Sanitary Survey Report and Sampling Plan

for Oysterhaven, Co. Cork

Produced by

AQUAFACT - APEM Group

In conjunction with

The Sea Fisheries Protection Authority

December 2024

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Statement of use:

Under EU Regulation 2019/627, which lays down uniform practical arrangements for the performance of official controls on products of animal origin intended for human consumption, a sanitary survey relevant to bivalve mollusc production in Oysterhaven was undertaken in 2024. This will provide an appropriate hygiene classification zoning and monitoring plan based on the best available information with detailed supporting evidence. AQUAFACT undertook the desktop component of the work on behalf of the SFPA.

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Revisions

Revision No.	Date	Comment
1	06/09/2024	Interim report for SFPA review
2	05/11/2024	Draft final report for SFPA review
3	13/12/2024	Final report

Document and QA Approval

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Checked (Draft final)	Aisha O'Connor Ronan Browne	Senior Consultant Ecologist Associate Director	05/11/2024 02/11/2024
Approved (Final)	Ronan Browne Aisha O'Connor	Associate Director Senior Consultant Ecologist	11/12/2024 13/12/2024

Consultation

Consultee	Date of Consultation	Date of Response
SFPA (Interim)	06/09/2024	20/09/2024
SFPA (Draft final)	05/11/2024	18/11/2024
Approved by SFPA (Final)	13/12/2024	

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Glossary

AER	Annual Environmental Report
BMPA	Bivalve Mollusc Production Area
BOD	Biochemical Oxygen Demand
CSO	Central Statistics Office
Depuration	The process of purification or removal of impurities
DSW	Designated Shellfish Waters
ED	Electoral Divisions
E. coli	*Escherichia coli*
EPA	Environmental Protection Agency
EU	European Union
GIS	Geographical Information Systems
GPS	Global Positioning System
GSI	Geological Survey of Ireland
HABs	Harmful Algal Blooms
IE	Industrial Emission
I-WeBS	Irish Wetland Bird Survey
Kn	Knots (kilometres per hour [km/hr] is equal to 0.54 knots)
NBDC	National Biodiversity Data Centre
NoV	Norovirus
NTU	Nephelometric Turbidity Units
PE	Population Equivalent

Pollution	Encompasses *E. coli* contamination only for the purpose of this sanitary survey report
RMP	Representative Monitoring Point
SAC	Special Area of Conservation
SFPA	Sea Fisheries Protection Authority
SI	Statutory Instrument
SPA	Special Protection Area
SWO	Storm Water Overflow
WFD	Water Framework Directive
WWTP	Wastewater Treatment Plan

1. Executive Summary

Under Regulation (EU) 2017/625 and its subsequent Implementing Regulation (EU) 2019/627, there is a requirement for competent authorities intending to classify bivalve mollusc production and relaying areas to undertake a sanitary survey. The purpose of the sanitary survey is to determine the extent to which potential sources of pollution may impact a bivalve mollusc production area (BMPA) and ultimately inform the sampling plan for the National Microbiological Sampling Programme, as operated by the Sea Fisheries Protection Authority (SFPA), the results of which determine the annual classification for BMPAs. In the context of this sanitary survey report, pollution encompassed *Escherichia coli* (*E. coli*) contamination only.

In accordance with the European Union Reference Laboratory Guide to Good Practice on the microbiological monitoring of bivalve mollusc harvesting areas, a re-evaluation of pollution sources and the sampling plan (primary sanitary survey) should be undertaken if a time trigger (six years or more since the last survey) or a change in the environment has occurred. There is licensed Pacific oyster (*Magallana gigas*, formerly *Crassostrea gigas*) aquaculture in Oysterhaven Bay. As a sanitary survey has not previously been conducted for this classification area, one must be undertaken to determine the representative monitoring point(s) (RMPs). This report identified the sources and types of faecal *i.e., E. coli,* contamination discharging into Oysterhaven Bay and assessed whether or not these sources are likely to affect the microbiological concentration in the production area.

Oysterhaven Bay is approximately 3.6 km^2 in area[1], located in the south of Co. Cork between Kinsale Harbour and Cork Harbour. It is part of the South Western River Basin District and is entirely covered by Water Framework Directive (WFD) designated shellfish waters. There are five licensed Pacific oyster sites within Oysterhaven Bay; there is also a licence for Manila clam however production of clams is currently inactive therefore is not assessed in this report.

Upon the reviewed classification of the amended BMPA in Oysterhaven Bay, the sampling plan recommends a minimum of 10 individual Pacific oysters (minimum 8 cm in length) be collected (CEFAS[2]; European Commission[3]) on a monthly basis year-round.

This report endeavours to document and quantify all known sources of pollution entering Oysterhaven Bay. The 2016-2021 WFD ecological status for river sub-basins discharging into Oysterhaven Bay was Good. However, Oysterhaven Bay transitional water body was assigned a Moderate ecological status. The contributing catchment is comprised of 96.5% agricultural land and is dominated by pastures and non-irrigated arable land (CORINE[4]) over which the River Stick, Farranamoy, and Newborough water bodies are expected to channel diffuse agricultural pollutants as they flow through and discharge from agricultural land. Domestic

and urban wastewater contamination is expected primarily in the Stick and Farranamoy Rivers which also flow through the Kinsale Rural electoral division (ED), the ED with the highest population. Kinsale Rural ED borders a large section of the shoreline of Oysterhaven Bay and has the highest number of farms and cattle, indicating this ED may contribute the largest proportion of agricultural and domestic/urban pollutants. Two wastewater treatment plants (WWTPs), namely Belgooly and Riverstick (also the only large towns within the contributing catchment), are situated on the Stick River which drains approximately 54% of the contributing catchment, therefore, this water body is potentially the main driver for contamination levels in the production area. Furthermore, there may be seasonal differences in contamination levels. For example, Met Éireann rainfall data show higher volumes of rainfall from October to January, which may result in increased *E. coli* levels.

In line with Regulation 627/2019 concerning Live Bivalve Mollusc Sanitary Surveys, this report mandates an update to the classification sampling for Oysterhaven Bay. Specifically, an RMP (RMP 1) has been assigned to monitor *E. coli* levels in Pacific oysters (**Figure 6-1**); the existing BMPA has been retained (**Figure 5-1**). These changes are imperative for meeting legislative requirements and are essential for the accurate monitoring and classification of shellfish production areas and safe harvesting practices. The RMP has been strategically chosen based on a range of hydrodynamic features, freshwater influence, and anthropogenic inputs. Consideration has also been given to the logistics of sampling from RMP 1, *i.e.*, accessibility and availability of shellfish stock.

2. Introduction

Consumption of raw or lightly cooked bivalve molluscs can result in illness due to the presence of microorganisms, many of which are derived from faecal contamination of the marine environment. Shellfish contaminated with pathogenic microorganisms may cause infectious disease in humans and such outbreaks are more likely to occur close to our coasts where production areas are impacted by sources of human and animal faecal contamination; referred to as pollution for the purposes of this report. The risk of contamination of bivalve molluscs with pathogenic microorganisms is assessed through national microbiological monitoring programmes. This assessment results in the classification of bivalve mollusc production areas (BMPAs), which in turn governs the level of treatment required for shellfish before human consumption.

Under European Union (EU) regulations, sanitary surveys of BMPAs and their associated hydrological catchments and coastal waters are required to establish the appropriate representative monitoring point(s) (RMPs) for these monitoring programmes. Specifically, under regulation (EU) 2017/625 and its subsequent Implementing Regulation (EU) 2019/627, there is a requirement to carry out a sanitary survey before classifying any shellfish production or relaying area. Article 56 of Implementing Regulation 627 of 2019 states:

1. Before classifying a production or relaying area, the competent authorities shall carry out a sanitary survey that includes:
    a. an inventory of the sources of pollution of human or animal origin likely to be a source of contamination for the production area.
    b. an examination of the quantities of organic pollutants released during the different periods of the year, according to the seasonal variations of human and animal populations in the catchment area, rainfall readings, wastewater treatment, *etc*.
    c. determination of the characteristics of the circulation of pollutants by virtue of current patterns, bathymetry, and the tidal cycle in the production area.
2. The competent authorities shall carry out a sanitary survey fulfilling the requirements set out in paragraph one in all classified production and relaying areas, unless carried out previously.
3. The competent authorities may be assisted by other official bodies or food business operators under conditions established by the competent authorities in relation to the performance of this survey.

In addition, Article 57 of the same regulation requires competent authorities to establish a monitoring programme for live BMPAs that is based on an examination of the sanitary survey described above. Currently, the Sea Fisheries Protection Authority (SFPA) in conjunction with AQUAFACT are conducting sanitary surveys for new BMPAs and for those existing classified production areas which were previously not surveyed. This report contains the documents relevant to the sanitary survey of the BMPA at Oysterhaven, Co. Cork. It

identifies the RMPs and supporting sampling plan for Pacific oysters and it sets out the BMPA boundary in the bay.

3. Overview of the Fishery/Production Area

3.1. Description of the Area

Oysterhaven is a large Y-shaped sea inlet situated on the southern coast of Co. Cork (**Figure 3-1**), between Kinsale and the entrance to Cork Harbour. The exposed rocks around Oysterhaven were deposited during the late Devonian and Carboniferous periods (370 – 310 million years ago) and have been weakly metamorphosed (Pracht, 1994). The designated shellfish area within the bay is 1.5 km^2, encompassing the shoreline southwest of Mountlong to the shoreline east of Garraha to a point southwest of Rathmore and up the inlet to Ballinaclashet (**Figure 3-2**).

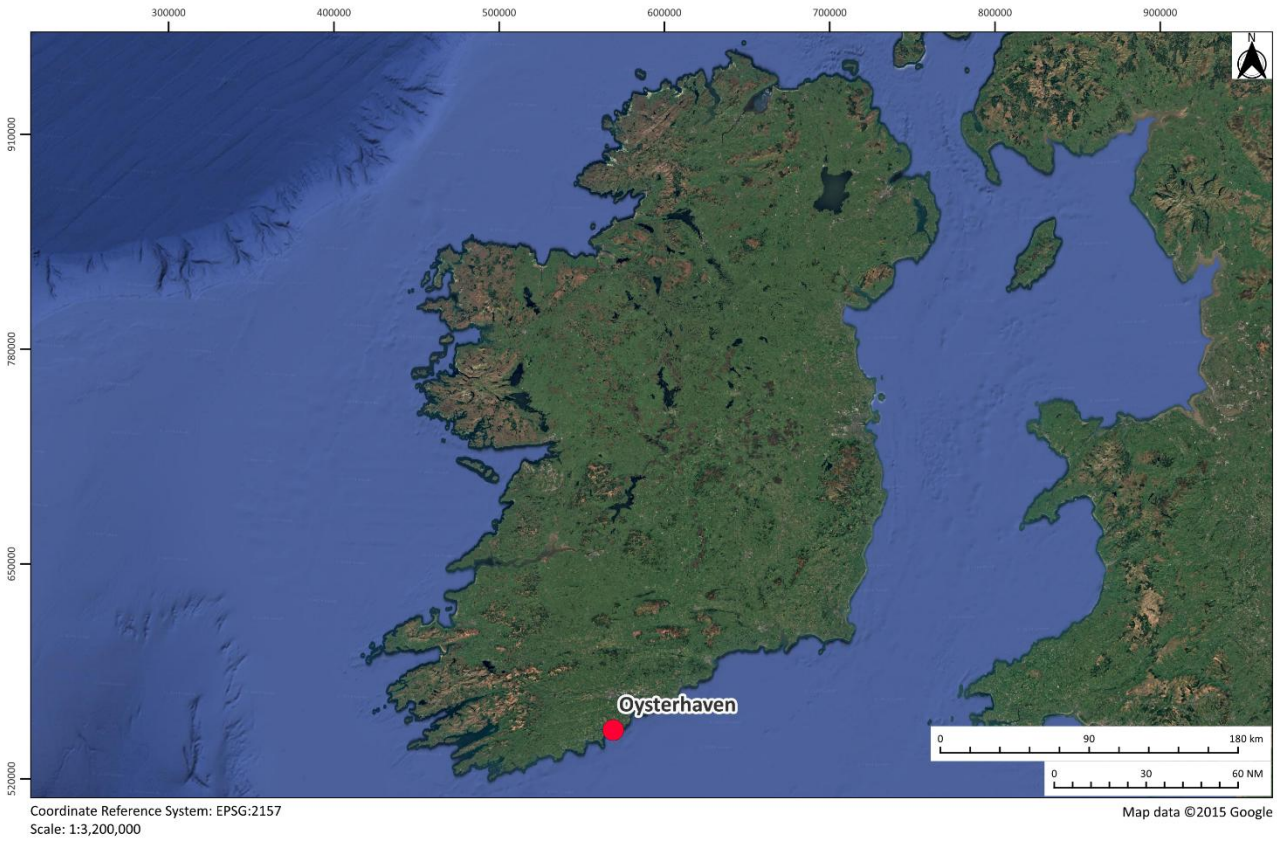

Figure 3-1: Location of Oysterhaven Bay, Co. Cork.

The Stick sub-catchment covers the land surrounding Oysterhaven Bay (**Figure 3-2**). As defined on the Environmental Protection Agency (EPA) Catchments website[5] regarding water, "a catchment is simply defined as an area of land around a river, lake or other body of water". The Stick sub-catchment is comprised of four river sub-basins, three of which (partially or fully) discharge into Oysterhaven Bay. It is necessary to note that the Water Framework Directive (WFD) river water bodies were established for hydrological purposes and not bacteriological, which is what is required for this sanitary survey. Oysterhaven contributing catchment has been determined accordingly by amending the boundaries of these three river sub-basins for the purposes of this sanitary survey report only. AQUAFACT has determined a boundary line based on the river water bodies

that flow into Oysterhaven Bay (see **Figure 3-2** for the River Stick sub-catchment and boundary line). According to Article 2(10) of Directive 2000/60/EC, a "body of surface water means a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water". As rivers are defined under the same directive as mainly being on the surface, a river water body can therefore be described based on the definition of a "body of surface water". The area within this boundary line will be hereafter referred to as Oysterhaven contributing catchment/the contributing catchment. Oysterhaven contributing catchment covers an area of *c*. 98.5 km^2. The contributing catchment is dominated by the Stick River, which drains 54% of the contributing catchment and along which towns/urban areas have developed, namely Belgooly and Riverstick. This contributing catchment is crucial in determining the potential routes by which *Escherichia coli* (*E. coli*) contamination may enter the Oysterhaven Bay area, particularly the shellfish production area.

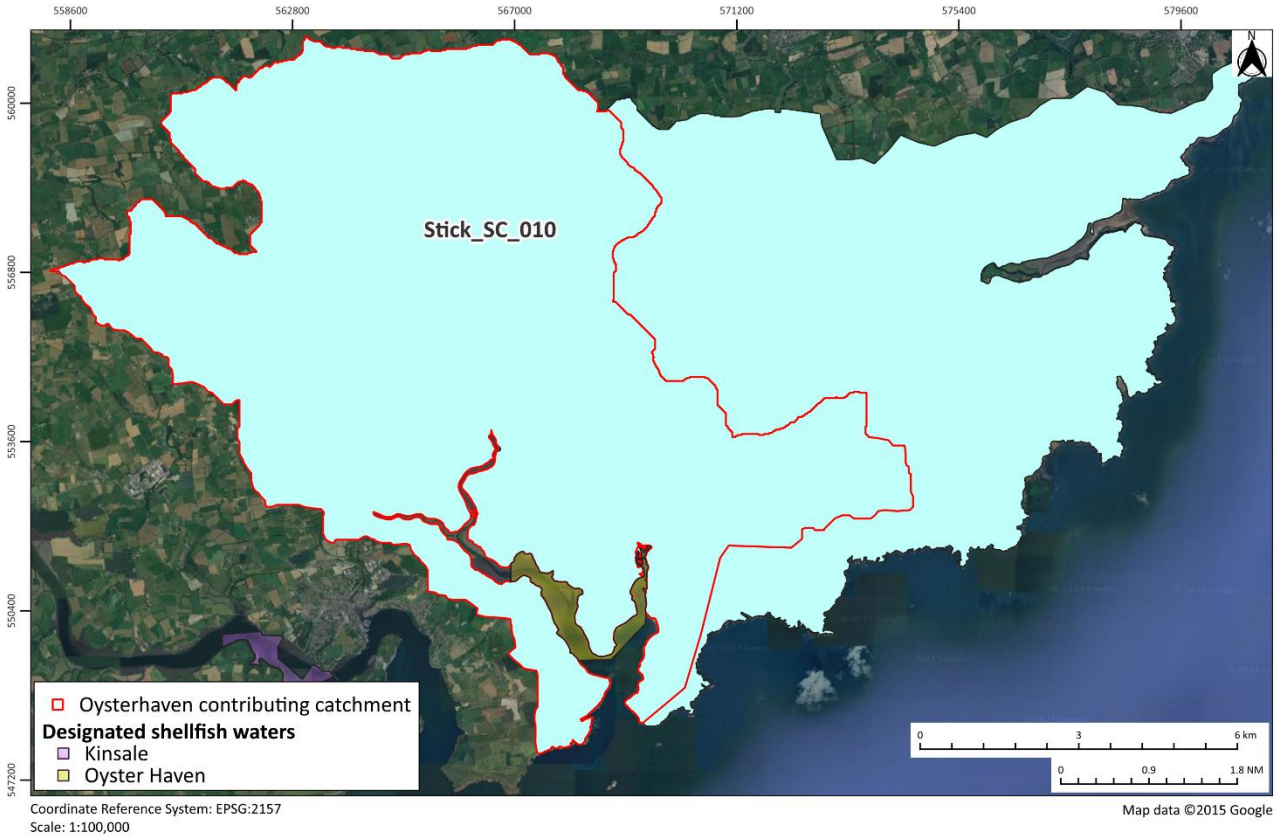

Figure 3-2: Water Framework Directive Stick sub-catchment surrounding Oysterhaven Bay. The area outlined in red forms the contributing catchment and highlights where the sub-catchment overlaps the contributing catchment. Designated shellfish waters within and around Oysterhaven Bay are displayed. This figure contains Irish Public Sector Data (Department of Housing, Local Government, and Heritage and EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

The CORINE land cover within Oysterhaven contributing catchment is predominantly comprised of agricultural land, with mountainous regions to the west, separating Kinsale Harbour and Oysterhaven Bay. Agricultural land is dominated by pastures and non-irrigated arable lands, and to a lesser extent by complex cultivation

patterns; mixed forest, land principally occupied by agriculture, discontinuous urban fabric, sports and leisure facilities, coniferous forest, estuaries, and sea and ocean are also present[4]. Oysterhaven is a shallow bay that largely drains on low tide resulting in the exposure of large expanses of shoreline. The sediment type within Oysterhaven Bay is muddy sand and becomes gravel-dominated mixed sediment towards the mouth of the bay[6]. There is an extensive natural seagrass (*Zostera marina*[7]) bed present in Oysterhaven Bay which provides an important habitat for other organisms[8].

There are no designated Special Areas of Conservation (SACs) or Special Protected Areas (SPAs) within Oysterhaven Bay or the contributing catchment. However, the Stick Estuary is monitored by the Irish Wetland Bird Survey (I-WeBS) for wintering waterbird populations and has been considered in this report.

3.2. Oysterhaven Shellfish Fisheries

3.2.1. Location/Extent of Growing/Harvesting Area

Oysterhaven Bay became a classified shellfish production area in 2013 but requires a sanitary survey to establish an RMP. The area of the Oysterhaven transitional water body is approximately 3.6 km^2 [1] with the designated shellfish area within the bay covering 1.5 km^2. In Oysterhaven Bay, there are five licensed aquaculture sites for the cultivation of Pacific oyster (*Magallana gigas*). The sites are identified as T05-081 (5.59 hectares (ha); 0.059 km^2), T05-231 (2.13 ha; 0.0213 km^2), T05-392 (0.89 ha; 0.0089 km^2), T05-588A (0.88 ha; 0.0088 km^2), and T05-589A (2.42 ha; 0.0242 km^2), as illustrated in **Figure 3-3**. Currently, T05-081 is the only consistently active site for the production of Pacific oysters in Oysterhaven Bay.

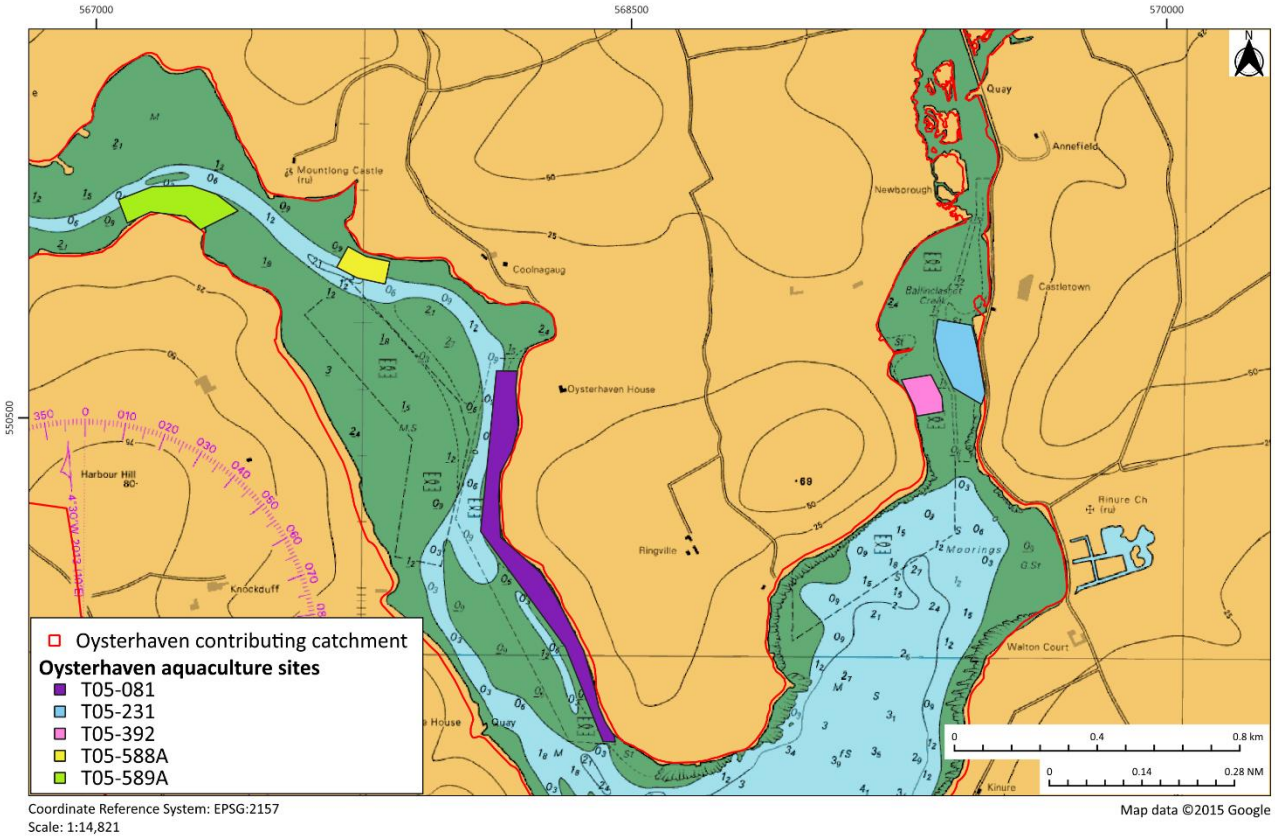

Figure 3-3: Licensed aquaculture sites in Oysterhaven Bay (source: Irelands Marine Atlas[9]).

3.2.2. Description of Bivalve Species

3.2.2.1. Pacific Oyster (*Magallana gigas*)

Pacific oyster cultivation is currently the only shellfish production within Oysterhaven Bay. Haven Shellfish (T05-081, T05-589A, T05-588A) cultivate their oysters for three years in mesh bags on trestles before harvesting, depuration, and distribution[10]. PKC Oysters Ltd. are in the renewal process for their aquaculture licences for T05-392 and T05-231 as of February 2024[11]. **Figure 3-3** shows the licensed shellfish sites within Oysterhaven Bay, which combined cover an area of 11.91 ha (0.01191 km^2) .

Aquaculture and/or Fishery Operations

Oyster farming is the primary aquaculture activity within the bay, though manila clams are also licensed at site T05-081. Oyster cultivation takes place using trestles and bags. There are approximately three inshore lobster fishing boats operating in the area also (SFPA, *pers. comm*).

4. Overall Assessment of Pollution Sources Likely to be a Source of Contamination on Shellfish

This section endeavours to summarise the potential pollution sources impacting Oysterhaven BMPA and the associated designated shellfish waters (DSW); in the context of this report, pollution refers to *E. coli* contamination only. For that reason, details on the local human population, boating activities, and sewage discharges are provided. Also included are potential contamination sources from agricultural operations, contributions from rivers and streams, and an analysis of contaminant movement throughout the DSW and Oysterhaven BMPA, based on currents, tidal data, and local bathymetry. Additional potential pollution sources including changes in tourist numbers and activities, yearly variations in agricultural practices, and seasonal precipitation are detailed. Notably, this section incorporates a summary of the pollution sources observed during the shoreline survey, complemented by a discussion on the bacteriological sampling results acquired concurrently; a detailed inventory of all shoreline survey features can be found in **section 7.2**.

4.1. Human population

Oysterhaven has a contributing catchment of 6,457 people, which equates to a population density of *c.* 65.6 people per km^2. There are two main towns/urban areas within the contributing catchment; Belgooly (population 823) accounts for more than half the population of Kilmonoge electoral division (ED) (*c.* 61.5%) and Riverstick (population 772) which notably comprises almost 69% of the Ballymartle ED population within the contributing catchment. The population density of the overall contributing catchment is considered to be average compared to the population density of the State in 2016 (73 people per km^2)[12]. Based on the 2022 census, there were 2,379 houses within the contributing catchment, of which 126 (5.3%) were vacant and 114 (4.8%) were holiday homes. Considering the low number of holiday homes in the contributing catchment, it is unlikely that there will be seasonal increases in *E. coli* pollution from households, instead inputs are expected to be relatively consistent year-round.

4.2. Boating

An activity centre was established within Oysterhaven in 1981[13], which offers equipment hire, sailing and windsurfing lessons, and summer camp activities. There were no significant commercial bivalve fisheries, but there were three lobster fishing vessels operating within the area: no data were available for their catch or operations.

There were two boat facilities, one jetty, five beaches, three additional beach/shore access points, five sites of aquaculture, and five slips identified during the desktop survey. The shoreline survey validated one of these slips and two beach/shore access points (map ID 32 and 38, **Figure 7-20**) from the desktop review. The slip

identified (map ID 22, **Table 7.10**) was not photographed but from the available information, it is used by the coastguard.

4.3. Sewage Discharges

There are two wastewater treatment plants (WWTPs) within Oysterhaven contributing catchment each serving a population equivalent (PE) of greater than 500; namely Belgooly WWTP (licence registration D0541-01)[14] and Riverstick WWTP (licence registration D0433-01)[15], both of which are operated by and under the jurisdiction of Uisce Éireann.

The Belgooly WWTP has a design capacity of 1,000 but currently operates under capacity at a PE of 855[14], and it was anticipated that this capacity would not be exceeded in the years following the 2023 Annual Environmental Report (AER) for Belgooly WWTP, up to 2026. It is a tertiary treatment facility which means that, after primary and secondary treatment measures, further treatment is conducted to purify the water so that it may be reused. Cramer's Close WWTP (TPEFF0500D0541SW002) is a secondary discharge within Belgooly WWTP and serves a PE of 75 undergoing secondary rotation biological contractor treatment[16,14].

In 2022, Belgooly WWTP was in breach of emission limits for suspended solids (>35 mg/l)[14] as set out in the wastewater discharge licence for this WWTP[17]. Six samples were taken from each of SW002 and SW003, resulting in an annual mean for suspended solids of 49 mg/l and 57 mg/l, respectively. Additionally in 2023, Belgooly WWTP exhibited non-compliance with emission limits set in the wastewater discharge licence and failed to meet compliance limits for *E. coli* (no./100 ml) and suspended solids (mg/l). Belgooly WWTP has two secondary discharges, Cramer's Close WWTP and TPEFF0500D0541SW003, both of which are untreated discharges and exceeded emission limits in 2023 for suspended solids[14]. Consecutively, a deterioration in water quality was identified from samples taken at ambient monitoring points in relation to these secondary discharges (**Figure 7-5**), however the cause cannot be verified as there was no definitive link to the WWTP. In 2023, there was no observable negative impact from the WWTP primary discharge on the WFD status. The AERs for Belgooly WWTP, from 2020 to date, stipulate a shellfish waters impact assessment is conducted[14]; these assessments fall under the remit of Uisce Éireann. At the time of writing this report, the 2020-2023 AERs did not included these shellfish impact assessments; however, Uisce Éireann provided the 2017 and 2018 assessment reports upon request and the relevant findings have been included here.

