harbour (See **Figure 9)**. This is a small fast flowing stream which arises in the uplands to the north east of the town. The stream is of sufficient size to support salmonids but is not of sufficient size to be included in the standard EPA biological monitoring programme. There will be no direct impacts on this stream. The development site is located in improved agricultural grassland which is located upgradient and approximately 15m from the tidal section of this stream.

Figure 9: Habitat Map - Brandyhall Bridge (Source Bing Maps). Yellow – improved agricultural grassland GA1

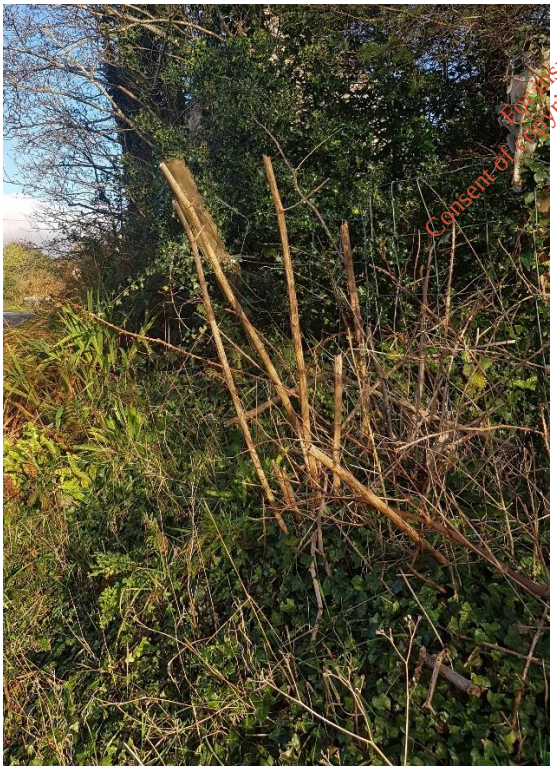
Photo 4 showing Brandyhall Bridge site.

5. 3 Gravity Main Foildarrig

This proposed rising mains will run along an existing minor road which runs northward from the town. The linear habitats adjoining the road consist of a mixture of low growing treelines (WL2) with holly, ash and willow and sections of rock escarpment /stonewall (Stonewall and other stonework BL1) which have become vegetated and domestic gardens with *Griselinia sp.* hedging. The non-linear habitats adjoining the road consists of a mixture of improved grassland (GA1) wet grassland (GS4) and scrub (WS1). These habitats will generally not be affected by the proposed works as the rising mains will be laid within the existing road. The off road section will impact on bramble and bracken scrub (WS1) and a small section of stonewall (BL1). None of these habitats are considered of high value at a local or regional level. No Japanese Knotweed was recorded within the works area itself however there is a dense stand to the south of this area in an area of grassland and along the roadside verge. This area has been treated but as of November 2019 regrowth is evident. A habitat map is provided as **Figure 10.** The area of Japanese Knotweed is shown in **Figure 11.**

Figure 11 Habitat map offline area Foildarrig. Yellow – Scrub WS1, Dark blue - Stonewall and other stonework BL1

Figure 11: Location of Japanese Knotweed (outlined in red)



Photograph 5 showing Japanese knotweed canes along the roadside with regrowth evident in November 2019.

5.3 Cametringane Woods

The impact will be large confined to the existing road however two sycamore trees will need to removed to facilitate the construction of the proposed pumping station and associated infrastructure. These are part of a treeline (WL2) of sycamore and elm which runs between the road and the sea with a ground layer of amenity grassland (GA2). These are old trees with numerous cracks and crevices. In particular the presence of mature elm is notable. Due to the ubiquity of Dutch Elm Disease, which attacks older trees, this species generally only occurs as an immature hedgerow species. Only a few small pockets of mature trees exist in Ireland at the present time. There are two mature elm within the treeline and as they are considered a conservation priority the proposed overflow pipe which connects to the existing effluent outflow has been rerouted to protect these trees. This pipe will be laid within the road surface where development of the root system has been already curtailed. Details are provided in **Figures 12, 13 and 14.**

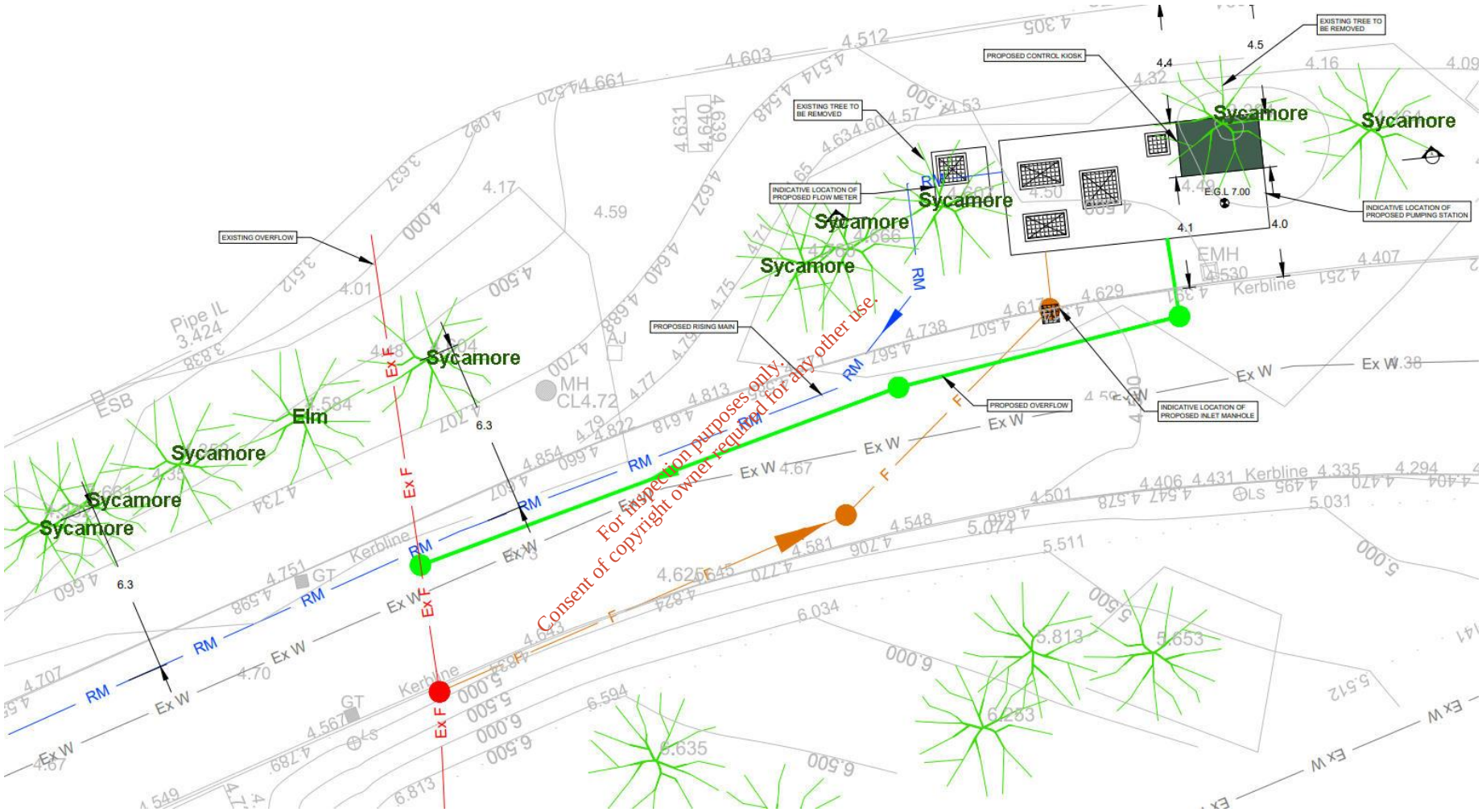


Figure 12 Proposed works in relation to trees at Cametringane Woods

Figure 13 Section of treeline unaffected with mature elm. U denotes unaffected.

Figure 14 Showing treeline at proposed development area U denotes trees unaffected. R denotes trees to be removed.

5.4 St Peters Church

A former church and grounds which is now used for community events. Holes were evident in the slate roof which may provide entrance/exit points for bats. However no impact on the structure of the church is proposed. Likewise mature trees in the front garden (ash and sycamore) which have nest boxes in place will be unaffected. The proposed works will impact on recently seeded amenity grassland (GA2), a gravel track (Buildings and artificial surfaces BL3) and bare concrete walls (Stonewalls and other stonework BL1). See **Figure 15.**

Figure 15 habitat map orange –amenity grassland GA1/ Buildings and artificial surfaces BL3 Dark Blue - Stonewalls and other stonework BL1

Photograph 6 showing amenity grassland, gravel track and concrete walls.

5.4 St Joseph's Community Hospital

The site in proximity to St. Joseph's Hospital is dominated by a mixture of amenity grassland (GA2) and scrub (WS2) including bramble nettle, privet and bracken and large stands of lesser knotweed (*Persicaria campanulate*) which is a knotweed native to north India. It resembles other knotweeds but is relatively small growing to a height of 0.9m. This is considered a low risk invasive species (Risk analysis and prioritisation *For invasive and non-native species in Ireland and Northern Ireland,* J. Kelly, C. O'Flynn &C. Maguire, 2013). A small drain emerges from a pipe and runs through the site via as small drainage ditch (FW4) before discharging to the sea. See **Figure 16.**

Figure 16. Habitat map. Dark Blue – Amenity grassland GA2, light blue- drainage ditch FW4

5.5 Habitat evaluation

The ecological value of habitats as shown in **Table 4** is defined by the classification scheme outlined in the Guidelines for Assessment of Ecological Impacts of National Road Schemes (National Roads Authority, 2009) which is included in **Appendix 1.**

Table 4: Evaluation of habitats recorded within the proposed development site.