The Riverstick WWTP has a design capacity of 1,000 but currently operates under capacity at a PE of 657[15], it is also a tertiary treatment facility. Riverstick WWTP is designed to have a peak hydraulic capacity of 675 m^3/day and in 2023 was operating at an average hydraulic loading to the WWTP of 184.83 m^3/day[15]. The capacity of the Riverstick WWTP was not anticipated to be exceeded in the following three years after the 2023 AER for Riverstick D0433-01 was written[15].

In 2023, the Riverstick WWTP (**Figure 7-6**) reported no observable negative impact on WFD status. A shellfish impact assessment was required in 2020 and 2023; however, it was not included in the 2023 AER[15]. Within the Riverstick WWTP documents[15], a shellfish waters desk study was issued in 2017 and concluded that the monitoring data for *E. coli* showed non-compliance with shellfish regulations for the 2014-2016 period. A detailed assessment was proposed incorporating both WWTPs in a combined review (*i.e.,* Belgooly and Riverstick). Additionally, in 2023, Riverstick WWTP was in breach of emission limits for suspended solids (>35 mg/l) as set in the wastewater discharge licence[17]; six samples were taken from the primary discharge, resulting in an annual mean for suspended solids of 41 mg/l.

The estimated total number of permanent private households within the contributing catchment (based on % within the contributing catchment) is 2,070 and of this 42.1% (*c.* 872) are on the public system, while 54.4% (*c.* 1,126) have their own septic tank or other individual treatment system. Households with another treatment system or where the treatment system is not stated account for 3.2% (*c.* 66), and 0.2% (*c.* 5) had no sewage facility. Though a national monitoring programme of private septic tanks is not in place, owners are required to register their septic tanks on 'Protect Our Water'[18], the domestic wastewater treatment systems registration, governed by the Department of Housing, Local Government and Heritage. Additionally, there are laws and regulations which stipulate the safe maintenance and operation of septic tanks[19, 20].

The shoreline survey also revealed a number of potential *E. coli* inputs via one outflow, one pipe, 12 drains, two rivers, and 20 streams (**Figure 7-32**). Water quality of the three river water bodies within the contributing catchment was of 'Good' status during the 2016-2021 monitoring period, according to the EPA[21] (**Figure 8-11**).

4.4. Agricultural Sources

Land cover in the contributing catchment is dominated by pastures (63.0 km^2; 64%), followed by non-irrigated arable land (28.8 km^2; 29.2%), and complex cultivation patterns (2.3 km^2; 2.3%). The remaining 4.5% (4.4 km^2) of land cover is comprised of mixed forest, land principally occupied by agriculture with significant areas of natural vegetation, discontinuous urban fabric, sport and leisure facilities, coniferous forest, estuaries, and sea and ocean, with each individually having less than 2% cover (**Figure 7-9**).

Data from the Census of Agriculture (Central Statistics Office [CSO][12]) showed that the total number of cattle within the EDs ranged from 834 in Kinure to 6,397 in Kinsale Rural. The number of dairy cows ranged from 499 in Nohaval to 2,725 in Kinsale Rural; numbers of dairy cows within Kinure and Ballyfoyle were noted as being confidential on the CSO database. The number of other cows ranged from 63 in Kinure to 338 in Leighmoney, these data were confidential for the Cullen ED; see **endnote 22** for definitions of other cows and total cattle per the CSO. Sheep data for all the EDs was labelled confidential on the CSO database at the time of writing this report. Within Oysterhaven contributing catchment, the estimated total number of cattle ranged from 41

in Farranbrien to 3,102 in Ballymartle. The estimated number of dairy cows ranged from 15 in Farranbrien to 1,190 in Ballymartle. The estimated number of other cows ranged from two in Farranbrien to 190 in Ballymartle. The shoreline survey noted one location with cows on the western shore of the River Stick (map ID 5, **Figure 7-20**); approximately 25 cows were observed at this location.

4.5. Rivers and Streams

Two WFD river sub-basins drain fully into the contributing catchment of Oysterhaven, primarily the Stick (54%). The Farranamoy (27%) and the Newborough (19%) river sub-basins drain partially into the contributing catchment also (**Figure 8-11** and **Figure 8-12**). These three river water bodies were classified as having Good WFD status for the 2016-2021 monitoring period, with the Oysterhaven transitional water body being classified as Moderate over this same period. The Western Celtic Sea coastal waterbody was classified as having High WFD status.

4.6. Movement of Contaminants

Water movement within Oysterhaven is dominated by wind prevailing from the south-southwest and west over the period from 2019-2023. As *E. coli* pollution is generally transported into the bay via freshwater, it is likely that *E. coli* levels will be higher in surface waters which sit on top of the denser seawater. Therefore, the prevailing wind likely plays a large role in the movement of contaminants in Oysterhaven and across the BMPA, and this movement may be highly varied due to changing wind and environmental conditions. Residence times were calculated by the Marine Institute to be 10.9 days within Oysterhaven Bay (Hartnett *et al.,* 2011), which gives an indication as to the length of time water particles may be present in Oysterhaven Bay. Given that residence times are high for the bay, there is potential for contamination to remain in the water system rather than being flushed out. In addition to this, turbidity levels and variability are highest during the winter season. High turbidity values can indicate a high organic load associated with nutrient and bacteriological elevation, so potentially there could be higher levels of *E. coli* detected at RMP 1 during this period. However, there is not a direct relationship between *E. coli* levels and turbidity, and other parameters should be considered to interpret high turbidity data appropriately (Keogh *et al*, 2020).

4.7. Wildlife

Oysterhaven is within the foraging/breeding range of a variety of bird species so it is possible that these species will visit the shellfish production area. This is due to the habitat type and aquaculture infrastructure present which has been known to support these species for a range of activities. While the contributing catchment does not overlap with any SPAs, Oysterhaven is a wetland bird habitat under I-WeBS so there is likely to be birds present within the contributing catchment (see **Table 7.9** for bird numbers over the last five years).

Additionally, as Oysterhaven is coastal, marine birds from nearby SPAs may visit due to the presence of shellfish in the bay. There are no SACs within Oysterhaven Bay, however several marine mammals have been documented there through strandings or sightings of live animals, so it is possible these species could occasionally occur in the bay. There were a number of sightings of common bottlenose dolphin (*Turiops truncates*), common dolphin (*Delphinus delphis*), and European otter (*Lutra lutra*) in the area. Outside of Oysterhaven Bay grey seals (*Haliochoerus* grypus) and basking sharks (*Cetorhinus maximum*) have been sighted but there have been none of these recorded within the bay according to the National Biodiversity Data Centre database[7].

4.8. Seasonality

In 2023, there were 1,706,000 domestic trips to County Cork by Irish residents over 4,498,000 nights, spending an average of 2.6 nights[23]. Data from Fáilte Ireland suggests that in 2022 there were 2,763,000 domestic trips to the southwest (Cork and Kerry) spending a total of 7,763 nights and an average length of stay of 2.8 nights[24]. Fáilte Ireland data indicates the southwest region (Cork and Kerry) received 4.7 million tourists in 2019, of which 49% accounted for domestic tourists and, of the overseas visitors, 73% were travelling for a holiday[25]. Over the same period, 1.5 million overseas tourists visited County Cork[25]. For Ireland as a whole, in 2019 most tourists visited between June and August (32%), followed by October to December (22%), January to March (19%) and 9% in each of April, May, and September. This trend may differ from the southwest region due to weather, the number of attractions, and the level of demand for those attractions

There are a range of tourism facilities in Oysterhaven contributing catchment. Oysterhaven Bay Beach is a sheltered beach (**Figure 7-4**) and currently reports excellent water quality; it has had historically good to excellent water quality over the bathing season (June 1st to September 5th) since August 2013[26]. Despite these high ratings there are no Blue Flag beaches in Oysterhaven Bay[27].

Attractions within the contributing catchment include Kinsale Golf Club, Kinsale Hotel and Spa, the Oysterhaven Centre (activity centre), FootGolf Cork, and a range of national heritage monuments and sites[28] (**Figure 7-4**).

In terms of agriculture, the number of sheep is expected to be highest in spring/summer when lambs are present; also, at that time of year there may be more extensive grazing on the hills and thus bacterial impacts would be more widely spread. However, definitive numbers of sheep could not be included in this report as these data were marked as confidential on the CSO database.

The Fifth Nitrates Action Programme 2022-2025 restricts slurry spreading before October 1st of a given year and prohibits the spreading of soiled water between December 1st and 31st; these restrictions came into effect

as of January 1st, 2024[29]. Specific guidelines (*i.e.,* Statutory Instrument [S.I.] No. 113/2022) are also in place for slurry spreading near watercourses, with recommended buffer strip distances provided, *e.g.,* 20 m from lakes and main river channels[30].

4.9. Shoreline Survey

Inventory of Pollution Sources

In the course of the shoreline survey there were a total of 47 features identified (see **Appendix 4: Shoreline Survey Images**), of which there were one outflows, 12 drains, 20 streams, two rivers, one pasture, one site with cows, one pontoon, one slip, one sluice gate, and two beach access points which discharged directly into the DSW. From prior observations in the contributing catchment, the SFPA have noted that there is a significant *E. coli* source discharging along the west coast of the BMPA, corresponding to map ID one in **Figure 7-20** (feature no. 1, **Table 7.10**). This observation will be considered in the placement of the RMP.

Bacteriological Sampling Results

Water sampling was undertaken as part of the shoreline survey over two sampling periods, with a total of eleven water samples taken from nine locations along the shoreline of Oysterhaven contributing catchment (**Figure 9-1**). The Stick sub-catchment drains the largest percent of the contributing catchment (54%), flowing predominantly through pastures (64%) and agricultural land. However, majority of water sampling stations overlapped with the Farranamoy (27%) and Newborough (19%) sub-catchments. Samples from five rivers/streams, one outflow, one discharge point, one bridge, and one slip were taken during the first bacteriological survey. Duplicate samples were taken from two river/stream locations during the second bacteriological survey, namely stations 5 and 10 (**Figure 9-1**), to verify the *E. coli* results from corresponding stations 4 and 9 (**Figure 9-1**). The stream/drain at the north Oysterhaven Bay bridge (*i.e.*, station 4, **Table 9.4**) initially had the highest *E. coli* result at 14,000 cfu/100 ml, however when this station was resampled the result was significantly lower (400 cfu/100 ml, station 5, **Table 9.4**).The next highest results were recorded at the Brownmills stream (1,600 cfu/100 ml) and Ballinaclashet Bridge (700 cfu/100 ml). The lowest recorded levels of *E. coli* were initially from the Belgooly River where 0 cfu/100 ml was recorded (station 9; **Table 9.4**). Upon resampling in the second bacteriological survey a more accurate result of 100 cfu/100 ml was reported (station 10; **Table 9.4**). The slip (station 1, **Table 9.4**) had the lowest *E. coli* result overall (1 cfu/100 ml).

Of the discharges noted during the shoreline survey, 15 of 35 were definitely man-made discharges or pipes. During the shoreline survey, it could not be determined if the run-off points were man-made or of natural origin. Water samples were not taken for all discharge points, therefore a definitive evaluation as to the sources and significance of these discharges cannot be made at this time. However, it is important to note that

these water samples only provide a snapshot of *E. coli* levels from discharges from a particular point in time. Replicated water samples over a greater time period (*i.e.*, number of months to a year) would be required to fully rely on these results as a robust representation of *E. coli* contamination entering the Oysterhaven Bay BMPA.

5. Recommended Amendments

Oysterhaven Bay has had a classified BMPA since 2013, the boundary of which aligns to the MI monitored harmful algal blooms (HABs) inshore shellfish production area (**Figure 5-1**). At this time, no amendment to the BMPA is required as it remains fit for purpose.

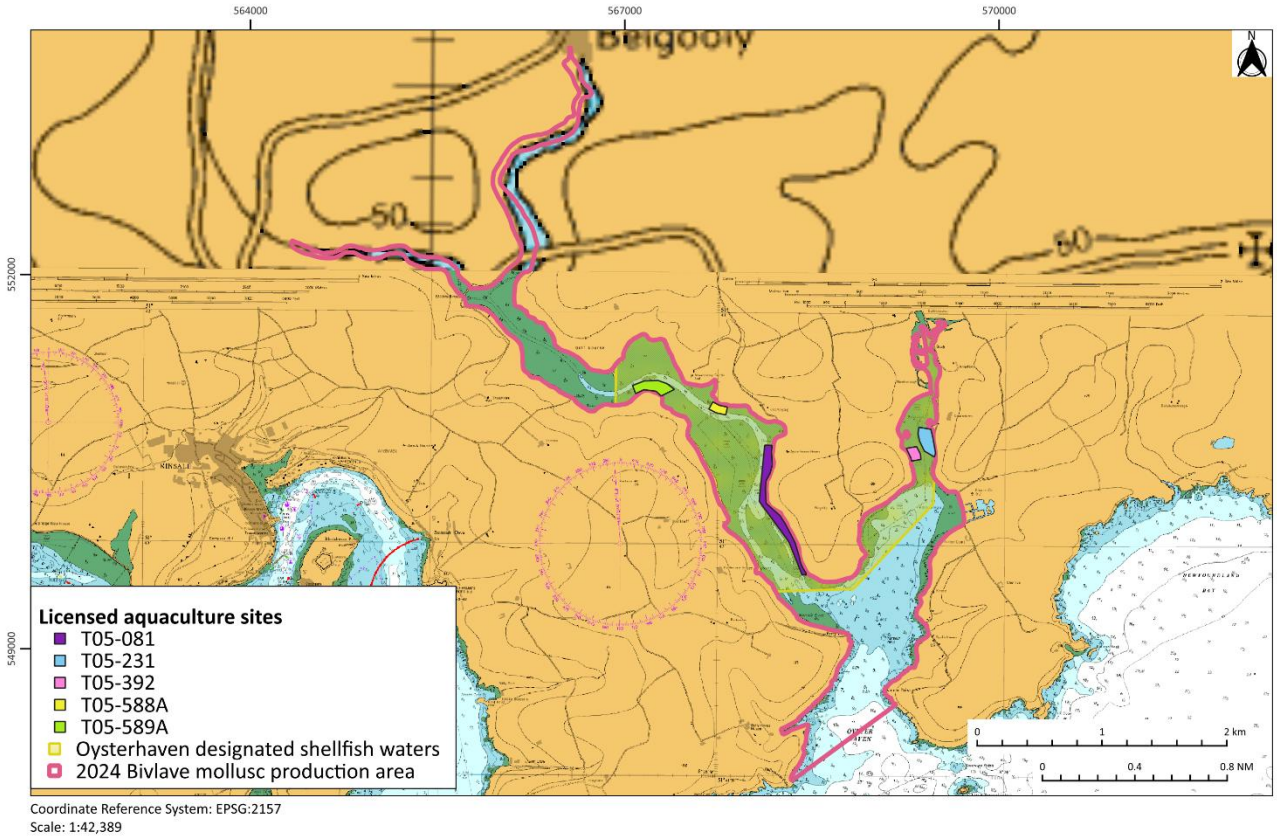

Figure 5-1: The 2024 bivalve mollusc production area boundary for licensed shellfish production in Oysterhaven Bay.

6. Conclusion of the Sanitary Survey

6.1. RMPs for Pacific oyster (*Magallana gigas*)

This assessment concludes that RMP 1 for Pacific oysters is best located at site T05-081 (**Figure 6-1, Table 6.1**). At the time of writing site T05-081 was the only consistently active shellfish site in Oysterhaven Bay BMPA, ensuring a reliable supply of Pacific oyster flesh is available for sampling. RMP 1 has been strategically placed on the northwestern part of site T05-081 to account for *E. coli* pollution entering the River Stick and for pollution transported from further downstream over this site on the incoming tide. Residence times are relatively high in Oysterhaven Bay (**section 8.9**) and the shellfish sites are located in quite shallow waters in the intertidal zone indicating pollution that enters the system is likely to linger there rather than be readily flushed out by the tide.

Land use within the contributing catchment is dominated by agricultural activities, primarily livestock grazing and crop production (**Figure 7-8**). Bordering the site is the CORINE land type 'non-irrigated arable land' and further upstream as well as directly west of the site the land type 'pastures' comprises the land type along the shoreline. While there are no watercourses associated with the WFD river waterbodies dataset near this site, the shoreline survey identified a features as a stream entering the Stick Estuary on the northern boundary of site T05-081, and a further four just upstream of this site (map ID 13-17, **Figure 7-31**, **Table 7.11**), as well as beach access and an outflow pipe to the north of the site (map ID 36 and 38, **Figure 7-20**, **Table 7.10**). No water samples were taken from these streams or the outflow pipe during the bacteriological survey, and while the streams were all noted as running clear at the time of surveying, these features potentially provide a pathway for *E. coli* runoff from the land to enter the BMPA. Additionally, these features occur within the Kilmonoge and Kinsale Rural EDs, both of which have high numbers of farms, grass and rough grazing, total cattle, and dairy cows relative to the other EDs in the contributing catchment (**Table 7.6**).

Over-reliance on the indicative bacteriological survey results could be misleading, as some results may be outliers influenced by combined environmental and anthropogenic conditions at the specific time when the water sample was taken. Therefore, other data collected during the desktop and shoreline surveys are also considered to corroborate the placement of the RMPs.

Belgooly and Riverstick are the only two towns of note within the contributing catchment regarding potential sources of *E. coli*, and they are situated upstream of the western part of Oysterhaven Bay BMPA. Located in these towns are the only WWTPs within the contributing catchment too (PE greater than 500; **section 7.1.3**). By placing RMP 1 on site T05-081, *E. coli* contamination entering the Stick Estuary from these populated towns and associated WWTP discharges should be captured by sampling at this point.

Should the other licensed Pacific oyster sites in Oysterhaven Bay (**Figure 3-3**) become stocked and active, an assessment of RMP 1 will need to be conducted to ensure it remains representative of the *E. coli* levels in shellfish in the BMPA. Furthermore, a review of the *E. coli* sources identified in this sanitary survey would be required to determine if there has been a significant change in the number, distribution, and type of pollution sources since this sanitary survey was conducted.

6.2. Microbiological Sampling Plan

A minimum of 10 individual Pacific oysters of market size (minimum 8 cm shellfish length) are required to be sampled monthly from RMP 1[3, 31]. Shellfish samples for flesh analysis should be taken within the top one metre of the water column and as close to the surface as possible to obtain a representative sample of the *E. coli* levels within Oysterhaven BMPA. Flesh samples should be taken within a maximum of 100 m from the RMP. Once the production area has been classified and considering that harvesting can potentially take place year-round, the minimum sampling frequency for ongoing monitoring should be at least monthly at the RMP on a year-round basis. The SFPA are the competent authority responsible for implementing this sampling plan.

Table 6.1: Coordinates of the representative monitoring point (RMP 1) for Pacific oysters in Oysterhaven Bay. Note: latitude and longitude coordinates are in coordinate reference system (CRS) EPSG:4326-WGS 84 and the CRS for the easting and northing coordinates is Irish Transverse Mercator[32].

RMP	Site code	Species	Latitude	Longitude	Easting	Northing
1	CK-ON-ON	*M. gigas*	51.70653	-8.46071	568149.1	550561.4

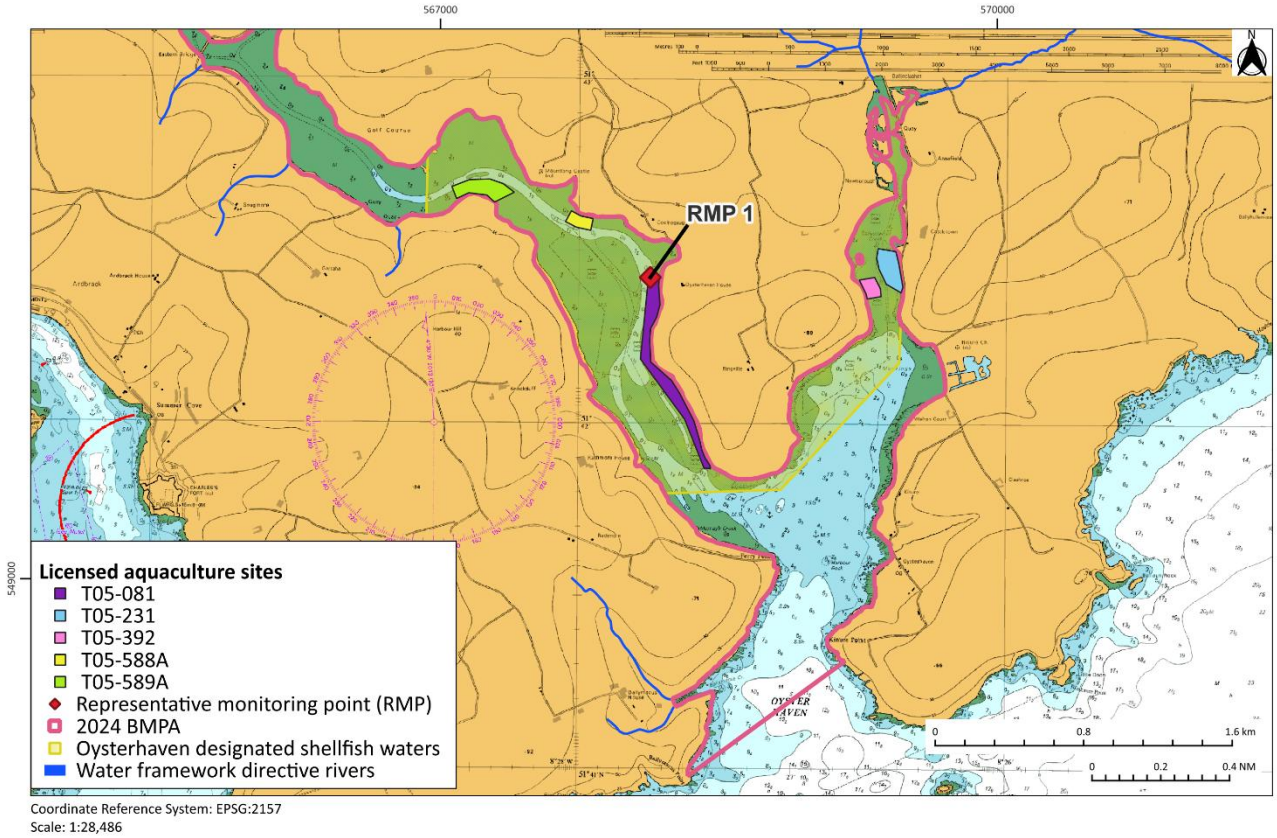

Figure 6-1: Representative monitoring point (RMP 1) for Pacific oysters in Oysterhaven Bay bivalve mollusc production area. Note that the RMP hasn't been drawn to scale and has been enlarged for ease of visibility.

6.3. General Sampling Method

All collection and transport of shellfish samples for *E. coli* testing under the sampling plan identified as part of the Oysterhaven Bay Sanitary Survey should adhere to the Code of Practice for the Microbiological Monitoring of Bivalve Mollusc Production Areas[31]. The sampling procedure and guidance notes are found in Appendix 9.2 of that document.

7. Appendix 1: Identification of Pollution Sources

This section documents all pollution sources identified during the desktop and shoreline surveys within Oysterhaven contributing catchment; in the context of this report, pollution encompasses *E. coli* contamination only.

7.1. Desktop Survey

Pollution sources were considered within the contributing catchment of Oysterhaven (**Figure 7-1**). The contributing catchment covers an area of approximately 98.5 km^2.

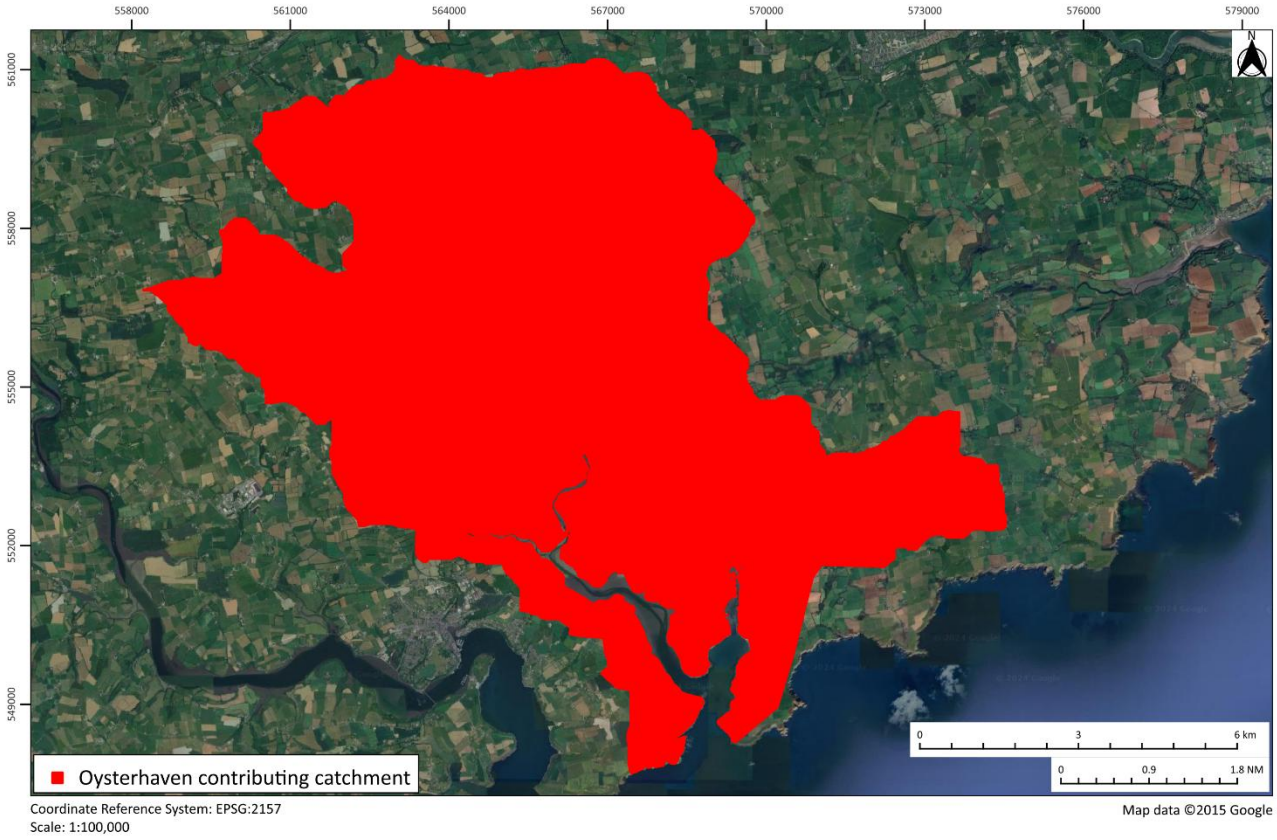

Figure 7-1: Oysterhaven contributing catchment established for the assessment of pollution sources into the Oysterhaven bivalve mollusc production area.

7.1.1. Human Population

Population census data compiled by the Central Statistics Office (CSO) is given in units of EDs; **Figure 7-2** shows the EDs within the contributing catchment. The population data used in this report are from the 2022 census[12]; as the census takes place every five years in Ireland this is the most recent data available. **Figure 7-3** shows the human population within Oysterhaven contributing catchment and **Table 7.1** shows these data in tabular form.

Figure 7-2: Electoral divisions within Oysterhaven contributing catchment. Note that electoral division are illustrated in their entirety above, however for some of the electoral divisions there is only partial overlap with the contributing catchment. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Oysterhaven contributing catchment overlaps 13 EDs; 12 of these EDs overlap partially and Kilmonoge ED overlaps entirely with the contributing catchment. The EDs partially within the contributing catchment are Ballyfeard, Ballyfoyle, Ballymartle, Farranbrien, Inishannon, Kinsale Rural, Kinure, Leighmoney, Liscleary, Nohaval, Templemichael, and Cullen.