Habitat	Comments	Ecological value (NRA guidelines)
Tidal River CW2	There will be no direct impacts on the tidal section of the stream which discharges at Brandyhall Bridge. As this section of the stream is tidal any minor spills of hydrocarbons or increased in suspended solids in surface water during construction would be predicted to have a negligible impact on water quality.	Local Importance (higher value)

Treelines (WL2)	A small section of sitka spruce treeline will be removed at the WWTP.	Local Importance (lower value)
Treelines (WL2)	Sycamore and elm treeline. Two sycamore will be removed.	Local Importance (higher value). Elm trees considered of national value.
Amenity grassland (GA2)	Small areas affected.	Local Importance (lower value)
Wet Grassland (WS2) and Scrub (WS1)	Areas of wet grassland and scrub will be removed by the provision of the WWTP and effluent outfall pipeline. Areas of scrub will be affected at St. Josephs Hospital and the offline area at Foildarrig..	Local Importance (lower value)
Drainage Ditches (FW4)	Drainage ditches occur in proximity to the WWTP and at St. Josephs Hospital.	Local Importance (lower value)
Stonewall and other stonework BL1	Sections of old stone wall on the edges of roads will generally not be affected. A small section will be affected at the off road section at Foildarrig	Local Importance (lower value)
Moderately Exposed Rocky Shore (LR2)/ Sea walls, piers and jetties CC1/ shingle and gravel shores	The effluent outfall pipeline will impact on a small area of this habitat.	Local Importance (higher value)

6. Flora

The site of the proposed development lies within Ordnance Survey National Grid 10km square V64. The National Parks and Wildlife Service database (www.npws.ie) was consulted with regard to rare species and species protected under the Flora Protection Order 2015 (S.I. No. 356 of 2015)) within the grid square V64. Dropping Lady's Tresses (*Spiranthes romanzoffiana)* was the only species recorded within this grid square. It was recorded on two occasions, in 1810 and 1927, but there have been no recordings since. None of the habitats affected by the proposed development are of value for this plant.

The National Biodiversity Data Centre (NBDC) online database provides data on the distribution of mammals, birds, and invertebrates within the 10km grid squares. Some 256 flowering plants are listed by the NBDC as present in the grid square V64. No floral species listed as threatened or requiring designation were recorded within the 10km grid square. No rare species were recorded during the site survey.

7. Fauna

7.1 Otter

Otters, along with their breeding and resting places are protected under the provisions of the Wildlife Act 1976, as amended by the Wildlife (Amendment) Act, 2000. Otters have additional protection because of their inclusion in Annex II and Annex IV of the Habitats Direct which is transposed into Irish law in the European Communities (Natural Habitats) Regulations (S.I 94 of 1997), as amended. Otters are also listed as requiring strict protection in Appendix II of the Berne Convention on the Conservation of European Wildlife and Natural Habitats and are included in the Convention on International Trade of Endangered species (CITES). This species is listed as a qualifying interest for the Kenmare River SAC.

Although rare in parts of Europe they are widely distributed in the Irish countryside in both marine and freshwater habitats. Otters are solitary and nocturnal and as such are rarely seen. Thus, surveys for otters rely on detecting signs of their presence. These include spraints (faeces), anal gland secretions, paths, slides, footprints and remains of prey items. Spraints are of particular value as they are used as territorial markers and are often found on prominent locations such as grass tussocks, stream junctions and under bridges,

Otters occasionally dig out their own burrows but generally they make use of existing cavities as resting placing or for breeding sites. Suitable locations include eroded riverbanks, under trees along rivers, under fallen trees, within rock piles or in dry drainage pipes or culverts etc. If ground conditions are suitable the holt may consist of a complex tunnel and chamber system. Otters often lie out above ground especially within reed beds where depressions in the vegetation called “couches” are formed. Generally, holts or resting areas can be located by detecting signs such as spraints or tracks.

It is noted that otters are largely nocturnal, particularly in areas subject to high levels of disturbance as evidenced by the presence of otters in the centre of Cork and Limerick City. Thus, otters are able to adapt to increased noise and activity levels; however, breeding holts are generally located in areas where disturbance is lower.

A review of existing records within a 10km radius of the study site (Grid Square V64) showed that otter or signs of otter have been recorded on 6 occasions, the most recent being in May 2016. Otters are also known to frequent sections of the Harbour and coastline in close proximity to the proposed development site.

Otter spraints were recorded in immediate proximity to where the proposed effluent discharge pipeline crosses the shoreline (See **Figure 17**). This area is relatively undisturbed and spraints were noted on a narrow band of grassland along the upper shore. Otter are likely to use this area

for feeding however no holts or couches were recorded within 150m of the proposed site works during site surveys.

Figure 17 Otter sprainting site

7.2 Bats

In Ireland, nine species of bat are currently known to be resident with the residency of the tenth recorded species yet to be proven. These are classified into two Families: the Rhinolophidae (Horseshoe bats) and the Vespertilionidae (Common bats). The lesser horseshoe bat *Rhinolophus hipposideros* is the only representative of the former Family in Ireland. All the other Irish bat species are of the latter Family and these include three pipistrelle species: common *Pipistrellus pipistrellus*, soprano *P. pygmaeus* and Nathusius' *P. nathusii*, four *Myotids*: Natterer's *Myotis nattereri*, Daubenton's *M. daubentonii*, whiskered *M. mystacinus*, Brandt's *M. brandtii*, the brown long-eared *Plecotus auritus* and Leisler's *Nyctalus leisleri* bats.

The review of existing bat records within a 10km radius of the study site (sourced from Ireland's BioBlitz, BCIreland's National Bat Records Database and the National Lesser Horseshoe Bat Database) showed that the following Irish bat species have been recorded locally, **Table 5**. It is noted that other species which have not been included within this database may also occur.

Table 5: Presence of Irish bat species within a 10km radius

Common name	Scientific name	Presence
Lesser Noctule	*Nyctalus leisleri*	Present
Pipistrelle	*Pipistrellus pipistrellus sensu lato*	Present
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Present
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Present

Common name	Scientific name	Presence
Unidentified Myotis Bat	*Myotis species*	Present
Brown Long-eared Bat	*Plecotus auritus*	Present

All bat species are protected under the Wildlife Acts (1976 & 2000) which make it an offence to wilfully interfere with or destroy the breeding or resting place of all species; however, the Acts permit limited exemptions for certain kinds of development. All species of bats in Ireland are listed in Schedule 5 of the 1976 Act and are therefore subject to the provisions of Section 23 which make it an offence to:

- Intentionally kill, injure or take a bat
- Possess or control any live or dead specimen or anything derived from a bat
- Wilfully interfere with any structure or place used for breeding or resting by a bat
- Wilfully interfere with a bat while it is occupying a structure or place which it uses for that purpose.

In addition to domestic legislation bats are also protected under the EU Habitats Directive (92/43/EEC) with all bat species are listed in Annex IV of the Directive. The Irish government is also a signatory to the 1979 Bonn convention (Convention on the conservation of migratory species of wild animals) and the 1982 Bern convention (The convention on the conservation of European wildlife and natural habitats), and has a commitment to the 1991 Eurobats agreement (Agreement on the conservation of bats in Europe).

Evidence of bat activity associated with potential roost sites includes bat droppings, urine staining, feeding remains and dead/alive bats. Indicators that potential roost locations and access points are likely to be inactive include the presence of cobwebs and general detritus within the apertures. Potential roost features associated with trees include cracks, crevices, loose bark, woodpecker holes and splits. Evidence indicating bat presence, includes dark stains running below holes or cracks, bat droppings, odours, or scratch marks.

A small number of sitka spruce adjoining the WWTP and of negligible value for bats will be removed. Two sycamore at Cametringane Woods will be removed and these are considered of low value for bats (See **Figure 12,13 and 14**) A visual examination of these trees from ground level did not record any signs of bats. The line of trees, from which these sycamore will be removed, may be used by bats for foraging or as a commuter route. However it does not link up bat habitats of high value and the loss of two trees will have a negligible impact.

7.3 Other terrestrial mammals

Ten other species of terrestrial mammal have been recorded within a 10km radius of the proposed development site. Five of which are protected under the Irish Wildlife Act; namely Sika Deer, Badger, Hedgehog, Irish Hare and Irish Stoat.

7.3.1 Badger (*Meles meles*) and their setts are protected under the provisions of the Wildlife Act 1976, as amended, and it is an offence to intentionally, knowingly or unknowingly kill or injure a protected species, or to wilfully interfere with or destroy the breeding site or resting place of a

protected wild animal. Badger setts are formed by a complex group of interlinked tunnels, and therefore works in proximity to setts can potentially cause damage a protected species. Badgers are also protected under Appendix III of the Berne.

Badgers are known to occur within the wider landscape (NBDC), however no signs of badger, setts or otherwise were recorded during the site visit.

7.3.2 Sika Deer (*Cervus nippon*) prefer forest with dense understorey, thickets, natural woodlands and commercial plantations, but will also forage in open grassy areas with dense cover nearby. Sika Deer are highly opportunistic feeders, foraging on grasses to a range of shrubs and tree species. They have very large daily ranges, moving up to 2.5km per day and are classified as intermediate grazer-browsers due to their highly opportunistic feeding patterns. Due to the habitats recorded within the site, it is unlikely that Sika Deer will occur.

7.3.3 Hedgehog (*Erinaceus europaeus*), also listed on Appendix III of the Berne Convention can be found throughout Ireland, with male hedgehogs having an annual range of around 56 hectares. A number of factors are thought to influence the distribution of hedgehogs in a habitat, with nest sites, food availability and the presence of predators believed to be major contributory factors. Generally, hedgehogs prefer edge habitat and pasture but in recent years have begun to colonize urban areas. Due to the habitats recorded within the site, it is likely that hedgehog could occur.

7.3.4 The Irish hare (*Lepus timidus hibernicus*) is one of three lagomorphs found on the Island of Ireland and the only native lagomorph. It is listed on Appendix III of the Berne Convention, Annex V(a) of the EC Habitats Directive (92/43/EEC) and as an internationally important species in the Irish Red Data Book.

The Irish hare is adaptable and lives in a wide variety of habitats from heaths, upland grasslands to coastal sand dune systems. It typically reaches its highest densities on farmland, particularly where there is a mix of grassland and arable fields along with hedgerows and other cover. Due to the habitats recorded within the site, it is likely that Irish hare could occur, if not sporadically.

7.3.5 Irish Stoat (*Mustela erminea hibernica*) is one of the species protected under regulations (Protection of Wild Animals) in 1980 which enabled Ireland to comply with the provisions of the Bern Convention of European Wildlife and Natural Habitats, which was ratified by Ireland in April 1982. Irish stoats occur in most habitats with sufficient cover, including urban areas. It is likely that stoat will occur in the area given the presence of prey species.

7.4 Marine mammals.

In Ireland, there are two groups of mammals that inhabit almost exclusively the marine environment, cetaceans and seals. In Ireland, the 1992 EC Habitats Directive as transposed by the EC (Natural Habitats) Regulations requires that both seal species and all cetaceans occurring in Ireland are maintained at favourable conservation status. Under Article 12 of the Directive, all cetaceans should receive strict protection within the Exclusive Economic Zone. Under the Wildlife (Amendment) Act 1976-2005, all cetaceans and seals are protected species listed on the 5th

Schedule. The National Biodiversity Data Centre (NBDC) databases for grid square V64 lists the following species as present (**Table 6**).

Table 6: NBDC marine mammal species

Marine Mammal Species	Latin Name	EU Designation/Legal Protection
Common Dolphin	*Delphinus delphis*	Protected Species: EU Habitats Directive Annex IV & Protected Species: Wildlife Acts
Minke Whale	*Balaenoptera acutorostrata*	Protected Species: EU Habitats Directive Annex IV & Protected Species: Wildlife Acts
Long-finned Pilot Whale	*Globicephala melas*	Protected Species: EU Habitats Directive Annex IV & Protected Species: Wildlife Acts
Grey Seal	*Halichoerus grypus*	Protected Species: EU Habitats Directive Annex II & V. Protected Species: Wildlife Acts
Harbour Porpoise	*Phocoena phocoena*	Protected Species: EU Habitats Directive Annex II & IV. Protected Species: Wildlife Acts. Threatened Species: OSPAR Convention
Bottle-nosed Dolphin	*Tursiops truncatus*	Protected Species: EU Habitats Directive Annex II & IV. Protected Species: Wildlife Acts
Northern Bottlenose Whale	*Hyperoodon ampullatus*	Protected Species: EU Habitats Directive Annex IV & Protected Species: Wildlife Acts
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	Protected Species: EU Habitats Directive Annex IV & Protected Species: Wildlife Acts

7.4.1 Seals

Grey and Harbour Seals are strictly protected in the Republic of Ireland under the Wildlife Act, 1976 and the Wildlife (Amendment) Act, 2000. They are also listed under Annex II of the European Union's EC Habitats Directive (92/43/EEC) as species of Community Interest, whose conservation requires the designation of Special Areas of Conservation (SACs). In the latter part of the 1990s, the National Parks & Wildlife Service (NPWS) proposed all of the major known breeding sites as candidate SACs, ten sites for the grey seal and seven for the Harbour Seal. Both Harbour Seal and Grey Seal are known to occur and feed within Berehaven Harbour.

Harbour Seal (*Phoca vitulina*) is one of two seal species that occur in Ireland and tend to inhabit inshore bays, coves and estuaries. This species is listed as a qualifying interest for the Kenmare River SAC**.**

Harbour Seals are generalist feeders that take a wide variety of fish, cephalopods, and crustaceans obtained from surface, mid-water, and benthic habitats. Patterns of movement have been observed at two geographical scales; while some seals travelled over 100 km, 50% of trips were within 25 km of a haul-out site (Cunningham, 2008).

Harbour seals come to shore during June to give birth and mate again around this time but usually in the water. Pups are capable of swimming within a few hours of being born but stay with their mother until weaned. Common Seals also come to shore to moult (shed their fur) during July and August often forming large groups on sheltered shores that have ready access to the sea. They are usually extremely wary and shy on land and therefore it is almost impossible to approach them when they are hauled out without stampeding them into the water. However, habituation to human activities in their vicinity can occur. Most haul-out sites are used daily, based on tidal cycles and other environmental variables, although foraging trips can last for several days (Lowry *et al.* 2001). Harbour Seal have been recorded from the Berehaven Harbour and Harbour Seals from the Kenmare River SAC could potentially feed in proximity to the site and although they were not recorded could potentially use the rocky outcrop which forms an island at high tide a haul out site.

Grey seals generally select more remote haul-out locations on rocky skerries, uninhabited islands, isolated mainland beaches and in sea-caves (Kiely et al., 2000). Pups are born with a white coat that they shed before they can take to the water, usually after about six weeks. The mother stays with the pups whilst they remain on the shore. The seals shed their fur during the spring months and remain ashore for the majority of this time. Grey seal and harbour seal are known to feed within the harbour (personal observation).

7.5 Reptiles and Amphibians

According to records held by the NBDC, Common Frog (*Rana temporaria)* is the only amphibian recorded in grid square V64. Common Frog is listed in Annex V of the EU Habitats Directive and is protected under the Wildlife Acts. The species was not recorded during the site visit but there is the possibility of it occurring within wet grassland habitat.

The Common Lizard (*Zootoca vivipara*) is protected under the Wildlife Act. There are two recordings of Common Lizard (*Zootoca vivipara*) occurring within grid square V64 (NBDC). Although common lizard can occur in a wide range of habitats, no value habitat for this species will be affected.

Leathery Turtles (*Dermochelys coriacea*) are also protected under EU Habitats Directive Annex IV and Wildlife Act but are also listed as a threatened Species under the OSPAR Convention. Leathery Turtles have been recorded on 13 occasions within the grid square V64 with the most recent sighting dating back to 1982 (NBDC).

7.6 Other species listed by NBDC as present within grid square V64.

Table 7 below lists other species recorded within grid square V64, along with any species considered under threat and provided with legal protection.

Table 7: Other species listed by NBDC as present within grid square V64

Species Group	Named species
Other Mammals	Wolf, Red fox.
Invasive Mammals	Feral Goat, Bank Vole, European rabbit
Acarine (Acari)	2 species recorded. None protected
Fish (Actinopterygii)	21 fish are present. European eel: Threatened Species OSPAR Convention. Critically endangered.
Bryozoan	11 species recorded. None protected
Fish (Chondrichthyes)	3 species recorded: Basking Shark & Thornback Ray: Threatened Species OSPAR Convention.
Alga	99 species recorded. Coral Maërl: Protected Species: EU Habitats Directive Annex V
Coelenterate (=cnidarian)	47 species recorded. None protected.
Mollusc	72 species recorded. Kerry Slug: Protected Species: EU Habitats Directive Annex II & IV. Protected Species Wildlife Acts. Dog Whelk: Threatened Species OSPAR Convention
Beetle (Coleoptera)	15 species recorded. None protected
Centipede	3 species recorded. None protected
Crustacean	16 species recorded. None protected.
Echinoderm	17 species recorded. None protected.
Flatworm (Turbellaria	2 species recorded. None protected
Fungus	15 species recorded. None protected.
Hairworm (Nematomorpha)	1 species recorded. Not protected.
Hornwort	1 species recorded. Not protected.
Alderfly (Megaloptera)	1 species recorded. Not protected.
Moths	55 species recorded. None protected.
Caddis-fly (Trichoptera)	5 species recorded. None protected.
Mayfly (Ephemeroptera)	3 species recorded. None protected.
Stonefly (Plecoptera)	3 species recorded. None protected.
Butterflies	22 butterflies. Dark Green Fritillary Vulnerable. Grayling, Small Heath & Gatekeeper Near Threatened. Wall Endangered. Marsh Fritillary Protected Species: EU Habitats Directive Annex II & Threatened Species: Vulnerable
Dragonfly (Odonata)	13 dragonfly species recorded. None protected.
Annelids	12 species recorded. None protected.
Hymenopteran	9 species recorded. None protected.
Flea (Siphonaptera)	1 species recorded. Not protected.
Earwig (Dermaptera)	1 species recorded. Not protected.
Orthopteran	4 species recorded. None protected.
True bugs (Hemiptera)	17 species recorded. None protected.
True flies (Diptera)	17 species recorded. None protected.
Spider (Araneae)	1 species recorded. Not protected.
Sponge (Porifera)	25 species recorded. None protected.
Horsetail	1 species recorded. Not protected.

Species Group	Named species
Ferns	17 species recorded. None protected
Conifers	3 species recorded. None protected
Lichen	12 species recorded. None protected
Liverwort	18 species recorded. None protected
Moss	55 species. Hair-pointed Grimmia: Threatened Species Data deficient
Tunicate (Urochordata)	13 species recorded. None protected.

7.7 Birds

The National Biodiversity Centre online data base lists 115 species of bird recorded within grid square V64. Of these 15 species, 13 are listed under Annex I of the Birds Directive, namely, Kingfisher, Little Egret, Peregrine Falcon, European Storm-petrel, Mediterranean Gull, Dunlin, Hen Harrier, Corn Crake, Great Northern Diver, Red-billed Chough, Red-throated Diver, Artic Tern, and Common Tern.

An additional 13 species are Red Listed Birds of Conservation Concern in Ireland; Twite, Northern Shoveler, Yellowhammer, Herring gull, Black-headed gull, Eurasian Curlew, Common Redshank, Northern Lapwing, Grey Wagtail, Meadow pipit, Dunlin, Corn Crake, and Eurasian Wigeon

Bird survey (non-breeding) was carried out in conjunction with habitat survey in January 2018 and November 2019. During the survey, all birds seen or heard within the development site were recorded. The majority of birds utilising the proposed works areas are common in the local landscape. Birds species listed on Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists. Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Green listed species are regularly occurring bird species whose conservation status is currently considered favourable. Species recorded within the proposed development site are shown in **Table 8.**

Table 8: Bird Species recorded during the site visits.