These 13 EDs accommodate a total population of 19,829 people. As Kilmonoge was the only ED that is encompassed completely within the contributing catchment, an effort was made to estimate the actual population of the remaining 12 EDs within the contributing catchment. The geographical area of the 12 EDs overlapping the contributing catchment was calculated using QGIS software and then converted to a percentage of the overall area (km^2) of the ED using Microsoft Excel. From this value the population size of each ED was calculated, *e.g.*, if 50% of the ED lies within the contributing catchment then 50% of that total population was taken to be the population size of the area within the contributing catchment. Using this method, the population of Oysterhaven contributing catchment is estimated at 6,457 people. Kinsale Rural contains the largest population within the contributing catchment (2,059), followed by Kilmonoge (1,337), and Ballymartle (1,119) (see **Table 7.1**). There are two towns/urban areas within the contributing catchment[12], namely Belgooly and Riverstick. Belgooly, which lies within Kilmonoge ED, has a population of 823, accounting

for more than half of the population in this ED (*c.* 61.5%). Riverstick occurs in the ED of Ballymartle and has a population of 772, notably comprising *c.* 69% of the population in this ED[12].

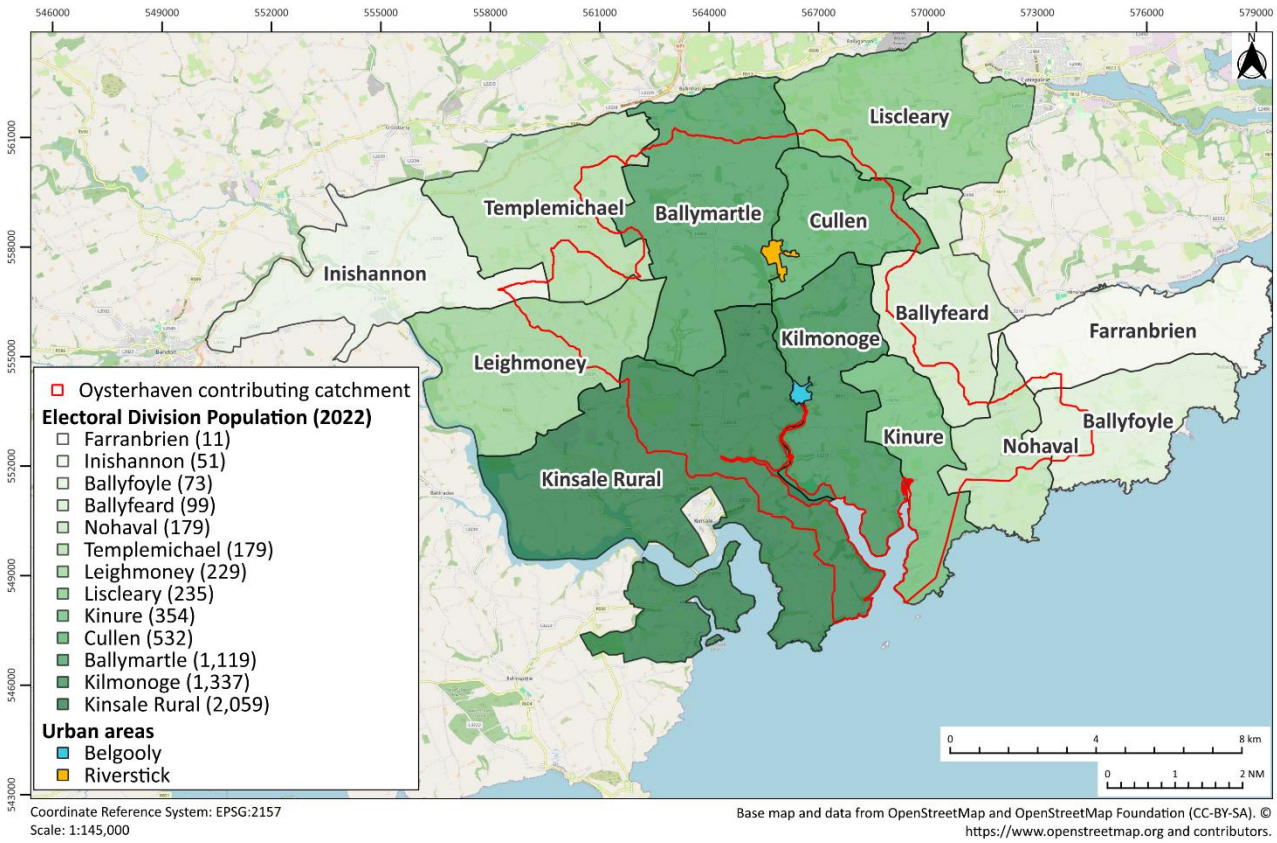

Figure 7-3: Human population per electoral division within Oysterhaven contributing catchment (source: CSO[12]). Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7.1: Human population within Oysterhaven contributing catchment (source: CSO[12]).

Electoral Division (ED)	Population (2022)	% ED in the Contributing Catchment	Estimated Population in the Contributing Catchment
Ballyfeard	408	24.24	99
Ballyfoyle	404	18.01	73
Ballymartle	1409	79.42	1119
Cullen	584	91.17	532
Farranbrien	532	2.15	11
Inishannon	2094	2.43	51
Kilmonoge	1337	100	1337
Kinsale Rural	5605	36.73	2059
Kinure	395	89.71	354
Leighmoney	814	28.19	229
Liscleary	5124	4.59	235
Nohaval	345	51.95	179
Templemichael	778	23.01	179
Total	19,829		6,457

There are 7,256 households in total within the 13 EDs considered here. Of this, 5.2% are vacant (374) and a further 3.6% (264) are holiday homes. Of the 2,379 houses within the contributing catchment (based on % of the ED within the contributing catchment), 5.3% (126) are vacant and 4.8% (114) are holiday homes. **Table 7.2** shows the number of households in each ED and the proportion within the contributing catchment.

The human population in given areas is obtainable from census data; however, relating this information to the anthropogenic contribution of microbial contamination in coastal waters is difficult and is constrained by the geographic boundaries used. Nonetheless, it is credible that areas with a higher population will have higher levels of sewage and wastewater entering the Oysterhaven Bay system. While the ED of Kinsale Rural has the highest calculated population within the contributing catchment, this may be skewed by the fact that Kinsale Rural ED covers the largest geographic area of all the EDs considered in this report. While the population within the contributing catchment is calculated above, this is only an approximation. It is more likely that the highest levels of sewage and waste originate from the ED of Kilmonoge, as this ED lies completely within the contributing catchment and encompasses the town of Belgooly (population of 823). As there are a low number of unoccupied dwellings within the contributing catchment, the pollution load is likely to be relatively consistent throughout the year. If a large proportion of the households within Kilmonoge ED were unoccupied holiday homes or vacant houses a seasonal increase in sewage and waste levels would be expected in the summer.

Table 7.2: Households within the electoral divisions in Oysterhaven contributing catchment (source: CSO[12]).

	Total				Contributing Catchment			
Electoral Division	**Total Households**	**No. Occupied***	**Unoccupied Holiday Homes**	**Vacant Houses**	**Total Households**	**No. Occupied***	**Unoccupied Holiday Homes**	**Vacant Houses**
Ballyfeard	156	139	2	15	38	34	0	4
Ballyfoyle	157	138	6	12	28	25	1	2
Ballymartle	485	459	2	21	385	365	2	17
Cullen	191	182	3	6	174	166	3	5
Farranbrien	219	196	9	14	5	4	0	0
Inishannon	770	731	4	35	19	18	0	1
Kilmonoge	444	420	6	17	444	420	6	17
Kinsale Rural	2267	1903	185	141	833	699	68	52
Kinure	189	139	34	13	170	125	31	12
Leighmoney	284	259	6	19	80	73	2	5
Liscleary	1702	1643	5	51	78	75	0	2
Nohaval	122	114	1	6	63	59	1	3
Templemichael	270	245	1	24	62	56	0	6
Total	7256	6568	264	374	2379	2119	114	126

*This figure includes those houses temporarily unoccupied on census night.

7.1.2. Tourism

In quarter four (October, November, and December) of 2023, the southern region (including County Cork) was recorded as having the most domestic overnight trips (42%) compared to Ireland as a whole[33]. In 2023, there were 1,706,000 domestic trips to Cork by Irish residents over 4,498,000 nights, spending an average of 2.6 nights[23]. Data from Fáilte Ireland suggests that in 2022 there were 2,763,000 domestic trips to the southwest (Cork and Kerry), with visitors spending a total of 7,763 nights and an average length of stay of 2.8 nights[24]. Fáilte Ireland data indicates the southwest region (Cork and Kerry) received 4.7 million tourists in 2019, of which 49% accounted for domestic tourists and, of the overseas visitors, 73% were travelling for a holiday[25]. Over the same period, 1.5 million overseas tourists visited County Cork[25].

There are a range of tourist facilities in Oysterhaven contributing catchment. Oysterhaven Bay Beach is a sheltered beach (**Figure 7-4**) and currently reports excellent water quality; it has had historically good to excellent water quality over the bathing season (June 1st to September 5th) since August 2013[26]. There are no Blue Flag beaches in Oysterhaven Bay[27].

Attractions within the contributing catchment include Kinsale Golf Club, Kinsale Hotel and Spa, the Oysterhaven Centre (activity centre), FootGolf Cork, and a range of national heritage monuments and sites[28] (**Figure 7-4**). The Oysterhaven activity centre offers a range of primarily water-based activities including sailing, windsurfing, stand-up paddleboarding, kayaking, and camps[13]. Kinsale Golf Club boasts two courses and has hosted several major tournaments[13].

Walking/cycling routes in the region include Nohoval to Oysterhaven, Belgooly River trail, and Curra Wood trails all ranging from 3.5 km to 8 km[34].

The abovementioned tourist attractions and amenities provide an indication as to the number of external visitors that may frequent the area, subsequently adding to the *E. coli* levels in Oysterhaven contributing catchment.

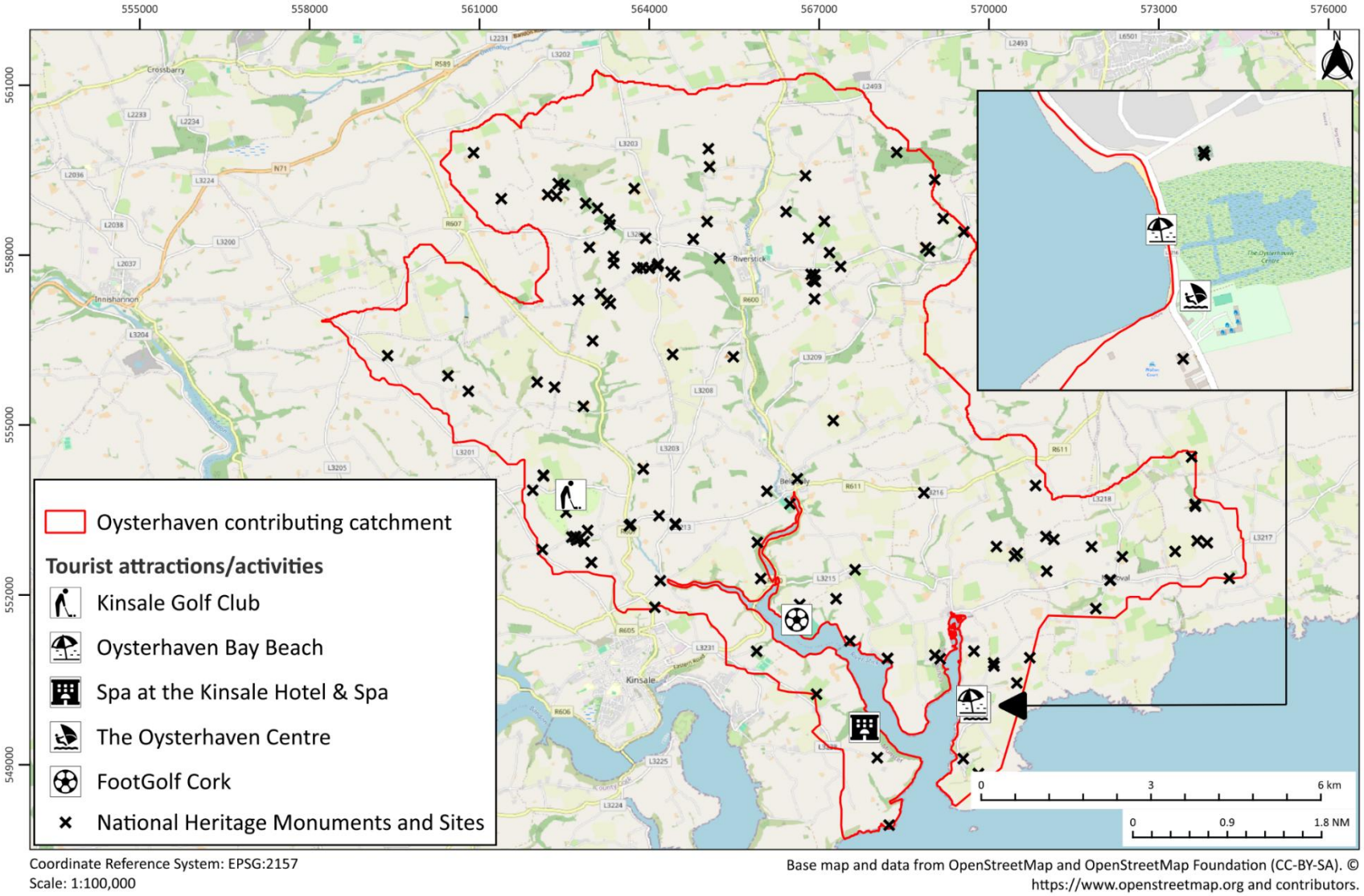

Figure 7-4: Tourist attractions and national heritage sites within Oysterhaven contributing catchment. This figure contains Irish Public Sector data (Fáilte Ireland and Department of Housing, Local Government and Heritage) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

7.1.3. Sewage Discharges

Sewage effluent can vary in nature depending on the degree to which the sewage has been treated. Discharges of sewage effluent can arise from a variety of different sources and be continuous or intermittent in nature:

- treated effluent from urban sewage treatment plants (continuous);
- storm discharges from urban sewage treatment plants (intermittent);
- effluent from 'package' sewage treatment plants serving small populations (continuous);
- combined sewer and emergency overflows from sewage systems (intermittent);
- septic tanks (intermittent);
- crude sewage discharges at some estuarine and coastal locations (continuous);

Treatment systems for sewage range from:

- none (crude sewage);
- preliminary (screening and/or maceration to remove/disguise solid matter);
- primary (settling to remove suspended solids as sewage sludge). Typically removes 40% of BOD (Biochemical Oxygen Demand), 60% of suspended solids; 17% of nitrogen, and 20% of phosphorus from the untreated sewage;
- secondary (settling and biological treatment to reduce the organic matter content). Typically removes 95% of BOD, 95% of suspended solids, 29% of nitrogen, and 35% of phosphorus from the untreated sewage. Nutrient removal steps can be incorporated into secondary treatment which can reduce ammonia – nitrogen down to 5 mg/l and phosphorus to 2 mg/l;
- tertiary (settling, biological treatment, and an effluent polishing step which may involve a reed bed (unlikely for coastal works), or a treatment to reduce the load of microorganisms in the effluent). Typically, this treatment removes 100% of BOD, 100% of suspended solids, 33% of nitrogen, and 38% of phosphorus from the untreated sewage.

7.1.3.1. Water Treatment Works

There are two WWTPs within Oysterhaven contributing catchment with a PE of greater than 500; namely Belgooly WWTP (licence registration D0541-01)[14] and Riverstick WWTP (licence registration D0433-01)[15], both of which are operated by and under the jurisdiction of Uisce Éireann. **Figure 7-5** and **Figure 7-6** show the locations of the Belgooly and Riverstick WWTPs, respectively, with associated discharge locations, monitoring points, and overflows. **Table 7.3** shows the coordinates and capacity of these WWTPs. Cramer's Close WWTP

(TPEFF0500D0541SW002) is a secondary discharge within Belgooly WWTP and serves a PE of 75 undergoing secondary rotation biological contractor treatment[14, 16].

7.1.3.2. Continuous Discharges

The Belgooly WWTP has a design capacity of 1,000 but currently operates under capacity at a PE of 855[14]. It is a tertiary treatment facility which means that, after primary and secondary treatment measures, further treatment is conducted to purify the water so that it may be reused. The Belgooly WWTP is designed to have a peak hydraulic (flow) capacity of 675 m^3/day and is currently operating at an average hydraulic loading to the WWTP of 168.47 m^3/day[14]. The annual maximum hydraulic loading in 2023 was 409 m^3/day[14]. Belgooly WWTP has a dry weather flow (DWF) rate of 225 m^3/day. The capacity of the Belgooly WWTP was not anticipated to be exceeded in the following three years after the 2023 AER for the WWTP was written. Efficiency of treatment at the Belgooly WWTP, presented as percentage removal rate, was reported as a 90% reduction in suspended solids[14]. There are three ambient monitoring points in the Belgooly WWTP. The upstream monitoring point RS20B690960 and the downstream monitoring point TW05003164OY1001 are used to monitor all three discharges associated with this WWTP; there is an additional upstream monitoring point, RS20S030800, for the primary discharge TPEFF0500D0541SW001[14].

In 2022, Belgooly WWTP (**Figure 7-5**) was in breach of emission limits for suspended solids (*i.e.*, emission greater than 35 mg/l) as set out in the wastewater discharge licence for this WWTP. Six samples were taken from each of SW002 and SW003, resulting in an annual mean for suspended solids of 49 mg/l and 57 mg/l, respectively. In 2023, Belgooly WWTP was non-compliant with emission limits set in the wastewater discharge licence and failed compliance regarding *E. coli* (no./100 ml) and suspended solids (mg/l). Belgooly secondary discharge (TPEFF0500D0541SW003) and Cramer's Close WWTP are untreated discharges and exceeded emission limits in 2023 for suspended solids[14]. Consecutively, a deterioration in water quality was identified, however the cause was unknown; there was no definitive link to the WWTP. In 2022, there was an observable impact on the designated shellfish water quality and similarly in 2023, there was an observable impact from the WWTP primary discharge on the WFD status.

A number of improvement programmes for the Belgooly WWTP were identified in the 2023 AER, all of which are in the planning stages, with completion targeted to 2029[14]. Improvements to ensure compliance with emission limits and provide sufficient capacity in the WWTP are to be implemented to satisfy the requirements of the wastewater discharge licence; secondary discharges are to be discontinued[14]. Inspection of the 2023 effluent monitoring results revealed breaches of the emission limits set out in the wastewater discharge licence. Consequently, a 2024 site visit and subsequent report by Uisce Éireann[14] outlined corrective actions. Those of relevance to this sanitary survey are:

- To provide a clear corrective action plan, with timeframes, of how and when the WWTP will comply with emission limits.
- To provide a report on inlet and outlet flow data for the past 12 months and data on frequency/volume of the associated discharges and monitoring information on any storm water overflows (SWOs) in the agglomeration.
- to confirm the location of secondary discharges and submit monitoring results for 2023 in a report.
- to provide an update on the methods by which Uisce Éireann intend to comply with the wastewater licence limits.

The Riverstick WWTP (D0433-01) (**Figure 7-6**) has a design capacity of 1,000 but currently operates under capacity at a PE of 657[15]. Like Belgooly, Riverstick WWTP is a tertiary treatment facility. This WWTP is designed to have a peak hydraulic capacity of 675 m^3/day and in 2023 was operating at an average hydraulic loading to the WWTP of 184.83 m^3/day[15]. Riverstick WWTP has a DWF rate of 225 m^3/day. The capacity of the Riverstick WWTP was not anticipated to be exceeded in the following three years after the 2023 AER for Riverstick was written[15], and it was noted that no apparent negative impact was caused by discharges from the Riverstick on WFD status (**Figure 8-11**).

A shellfish impact assessment was required in 2020 and 2023; however, it was not included by Uisce Éireann in the 2023 AER[15]. Within the Riverstick WWTP documents[15], a shellfish waters desk study was issued in 2017 and concluded that the monitoring data for *E. coli* showed non-compliance with shellfish regulations for the 2014-2016 period. A detailed assessment was proposed incorporating both Belgooly and Riverstick WWTPs in a combined review. In 2023, the Riverstick WWTP was in breach of emission limits for suspended solids (>35 mg/l) as set out in the wastewater discharge licence for this WWTP. Six samples were taken from the primary discharge, resulting in an annual mean for suspended solids of 41 mg/l.

A compliance investigation was instigated in 2021 regarding the regular exceedance of emission limits at Riverstick WWTP. A site visit was undertaken in January 2024 and, as of April 2024, the EPA were awaiting a response. A number of corrective actions have been set[15] and those of relevance to this sanitary survey are:

- Provide a clear corrective action plan, with timeframes, of how and when it will comply with emission limits.
- To consider installing ultraviolet disinfection as the effluent discharges into a shellfish protected area.
- To confirm the location of the downstream ambient monitoring station and to submit data for 2022 and 2023 for this monitoring point to the EPA.

- To provide inlet and outlet flow data, and all available data on the frequency/volume of the discharges and any monitoring of relevant SWOs over the past 12 months.

In section 4 of the 2023 AER for Riverstick, a proposal was made to upgrade/construct a new WWTP to comply with improvement programme requirements, and the status of these works was marked as completed.

In previous AERs for the Riverstick WWTP, there were two ambient monitoring points, one upstream and one downstream, respectively. In the 2023 report, there were no available data on the downstream monitoring point, implying that there was no downstream monitoring for this WWTP in 2023.

Shellfish Water Impact Assessments were required by the EPA for the Belgooly and Riverstick WWTPs as part of the WWTP licences. Belgooly WWTP was identified as having a likely impact on DSW. This WWTP did not achieve significant removal rates, there was an unmonitored emergency overflow identified within the plant, and there was untreated effluent discharging directly into the Belgooly River from four residences. In 2018 at the time of the survey, both tertiary and secondary treatment processes from the Belgooly WWTP were concluded as having a high likelihood of impacting the DSW. Riverstick WWTP was not receiving tertiary treatment at the time of the assessment, however effluent data suggested the plant was operating well.

There is no geo-referenced database for septic tanks or on-site domestic wastewater treatment systems available in Ireland. Additionally, the effectiveness of private treatment systems is unknown. To estimate the number of these domestic sewage facilities within the contributing catchment, data on the number of permanent private households and their sewage facilities was sourced from the 2022 census[35]. Of the 6,431 permanent private households within the 13 EDs, 50.5% (3,250) were connected to a public sewage/treatment system and 46.6% (2,998) had septic tanks or other individual systems. A further 2.6% (168) had another treatment or the treatment system was not stated, and 0.2% (15) had no sewage facility. The estimated total number of permanent private households within the contributing catchment (based on % within the contributing catchment) is 2,070 and of this 42.1% (*c.* 872) are on the public system, while 54.4% (*c.* 1,126) have their own septic tank or other individual treatment system. Households with another treatment system or where the treatment system is not stated account for 3.2% (*c.* 66), and 0.2% (*c.* 5) had no sewage facility. **Table 7.4** shows this information at the ED level and as estimations within the contributing catchment.

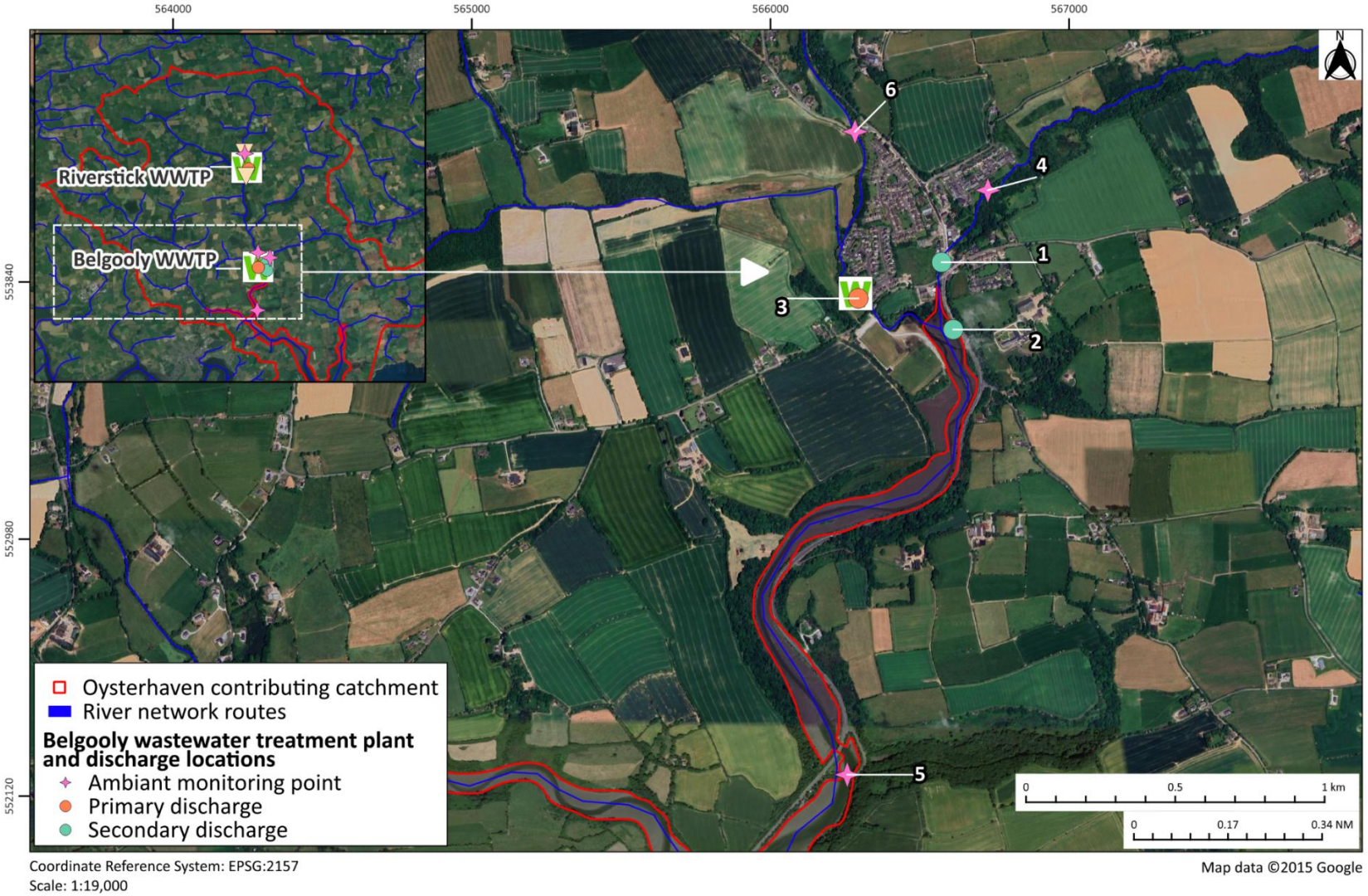

Figure 7-5: Locations of wastewater treatment plants (WWTPs) in Oysterhaven contributing catchment shown in insert on left. In main map, the discharge locations of the Belgooly WWTP in Oysterhaven contributing catchment are displayed. Map IDs cross-referenced to Table 7.3. This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Figure 7-6: Locations of wastewater treatment plants (WWTPs) in Oysterhaven contributing catchment shown in insert on left. In main map, the discharge locations of the Riverstick WWTP in Oysterhaven contributing catchment are displayed. Map IDs cross-referenced to Table 7.3. This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7.3: Details of discharges related to Belgooly and Riverstick wastewater treatment plants (WWTPs). Map IDs cross-referenced to Figure 7-5 and Figure 7-6. Latitude and longitude values are in CRS WGS84, easting and northing are in CRS Irish Transverse Mercator[32].

Map ID	WWTP	Name	Type	Treatment	Receiving water body	Easting	Northing	Latitude	Longitude
1	Belgooly	Cramer's Close WWTP TPEFF0500D0541SW002	Secondary discharge	Secondary rotating biological contractor	Ballindeenisk River/stream	566573.46	553906.17	51.73651	-8.48397
2		TPEFF0500D0541SW003	Secondary discharge	Untreated	Oysterhaven	566612.46	553681.21	51.73449	-8.48338
3		TPEFF0500D0541SW001	Primary discharge	Tertiary	River Stick	566294.52	553785.19	51.7354	-8.48799
4		RS20B690960	Ambient monitoring point (upstream)	N/A	N/A	566728.43	554147.11	51.73868	-8.48175
5		TW05003164OY1001	Ambient monitoring point (downstream)	N/A	N/A	566257.53	552191.54	51.72107	-8.48837
6		RS20S030800	Ambient monitoring point (upstream)	N/A	N/A	566283.53	554343.07	51.74042	-8.48821
7	Riverstick	TPEFF0500D0433SW001	Primary discharge	Tertiary	River Stick	565932.61	557454.39	51.76836	-8.49359
8		SW2	Storm water overflow (SWO)	N/A	N/A	565841.63	557162.45	51.76573	-8.49488
9		TBC	Storm water overflow (SWO)	N/A	N/A	565778.64	558046.26	51.77367	-8.49588
10		RS20S030440	Ambient monitoring point (upstream)	N/A	N/A	565792.64	558013.27	51.77338	-8.49568

Table 7.4: Sewage facilities at permanent private households in the contributing catchment (CSO[35]).