Species		Birds Directive Annex			BOCCI	
		I	II	III	Red List	Amber List
Sturnusvulgaris	Starling					X
Saxicolatorquata	Stonechat					X
Larus ridibundus	Black-headed Gull				X	
Larus argentatus	Herring Gull				X	
Haematopus ostralegus	Oystercatcher					X
Anthus pratensis	Meadow Pipit				X	
Turdus merula	Blackbird					
Phasianus colchicus	Pheasant					
Prunella modularis	Dunnock					
Corvus frugilegus	Rook					
Phalacrocorax carbo	Cormorant					
Corvus monedula	Jackdaw					
Columba palumbus	Woodpigeon		X	X		
Fringilla coelebs	Chaffinch					
Corvus cornix	Hooded Crow					
Parus caeruleus	Blue Tit					
Motacilla alba yarrellii	Pied Wagtail					
Parus major	Great Tit					
Arenaria interpres	Turnstone					
I	**Annex 1**: species and sub-species are particularly threatened. Member States must designate Special Protection Areas (SPAs) for their survival and all migratory bird species.					
II	**Annex 2**: bird species can be hunted. However, the hunting periods are limited and hunting is forbidden when birds are at their most vulnerable: during their return migration to nesting areas, reproduction and the raising of their chicks.					
III	**Annex 3**: overall, activities that directly threaten birds, such as their deliberate killing, capture or trade, or the destruction of their nests, are banned. With certain restrictions, Member States can allow some of these activities for species listed here.					

Overall, most of the proposed development site is of local value for terrestrial bird species that are relatively common in the Irish countryside. There are no terrestrial features or habitats of particular value, which would differentiate the proposed development site from large areas of similar habitat in the surrounding countryside. The mix of rocky and sedimentary shoreline provides habitat for some typical shore species. Of particular note is the small rocky outcrop immediately offshore (See **Figure 8, Photos 7 and 8**). At high tide this forms a small island and is used as a high tide roost by oystercatcher (15 recorded) and turnstone (3 recorded). Short-term disturbance of birds using these rocky islands is predicted to occur.

Chough is listed as a qualifying interest for the Beara Peninsula SPA (Site Code 004155) which located 1.5km away at the its closest point (A more detailed assessment of the potential impact

on European sites and qualifying interests including chough is provided in the AA screening report for this project

Chough has a scattered distribution, resulting from specific ecological requirements, (i.e. suitable nesting sites: shallow caves in cliffs) and foraging areas (short grassland with low cover, Blanco, Tella & Torre 1998). During the 19th and 20th centuries, the distribution and population sizes of the chough in Europe have declined drastically (Kerbiriou 2001; Burfield & Bommel 2004) and the species is now listed in Annex 1 of the European Union Directive on the Conservation of Wild Birds (79/409/EEC). This strong decrease is thought to result from changes in agricultural practices, notably abandonment of grasslands that used to provide suitable foraging habitats for choughs (Kerbiriou 2001). No areas of suitable grassland which could potentially be of high value as feeding habitat for this species occurs within the proposed development area. No potential breeding sites will be affected. No potential impacts on Fulmar which is also listed as a qualifying species for the Beara Peninsula SPA (Site Code 004155) have been identified.

Photograph 7 showing rocky outcrop in background.

Photograph 8 showing rocky outcrops as islands at high tide.

8. Invasive species

Non-native plants are defined as those plants which have been introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and, (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities and is not managed it can potentially: (1) out compete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; and, (3) have an adverse effect on landscape quality.

Japanese Knotweed was not recorded within the works area; however, it was recorded approximately 40m from the proposed works area (**Figure 9**). A detailed invasive species report is attached as part of this report, see **Appendix 2**. Lesser Knot was recorded at the St. Josephs Hospital Site; this species is not considered problematic and no impact from the spread of this species will occur.

Montbretia was recorded within the works area, however this species is ubiquitous within this part West Cork. It is however classified as Amber Threat species by Invasive Species Ireland which under the right ecological conditions and may have an impact native species or habitats. Montbretia is also included in the NRA Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads (NRA, 2010) as this species has been shown to have an adverse impact on landscape quality, native biodiversity or infrastructure; and is likely to be encountered during road schemes. Montbretia is not deemed a source of concern with regard to this proposed development.

The NBDC lists a number of aquatic and terrestrial high impact invasive species which have been recorded within grid square V64 (**Table 9**). None of these were recorded within the proposed works area.

Table 9: NBDC list of high impact invasive species

Common Name	Latin Name
New Zealand flatworm	*Arthurdendyus triangulatus*
Japanese Knotweed	*Fallopia japonica*
Giant-rhubarb	*Gunnera tinctoria*
Rhododendron	*Rhododendron ponticum*
Sika Deer	*Cervus nippon*

9. Water Quality Data

The EPA have defined the area in proximity to the proposed development site as 'Coastal Waters'. Coastal waters can be assigned a classification of; High, Good, Moderate, Poor or Bad. The former three are considered to be acceptable, while the latter two water quality ratings are considered as unsatisfactory. Treated waste water from the proposed development site will ultimately be discharged to the Harbour following treatment. Results indicate that the water quality within the coastal waters of the Berehaven Harbour is of an acceptable quality (**Figure 10**.

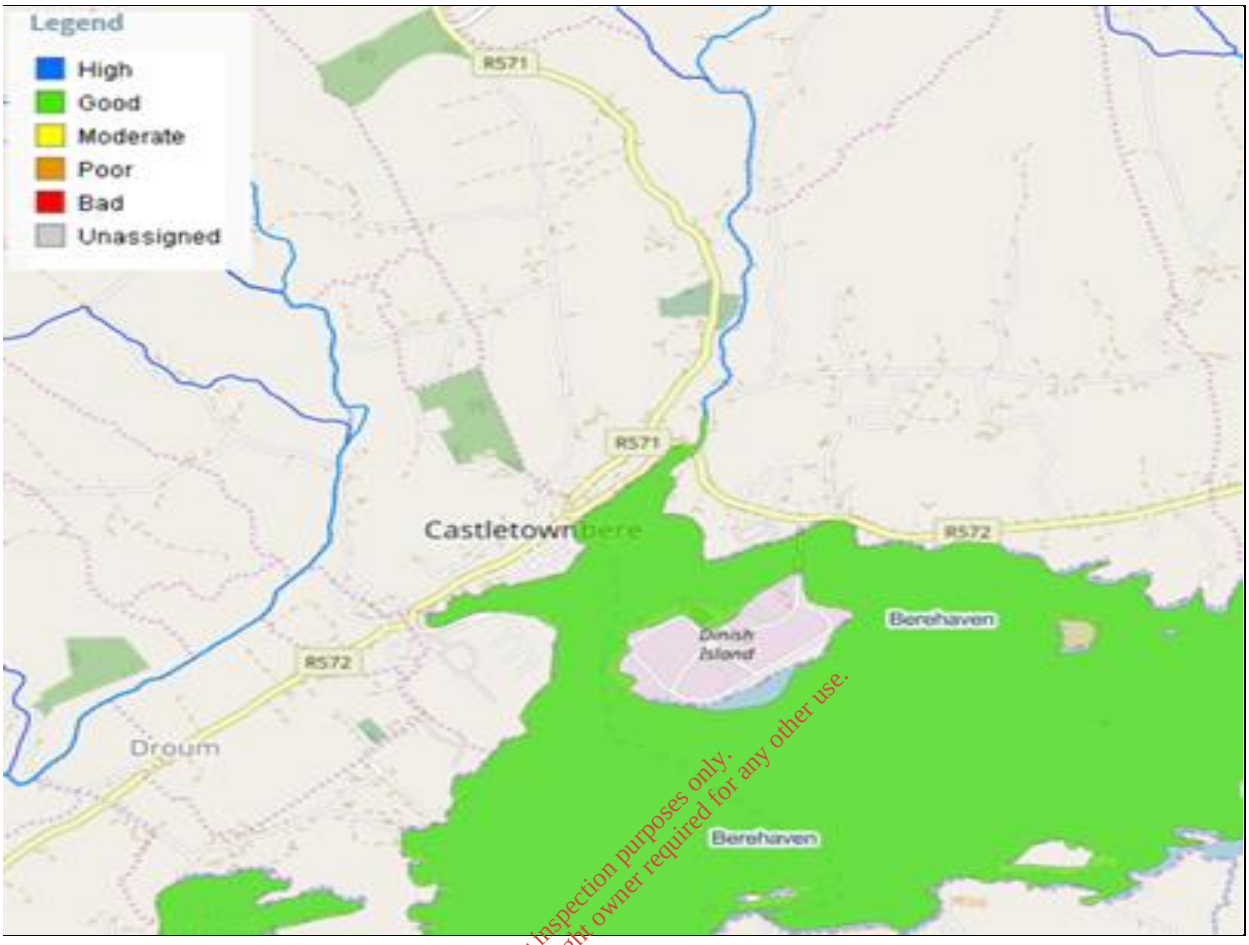


Figure 18 EPA Water Quality Status.

9.1 River Basin Management Plan for Ireland 2018 – 2021 (2nd Cycle)

The Water Framework Directive (WFD) sets out the environmental objectives which are required to be met through the process of river basin planning and implementation of those plans. Specific objectives are set out for surface water, groundwater and protected areas. The challenges that must be overcome in order to achieve those objectives are very significant. Therefore, a key purpose of the River Basin Management Plan (RBMP) is to set out priorities and ensure that implementation is guided by these priorities.

The second-cycle RBMP aims to build on the progress made during the first cycle. Key measures during the first cycle included the licensing of urban waste-water discharges (with an associated investment in urban waste-water treatment) and the implementation of the Nitrates Action Programme (Good Agricultural Practice Regulations). The former measure has resulted in significant progress in terms both of compliance levels and of the impact of urban waste-water on water quality. The latter provides a considerable environmental baseline which all Irish farmers must achieve and has resulted in improving trends in the level of nitrates and phosphates in rivers and groundwater. It is acknowledged, however, that sufficient progress has not been made in developing and implementing supporting measures during the first cycle.