	Entire ED						Contributing Catchment %					
Electoral Division (ED)	**Permanent Private Households**	**Public Sewage Scheme**	**Individual Septic Tank**	**Other individual treatment**	**Other/ Not Stated**	**No sewage facility**	**Permanent Private Households**	**Public Sewage Scheme**	**Individual Septic Tank**	**Other individual treatment**	**Other/ Not Stated**	**No sewage facility**
Ballyfeard	137	0	119	18	0	0	33	0	29	4	0	0
Ballyfoyle	133	1	106	23	3	0	24	0	19	4	1	0
Ballymartle (incl. Riverstick town)	450	166	234	41	8	1	357	132	186	33	6	1
Cullen	178	51	104	18	5	0	162	46	95	16	5	0
Farranbrien	193	8	166	16	2	1	4	0	4	0	0	0
Inishannon	717	384	267	40	25	1	17	9	7	1	1	0
Kilmonoge (incl. Belgooly town)	415	231	137	29	16	2	415	231	137	29	16	2
Kinsale Rural	1841	1041	600	142	53	5	676	382	220	52	19	2
Kinure	134	0	94	33	7	0	120	0	84	30	6	0
Leighmoney	258	15	187	33	22	1	73	4	53	9	6	0
Liscleary	1620	1338	209	52	17	4	74	61	10	2	1	0
Nohaval	113	13	83	10	7	0	59	7	43	5	4	0
Templemichael	242	2	196	41	3	0	56	0	45	9	1	0
Total	**6431**	**3250**	**2502**	**496**	**168**	**15**	**2070**	**872**	**932**	**194**	**66**	**5**

7.1.3.3. Rainfall Dependent/Emergency Sewage Discharges

There was one SWO identified in the 2023 AER for Riverstick WWTP (**Figure 7-6**; **Table 7.3**), namely SW2[15]. SW2 is monitored and had a total discharge volume of 2,764.5 m^3 in 2023 and is listed as having a low significance of overflow[15]. There was no storm water overflow identified within the Belgooly WWTP agglomeration; an on-going national SWO programme aims to identify any additional overflows[14].

7.1.4. Industrial Discharges

There was one Industrial Emissions (IE) licence within the contributing catchment. IE licence P0943-01 is licensed for the rearing of poultry in instalments and associated activities[36]. Included in the licence are 94,000 broilers (chickens raised for meat production). It is a category 6 activity specified in Section 6.6 of Annex I of Directive 2010/75/EU regulating industrial emissions (integrated pollution prevention control), namely '6.6 Intensive rearing of poultry or pigs'[37]. It is further defined under Commission Implementing Decision EU/2017/302 for establishing the best available techniques for the intensive rearing of poultry or pigs, under Directive 2010/75/EU of the European Parliament and of the Council. The licence stipulates that there will be no emissions to water or sewers, however it does require the monitoring of storm water emissions or groundwater. There are mitigations to prevent slurry/wash water from contaminating surface or ground water at the facility, however in 2022 these facilities were noted as needing maintenance[38]. In 2021, 18 m^3 of poultry wash water was spread on the licensee's land and 32 m^3 in 2019.

A Section 4 discharge licence allows for the discharge of trade or sewage effluent to waters. Under the Local Government (Water Pollution) Acts 1997 and 1990, Cork County Council grants licences for Section 4 discharges within the county of Cork. There are three Section 4 discharge licences within the Oysterhaven contributing catchment (**Figure 7-7**) as identified on EPA Maps[21]; each licence has various stipulations to reduce pollution and monitor discharges. The following information has been extracted from Section 4 discharge licences in Co. Cork[39]; the licences can be accessed from the link at **endnote 39** should further information be sought.

- Reference number 07/09 (map ID 1; **Figure 7-7**) is licensed to discharge trade effluent from the Oysterhaven Activity and Holiday Centre to groundwaters; the holiday cottages are served by a sand polishing filter and the activity centre is served by a soil polishing filter, the flows of both will not exceed 12 m^3/day and 10 m^3/day, respectively, as stipulated in the licence. Contaminated wastewaters include domestic wastewater, and any activity approved by the licensing authority, and will be collected and treated prior to discharge to groundwaters.

- Reference number 04/06 (map ID 2; **Figure 7-7**) is licensed to discharge effluent and wastewater from the Rathmore House Hotel to groundwater and is not to exceed 160 m^3/day as stipulated in the licence. Wastewater from the operation of the hotel, spa, swimming pool complex, and holiday suites development will be treated on site before discharge to soakaway prior to discharge to groundwater.
- Reference number 05/12 (map ID 3; **Figure 7-7**) is licensed to discharge trade/sewage effluent from Cramer's Court Nursing Home, trading as Inis Ban Ltd., to groundwater and is not to exceed 26 m^3/day as stipulated in the licence. Contaminated wastewaters include domestic effluent, kitchen and laundry wastewater, contaminated runoff from bunded areas, and any activity approved by the licensing authority. Waste will be treated on site prior to discharge to polishing filter.

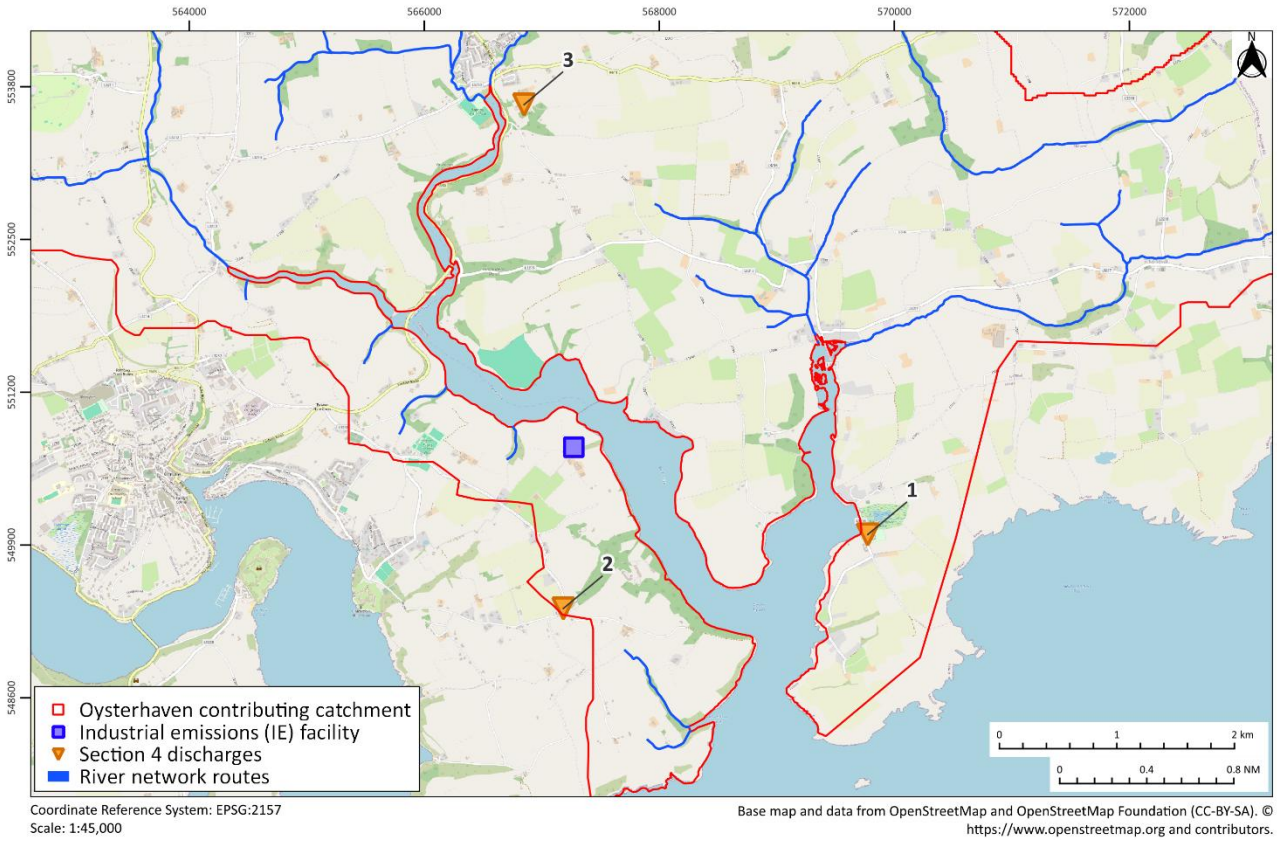

Figure 7-7: Location of industrial discharges within Oysterhaven contributing catchment[21]. This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

7.1.5. Land Use Discharges

Figure 7-8 shows the CORINE land cover within Oysterhaven contributing catchment[4]. CORINE land cover distributes cover types over three hierarchical classes whereby Class 1 is the most broad and is comprised of Classes 2 and 3. Class 3 is the descriptor level used in this report to identify and examine land cover within the contributing catchment (**Figure 7-8**). When examining land cover at the Class 1 level, 96.5% are agricultural areas, 2.2% are forest and semi-natural areas, 1.1% are artificial surfaces, and 0.2% are water bodies; this emphasises the significance of agricultural regions in the contributing catchment.

Land cover in the contributing catchment is dominated by pastures (63.0 km^2; 64%), followed by non-irrigated arable land (28.8 km^2; 29.2%) and complex cultivation patterns (2.3 km^2; 2.3%). The remaining 4.5% (4.4 km^2) of land cover is comprised of mixed forest, land principally occupied by agriculture with significant areas of natural vegetation, discontinuous urban fabric, sport and leisure facilities, coniferous forest, estuaries, and sea and ocean, with each individually having less than 2% cover (**Figure 7-9**). To assess the potential routes by which *E. coli* pollution may be transferred from the various land types within the contributing catchment to the shellfish production area, it can be useful to view the CORINE land cover map (**Figure 7-8**) in relation to the river water bodies (**Figure 8-12**) and groundwater vulnerability status (**Figure 7-18**).

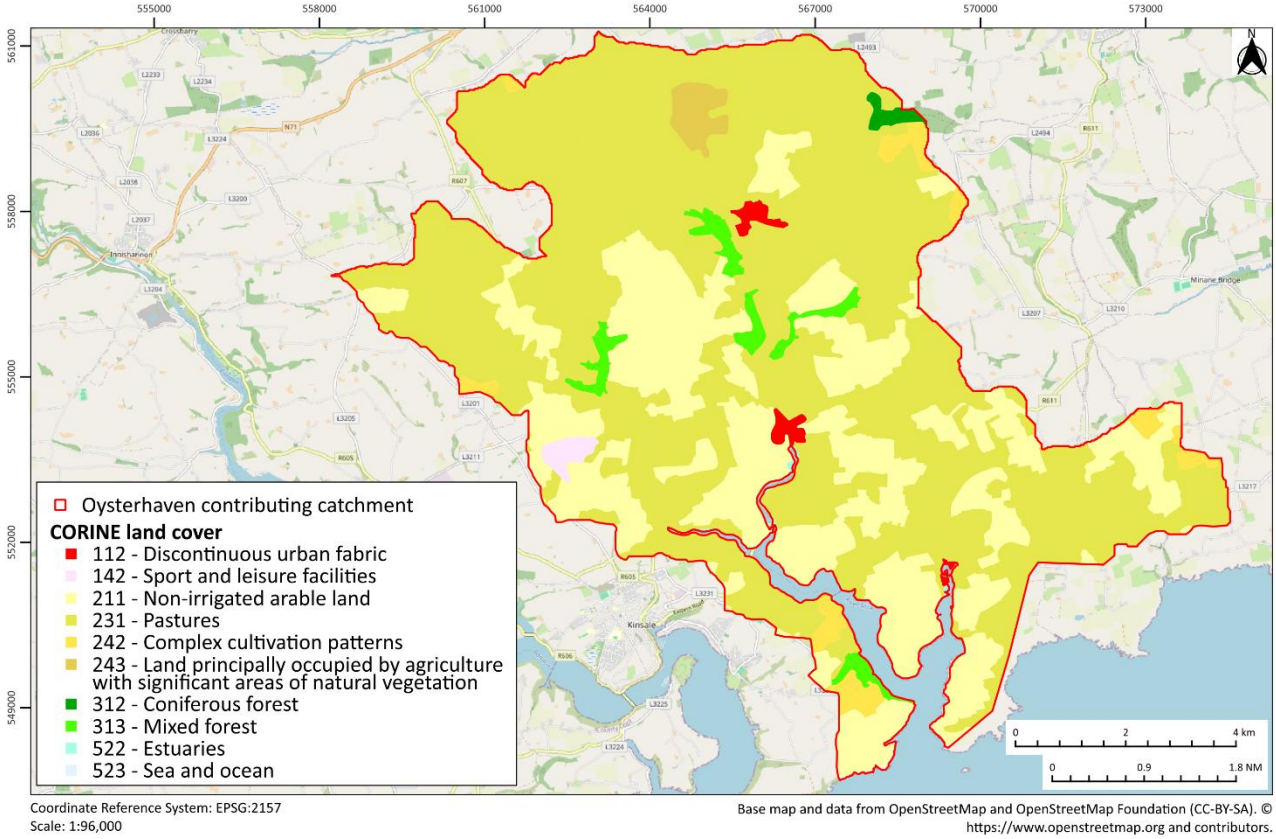

Figure 7-8: Land cover within Oysterhaven contributing catchment; colour coding corresponds to CORINE land cover legend colour scheme[4] (source: EPA[21]). This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

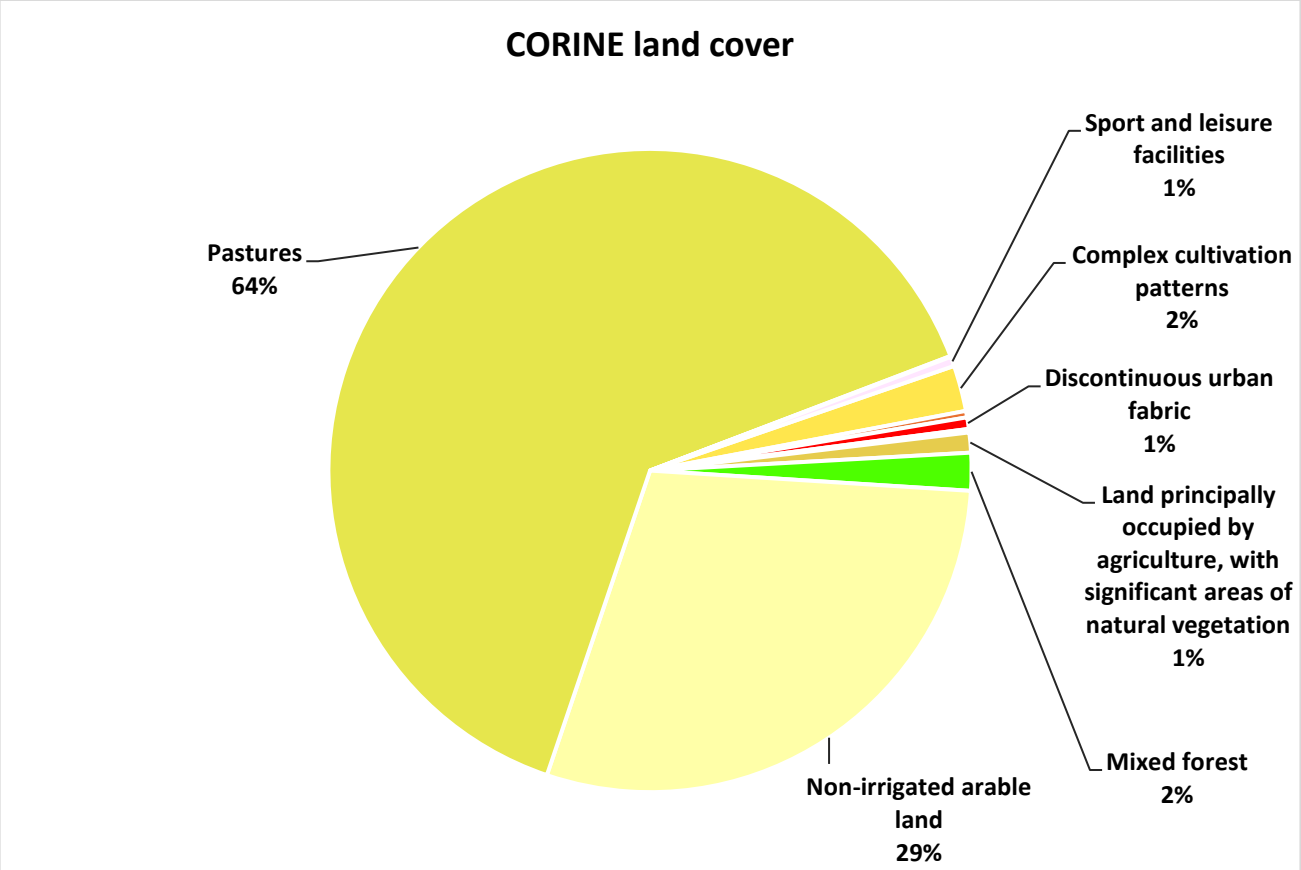

Figure 7-9: Breakdown of CORINE land cover based on 2018 data within Oysterhaven contributing catchment (percentages have been rounded to the nearest whole number and only land uses ≥1% are labelled); colour coding corresponds to CORINE land cover legend colour scheme[4]. See Figure 7-8 for the geospatial distribution of this land cover.

Data from the Census of Agriculture (CSO[12]) were used to inform land use and agricultural practices around Oysterhaven Bay. The number of farms within the EDs overlapping the contributing catchment ranges from 14 in Kinure to 82 in Kinsale Rural. The average farm size ranges from 34.9 ha in Inishannon to 56.6 ha in Nohaval. The total area farmed varies from 774.1 ha in Kinure to 4,329.4 ha in Kinsale Rural and across the entire 13 EDs amounts to 20,068.6 ha.

However, as all of these EDs, except for Kilmonoge, only partially overlap the contributing catchment, an attempt was made to estimate the area farmed (and other relevant agricultural CSO data) within the contributing catchment using the same method as was employed above for estimating the human population. The percentage of the ED lying within the contributing catchment was calculated in QGIS, and from this value the area farmed was calculated (*e.g.*, if 50% of the ED lies within the contributing catchment, then 50% of the area farmed was taken to be the area farmed within the contributing catchment). Using this method, the total area farmed within the contributing catchment is estimated at 7,581.3 ha, which represents 77% of the total contributing catchment. These data are displayed for the entire EDs in **Table 7.5** and, using the method

described above, as estimates within the contributing catchment in **Table 7.6** and visually in **Figure 7-10** to **Figure 7-17**.

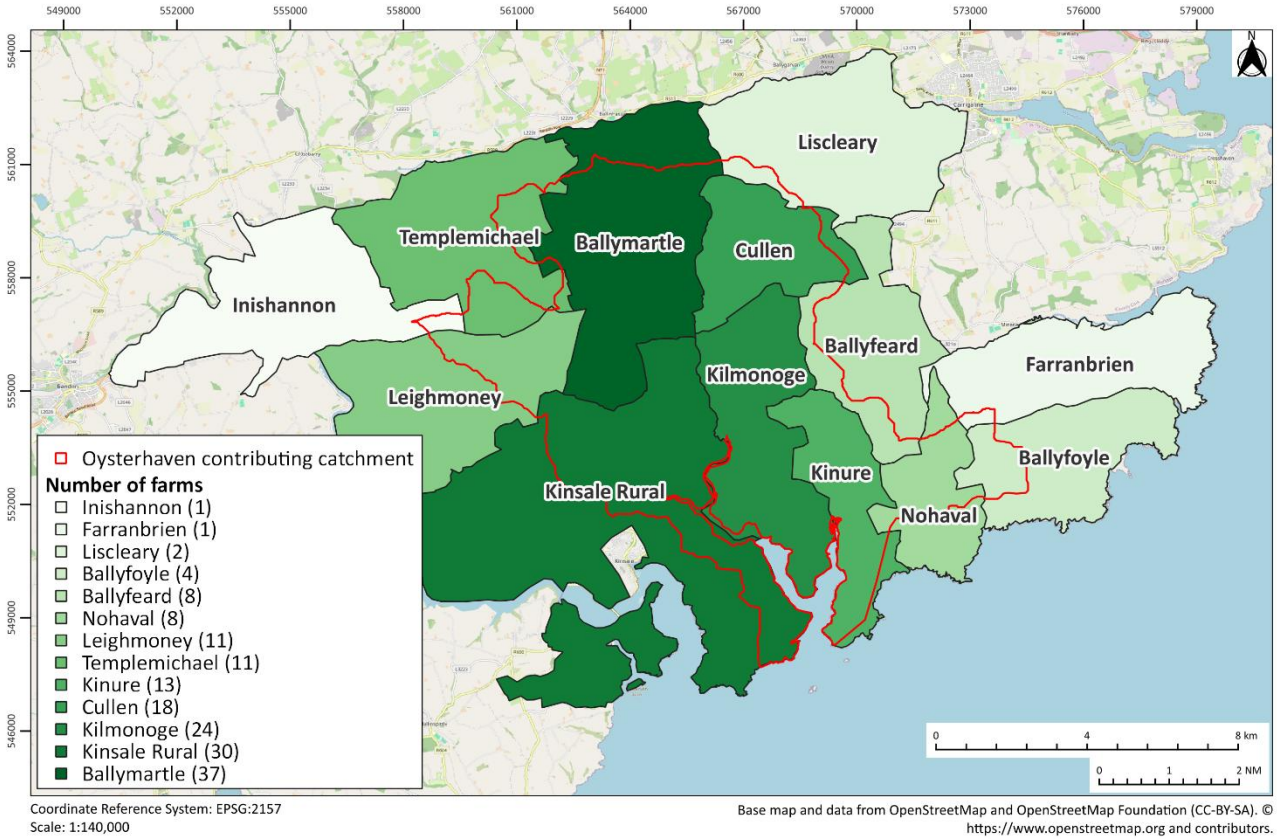

Figure 7-10: Number of farms per electoral division (ED) within the Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the least number of farms, and the darkest colour has the most. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

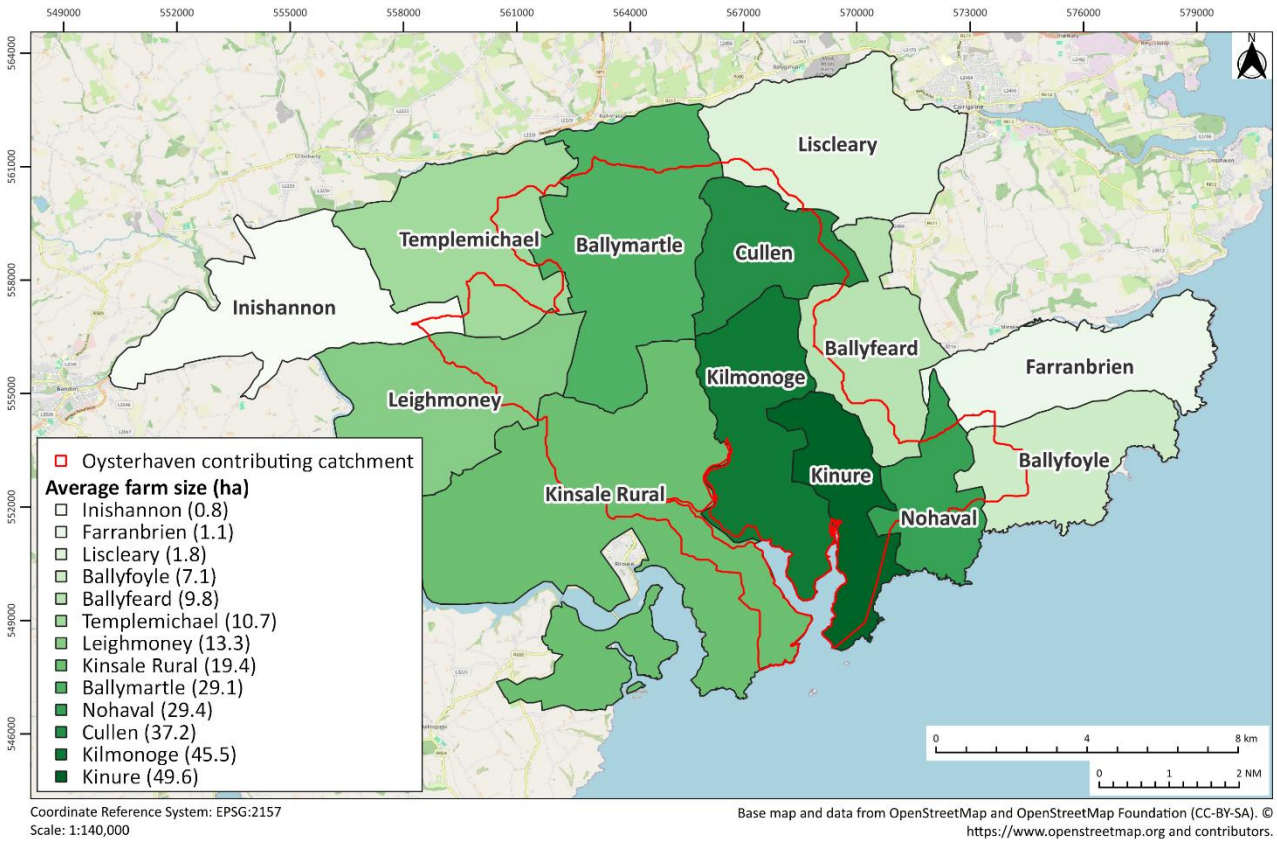

Figure 7-11: Average farm size (ha) per electoral divisions (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the smallest average farm size and the darkest colour has the largest average farm size. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

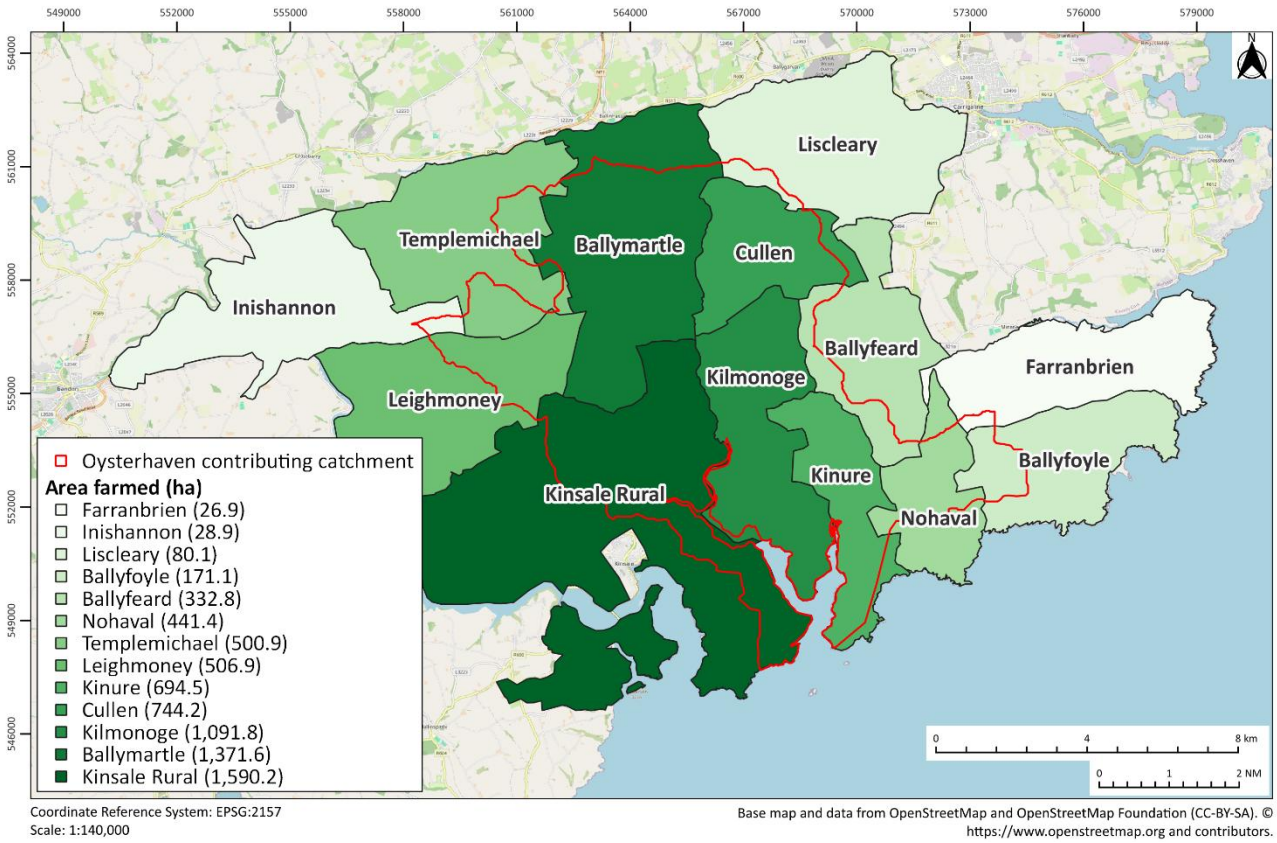

Figure 7-12: Area farmed (ha) per electoral divisions (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the least area farmed and the darkest colour has the most. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Total grass and rough grazing (combination of total pasture, total silage, total hay, and rough grazing) accounted for a high proportion of the area farmed (74.6%) and ranged from 347.3 ha in Kinure to 2,565.3 ha in Kinsale Rural. Total cereals data were available for all EDs, except Templemichael for which it was supressed for confidentiality purposes. Total cereals ranged from 78.7 ha in Liscleary to 1,504.5 ha in Kinsale Rural and accounted for 21.3% of the total area farmed. Within Oysterhaven contributing catchment, the estimated total grass and rough grazing ranged from 15.8 ha in Farranbrien to 1,095.4 ha in Ballymartle; the estimated total cereals ranged from 2.4 ha in Inishannon to 552.6 ha in Kinsale Rural.