Overall, RBMP assesses the quality of water in Ireland and presents detailed scientific characterisation of our water bodies. The characterisation process also takes into account wider water quality considerations, such as the special water-quality requirements of protected areas. The characterisation process identifies those water bodies that are *At Risk* of not meeting the objectives of the WFD, and the process also identifies the significant pressures causing this risk. Based on an assessment of risk and pressures, a programme of measures has been developed to address the identified pressures and work towards achieving the required objectives for water quality and protected areas. Data relating to the watercourses within the study area is provided in **Table 10.**

Table 10. Water Framework Directive Data – Relevant data

Catchment: Dunmanus-Bantry-Kenmare (Code 21) – 2nd Cycle			
This catchment includes the area drained by all streams entering tidal water in Dunmanus, Bantry and Kenmare Bays between Mizen Head and Glanearagh Head, Co. Kerry, draining a total area of 1,898km². The largest urban centre in the catchment is Bantry. The other main urban centre in this catchment is Kenmare. The total population of the catchment is approximately 24,280 with a population density of 13 people per km². This catchment is dominated by the east–west trending series of sandstone ridges and limestone valleys that dominate the landscape of south and west Munster. In this catchment, the limestone valleys are nearly completely submerged by the sea – having been preferentially eroded compared to the sandstone ridges lying between them and these valleys now make up Dunmanus, Bantry and Kenmare Bays while the sandstone ridges form the Mizen, Sheep's Head, Beara and Iveragh Peninsulas. The Dunmanus-Bantry-Kenmare catchment comprises 20 subcatchments with 91 river water bodies, 39 lakes, twenty transitional and coastal water bodies, and three groundwater bodies. There are no heavily modified or artificial water bodies in the Dunmanus-Bantry-Kenmore Catchment.			
Dunmanus-Bantry-Kenmare – River and Coastal Waterbodies relevant to the proposed project			
Waterbody	**Ecological Status**	**Risk**	**Date to Meet Environmental Objective**
Felane_West_010	Unassigned	Not at Risk	met its 2015 environmental objective
Berehaven	Good	Not at risk	met its 2015 environmental objective

Source: EPA Envision map system

10. Evaluation of potential Impacts

During construction, potential impacts could arise from increased noise and disturbance which could result in the disturbance/displacement of birds and mammals. There will be a net, permanent loss of terrestrial and aquatic habitats. Increased dust levels during construction could have localised impacts on local vegetation and habitats. Minor spills of hydrocarbons during construction could impact on groundwater or surface water quality with resultant impacts on aquatic ecology.

Potential impacts on designated Natura 2000 sites (SAC/cSAC/SPA) are specifically addressed in an Appropriate Assessment Screening Report which has been submitted as part of this application. This report concluded that it is possible to rule out likely significant impacts on any Natura 2000 sites.

10.1 Do Nothing' Impact

Most of the habitats to be affected have been significantly modified from the natural state by human activity. If habitats were left unmanaged a general pattern of succession from grassland/ scrub to woodland would be expected to occur. If sufficient time elapsed without development, the unused areas of the proposed development area would be expected to develop a covering of woodland with a mix of native and introduced species. In the absence of this development it is expected that the areas which are currently managed for agriculture would remain under the same management regime and no significant changes to the boundary habitats noted on site are likely to occur. The discharge of untreated sewage will continue to have a negative impact on water quality if a new system is not provided.

10.2 Magnitude, Probability and Significance of Impacts

When describing changes/activities and impacts on ecosystem structure and function, important elements to consider include magnitude, duration and probability of occurrence (IEEM, 2016).

Magnitude refers to the 'size' or 'amount' of an impact, determined on a quantitative basis if possible. Duration refers to the time for which the impact is expected to last prior to recovery or replacement of the resource or feature. This should be defined in relation to ecological characteristics (for example species' lifecycles) rather than human timeframes. Appropriate criteria for the assessment of magnitude and duration for this project are provided in **Tables 11** and **12** below.

Table 11 Criteria for Determining the Magnitude of Ecological Impacts

Magnitude	Examples
Very High	e.g. The proposal (either on its own or with other proposals) will result in – The total loss of or very major alteration to key elements/features of the baseline conditions such that post-development/character/composition/attributes will be fundamentally changed and may be lost from the site altogether.
High	e.g. The proposal (either on its own or with other proposals) will result in – Major alterations to key elements/features of the

	baseline (predevelopment) conditions such that post-development/character/composition/attributes will be fundamentally changed.
Medium	e.g. The proposal (either on its own or with other proposal) will result in – The loss of or alteration to one or more key elements/features of the baseline conditions such that post-development/character/composition/attributes of baseline would be partially changed.
Low	e.g. The proposal (either on its own or with other proposals) will result in – A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline conditions would be similar to predevelopment circumstances/patterns.
Negligible	e.g. The proposal (either on its own or with other proposals) will result in – A very slight change from baseline condition. Change barely distinguished approximating to the “no change” situation.

Table 12 Criteria for assessment of duration

Duration	Criteria
Permanent	Effects continuing beyond one human generation (c.25 years) are expected. There is likely to be a substantial improvement after this period, whereby these would be described as "very long term effects."
Temporary	Long term-(15-25 years) Medium (5-15 years) Short term (0-5 years)

10.3 Probability of occurrence

It is important to consider the likelihood that a change/activity will occur as predicted and also the degree of confidence in the assessment of the impact on ecological structure and function. The following scale (IEEM, 2016) is often utilised in ecological assessment:

- Certain/near-Certain: probability estimated at 95% chance or higher.
- Probable: probability estimated above 50% but below 95%.
- Unlikely: probability estimated above 5% but less than 50%.
- Extremely Unlikely: probability estimated at less than 5%.

10.4 Significance of impacts

Based on the above and the value of habitats and species a matrix of significance can be used to determine specific impacts. This matrix is shown below in **Table 13**

Table 13 Impact Significance Matrix

Impact Significance		Ecological Value				
		Very High	**High**	**Medium**	**Low**	**Negligible**
Magnitude	Very High	Major	Major	Major	Moderate	Minor
	High	Major	Major	Moderate	Minor	Negligible
	Medium	Major	Moderate	Minor	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible

11. Potential impacts.

11.1 Potential impacts on habitats

Impacts on terrestrial habitats are generally restricted to direct removal of habitats and possible impacts from the spread of invasive species; however, for this project impacts on semi-natural habitat will be limited in extent. Levels of dust during construction are predicted to be low and effectively managed by mitigation. The impact on vegetation in adjoining habitats from wind-blown dust is predicted to be negligible.

Overall, the habitats to be affected are generally common and no Annex 1 habitats or rare or uncommon habitats or floral species will be directly affected. Based on the criteria outlined by the IEEM, as described above, the predicted impacts are detailed in **Table 14**

Table 14 Impacts on Terrestrial Habitats

Habitat		Ecological value (NRA guidelines)	Predicted Impact
Tidal River CW2	There will be no direct impacts on the tidal section of the stream which discharges at Brandyhall Bridge. As this section of the stream is tidal any minor spills of hydrocarbons or increased in suspended solids in surface water during construction would be predicted to have a negligible impact on water quality.	Local Importance (higher value)	Negligible
Treelines (WL2)	A small section of sitka spruce treeline will be removed at the WWTP.	Local Importance (lower value)	Negligible
Treelines (WL2)	Sycamore and elm treeline. Two sycamore will be removed.	Local Importance (higher value). Elm trees considered of national value	Minor
Amenity grassland (GA2)	Small areas affected.	Local Importance (lower value)	Negligible
Wet Grassland (WS2) and Scrub (WS1)	Areas of wet grassland and scrub will be removed by the provision of the WWTP and effluent outfall pipeline. Areas of scrub will be affected at St. Josephs Hospital and the offline area at Foildarrig.	Local Importance (lower value)	Negligible
Drainage Ditches (FW4)	Drainage ditches occur in proximity to the WWTP and at St. Josephs Hospital.	Local Importance (lower value)	Negligible
Stonewall and other stonework BL1	Sections of old stone wall on the edges of roads will generally not be affected. A small section will be affected at the off road section at Foildarrig	Local Importance (lower value)	Negligible
Moderately Exposed Rocky Shore (LR2)/ Sea walls, piers and jetties CC1/ shingle and gravel shores	The effluent outfall pipeline will impact on a small area of this habitat.	Local Importance (higher value)	Minor

11.2 Potential impact from invasive species

Japanese Knotweed was not recorded within the proposed works area but does occur within 40m of same. The risk that that species will be spread by the proposed works is very low and can be further minimized by ensuring that standard construction protocols are put in place (see **Appendix 2**). *Montbretia sp.* is ubiquitous in this part of West Cork and any ecological impact from the accidental spread of this species would be negligible.

11.3 Potential impacts on Fauna

11.3.1 Protected Mammals

The habitats on the site are not rare, threatened nor do they require any special protection under existing or pending legislation and are considered relatively common in the local landscape. Although the habitats to be directly affected may form part of the territories of various mammal species, they do not provide critical resources and direct impacts on these habitats will be localised.

There will be no significant loss of habitat for mammal species located within the development site. Whilst increased noise and disturbance is predicted to occur during construction and to a lesser degree during operation, the impact to local populations is predicted to be minor in the short term and negligible in the long-term.

Sections of the development area do provide suitable feeding and resting habitat for otter. Although otter spraints were recorded in proximity to the proposed development area it is noted that the development is limited in scale and otter readily habitualise to short-term increases in noise and disturbance. There will be a short-term impact on feeding patterns during construction but the long-term impact is predicted to be negligible.

A preconstruction survey for otter will be carried out prior to the commencement of site works. If otter holts or resting areas were to be located work would be halted and where possible this area would be avoided. If this is not possible the supervising ecologist will determine the appropriate means of minimising impacts i.e. avoidance, moving works, timing of works etc. If required the ecologist will obtain a derogation licence from the NPWS, to facilitate licenced exclusion of the breeding or resting site in accordance with a plan approved by the NPWS.

11.3.2 Potential impacts on marine mammals

Hearing is the most important sense for most marine mammal, in particular cetaceans, and the ability to hear well is vital in all key aspects of their lives including finding food, navigating and social interactions. Any reduction in hearing ability, whether by physical damage or masking by other sound, may seriously compromise the viability of individuals and, therefore, populations. Whilst at an extreme level noise can lead to cetacean mortality from barotrauma, sub-lethal effects may also have a significant impact. Sub-lethal effects could include threshold shift or complete hearing loss, which would seriously compromise the viability of individuals or entire populations. Displacement of cetaceans from important feeding, migration or reproductive sites could also lead to a change in population dynamics (DoEHLG, 2007).