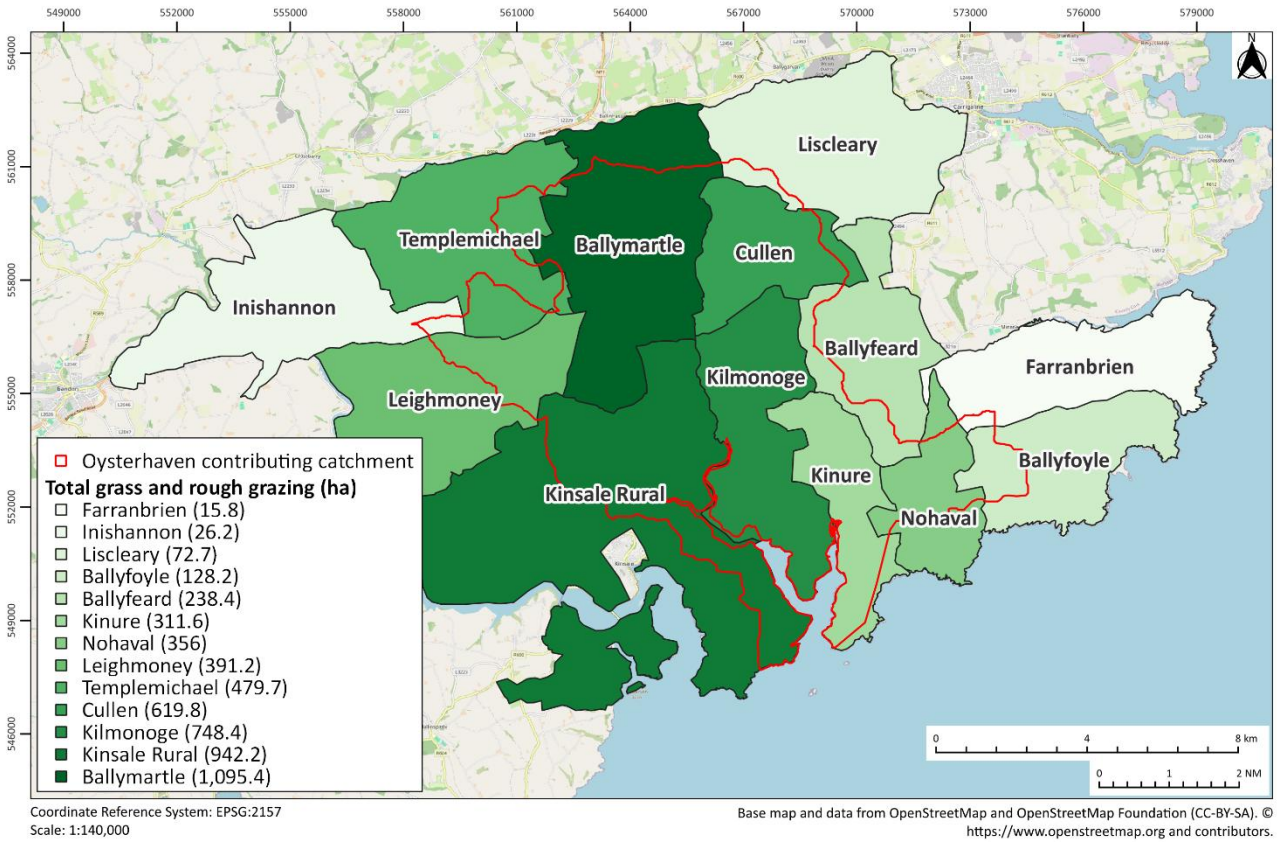

Figure 7-13: Total grass and rough grazing (ha) per electoral division (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the least area of total grass and rough grazing, and the darkest colour has the most. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

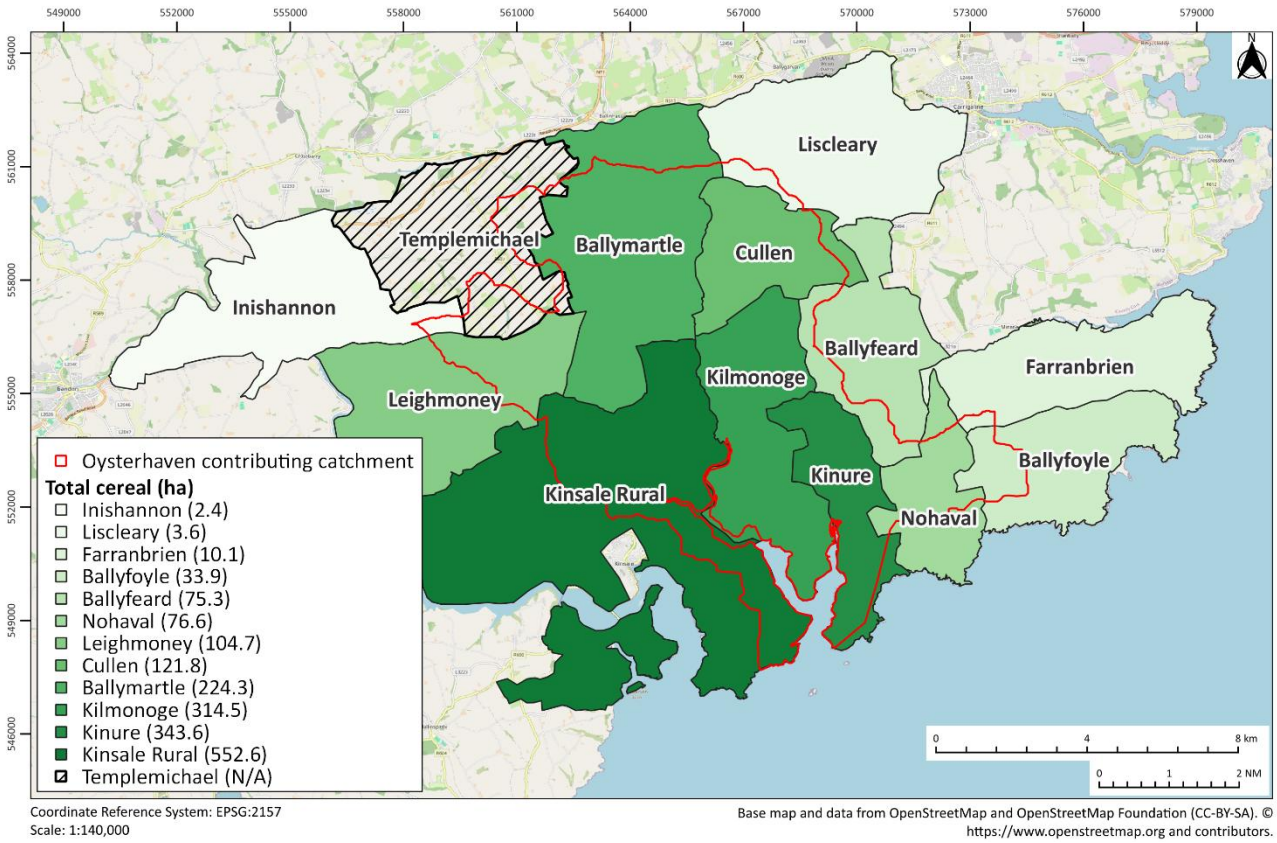

Figure 7-14: Total cereals (ha) per electoral division (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the lowest area of total cereals and the darkest colour has the highest area. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

The total number of cattle within the EDs ranged from 834 in Kinure to 6,397 in Kinsale Rural. The number of dairy cows ranged from 499 in Nohaval to 2,725 in Kinsale Rural; numbers of dairy cows within Kinure and Ballyfoyle were noted as being confidential on the CSO database. The number of other cows ranged from 63 in Kinure to 338 in Leighmoney, these data were confidential for the Cullen ED; see **endnote 22** for definitions of other cows and total cattle per the CSO. Sheep data for all the EDs were labelled confidential on the CSO database at the time of writing this report. Within Oysterhaven contributing catchment, the estimated total number of cattle ranged from 41 in Farranbrien to 3,102 in Ballymartle. The estimated number of dairy cows ranged from 15 in Farranbrien to 1,190 in Ballymartle. The estimated number of other cows ranged from two in Farranbrien to 190 in Ballymartle.

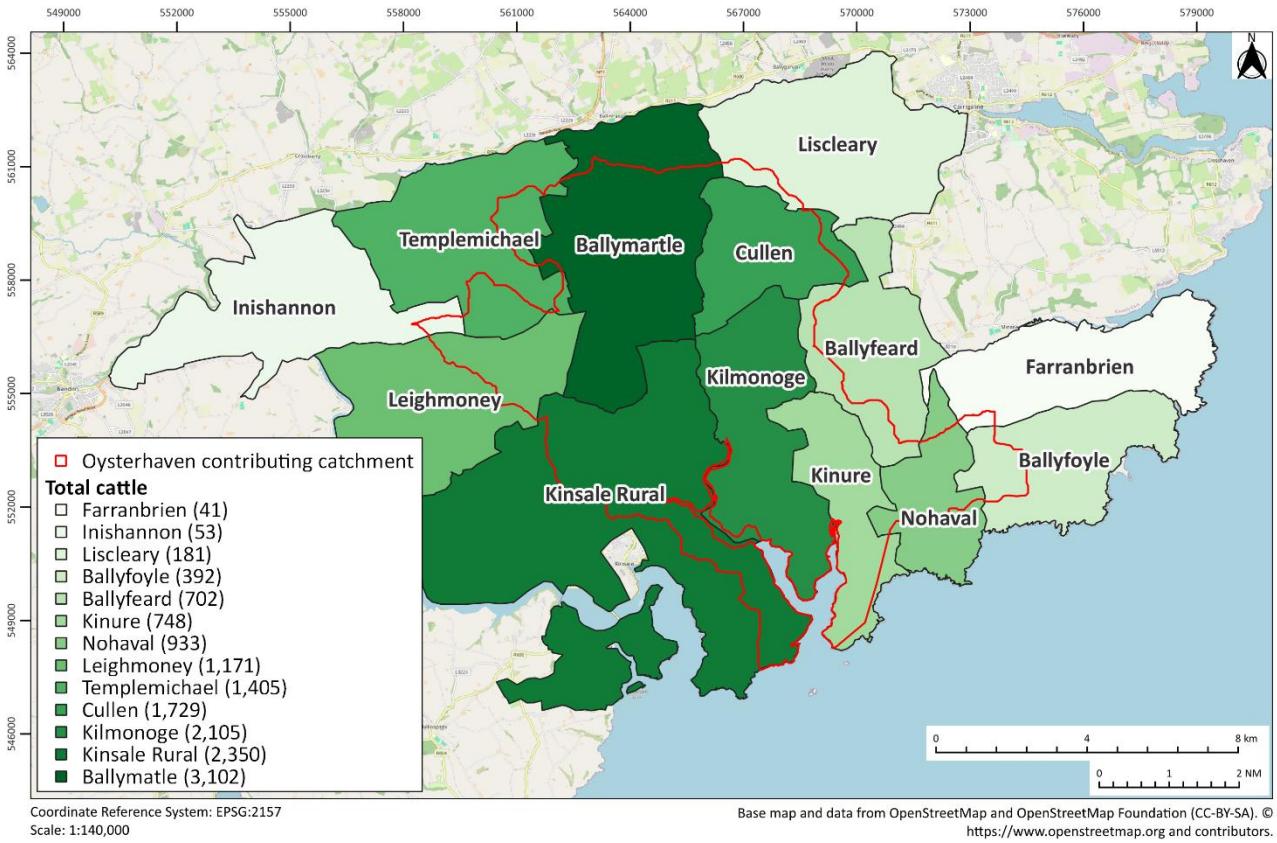

Figure 7-15: Number of cattle[22] per electoral division (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the least number of cattle and the darkest colour has the most. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

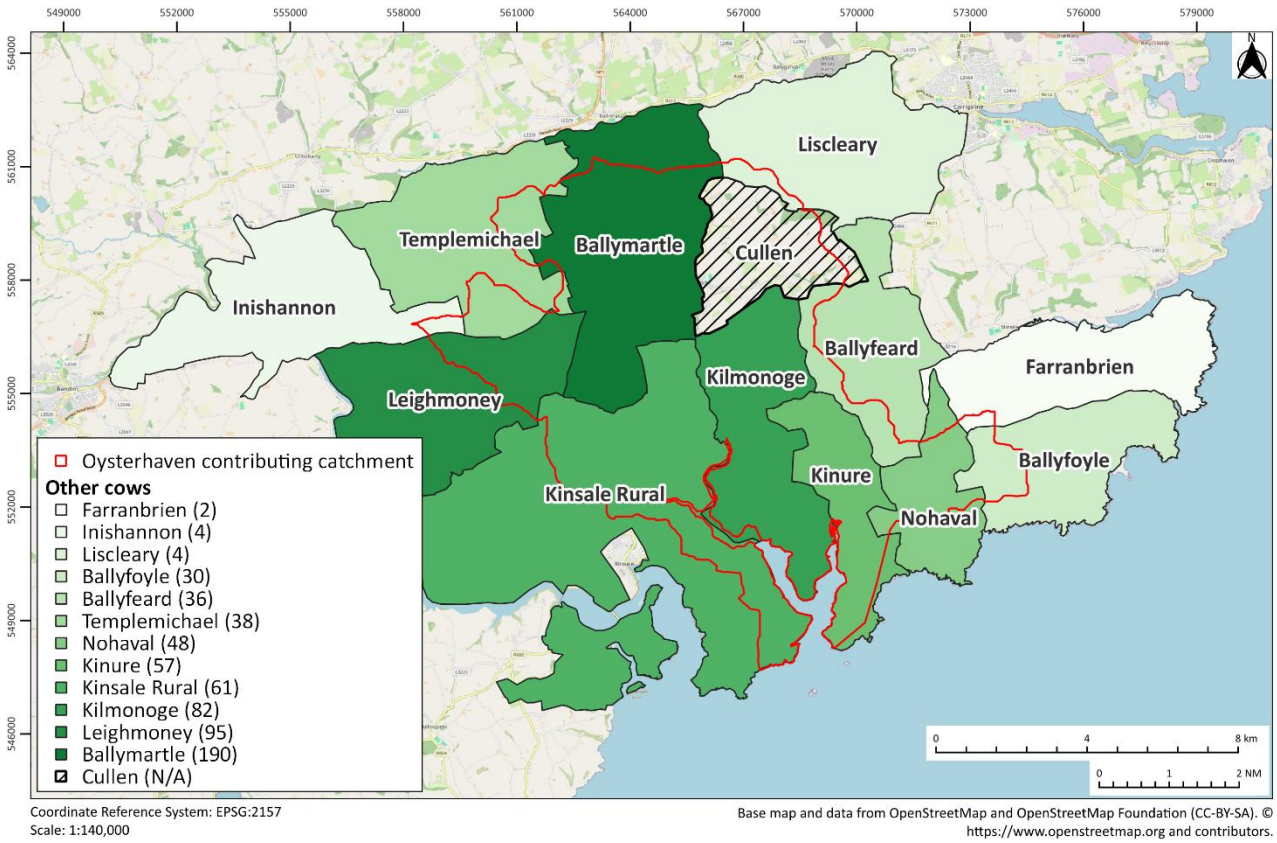

Figure 7-16: Number of other cows[22] per electoral division (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the least number of other cows and the darkest colour has the most. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

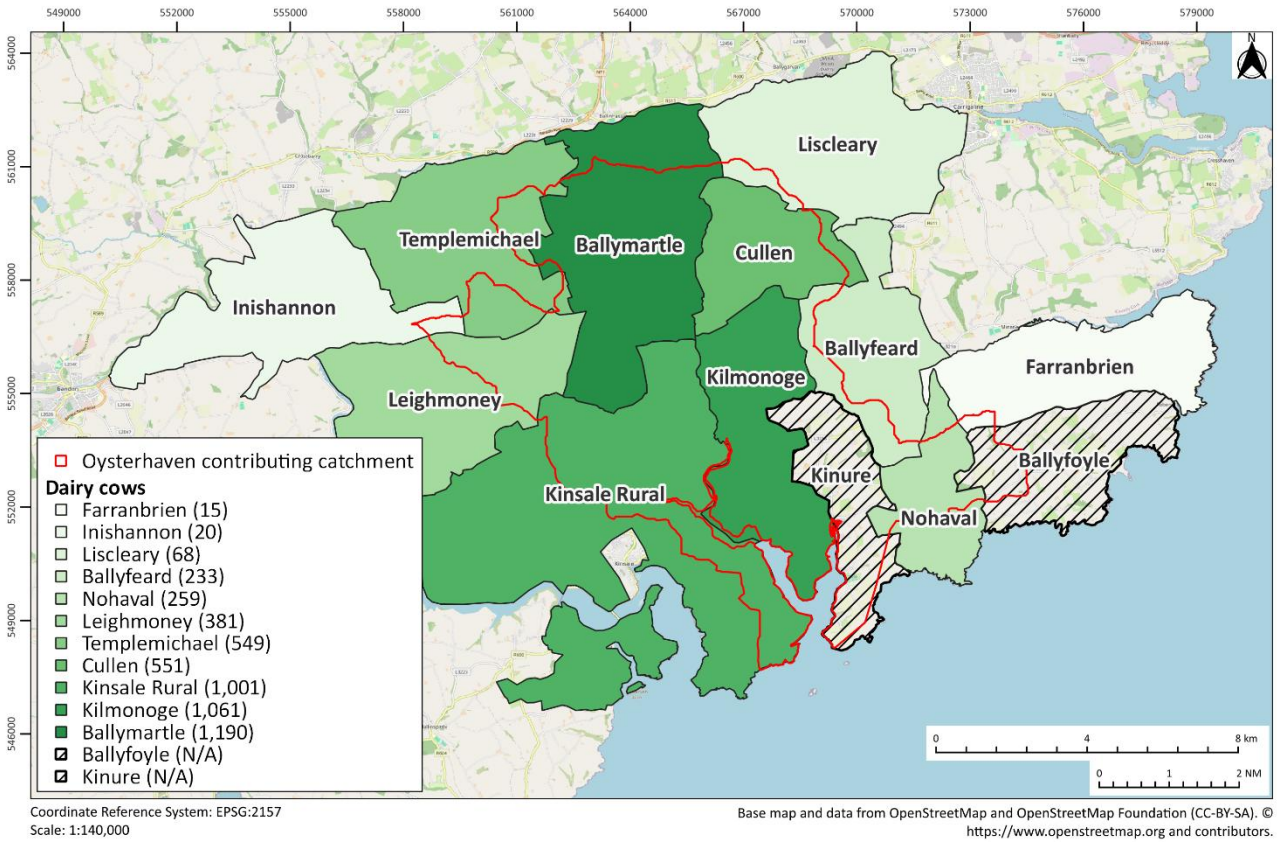

Figure 7-17: Number of dairy cows per electoral division (EDs) within Oysterhaven contributing catchment (source: CSO[12]). EDs are colour coded such that the lightest colour has the least number of dairy cows and the darkest colour has the most. Contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7.5: Overall farm census data for the electoral divisions that overlap with Oysterhaven contributing catchment (source: CSO[12]).

Electoral Divisions (EDs)	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Grass & Rough Grazing (ha)*	Total Cereals (ha)	Total cattle***	Other cows**	Dairy Cows
Ballyfeard	34	1373.2	40.4	983.4	310.6	2895	149	961
Ballyfoyle	24	949.7	39.6	711.5	188	2175	164	*
Ballymartle	47	1727	36.7	1379.2	282.4	3906	239	1498
Cullen	20	816.3	40.8	679.8	133.6	1896	*	604
Farranbrien	24	1250.1	52.1	735.6	467.5	1918	72	705
Inishannon	34	1186.9	34.9	1074.2	97.3	2171	149	802
Kilmonoge	24	1091.8	45.5	748.4	314.5	2105	82	1061
Kinsale Rural	82	4329.4	52.8	2565.3	1504.5	6397	166	2725
Kinure	14	774.1	55.3	347.3	383	834	63	*
Leighmoney	38	1797.9	47.3	1387.6	371.3	4154	338	1353
Liscleary	44	1745.5	39.7	1583.5	78.7	3938	97	1491
Nohaval	15	849.7	56.6	685.4	147.4	1796	92	499
Templemichael	47	2177	46.3	2085	*	6108	166	2388

*Total Grass and Rough Grazing is taken to be the sum of Total Pasture, Total Silage, Total Hay, and Rough Grazing.

**Other cows, as defined by the CSO, are female beef cattle.

***Total cattle is comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.

Table 7.6: Estimated farm census data for the electoral divisions within Oysterhaven contributing catchment (source: CSO[12]).

Electoral Divisions (EDs)	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Grass & Rough Grazing (ha)*	Total Cereals (ha)	Total cattle***	Other cows**	Dairy Cows
Ballyfeard	8	332.8	9.8	238.4	75.3	702	36	233
Ballyfoyle	4	171.1	7.1	128.2	33.9	392	30	*
Ballymartle	37	1371.6	29.1	1095.4	224.3	3102	190	1190
Cullen	18	744.2	37.2	619.8	121.8	1729	*	551
Farranbrien	1	26.9	1.1	15.8	10.1	41	2	15
Inishannon	1	28.9	0.8	26.2	2.4	53	4	20
Kilmonoge	24	1091.8	45.5	748.4	314.5	2105	82	1061
Kinsale Rural	30	1590.2	19.4	942.2	552.6	2350	61	1001
Kinure	13	694.5	49.6	311.6	343.6	748	57	*
Leighmoney	11	506.9	13.3	391.2	104.7	1171	95	381
Liscleary	2	80.1	1.8	72.7	3.6	181	4	68
Nohaval	8	441.4	29.4	356	76.6	933	48	259
Templemichael	11	500.9	10.7	479.7	*	1405	38	549

*Total Grass and Rough Grazing taken to be the sum of Total Pasture, Total Silage, Total Hay, and Rough Grazing.

**Other cows as defined by the CSO are female beef cattle.

***Total cattle is comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.

Several studies have reported a strong association between intensive livestock farming areas and faecal indicator concentrations of microorganisms in streams and coastal waters due to run-off from manure, especially during high flow conditions, both from point and non-point sources of contamination (Crowther *et al.,* 2002). **Table 7.7** shows the potential daily loading of *E. coli* from livestock compared to humans and birds. It can be seen that sheep rank the worst based on the average number of *E. coli* per gram of faecal production, followed by pigs, cows, birds, humans, and poultry.

Table 7.7: Potential daily loading of *E. coli* (Jones & White, 1984).

Source	Faecal Production (g/day)	Average Number (*E. coli*/g)	Daily Load (*E. coli*)	Rank
Man	150	13×10^6	1.9×10^9	5
Cow	23600	0.23×10^6	5.4×10^9	3
Sheep	1130	16×10^6	18.1×10^9	1
Chicken	182	1.3×10^6	0.24×10^9	6
Pig	2700	3.3×10^6	8.9×10^9	2
Gull	15.3	131.2×10^6	2×10^9	4

Data on sheep numbers in the contributing catchment have been marked confidential and so are unavailable. Nonetheless, it cannot be explicitly stated that sheep are not farmed within the contributing catchment, therefore consideration should be given to potential sources of *E. coli* from sheep and how this may increase seasonally during lambing time. Approximately half the agricultural land cover in the area is total grass and rough grazing. Additionally, cattle are present in high densities (14,912) with the highest number located predominantly in the western EDs, particularly Kinsale Rural which is also the largest ED.

Statutory Instrument (SI) No 113/2022[30] sets out regulations per the application of slurry and organic fertilisers, notably the method by which is it spread, the amount, the environmental conditions, and the required distance from water courses. The Fifth Nitrates Action Programme 2022-2025, given effect by S.I. No 113 of 2022, restricts slurry spreading before October 1st of a given year. The programme prohibits the spreading of soiled water between December 1st and 31st, effective from January 1st, 2024 (see publication on the overview of the programme for exceptions[40]).

Furthermore, the Geological Survey of Ireland (GSI) groundwater data viewer[41] shows significant areas of high to extreme groundwater vulnerability occur within the contributing catchment, with rock at or near surface or karst interspersed with areas of extreme vulnerability (**Figure 7-18**). The land along the shoreline of the bay and estuaries is almost entirely comprised of extreme groundwater vulnerability and rock at or near surface or karst; these areas predominantly overlap with pastures and non-irrigated arable land according to the CORINE land cover (see **Figure 7-8**). The GSI map of karst indicates it is not likely that rock at or near surface or karst within the contributing catchment is karstic[42].

The contributing catchment and relevant river sub-basins (see **Figure 8-11**) fall within the Stick sub-catchment (Stick_SC_010). The most recent WFD review found 83% of rivers within the Stick sub-catchment were not at risk and the remaining 17% were under review; however, transitional and coastal water bodies were at risk[43]. Within Stick_SC_010, natural pollution from agriculture was the only significant pressure impacting at risk waterbodies [43]; this indicates that agricultural practices and their impacts are of importance in this region in terms of water quality.

In areas of extreme vulnerability, S.I. No. 133/2022 states that "soiled water" cannot be spread on land if the quantity exceeds 25,000 litres/ha in a 42-day period or at an irrigation rate greater than three mm/hr on land of thickness less than one metre[30]. While the levels of slurry and soiled water spreading were not readily available for Oysterhaven contributing catchment at the time of writing this report, 96.5% (95.1 km^2) of the land is agricultural (predominantly pasture land cover; see **Figure 7-8**) overlapping primarily extreme to high groundwater vulnerability (including rock at or near surface or karst). This provides an indication of the potential discharge levels to groundwater, and subsequently, shellfish production areas in the bay.

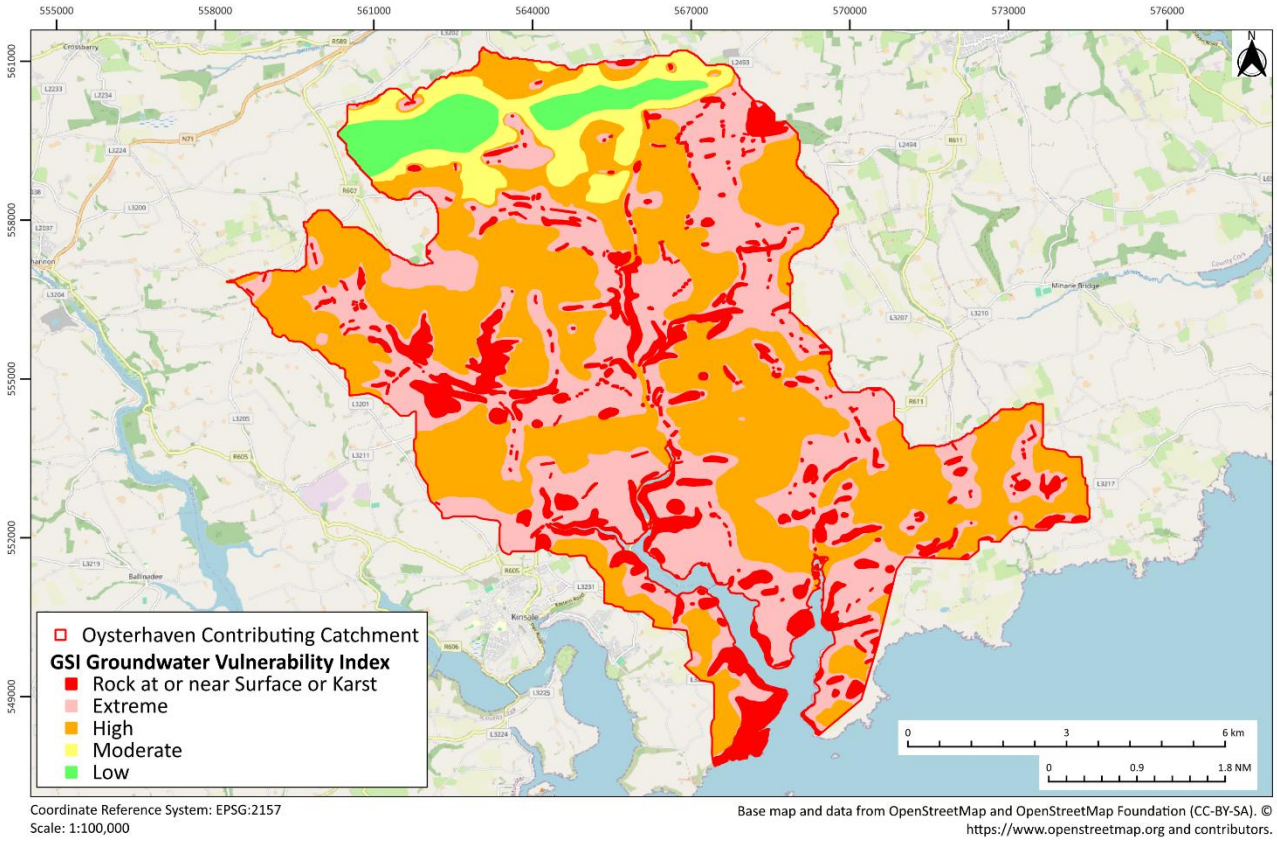

Figure 7-18: Geologic Survey of Ireland (GSI) groundwater vulnerability within Oysterhaven contributing catchment[41]. Contains Irish Public Sector Data (GSI) licensed under a Creative Commons Attribution 4.0 International (CC by 4.0) licence.

7.1.6. Other Pollution Sources

7.1.6.1. Shipping

Operational waste from vessels, if not properly managed, can end up in the sea where the potential for contamination or pollution occurs. Wastes generated or landed in ports and harbours can be broadly divided into a) operational and domestic waste from ships and boats, b) waste from commercial cargo activities, and c) waste generated from maintenance activities and associated maritime industry activities.

Marpol Annex IV defines sewage as "drainage from medical premises, toilets, urinals, spaces containing live animals and other waste waters when mixed with sewage waste streams"[44]. Although adopted in 1973, the Annex did not come into effect internationally until September 2003, with subsequent amendments entered into force in August 2005. Annex IV requires ships to be equipped with either a sewage treatment plant, a sewage comminuting and disinfecting system, or a sewage holding tank. Within three miles of the shore, Annex IV requires that sewage discharges be treated by a certified marine sanitation device prior to discharge into the ocean. Sewage discharges made between three and 12 miles offshore must be treated by no less than maceration and chlorination, and sewage discharges greater than 12 miles from shore are unrestricted. Annex IV also established certain sewage reception facility standards and responsibilities for ports and contracting parties[44].

Ship sewage originates from water-borne human waste, wastewaters generated in preparing food, washing dishes, laundries, showers, toilets, and medical facilities. However, as waste enters the marine environment from many sources, it makes the identification of specific impacts from ship/boat waste very difficult. It is widely recognised that the majority of pollution entering the marine environment comes from land-based sources and atmospheric inputs from land-based industrial activities, with only an estimated 12% originating from shipping activities (GESAMP [Joint Group of Experts on the Scientific Aspects of Marine environmental Pollution], 1990).

The desktop review has identified features which are potentially ports, piers, slips, and jetties (**Figure 7-19**) using Google Satellite imagery; details of each feature can be found in **Table 7.8**. There were no listed commercial harbours or fishing ports in Oysterhaven at the time of writing; Kinsale and Cork City are the nearest harbour and port facilities. With few shore facilities, Oysterhaven offers anchorage and shelter and is the largest natural inlet on the southern coast[45].

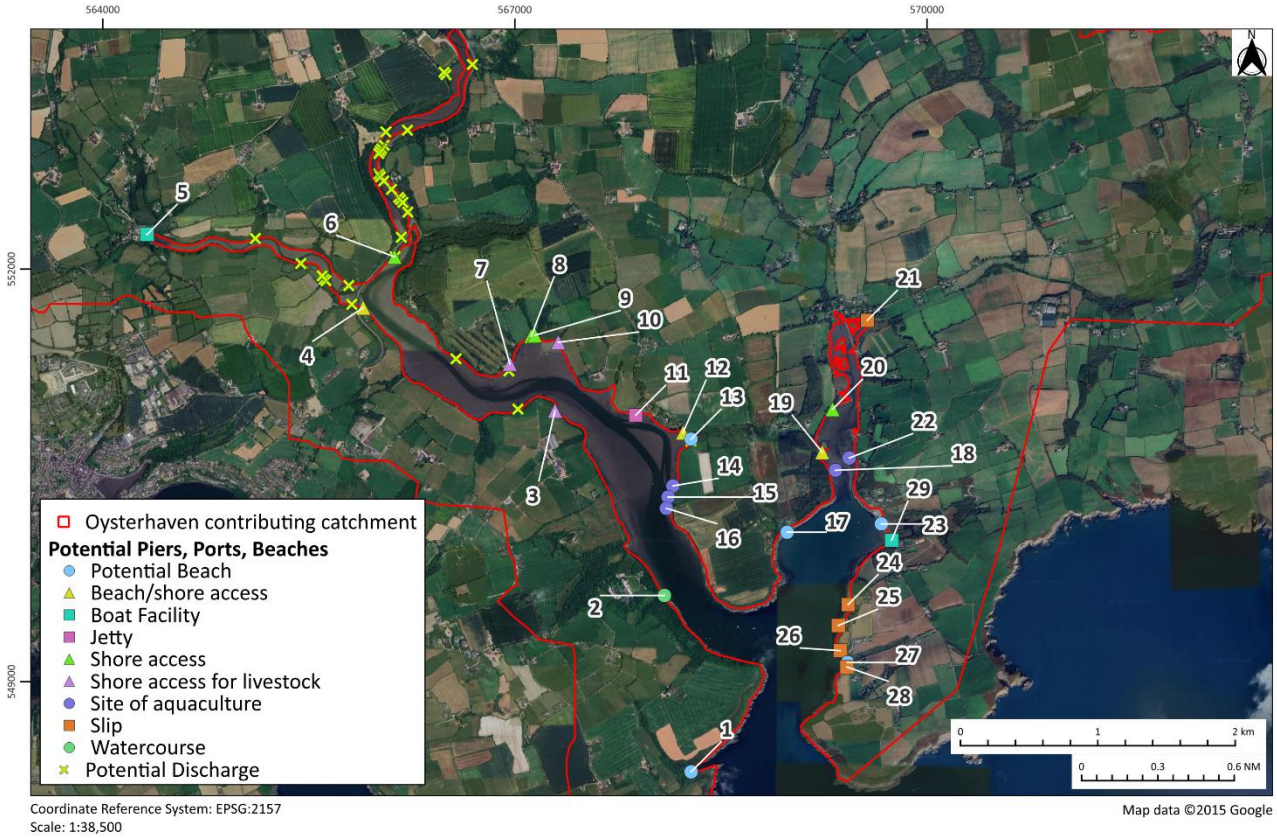

Figure 7-19: Potential beaches, ports, piers, marinas, and slips identified during the desktop review. Map IDs cross-referenced to Table 7.8.

Table 7.8: Potential beaches, ports, piers, marinas, and slips identified during the desktop review, corresponding to Figure 7-19 above. The features listed below were identified using Google Satellite imagery. Latitude and longitude values are in CRS WGS84, easting and northing are in CRS Irish Transverse Mercator[32].

Map ID	Feature	Longitude	Latitude	Easting	Northing
1	Beach	-8.459	51.687	568284.1	548344.3
2	Watercourse	-8.462	51.698	568089.8	549626.8
3	Shore access for livestock	-8.473	51.71	567292.7	550970.6
4	Beach/shore access	-8.494	51.717	565896.4	551720.2
5	Boat facility	-8.516	51.722	564322.7	552252.3
6	Shore access	-8.49	51.72	566124.7	552089.8
7	Shore access for livestock	-8.478	51.713	566963.8	551311.3
8	Shore access	-8.476	51.715	567119.4	551512.6
9	Shore access	-8.475	51.715	567145.7	551519.2
10	Shore access for livestock	-8.473	51.715	567316.3	551468
11	Jetty	-8.465	51.71	567880.2	550937.7
12	Beach/shore access	-8.46	51.709	568225.2	550811.7
13	Kilmonogue Beach	-8.459	51.708	568283.7	550763.4
14	Site of aquaculture	-8.461	51.705	568151.2	550423.9
15	Site of aquaculture	-8.461	51.705	568116.6	550342.7
16	Site of aquaculture	-8.461	51.704	568103.7	550260.7
17	Ringville Bay Beach	-8.449	51.702	568982.6	550086.6
18	Site of aquaculture	-8.444	51.706	569335.2	550537.5
19	Beach/shore access	-8.445	51.708	569238.7	550668.5

Map ID	Feature	Longitude	Latitude	Easting	Northing
20	Shore access	-8.444	51.71	569313.8	550981.3
21	Slip	-8.44	51.716	569567.1	551627.4
22	Site of aquaculture	-8.442	51.707	569435	550626.9
23	Oysterhaven Beach	-8.439	51.703	569669.1	550147.2
24	Slip	-8.442	51.698	569427	549560.4
25	Slip	-8.443	51.696	569356.1	549408.1
26	Slip	-8.443	51.695	569370.2	549225.5
27	Beach	-8.442	51.694	569422.5	549139.5
28	Oysterhaven Slip	-8.442	51.694	569418.2	549106.4
29	Boat Facility	-8.438	51.702	569744	550028.7

7.1.6.2. Wildlife

Birds

It is important to document the bird populations in the Oysterhaven area as bird faeces are rich in faecal bacteria (Oshira & Fujioka, 1995) and have been shown to be a source of faecal contamination in the marine environment (Jones *et al*., 1978; Standridge *et al*., 1979; Levesque *et al.*, 1993; Alderisio & DeLuca, 1999; Levesque *et al*., 2000; Ishii *et al.*, 2007).

The Sovereign Islands are two small islands forming an SPA, *c*. one km from the entrance to Oysterhaven Bay and have been known to support an important cormorant (*Phalacrocorax carbo*) colony since the late 1960s[46]. The islands are also known for breeding herring gull (*Larus argentatus*) and great black-backed gull (*Larus marinus*), whereby the population of great black-backed gulls are resident year-round[46]. While there has been no evidence to suggest oyster cultivation by trestles significantly increases the numbers and abundances of these species in an area, they have been observed loafing, resting, and preening at oyster cultivation sites and utilising intertidal areas, as such these bird species have the potential to occur within the contributing catchment (Hilgerloh *et al*., 2001). Cormorants are highly coastal and intertidal, and the Sovereign Islands hosts the largest breeding colony of cormorants in Co. Cork[46].

Ballinclashet Creek and Belgooly River estuary are subsites[47] within the Stick Estuary monitored under the Irish Wetland Bird Survey (I-WeBS) for wintering waterbird populations. Data over five years are presented in **Table 7.9** for the Stick Estuary[48]. In 2020, the total waterbird population was 1,591 and the five-year mean from 2015/2016 to 2019/2020 was 1,303. Species that had the highest abundances over the five year period were black-tailed Godwit (*Limosa limosa*; 970), curlew (*Numenius arquata*; 869), blacked-headed gull (*Chroicocephalus ridibundus*; 832), lapwing (*Vanellus vanellus* ; 827), and teal (*Anas crecca*; 819); all other species abundances over the five-year period recorded < 800 individuals[48]. 285 herring gull, 44 great-black backed gull, and 36 cormorants were recorded over the five-year period[48]. As observed on I-WeBS and the

National Biodiversity Data Centre (NBDC[7]), a range of waterbirds utilise these areas, subsequently they are likely to contribute to background levels of faecal contamination.

Table 7.9: Total number of waterbirds in Stick Estuary from 2015/2016 to 2019/2020[48].

Year	2015/16	2016/17	2017/18	2018/19	2019/20	5-year mean
Number of Birds	1920	1573	919	512	1591	1303

Aquatic Animals

There are no SACs for marine mammals in Oysterhaven. However, strandings of bottlenosed dolphin (*Tursiops truncatus*), harbour porpoise (*Phocoena phocoena*), and common dolphin (*Delphinus delphis*) have been recorded in the bay, and European otters (*Lutra lutra*) have been recorded in the area, specifically near Ballinaclashet and Belgooly (NBDC[7]). Grey seals (*Halichoerus grypus*) have been documented around the mouth of the bay and further offshore, but there have been no observed records within Oysterhaven Bay[7]. Dolphins and porpoise inhabit a range of marine habitats from shallow coastal waters to the deeper open ocean and have the potential to occur in Oysterhaven Bay, though bottlenosed dolphins have been reported to prefer depths in excess of approximately 20 m (Ingram & Rogan, 2002). Grey seals have been observed outside Oysterhaven Bay; Cronin *et al*. (2011) reported the mean distance travelled by the tagged seals in their study was 50.85 km, with a significant degree of variation between individuals.

All aquatic mammals that occur within Oysterhaven contributing catchment are likely to add to background levels of faecal contamination within the area. While there were few records of marine mammals within Oysterhaven Bay according to NBDC, considering their foraging and habitat ranges, there is potential for the aforementioned marine mammals to occur there. However, contributions to *E. coli* levels are expected to be low in comparison to bays and inlets around Ireland that have high densities of marine mammal observations and records.

7.2. Shoreline Survey

The aim of the shoreline survey is to confirm all observations from the desktop survey and to identify all additional discharges, pollution sources, waterways, and marinas along the shoreline. As part of the survey GPS (Global Positioning System) coordinates were recorded for all features and marked on a map. In addition, all features were photographed digitally (where possible). Notes were made of most of the features regarding the observation being made.

7.2.1. Shoreline Survey Report

Shoreline surveys undertaken by the SPFA to cover the extent of the contributing catchment shoreline were carried out between the 8th and 12th of September 2024. **Figure 7-20** shows the GPS locations of 47 sites, most of which were photographed (see **Appendix 4: Shoreline Survey Images,** note 13 features were not photographed). The shoreline survey transects can be determined from the data points in this figure; the shoreline was walked where practical.

Of the features observed, there were 20 streams, two rivers, 12 sites with drains, one pasture, one outflow, three oyster trestle sites, one pontoon, one slip, two road bridges, one sluice gate, two beach access points, and one site with cows. Additionally, 11 water sampling points were established as part of the bacteriological survey. **Table 7.10** details all the features identified, and the numbering used is cross-referenced to **Figure 7-21** to **Figure 7-30**.

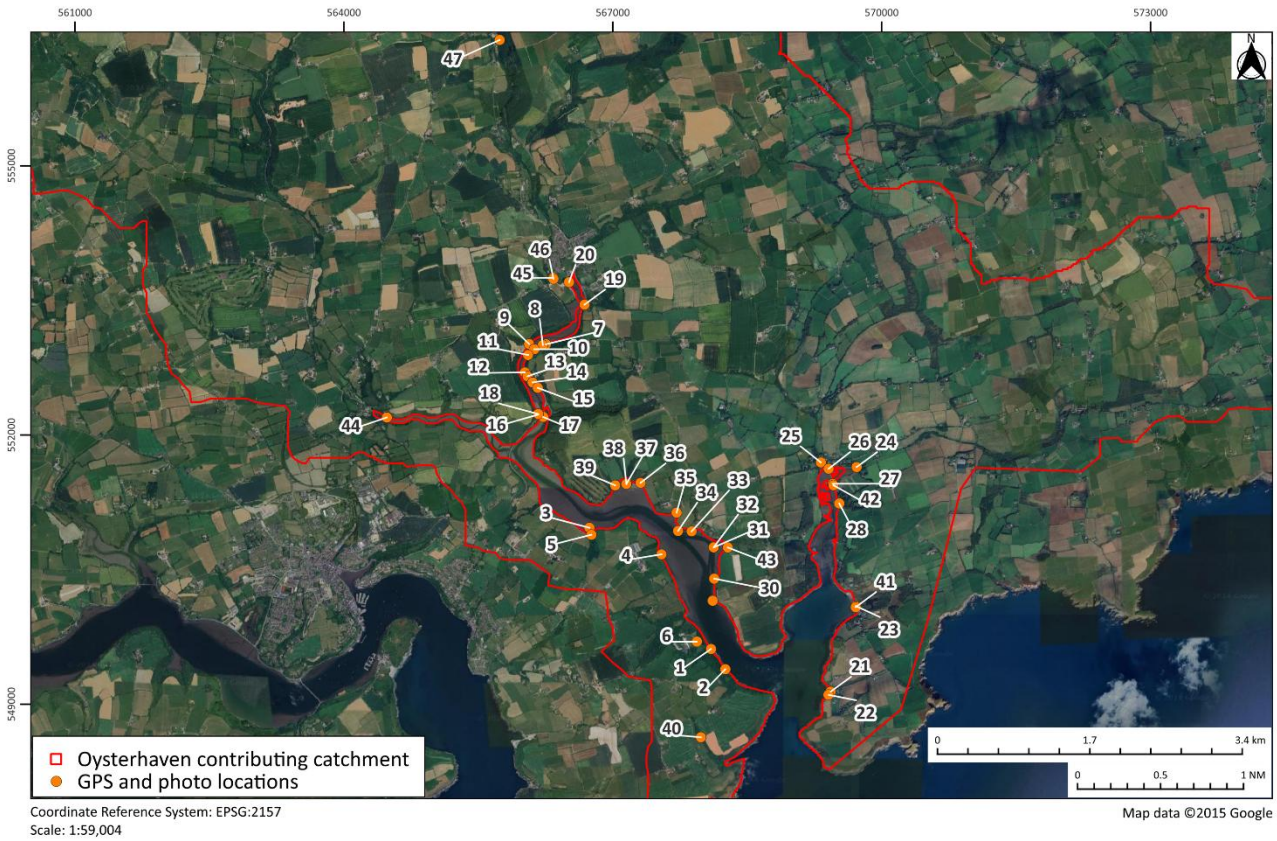

Figure 7-20: Locations of GPS and identified features from the shoreline survey (numbering cross-referenced to Table 7 10).

Table 7.10: Features identified during the shoreline survey. Latitude and longitude values are in coordinate reference system (CRS) WGS84, easting and northing values are in CRS Irish Transverse Mercator[32]. Refer to Figure 7-20 to Figure 7-30 for locations and Appendix 4: Shoreline Survey Images for photographs.

No.	Observation	Comments	Photo IDs	Latitude	Longitude	Easting	Northing
1	Outflow	Anaerobic patch with an odour.	1	51.69802	-8.46151	568097.4	549615
2	Stream	Stream. No evidence of contamination.	2	51.696	-8.45918	568257.1	549389.2
3	Stream	Stream. No evidence of contamination.	3	51.71009	-8.48127	566740.3	550966.5
4	Cows	Pasture with 25 cows in field.	4	51.70747	-8.4696	567544.9	550669.8
5	Stream	Stream. No evidence of contamination.	5	51.70939	-8.48094	566762.6	550888.4
6	Potential filtration	Potential filtration plant	6	51.69875	-8.46381	567938.9	549697.2
7	Drain	Under road.	7	51.72844	-8.4885	566254.3	553011.1
8	Drain	Under road.	8	51.72836	-8.48899	566220.4	553002.4
9	Stream	No comment provided from shoreline survey	9	51.72846	-8.49121	566067.1	553014.5
10	Drain	Under road.	10	51.72794	-8.49036	566125.5	552956.3
11	Drain	Under road.	11	51.72736	-8.49136	566056	552892.2
12	Drain	Under road.	12	51.72561	-8.49186	566020.1	552697.8
13	Drain	Under road.	13	51.72522	-8.49143	566049.5	552654.2
14	Drain	Under road.	14	51.72461	-8.4906	566106.4	552586
15	Drain	Under road.	15	51.72407	-8.48976	566164	552525.5
16	Stream	Stream. No evidence of contamination.	16	51.72139	-8.48966	566168.9	552227.3
17	Stream	Stream. No evidence of contamination.	17	51.72116	-8.48886	566224	552201.4
18	Stream	Stream. No evidence of contamination.	18	51.72145	-8.48966	566169.3	552233.6
19	Drain	Under road.	19	51.73244	-8.4823	566685.6	553453.2
20	Stream	Stream. No evidence of contamination.	20	51.73468	-8.48482	566513.2	553703.5
21	Stream	Stream	No photo	51.69382	-8.44216	569432.2	549139.5
22	Slip	Slip	No photo	51.6935	-8.4425	569408.5	549104
23	Sluice gate	In marsh in front of an adventure centre. No evidence of contamination.	21	51.70241	-8.43818	569713.1	550093.4
24	Stream and bridge	Road bridge.	No photo	51.71634	-8.43818	569722.4	551643
25	Drain and stream	Drain flowing into river with high *E. coli* outputs	22	51.71678	-8.44396	569323.3	551694.3
26	Drain	Three drains.	23	51.71615	-8.4427	569409.9	551623.7
27	Road bridge	Road bridge over river.	24	51.71465	-8.442	569457.3	551456.6

28	Drain	Drain under road with noticeable froth on surface of the water.	26	51.71268	-8.44096	569527.8	551237
29	Trestles	Start of trestles.	27	51.70286	-8.46129	568116.1	550152.9
30	Trestles	End of trestles.	28	51.70507	-8.46107	568132.8	550399
31	Stream	No comment provided from shoreline survey	No photo	51.70821	-8.46115	568129.5	550748.4
32	Beach access	No comment provided from shoreline survey	29	51.70821	-8.46118	568127.4	550748.4
33	Pontoon	No comment provided from shoreline survey	30	51.7098	-8.46476	567881.1	550926.8
34	Trestles	Trestles.	31	51.70983	-8.46695	567729.8	550931.1
35	Stream	No comment provided from shoreline survey	32	51.71166	-8.46721	567713.1	551134.8
36	Stream and pipe	Pipe is partially buried.	33	51.71462	-8.47306	567311	551466.7
37	Stream	Two streams. No evidence of contamination.	34	51.7145	-8.47535	567152.6	551454.4
38	Beach access	Beach access with evidence of tyre tracks.	35	51.7145	-8.47535	567152.6	551454.4
39	Stream	Stream. No evidence of contamination.	No photo	51.71435	-8.47715	567028.1	551438.5
40	Stream	No comment provided from shoreline survey	No photo	51.68917	-8.46306	567984	548631.2
41	Stream	Activity Centre bridge and stream near Oysterhaven Beach	No photo	51.7023	-8.4382	569711.6	550081.2
42	Bridge	Ballinaclashet Bridge	No photo	51.7145	-8.4419	569464.1	551439.8
43	Stream	Oysterhaven shellfish site stream	No photo	51.7082	-8.4589	568284.9	550746.3
44	Stream	No comment provided from shoreline survey	No photo	51.721	-8.5141	564480.1	552195.6
45	Pipe	Belgooly GAA river pipe	No photo	51.7351	-8.48736	566338	553751.4
46	River	Belgooly GAA river #2	No photo	51.735	-8.48734	566339.3	553740.3
47	River	River Stick	No photo	51.7589	-8.4963	565738.6	556403.1

Figure 7-21: Features 1, 2, 6, and 40 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-22: Features 3, 5, and 36-39 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-23: Features 4, 29-35, and 43 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-24: Features 7-11 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

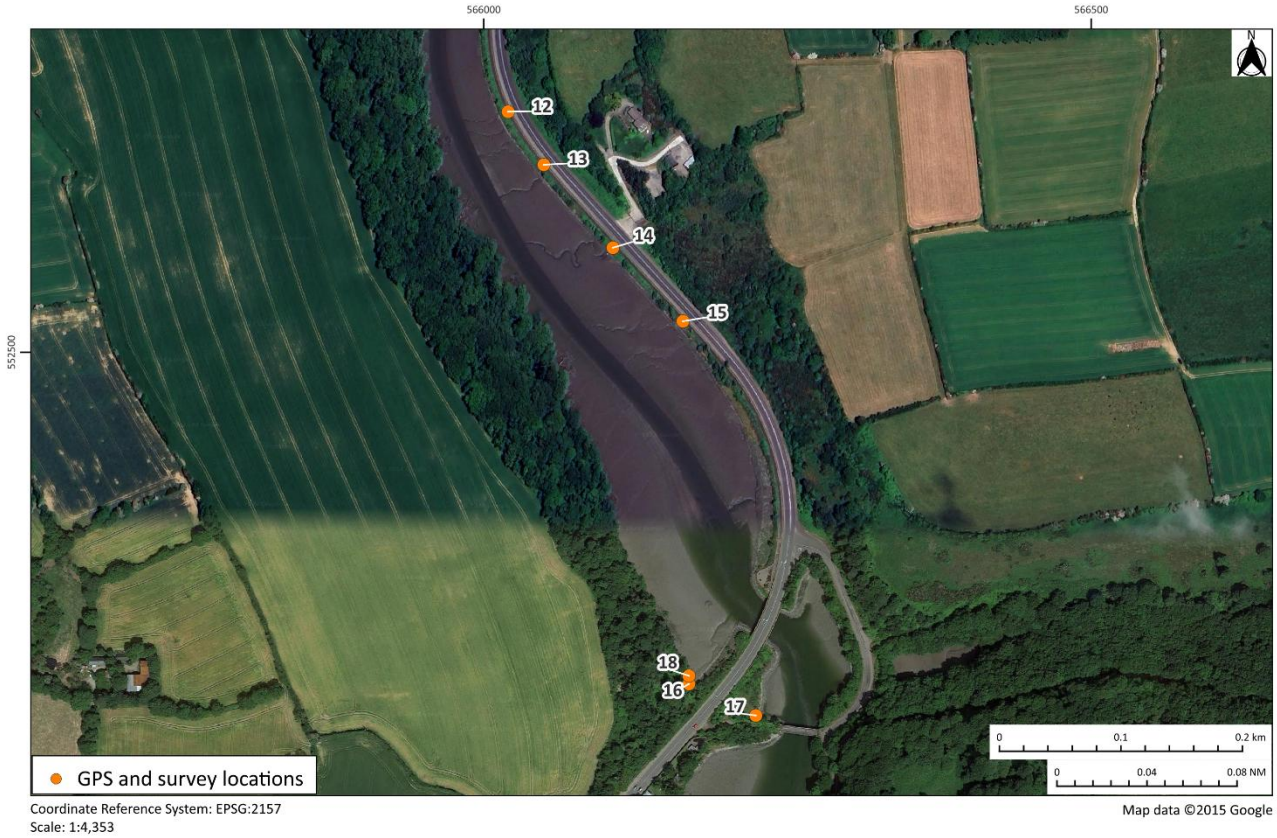

Figure 7-25: Features 12-18 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-26: Features 19, 20, 45, and 46 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

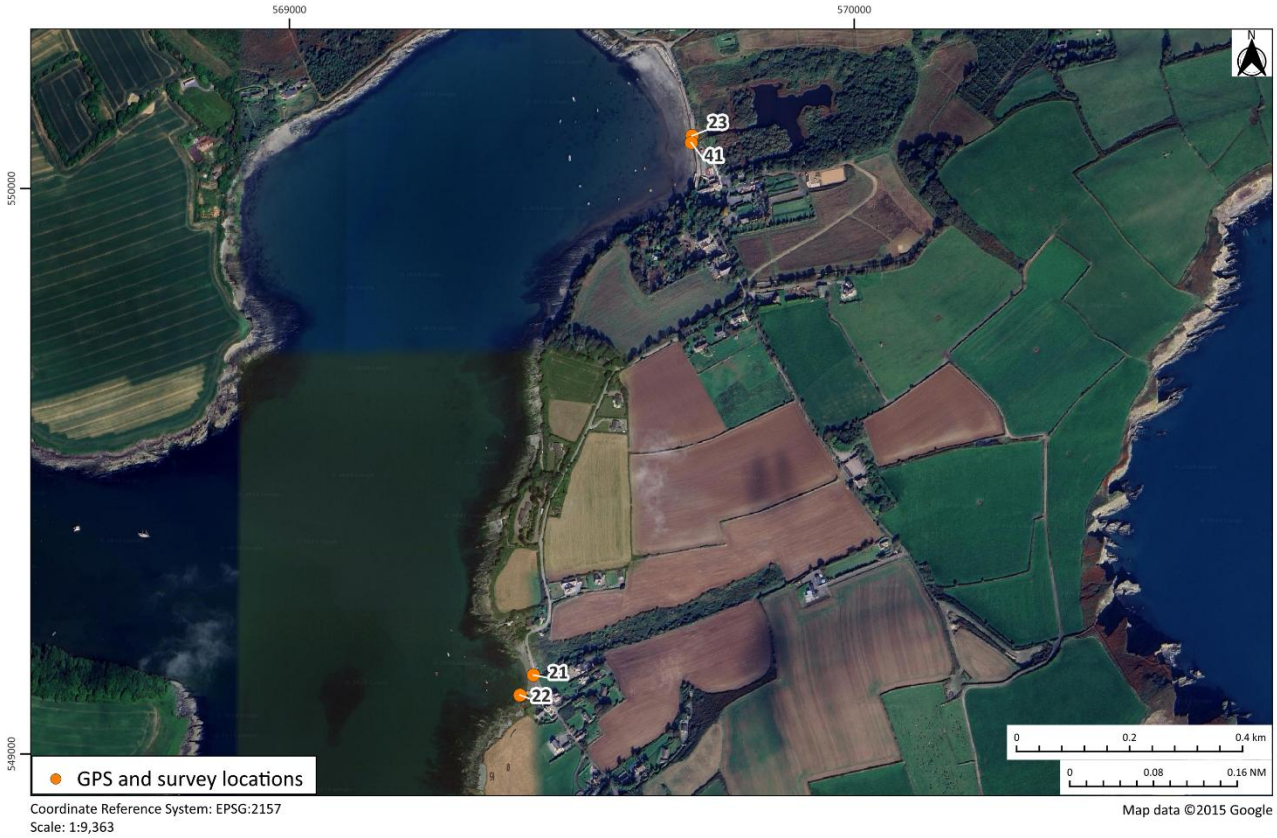

Figure 7-27: Features 21-23, and 41 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-28: Features 24-28, and 42 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-29: Feature 44 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-30: Feature 47 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

7.2.2. Locations of Sources

Figure 7-31 shows all river/streams that discharge into Oysterhaven and **Table 7.11** provides cross-referenced details for this map. **Figure 7-32** shows all discharges into Oysterhaven contributing catchment and **Table 7.12** provides cross-referenced details for discharges such as drains, pipes, rivers and streams.