Marine mammal sensory systems are adapted to life in the water or, in the case of seals, both in water and on land. Both Grey and Harbour seal and a number of cetacean species are likely to occur in proximity to the works area. There will be short-term disturbance during site works, however, there is large areas of comparable habitat in the surrounding area. Given the short-term nature of the proposed works, any long-term impact on seals and cetaceans is predicted to be short-term and minor. The long term impact will be negligible.

11.3.3 Potential impacts on birds

The terrestrial bird species recorded during bird surveys are typical of the types of habitat noted on site and are generally common. Some displacement of feeding birds may occur during construction due to increased noise and disturbance. However, this impact will be short-term in duration. The impact is therefore predicted to be a short-term, minor impact. The long-term impact will be negligible.

The small areas of scrub and hedgerow has some limited potential to provide suitable nesting and feeding resources for common birds. Overall, the loss of habitat for terrestrial breeding birds within the development site is considered a permanent, negligible impact.

A number of marine birds were recorded including waders and gulls. Of particular note is the small rocky island immediately offshore. At high tide this forms a small island and is used as a high tide roost by oystercatcher and turnstone. Both of these species are widely distributed along rocky/sedimentary shorelines along the Beara peninsula. Overall the impact on marine birds is predicted to be minor in the short term and negligible in the long-term.

11.4. Potential impacts on water quality and aquatic ecology

There are no substantial freshwater habitats which would be affected by construction works. Marine and tidal habitats are robust with high levels of dilution. Small seasonal drainage ditches will not be affected. The impact on water quality and aquatic ecology during construction is predicted to be short term and negligible. The proposed works will result in a better-quality discharge and thus the long-term impact during operation is predicted to be positive.

11.5. Potential impacts on designated sites.

Potential impacts on designated Natura 2000 sites (SAC/cSAC/SPA) are specifically addressed in an Appropriate Assessment Screening Report which has been submitted as part of this application. This screened out significant impacts any Natura 2000 sites. Given the distances involved and/or lack of connectivity no potential impacts on NHAs has been identified.

11.6. Cumulative Impacts

Cumulative impacts on fauna chiefly relate to increased noise and activity levels and potential impacts on water quality. In-combination impacts from noise/disturbance are likely to be most pronounced during construction. This is a short-term impact which will be localised. During operation a localised increase in traffic and noise is predicted. As this proposed development is

not predicted to significantly increase long term noise and disturbance levels no significant cumulative impacts have been identified.

12. Environmental Protection Measures

The likely success of the proposed measures is high, either in their current form or as they will be adapted on-site to achieve the desired result. The measures have been drawn up in line with current best practice and include an avoidance of sensitive habitats at the design stage. It is clear that the environmental protection measures are designed to achieve a lowering or reducing of the risk of impact to acceptable levels. Whilst the proposed methods may be amended and supplemented, the risk that the environmental protection measures will not function effectively in preventing significant ecological impacts is low. The following measures will be implemented.

12.1 Construction Phase Environmental Protection Measures

Environmental Protection Measures (of relevance in respect of any potential ecological impacts) will be implemented throughout the project, including the preparation and implementation of detailed method statements. The works will incorporate the relevant elements of the guidelines outlined below:

- Native Invasive Plant Species on National Roads. National Roads Authority, Dublin.
- H. Masters-Williams et al (2001) Control of water pollution from construction sites. Guidance for consultants and contractors (C532). CIRIA.
- E. Murnane, A. Heap and A. Swain. (2006) Control of water pollution from linear construction projects. Technical guidance (C648). CIRIA.

The following measures will form part of the CEMP.

- Site managers, foremen and workforce, including all subcontractors, will be trained in pollution risks and preventative measures,
- The working area used during construction will be clearly outlined prior to the commencement of works and will be kept to the minimum area necessary to effectively complete the works.
- Silt fences will be put in place to protect the drains at the St. Josephs Hospital site and at the WWTP site to protect small drains. A silt fence will also be put in place downgradient of the works area at Brandyhall Bridge to control silt levels in surface water run-off.
- All equipment and machinery will have regular checking for leakages and quality of performance. All site personnel will be trained and aware of the appropriate action in the event of an emergency, such as the spillage of potentially polluting substances.
- Works will primarily take place during hours of daylight to minimise disturbance to any roosting birds or feeding nocturnal mammal species.
- Existing roadways will be utilised where possible thus reducing the level of disturbance to existing habitats.
- All wastes generated as part of the construction process will be controlled and managed to ensure environmental protection.

- Environmental noise arising from activities on the construction site shall be controlled in accordance with the requirements of BS 5228. All contractors will ensure that the plant and construction methods employed are the quietest available for the required purpose insofar as practicable. Engines, vehicles and equipment will be switched off when not in use. Significant sources of noise will be enclosed.
- The proposed marine SI works for the proposed development will be confined to the site boundary areas. No works will take place in the vicinity of the nearby protected sites and equipment or materials will be stored in the vicinity of these sites. The employment of good SI management practices and standard environmental management will serve to minimise the risk of pollution of run-off.
- A Construction Environmental Management Plan has been prepared for the project and this will updated prior to the commencement of work.

12.2 Protection of habitats

To prevent incidental damage by machinery or by the deposition of spoil during the site clearance stage, any trees /habitats earmarked for retention (**Figure 12, 13 and 14**) will be securely fenced early in the construction phase. The fencing will be clearly visible to machine operators. The mature elm within the treeline at Cametringane Woods are considered a high conservation priority and any damage to adjoining sycamores could impact on wind dynamics and thus result in damage to the elm trees. Thus all sycamore to be retained must be adequately protected. Excavations will be minimised. The trees to be protected must be clearly demarcated by a physical barrier during construction in line with British Standard 5837-1912. This will be carried out under the supervision of the supervising aboriculturalist. Post construction the supervising aboriculturalist will determine if there has been any accidental damage to roots of adjoining trees and will specify appropriate crown reduction if required.

12.3 Landscape and invasive species.

All workers including subcontractors will be made aware of the presence of Japanese Knotweed 40m from the site works and the requirement not to allow vehicles to come into contact with same.

To prevent Japanese Knotweed from outside the site being inadvertently being brought in to the site, the contractor will be required to inspect vehicles before using them on site, and will pay particular attention to caterpillar tracks and where trucks and dumpers are stowed. The supplier of fill will be required to provide a guarantee that the fill to be imported does not contain knotweed. In addition, the fill will be inspected for signs of knotweed, prior to importation to site. The UK Environmental Agency's publication *Managing Japanese knotweed on development sites - The Knotweed Code of Practice* (EA 2013), states that inspection of topsoil brought into the site, should be carried out using the guidance in appendix I-IV of the code BS 3882:2007 '*The British Standard Specification for topsoil and requirements for use*'. This Standard was replaced subsequently by BS3882:2015 *Specification for Topsoil.* The inspection of fill will be carried out according to this Standard.

Habitats that are damaged and disturbed will be left to regenerate naturally or will be rehabilitated and landscaped, as appropriate, once construction is complete. Disturbed areas will be seeded as soon as practical after completion of site works.

12.5 Birds

The Wildlife Act 1976, as amended, provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land, or any such growing in any hedge or ditch from the 1st of March to the 31st of August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. Nonetheless, it is recommended that vegetation be removed outside of the breeding season.

12.6 Otter

A pre-construction otter survey will be carried out prior to the commencement of site works. Any holts found to be present will be subject to monitoring and mitigation as set out in the NRA *Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes (2006b)*. If found to be inactive, exclusion of holts may be carried out during any season. No wheeled or tracked vehicles (of any kind) will be used within 20m of active but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance will also not take place within 15m of such holts, except under license. The prohibited working area associated with otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the otters have left the holt, as determined by a specialist ecologist. Breeding may take place at any season, so activity at a holt must be adjudged on a case by case basis. The exclusion process, if required, involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the otters have left the holt prior to removal.

13. Conclusions

Overall the development will impact primarily on low value habitats. There will be a net loss of a common terrestrial habitats and of moderate value intertidal habitat. Two sycamores will be removed from the existing treelines. No adverse impact on designated sites or their conservation objectives will occur. No particular difficulties in the effective implementation of the prescribed environmental protection measures have been identified.

With the exception of localised impacts and short-term impacts during construction, no significant impacts on fauna are envisaged. The implementation of standard protection measures will prevent significant impacts on seals, otters and cetaceans from arising. The loss of habitat will result in the loss of some feeding habitats for some mammals and bird species. It is considered probable that these species will be displaced into the surrounding area or to alternative roosting sites. No impact from the spread of invasive species will occur.

During operation, levels of noise and activity will not be significant in the context of the surrounding landscape. The discharge will be required to meet applicable water standards. It is expected that

the effluent discharge plume will be quickly dispersed into the harbour and levels will quickly return to background concentrations such that there will not be a significant impact on water quality.

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Appendix 1 NRA (TII) 2009 Guidelines

Table 1: Examples of valuation at different geographical scales

Ecological valuation: Examples

International Importance:
 	
• 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.
• Proposed Special Protection Area (pSPA).
• Site that fulfills the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).
• Features essential to maintaining the coherence of the Natura 2000 Network.[4]
• Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.
• Resident or regularly occurring populations (assessed to be important at the national level)5 of the following:
  ○ Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or
  ○ Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
• Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
• World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
• Biosphere Reserve (UNESCO Man & The Biosphere Programme).
• Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
• Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
• Biogenetic Reserve under the Council of Europe.
• European Diploma Site under the Council of Europe.
• Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).[6]

National Importance: • Site designated or proposed as a Natural Heritage Area (NHA). • Statutory Nature Reserve. • Refuge for Fauna and Flora protected under the Wildlife Acts. • National Park. • Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA);

Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.

- Resident or regularly occurring populations (assessed to be important at the national level)7 of the following:
  - Species protected under the Wildlife Acts; and/or
  - Species listed on the relevant Red Data list.
- Site containing 'viable areas'[8] of the habitat types listed in Annex I of the Habitats Directive.

County Importance:

- Area of Special Amenity.[9]
- Area subject to a Tree Preservation Order.
- Area of High Amenity, or equivalent, designated under the County Development Plan.
- Resident or regularly occurring populations (assessed to be important at the County level)[10] of the following:
  - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
  - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
  - Species protected under the Wildlife Acts; and/or
  - Species listed on the relevant Red Data list.
- Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.
- County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, 11 if this has been prepared.
- Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county.
- Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.

Local Importance (higher value):

- Locally important populations of priority species or habitats or natural heritage features
  identified in the Local BAP, if this has been prepared;
- Resident or regularly occurring populations (assessed to be important at the Local level)12 of
  the following:
  - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
  - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
  - Species protected under the Wildlife Acts; and/or

- Species listed on the relevant Red Data list.

- Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;
- Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.

Local Importance (lower value):

- Sites containing small areas of semi-natural habitat that are of some local importance for wildlife;
- Sites or features containing non-native species that are of some importance in maintaining habitat links.

4 See Articles 3 and 10 of the Habitats Directive.
5 It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.
6 Note that such waters are designated based on these waters' capabilities of supporting salmon (*Salmo salar*), trout (*Salmo trutta*), char (*Salvelinus*) and whitefish (*Coregonus*).
7 It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.
8 A 'viable area' is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).

9 It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.
10 It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.
11 BAP: Biodiversity Action Plan
12 It is suggested that, in general, 1%of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

DixonBrosnan

environmental consultants

Project	**Ecological Assessment - Untreated Agglomerations Study – Cork Project (Castletownbere) – Invasive Species Survey**
Client	**Arup (on behalf of Irish Water)**

Project ref	Report no	Client ref	
1807.1	1807.1	-	

DixonBrosnan 12 Steam Packet House, Railway Street, Passage West, Cork.
Tel 086 851 1437 | carl@dixonbrosnan.com | www.dixonbrosnan.com

Date	Rev	Status	Prepared by	
06/12/19	0	Issue to client	Carl Dixon M.Sc.	
			Sorcha Sheehy PhD	
			Ian McDermott	

v180907

1. Introduction

Dixon.Brosnan were commissioned by Arup to survey for high risk invasive species prior to commencement of works associated with the Castletownbere Collection and Treatment System and all associated site works at Castletownbere, Co. Cork.

The surveys were carried out and subsequent report prepared by Carl Dixon M.Sc. Carl has an M.Sc. in ecological monitoring from UCC and has 20 years of experience in ecological consultancy. He has previously surveyed and/or proscribed management measures in relation to high risk invasive species, such as Japanese Knotweed and Himalayan Balsam, for a wide range of projects including the Fermoy Main Drainage Scheme, Great Island Gas Pipeline as well as smaller scale projects.

2. Proposed development

2.2 Overview of the Proposed Development

The objective of the proposed development is to provide a wastewater treatment plant (WWTP) capable of primary treatment in compliance with the Urban Waste Water Treatment Directive. Four new wastewater pump stations will be required to transfer wastewater to the WWTP, each of which will incorporate stormwater storage facilities.

The proposed Hospital wastewater pump station will be located within the grounds of St. Joseph's Hospital to the south of the R572, adjacent to an existing septic tank which collects flows from a number of properties towards the east of Castletownbere. From this pump station, the wastewater will be pumped to a proposed discharge manhole on the R572, approximately 160m north-west of the hospital entrance, from which it will flow by gravity to the existing foul sewer network, and onwards to the proposed Brandyhall Bridge wastewater pump station.

The proposed wastewater pump station at Brandyhall Bridge will be located immediately to the south of the R572, approximately 50m south of Brandyhall Bridge. The existing foul sewer network, which currently runs along the R572 to the existing septic tank adjacent to the north-eastern bridge abutment, will be diverted into the proposed pump station. From here, the combined flows from the Hospital and Brandyhall Bridge drainage areas will be pumped to a proposed discharge manhole on the R572, approximately 130m to the west of Brandyhall Bridge and will be conveyed onwards to the proposed Quays wastewater pump station via the existing gravity network. The proposed pump station will also be designed to accommodate flows from the Mariner's View drainage area to the north, although no connecting sewers will be laid under the current scheme.

The proposed wastewater pump station at Came Woods will be located adjacent to the existing public road which leads to the Beara Coast Hotel. Wastewater from this pump station will be pumped to a discharge manhole along the R572, approximately 175m to the west of the pumping station, and will be conveyed onwards to the proposed Quays wastewater pump station via the existing gravity network.

Flows emerging from the Foildarrig drainage area to the north of the town are currently discharged to a percolation area to the rear of a row of council-owned dwellings. Under this scheme, these flows will be conveyed via a proposed gravity sewer to the main gravity network within the town, and onwards to the WWTP via the Quays pump station.

All flows from the agglomerations will arrive, via the existing gravity sewer network, to a proposed manhole on Main Street, at the intersection of the R571 and R572, and will be conveyed via a proposed gravity sewer to the proposed Quays pump station, a terminal pumping station to be located in the towards the western end of the quays area.

From the Quays pump station, all flows emerging from the agglomeration will be pumped to a proposed discharge manhole (67491N, 45351E) located upstream of the proposed WWTP. From this discharge manhole, flows will be conveyed to the proposed WWTP via an existing gravity sewer running along the wastewater treatment plant access road.

The proposed WWTP will be located to the south-west of the town in Drom South. The proposed WWTP will provide primary treatment, appropriate to bring the agglomeration into Urban Wastewater Treatment Directive compliance. Effluent will be discharged into Bearhaven Harbour via a proposed 100m long treated effluent outfall.

The proposed site location is presented in **Figure 1**, while a flow diagram is presented in **Figure 2.**

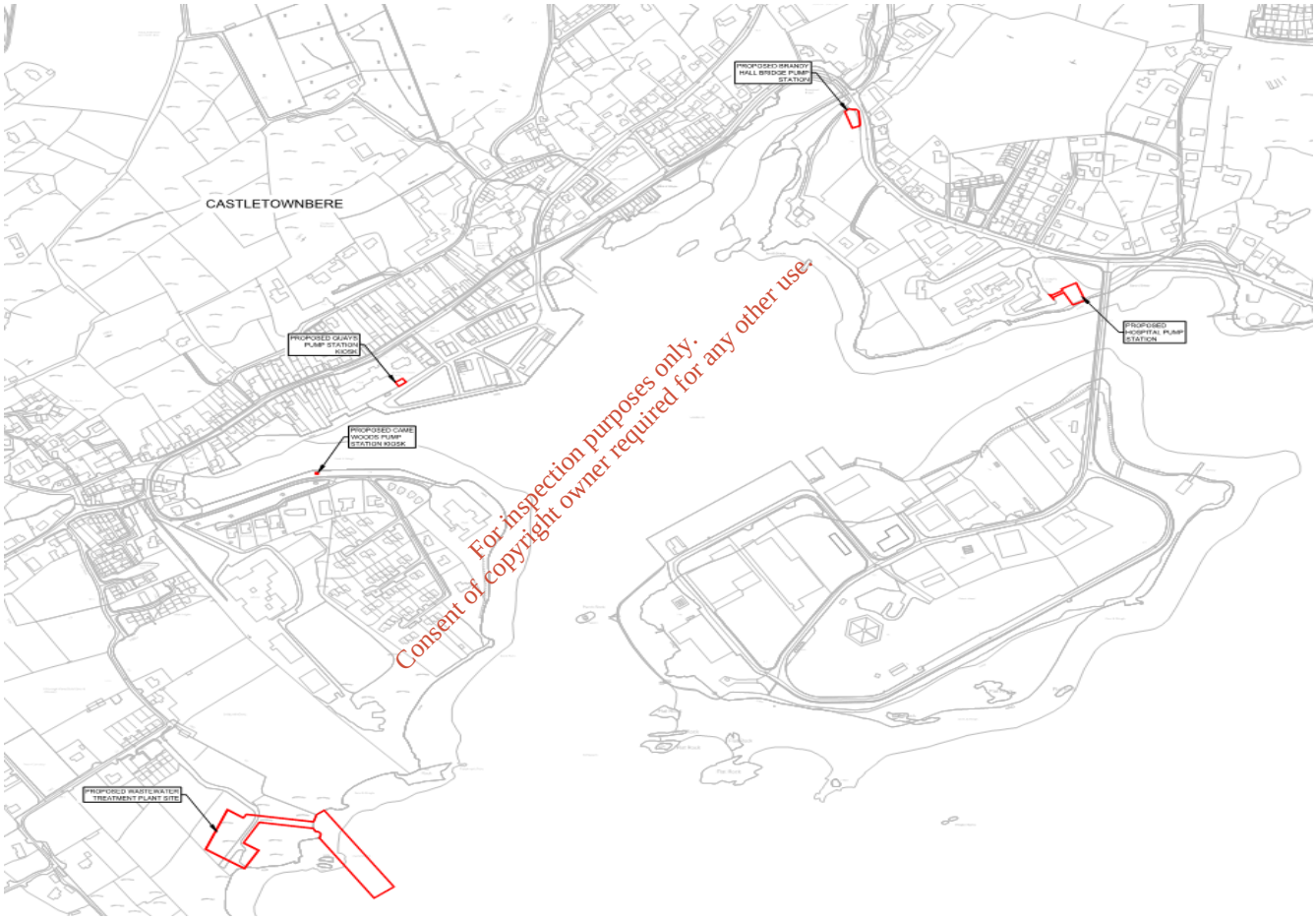

Figure 1: Proposed Development Locations (Red Line Boundary) | Not to Scale.