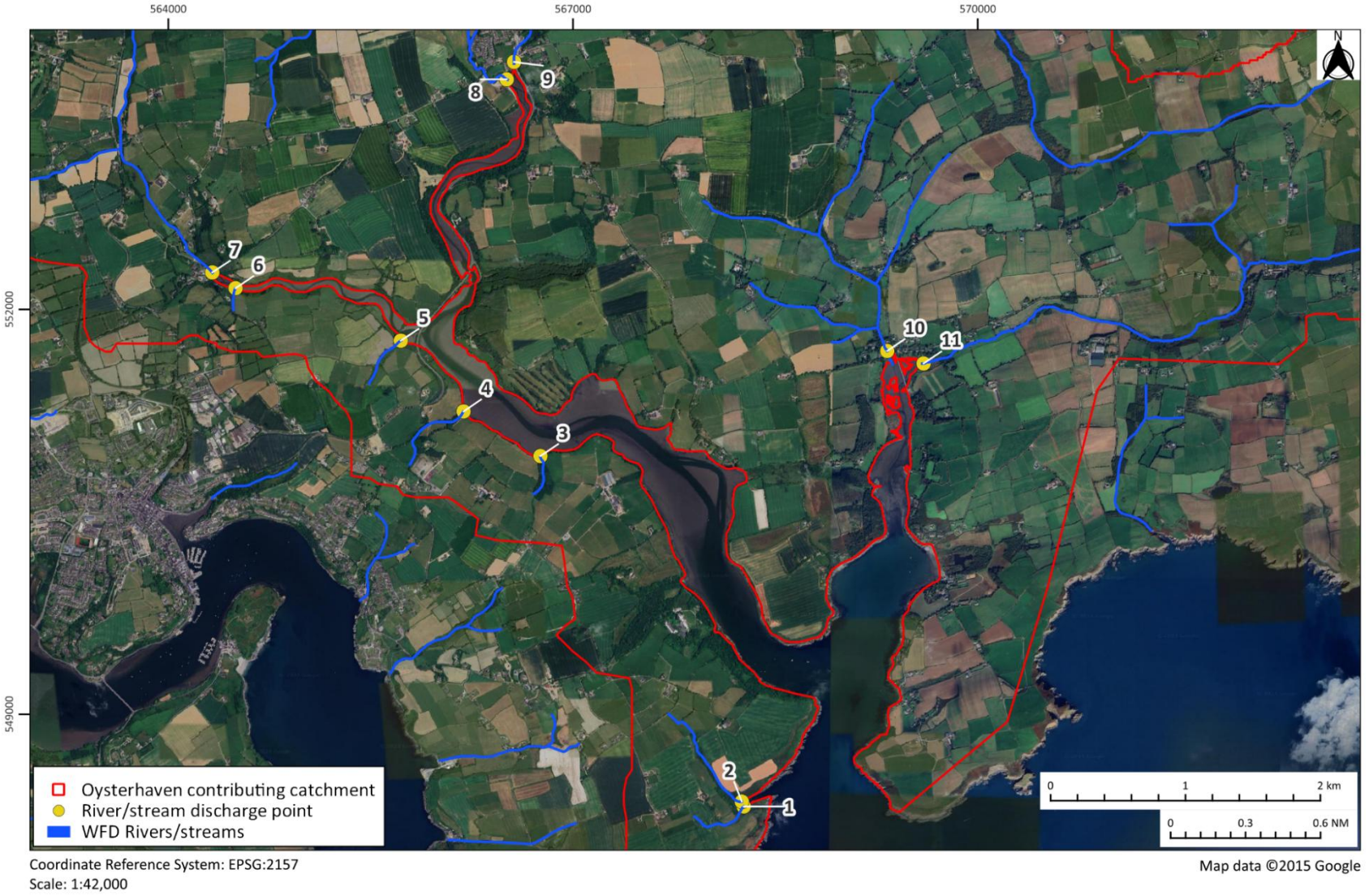

Figure 7-31: Location of all river/stream discharge points into Oysterhaven Bay according to EPA (source: EPA Geoportal[49]). Map IDs cross-referenced to Table 7.11. This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7.11: River/stream discharge points that discharge from the contributing catchment into Oysterhaven Bay. Map IDs are cross referenced to Figure 7-31. River names are those identified by the EPA (source: EPA Geoportal[49]).

Map ID	River name
1	Ballymacus
2	Rathmore 20
3	Mountlong
4	Farranatouke
5	Water-land North
6	Farranarouga
7	Farranamoy
8	N/A
9	Ballindeenisk 20
10	Newborough
11	Knocknanav

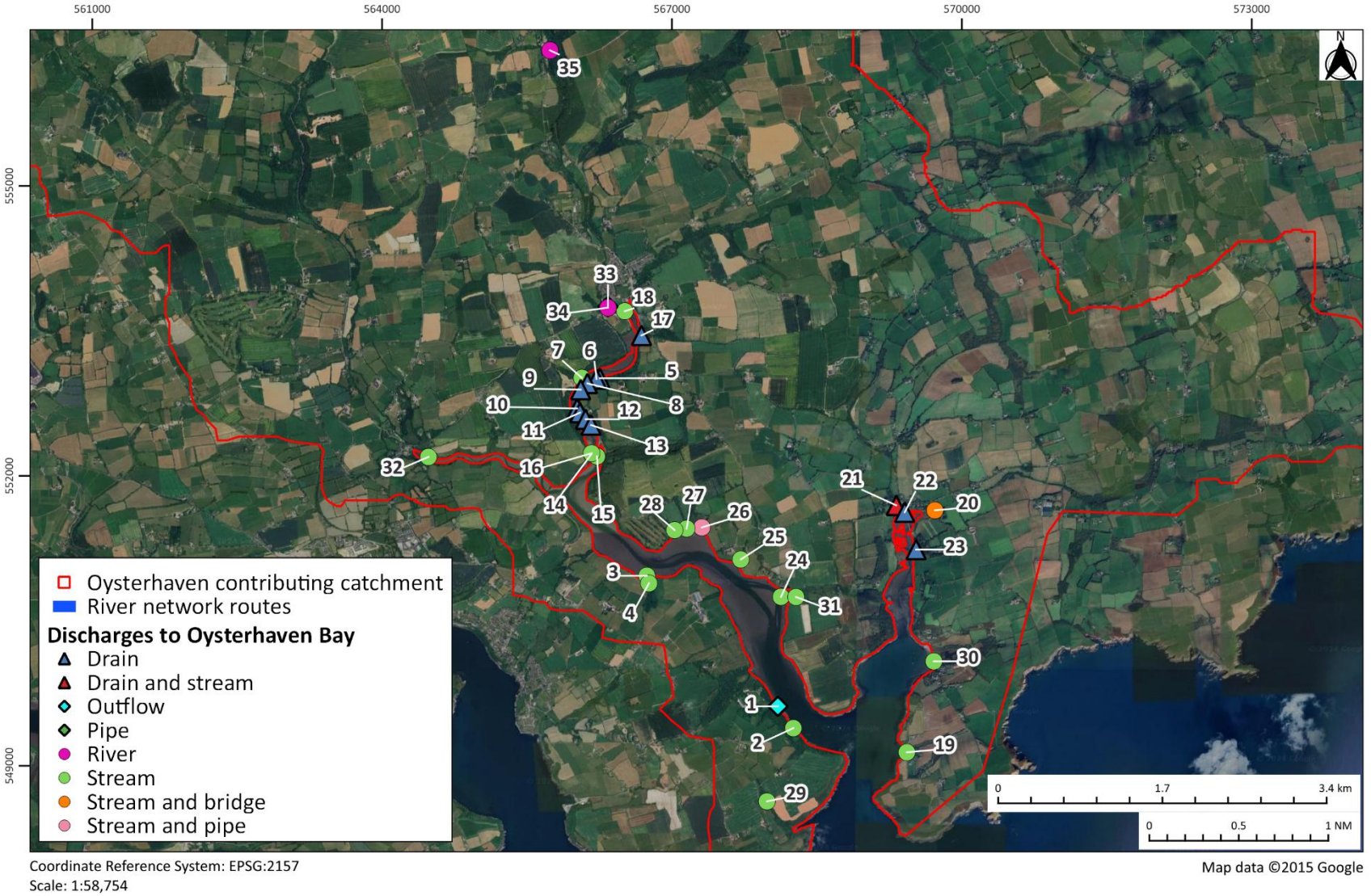

Figure 7-32: Locations of discharges, as observed during the shoreline surveys, into Oysterhaven Bay. Map IDs can be cross referenced to Table 7.12. This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7.12: Locations of discharges, as observed during the shoreline surveys, that discharge into Oysterhaven Bay. Map IDs can be cross-referenced to Figure 7-32. Latitude and longitude values are in CRS WGS84, easting and northing are in CRS Irish Transverse Mercator[32]. Refer to Appendix 4: Shoreline Survey Images for corresponding photo IDs.

Map ID	Observation	Comments	Photo IDs	Latitude	Longitude	Easting	Northing
1	Outflow	Anaerobic patch with an odour.	1	51.69802	-8.46151	568097.4	549615
2	Stream	Stream. No evidence of contamination.	2	51.696	-8.45918	568257.1	549389.2
3	Stream	Stream. No evidence of contamination.	3	51.71009	-8.48127	566740.3	550966.5
4	Stream	Stream. No evidence of contamination.	5	51.70939	-8.48094	566762.6	550888.4
5	Drain	Under road.	7	51.72844	-8.4885	566254.3	553011.1
6	Drain	Under road.	8	51.72836	-8.48899	566220.4	553002.4
7	Stream	No comment provided from shoreline survey	9	51.72846	-8.49121	566067.1	553014.5
8	Drain	Under road.	10	51.72794	-8.49036	566125.5	552956.3
9	Drain	Under road.	11	51.72736	-8.49136	566056	552892.2
10	Drain	Under road.	12	51.72561	-8.49186	566020.1	552697.8
11	Drain	Under road.	13	51.72522	-8.49143	566049.5	552654.2
12	Drain	Under road.	14	51.72461	-8.4906	566106.4	552586
13	Drain	Under road.	15	51.72407	-8.48976	566164	552525.5
14	Stream	Stream. No evidence of contamination.	16	51.72139	-8.48966	566168.9	552227.3
15	Stream	Stream. No evidence of contamination.	17	51.72116	-8.48886	566224	552201.4
16	Stream	Stream. No evidence of contamination.	18	51.72145	-8.48966	566169.3	552233.6
17	Drain	Under road.	19	51.73244	-8.4823	566685.6	553453.2
18	Stream	Stream. No evidence of contamination.	20	51.73468	-8.48482	566513.2	553703.5
19	Stream	Stream	No photo	51.69382	-8.44216	569432.2	549139.5
20	Stream and bridge	Road bridge.	No photo	51.71634	-8.43818	569722.4	551643
21	Drain and stream	Drain flowing into river with high *E. coli* outputs	22	51.71678	-8.44396	569323.3	551694.3
22	Drain	Three drains.	23	51.71615	-8.4427	569409.9	551623.7
23	Drain	Drain under road with noticeable froth on surface of the water.	26	51.71268	-8.44096	569527.8	551237
24	Stream	No comment provided from shoreline survey	No photo	51.70821	-8.46115	568129.5	550748.4
25	Stream	No comment provided from shoreline survey	32	51.71166	-8.46721	567713.1	551134.8
26	Stream and pipe	Pipe is partially buried.	33	51.71462	-8.47306	567311	551466.7

Map ID	Observation	Comments	Photo IDs	Latitude	Longitude	Easting	Northing
27	Stream	Two streams. No evidence of contamination.	34	51.7145	-8.47535	567152.6	551454.4
28	Stream	Stream. No evidence of contamination.	No photo	51.71435	-8.47715	567028.1	551438.5
29	Stream	No comment provided from shoreline survey	No photo	51.68917	-8.46306	567984	548631.2
30	Stream	Activity Centre bridge and stream near Oysterhaven Beach	No photo	51.7023	-8.4382	569711.6	550081.2
31	Stream	Oysterhaven Shellfish site stream	No photo	51.7082	-8.4589	568284.9	550746.3
32	Stream	No comment provided from shoreline survey	No photo	51.721	-8.5141	564480.1	552195.6
33	Pipe	Belgooly GAA river pipe	No photo	51.7351	-8.48736	566338	553751.4
34	River	Belgooly GAA river #2	No photo	51.735	-8.48734	566339.3	553740.3
35	River	River Stick	No photo	51.7589	-8.4963	565738.6	556403.1

8. Appendix 2: Hydrography/Hydrodynamics

8.1. Simple/Complex Models

At the time of writing there were no hydrodynamic models available of Oysterhaven Bay.

8.2. Depth

Oysterhaven is predominantly an intertidal bay characterised by a gradual depth profile, with depths ranging from approximately one meter in the centre of the bay to around 10 meters at the entrance as illustrated in **Figure 8-1**. The shallow intertidal zones are particularly extensive during low tide. The bathymetry of the bay, as illustrated in **Figure 8-1**, shows a gently sloping seabed, which plays a crucial role in the circulation patterns and water exchange with the open sea (Mercier & Guillou, 2021). This depth profile, combined with the semi-enclosed nature of the bay, contributes to its unique hydrodynamic environment, influencing both sediment transport and the distribution of nutrients within the bay (Williams, 1970).

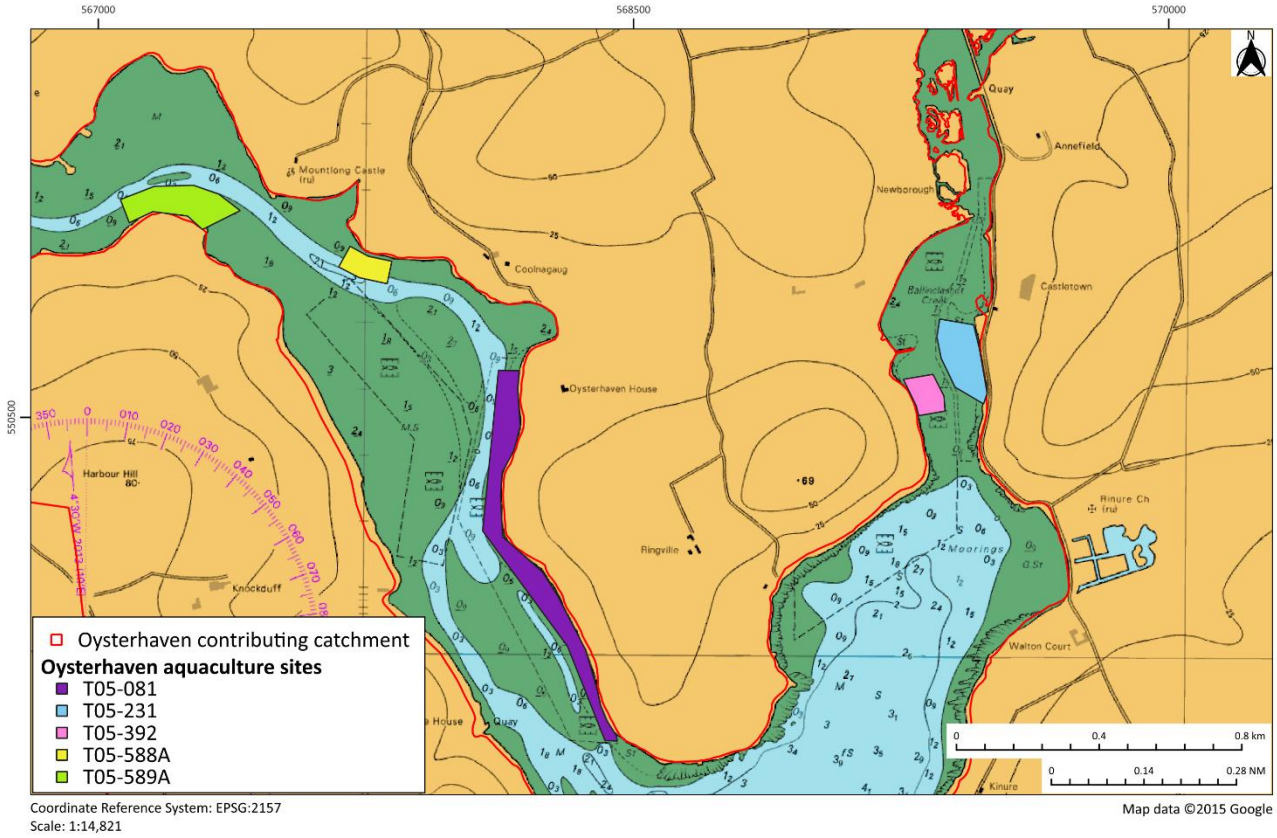

Figure 8-1: Oysterhaven Bay bathymetry and licensed sites for shellfish aquaculture.

8.3. Tides and Currents

The mean tidal range in Oysterhaven Bay typically varies between two and 3.5 meters, with a maximum recorded range of 4.37 meters (AQUAFACT, 2013). This variation reflects the regular daily fluctuations in water

levels caused by the semi-diurnal tidal pattern, which is characteristic of the southern coast of Ireland. These tidal movements play a crucial role in the bay's hydrodynamics, influencing water circulation and the exchange of water with the open sea. The semi-diurnal tides contribute to the flushing of the bay, helping to disperse potential pollutants and maintain water quality (Jiang & Gerkema, 2019). This natural flushing action is particularly important for the health of shellfish waters, as it reduces the concentration of contaminants and supports the overall ecological balance of the bay.

8.4. Wind and Waves

Wind data from 2019-2023 from Roches Point Met Éireann[50] station (**Figure 8-14**) are displayed in **Table 8.1** and **Table 8.2** below, and wind roses for each corresponding year can be seen in **Figure 8-2** to **Figure 8-4**.

Across the five-year data set, approximately 30% of the wind came from the south-southwest, *c.* 22% from the west, and *c.* 18% from the northwest. It can be seen from the wind roses (**Figure 8-4**) that the prevailing wind came from the southwest, Ireland's prevailing wind direction.

Table 8.2 shows the seasonal wind averages from 2019 to 2023. Seasons were selected by grouping the results from the following periods: spring (March-May), summer (June-August), autumn (September-November), and winter (December-February). Seasonal averages over the past five years indicated that winds are typically strongest in the winter months (14.3 kn), followed by autumn (12.7 kn), then spring (11.8 kn), and summer had the weakest average wind speed (10.9 kn).

Table 8.1: Tabular wind data from Roches Point Met Éireann station: wind speed (WS) and wind direction (WD) (source: Met Éireann[50]).

	2019		2020		2021		2022		2023	
Month	Average of WS (knots)	Average of WD (degrees)	Average of WS (knots)	Average of WD (degrees)	Average of WS (knots)	Average of WD (degrees)	Average of WS (knots)	Average of WD (degrees)	Average of WS (knots)	Average of WD (degrees)
January	11.0	253.3	13.4	227.5	11.9	251.5	10.7	235.0	13.2	242.0
February	15.8	201.3	19.2	238.2	16.9	184.5	17.1	244.6	12.1	203.9
March	13.5	250.3	13.1	187.3	12.7	227.4	12.0	178.8	14.6	187.1
April	13.4	164.8	9.7	163.5	10.5	182.6	11.2	193.5	12.1	189.8
May	10.4	229.7	11.2	161.0	13.0	230.2	11.3	229.2	9.4	219.8
June	10.7	219.5	12.5	239.0	10.4	230.8	11.5	226.1	9.8	176.8
July	10.4	229.7	11.6	248.8	9.5	217.2	10.0	234.4	12.4	236.2
August	12.7	231.0	10.7	222.8	10.0	205.6	9.6	227.2	12.3	238.4
September	12.0	231.6	11.2	222.6	9.1	204.8	11.7	244.4	12.3	216.7
October	13.0	220.7	15.3	244.4	12.6	230.0	14.9	209.4	10.3	198.2
November	13.9	243.5	13.7	220.6	10.9	264.1	16.4	224.8	13.6	232.8
December	14.1	230.8	15.9	259.0	14.3	197.5	13.2	200.5	16.2	242.0

Table 8.2: Five-year average wind speed in knots (kn), from Roches Point Met Éireann station, Co. Cork (source: Met Éireann[50]).

Season	2019	2020	2021	2022	2023	5-Year Average
Spring	12.4	11.3	12.0	11.4	12.0	11.8
Summer	11.3	11.6	9.9	10.3	11.4	10.9
Autumn	12.9	13.4	10.8	14.3	12.0	12.7
Winter	13.6	16.1	14.3	13.6	13.8	14.3

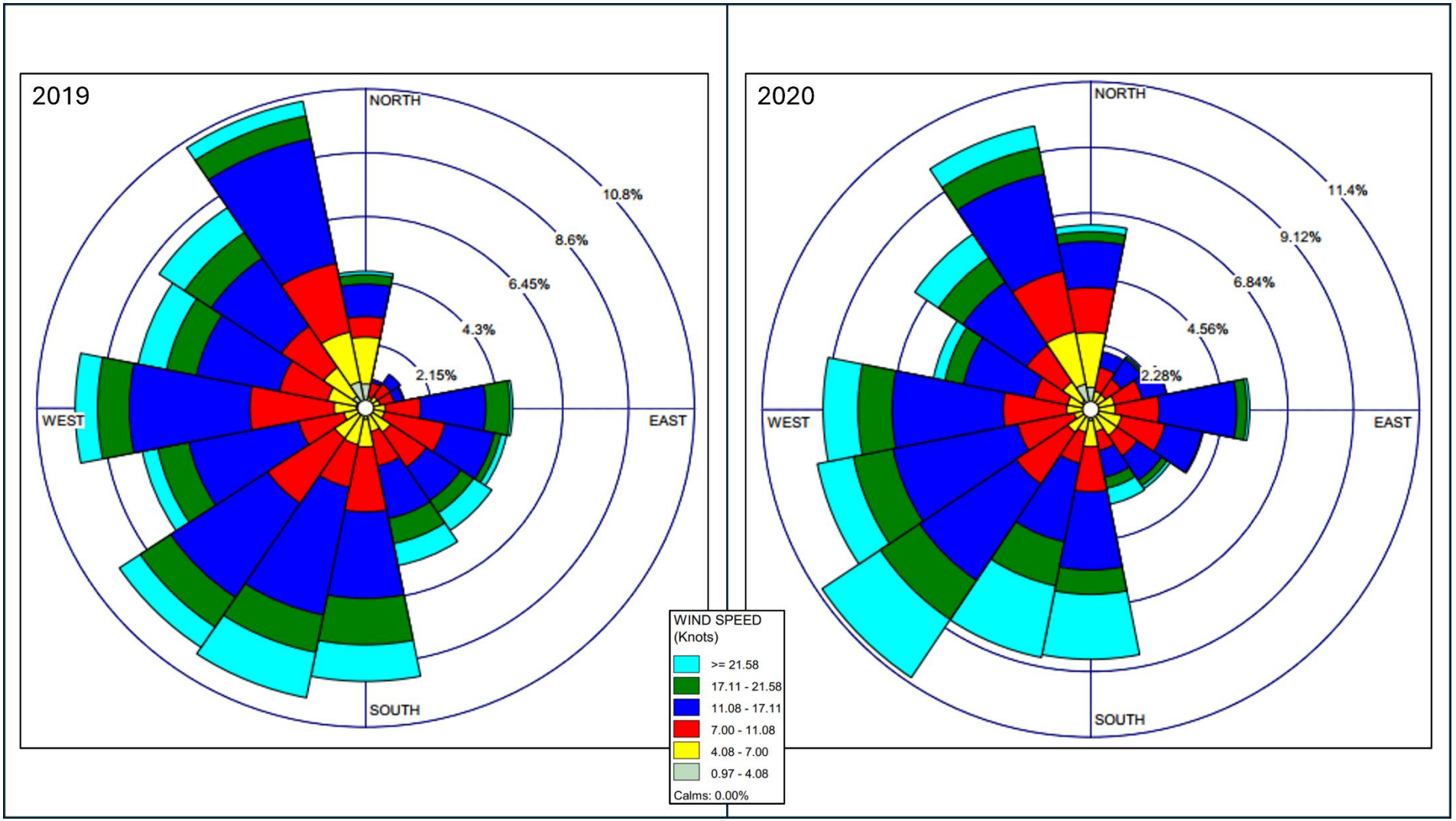

Figure 8-2: Wind roses for Roches Point Met Éireann station, Co. Cork from 2019 and 2020 (source: Met Éireann[50]).