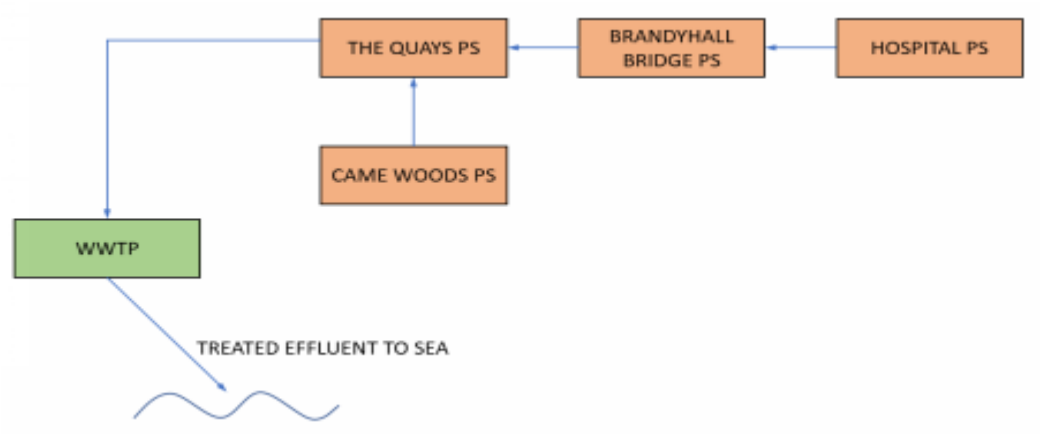

Figure 2: Flow diagram of the Castletownbere Sewerage Scheme

3. Non-native Invasive Species

Non-native plants are defined as those plants which have been introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and, (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities, and is not managed it can potentially: (1) out compete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; and, (3) have an adverse effect on landscape quality.

Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 make it an offence to plant, disperse, allow dispersal or cause the spread of certain species e.g. Japanese knotweed and Himalayan Balsam, keep the plant in possession for purpose of sale, breeding, reproduction, propagation, distribution, introduction or release, keep anything from which the plant can be reproduced or propagated from, without a granted licence and keep any vector material for the purposes of breeding, distribution, introduction or release. The Wildlife (Amendment) Act 2000 states that anyone who plants or otherwise causes to grow in a wild state in any place in the State any species of (exotic) flora, or the flowers, roots, seeds or spores of (exotic) flora shall be guilty of an offence.

There is a statutory obligation under S.I. 477 of 2011 of the European Communities (Birds and Natural Habitats) Regulations 2011 to address invasive species in Ireland. With relation to this particular project high risk invasive species like Japanese knotweed (*Fallopia japonica*) is of particular interest. This species for example is listed under the *3rd Schedule: Part 1 – Plants; Non-native species subject to restrictions under Regulations 49 & 50*. Regulation 49 deals with the '*Prohibition on introduction and dispersal*' while Regulation 50 deals with the '*Prohibition on dealing with and keeping certain species*'. Regulation 50 has yet to be brought into Irish law. Regulation 74 is a transitional provision in relation to Regulation 49 and 50.

Non-native plants are defined as those plants which have been introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth

from plant fragments; (2) rapid growth patterns; and, (3) resistance to standard weed control methods.

The NBDC lists a number of both aquatic and terrestrial high impact invasive species which have been recorded within the 10km grid square V64 (**Table 1**). None of these species were recorded within the proposed works area.

Table 1: NBDC list of high impact invasive species.

Common Name	Latin Name
New Zealand flatworm	*Arthurdendyus triangulatus*
Japanese Knotweed	*Fallopia japonica*
Giant-rhubarb	*Gunnera tinctoria*
Rhododendron	*Rhododendron ponticum*
Sika Deer	*Cervus nippon*

4. Site Survey

Surveys for high risk invasive species was carried out on the 15th of January 2018, 12 October 2018 and 22 November 2019 within the proposed work areas. Although other introduced species were recorded within the study area these species are not listed as an invasive alien species under Regulations 49 & 50 of the European Communities (Birds and Natural Habitats) Regulations 2011, and therefore not deemed a source of concern with regard to the proposed development.

It is noted that the survey provides a snapshot of current distribution. As high risk invasive species are highly invasive, there may be changes in distribution patterns if sufficient time elapses between this survey and the commencement of works.

5. Survey Results

No high risk invasive species were noted during the site inspection within the development boundary or within the proposed work areas. Montbretia was recorded within the works area at Brandyhall Bridge. It is classified as Amber Threat species by Invasive Species Ireland which under the right ecological conditions and may have an impact native species or habitats. Montbretia is also included in the NRA Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads (NRA, 2010). Montbretia is not deemed a source of concern with regard to this proposed development as this species is ubiquitous within this part West Cork.

The site in proximity to St. Joseph's Hospital is dominated by a mixture of amenity grassland and scrub including bramble nettle, privet and bracken and large stands of lesser knotweed (*Persicaria campanulate*) which is a knotweed native to north India. (See **Photo 1**). It resembles other knotweeds but is relatively small, growing to a height of 0.9m. This is considered a low risk invasive species (Risk analysis and prioritisation *For invasive and non-native species in Ireland and Northern Ireland,* J. Kelly, C. O'Flynn &C. Maguire, 2013).

Photograph 1 Lesser Knotweed

The high-risk invasive species Japanese knotweed (*Fallopia japonica*) was recorded approximately 32m south of the proposed wastewater gravity main from Foildarraig, see **Figure 7** below. Here it occurs within an existing field and along the road margin.

Figure 11: Location of Japanese Knotweed (outlined in red)

Photograph 2 showing Japanese knotweed canes along the roadside with regrowth evident in November 2019.

Japanese knotweed is a highly invasive, non-native species which was originally introduced as an ornamental plant but has since spread along transport routes and rivers to become a serious problem. Japanese Knotweed is listed on both the *"Most Unwanted: Established Threat"* and on the *"High Risk: Recorded Species"* lists compiled by Invasive Species Ireland.

From an ecological viewpoint, it out-competes native species by forming dense stands which suppresses growth of other species. It grows extremely vigorously and can penetrate through small faults in tarmac and concrete and thus can damage footpaths, roads and flood defence structures. As it can survive in poor quality soils, including spoil, it often thrives in brownfield sites and in urban areas. The key features of the plant are summarised below:

- Produces fleshy red tinged asparagus like shoots when it first breaks through the ground in an established stand.
- Has large, heart or spade-shaped green leaves which are approximately the size of your hand.
- Has leaves arranged in a zig-zag pattern along the stem.
- Grows up to 3 metres in height.
- Yellow / cream flowers in late summer (Typically the start forming from late July onwards).
- Hollow bamboo like stems which have distinctive ring like nodules at regular intervals along it.
- Brown stem remain in winter once it has died back.
- Extensive rhizome system (roots) (7m radius x 3m depth approximately)
- Orange centred rhizome.
- Spread entirely via the movement of plant and rhizome fragments.

The plant has woody underground rhizomes which can extend 7m laterally from a parent plant which enables it to spread rapidly forming dense stands 1 to 3 acres. The leaves and stems die back during winter, but growth is extremely rapid during spring. The plants spread mainly through fragments of rhizomes -as little as 0.7g of material or the size of a small fingernail is sufficient-and through cut stems. Stem material cannot regenerate once it has dried, but rhizome material may be viable for up to 20 years in the soil. Thus, control of this species is very difficult.

Japanese knotweed is the most common knotweed. There are however, a total of four species present in Ireland, namely Japanese knotweed *Fallopia japonica,* Giant knotweed *Fallopia sachalinensis,* Bohemian knotweed *Fallopia japonicus x bohemica* and Himalayan Knotweed *Persicaria wallichii*.

All of these knotweed species are considered invasive aliens and are listed under Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011. The same control measures apply to all of these species. Characteristics of these species are shown in **Figure 12**.

Figure 12. Leaves of Japanese knotweed on the top left in the top right picture are (from left to right) leaves of Giant knotweed, Bohemian knotweed, Japanese knotweed and Himalayan knotweed. Below are the key identification features of Japanese Knotweed.

Japanese Knotweed is also included in the NRA Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads (NRA, 2010) as this species has been shown to have an adverse impact on landscape quality, native biodiversity or infrastructure.

6. Literature on control of Japanese knotweed

There is an extensive body of literature on control of this species including the *NRA Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (2008)* and *Best Practice Management Guidelines Japanese knotweed Fallopia japonica (2008)* prepared for NIEA and NPWS as part of Invasive Species Ireland. The most extensive guidelines are available from the UK including *Managing Japanese knotweed on development sites - The Knotweed Code of Practice produced by the Environmental Agency* which outlines a management plant for the removal of Japanese knotweed. These publications generally prescribe the same management processes; however, the UK Environmental Agency has the most detailed information. In an Irish context the Irish Water guidelines, (Irish Water Report Information and Guidance Document on Japanese Knotweed Asset Strategy and Sustainability) provides information and guidelines on treatment.

7. Potential treatment procedures if required

A number of different methodologies employed to treat Japanese Knotweed are summarised below. These include the following:

- Herbicide treatment
- Combined treatment methods
- Burial method
- The bund method

- Root barrier membrane
- Soil Screening
- Removal of contaminated soil to landfill

8. Development of a management plan if required.

- The following factors should be considered when developing a management plan.
- Timeframe in which the work needs to be completed.
- Structural or environmental features that might affect control action, such as proximity to watercourses, designated sites
- Future plans for the site, such as development or landscaping plans.
- Hazards or risks identified during the site inspection, such as underground services and chemical contamination.
- Availability of storage areas on or off site.
- Access for machinery through private residences if required.
- Agreement with landowners where a stand is partially within the works area and partially within the landholding of another person or entity.
- Timeframe for works to be completed
- Seasonal restrictions to work
- Commencement date for proposed works.
- Financial constraints
- Location of underground services
- Site hygiene

9. Construction work protocols for the proposed extraction site.

1. Prior notification will be given to all contractors that parts of an adjoining site in proximity to the Gravity Main Foildarrig works area is contaminated with Japanese knotweed.

2. Although it is not envisioned that any such works will occur, if a site compound or other works are required in proximity to this stand of Japanese Knotweed then a buffer zone of 7m will be clearly delineated with hazard tape and fenced in a manner visible to machine operators. If required this will be put in place prior to the commencement of works. Under no circumstances will any personnel or machinery enter this area unless an Invasive Species Management Plan is put in place.

3. Where direct disturbance is unavoidable then an invasive species management plan will be drawn up to ensure that risks are minimised. This management plan should include all provisions for site hygiene and appropriate disposal of contaminated soil and subsoil.

10. Conclusions

No high-risk invasive species were recorded within the development boundary. A large stand of Japanese Knotweed was recorded approximately 32m from the proposed wastewater gravity main from Foildarraig in January and October 2018 and November 2019. The stand itself will not be directly affected.