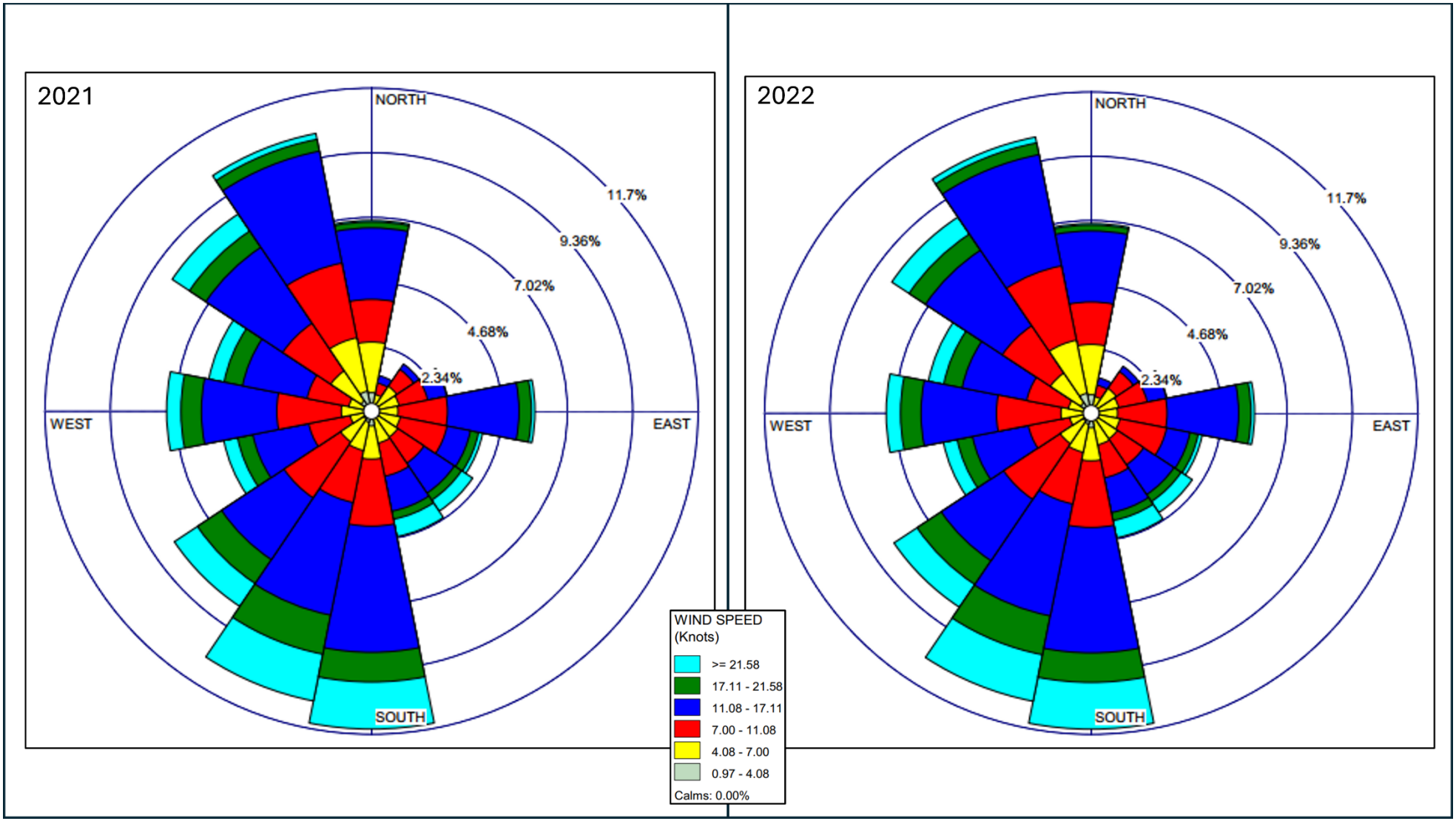

Figure 8-3: Wind roses for Roches Point Met Éireann station, Co. Cork from 2021 to 2022 (source: Met Éireann[50]).

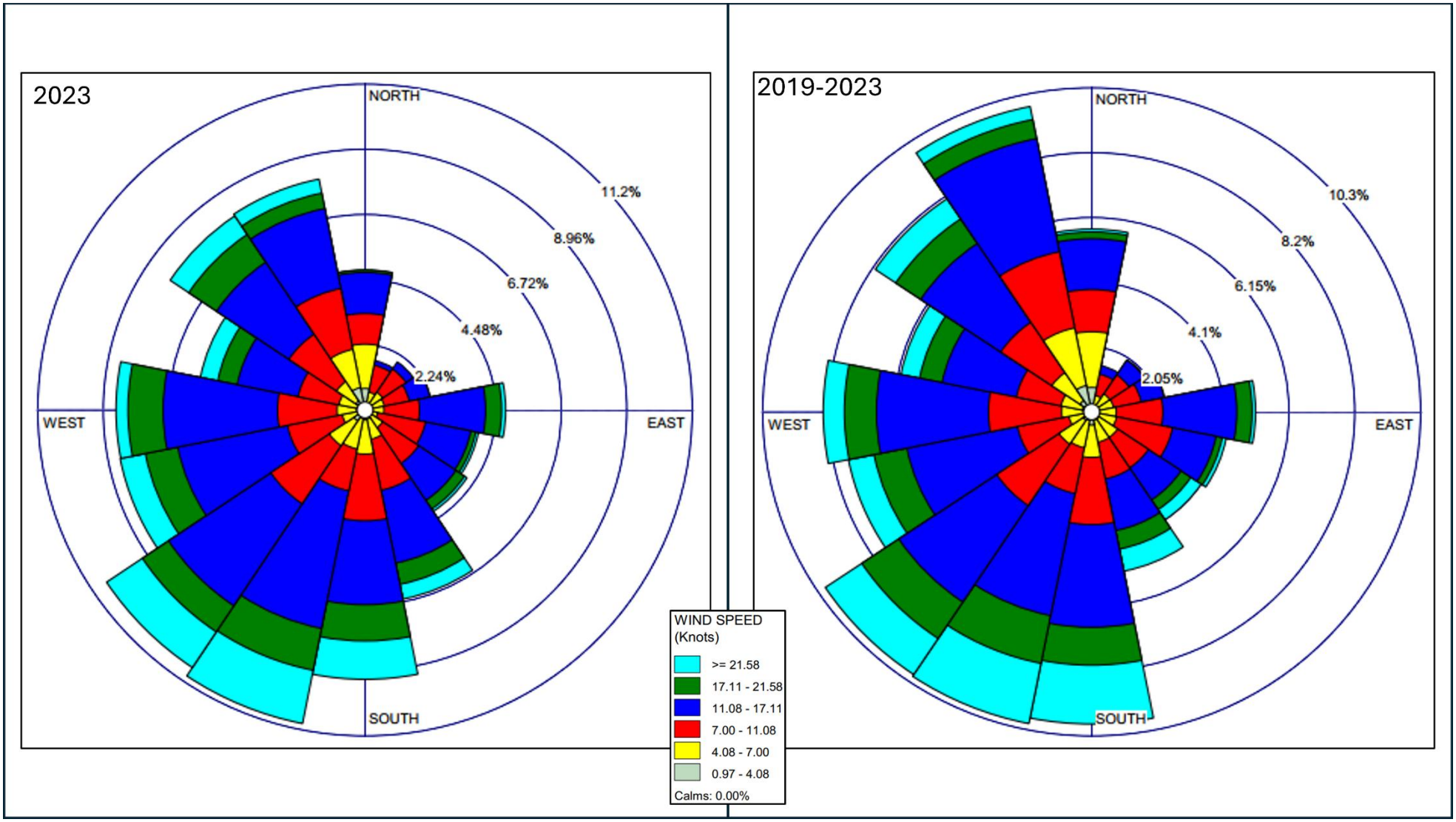

Figure 8-4: Wind roses for Roches Point Met Éireann station, Co. Cork for 2023 (left) and average wind speed from 2019 to 2023 is displayed in the right wind rose (source: Met Éireann[50]).

Wave height data was accessed from the Marine Institute ERDDAP data server[51] (**Figure 8-5** to **Figure 8-9**). The highest wave height in metres between September 2019-2024 was in February 2021 with a value of 2.27 metres, followed by February 2020 (2.1 m), and then November 2022 (1.9 m). When looking at these data for the six-year period in total, the greatest wave heights are evident over autumn and winter of each year with a steep decline moving towards spring (**Figure 8-10**). This is indicative of higher wave activity, possibly due to seasonal weather patterns or more frequent storm events, which would be expected during these seasons. The lowest wave height was in September 2022 (early autumn; 0.45 m).

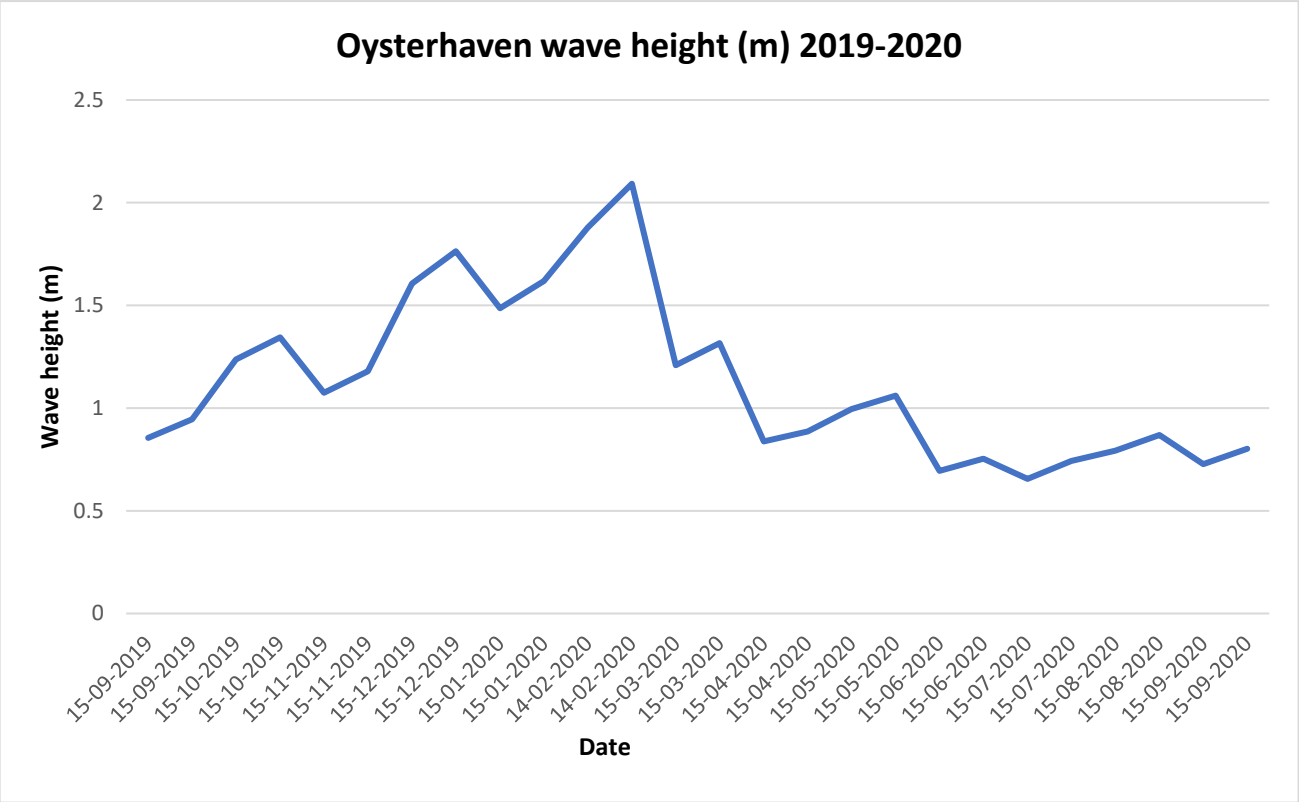

Figure 8-5: Oysterhaven wave height in metres from September 2019 - September 2020. Two measurements were taken per month as displayed here. Data was acquired from the Marine Institute ERDDAP data server[51].

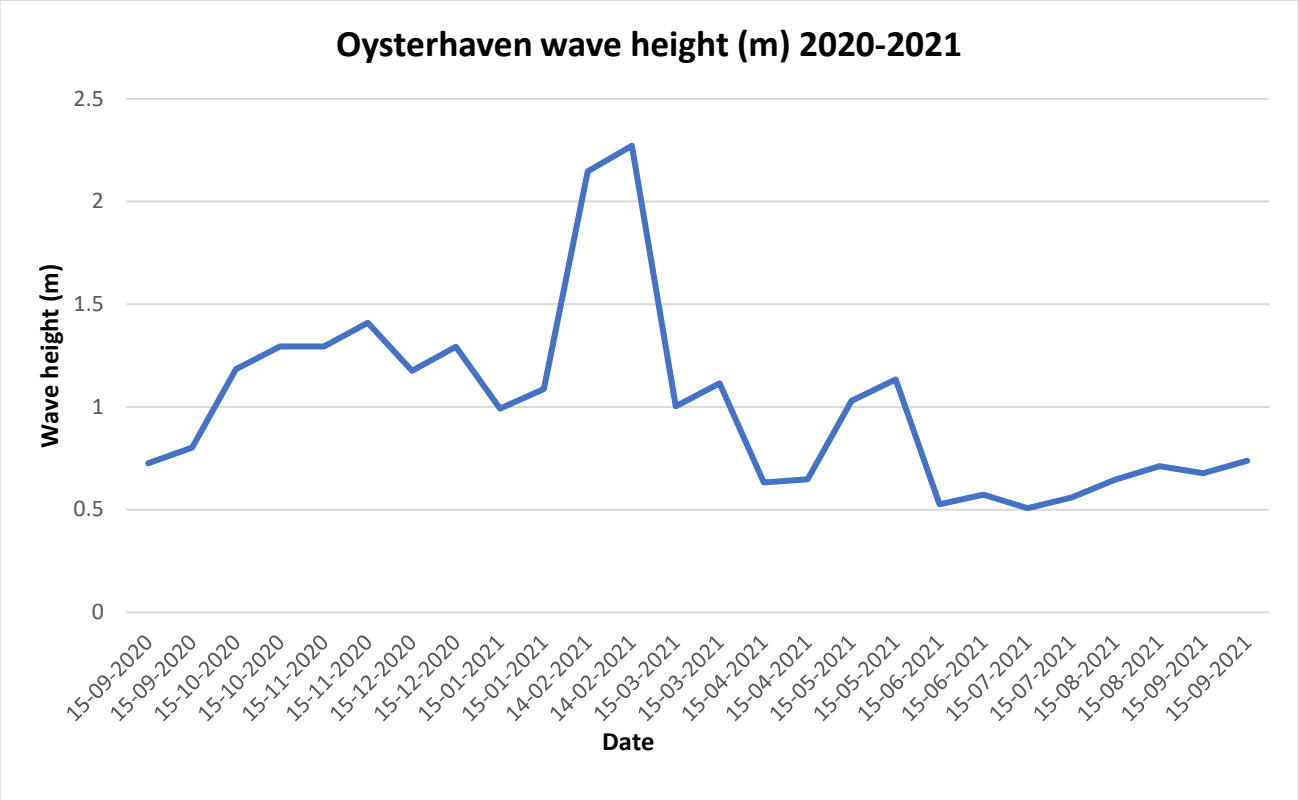

Figure 8-6: Oysterhaven wave height in metres from September 2020 - September 2021. Two measurements were taken per month as displayed here. Data was acquired from the Marine Institute ERDDAP data server [51].

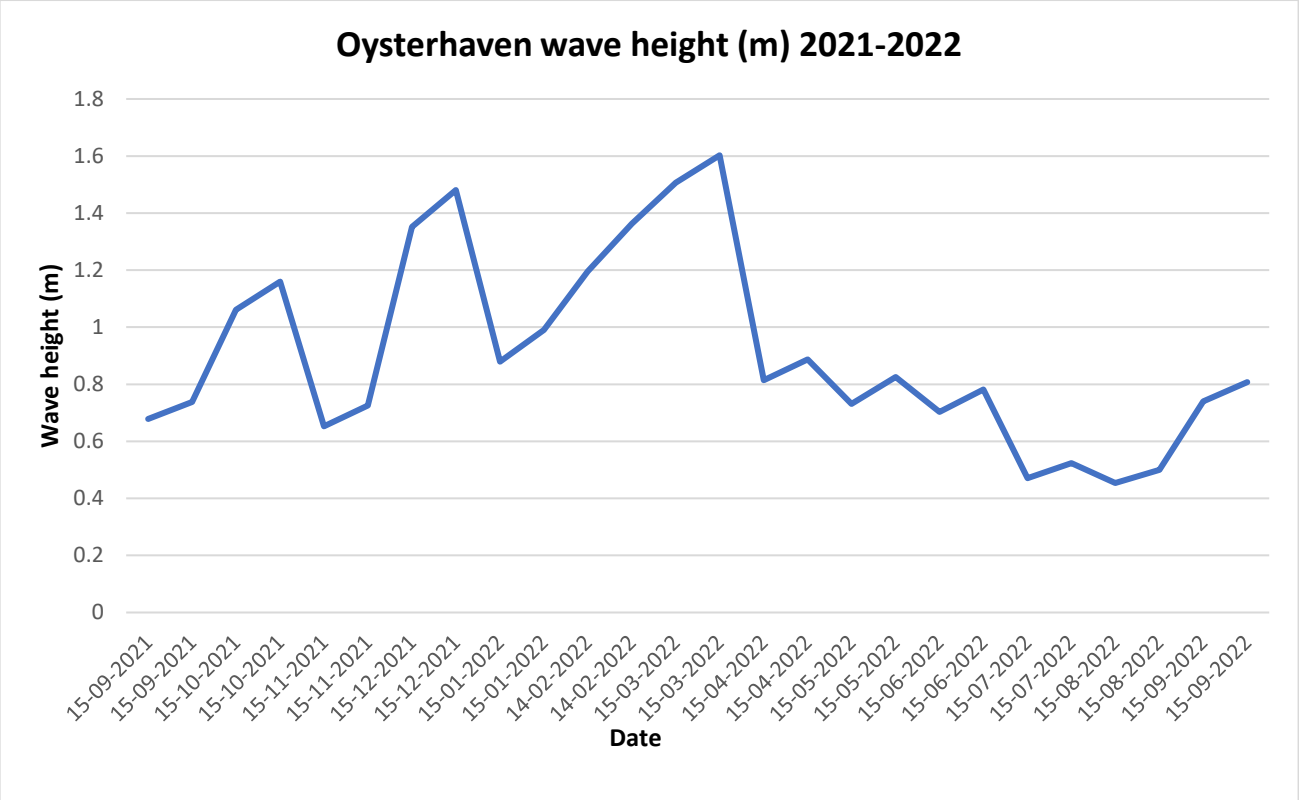

Figure 8-7: Oysterhaven wave height in metres from September 2021 - September 2022. Two measurements were taken per month as displayed here. Data was acquired from the Marine Institute ERDDAP data server [51].

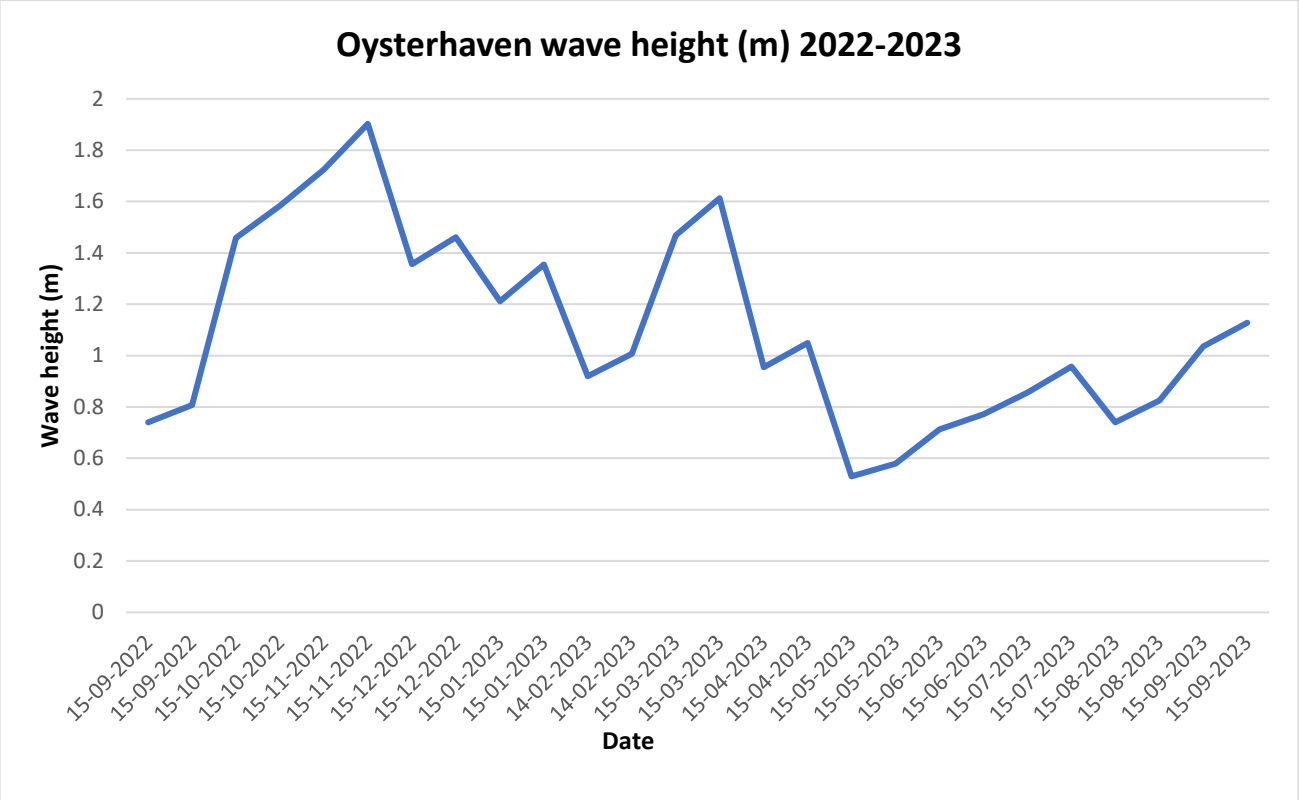

Figure 8-8: Oysterhaven wave height in metres from September 2022 - September 2023. Two measurements were taken per month as displayed here. Data was acquired from the Marine Institute ERDDAP data server [51].

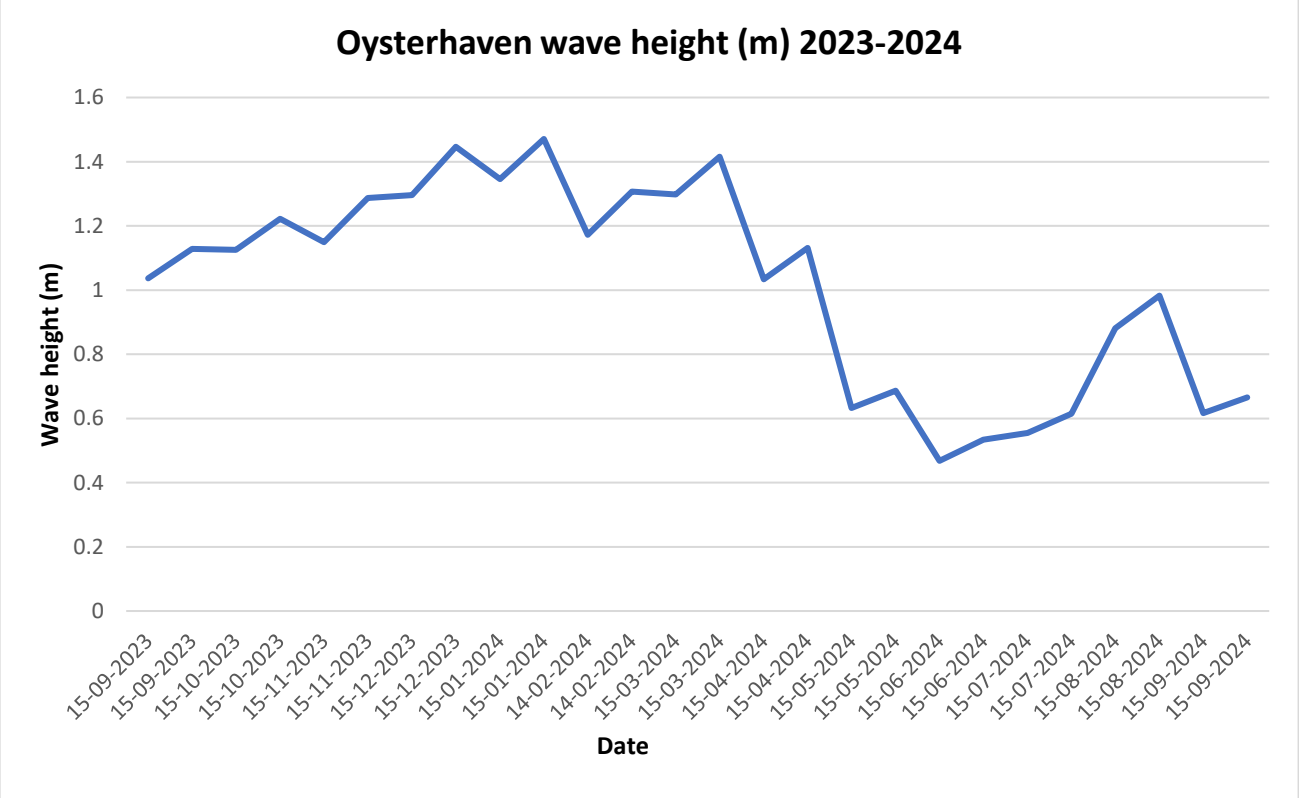

Figure 8-9: Oysterhaven wave height in metres from September 2023 - September 2024. Two measurements were taken per month as displayed here. Data was acquired from the Marine Institute ERDDAP data server [51].

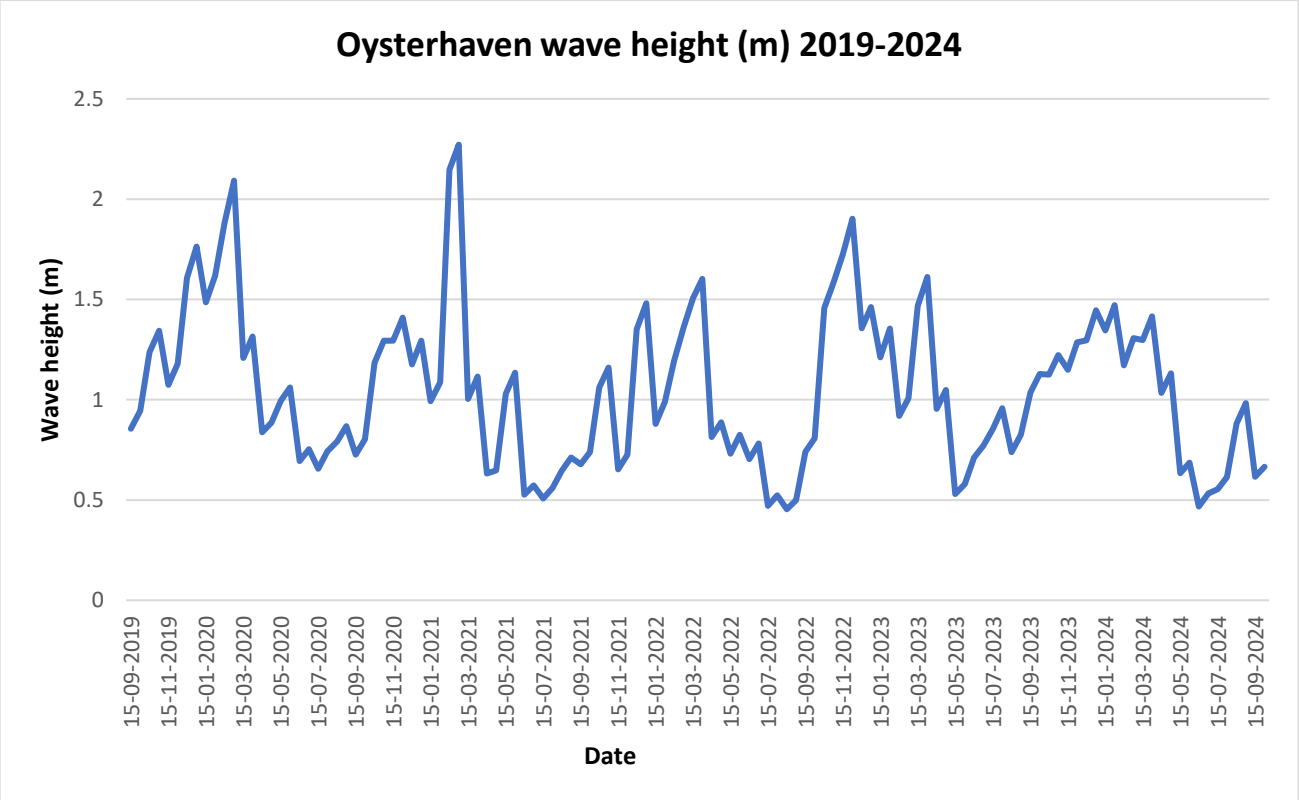

Figure 8-10: Oysterhaven wave height in metres from September 2019 - September 2024. Two measurements were taken per month as displayed here. Data was acquired from the Marine Institute ERDDAP data server[51].

8.5. River Discharges

There are two WFD river sub-basins which completely drain into Oysterhaven contributing catchment and one river sub-basin which partially drains into Oysterhaven contributing catchment, covering an area of 102.06 km^2; within these river sub-basins are three corresponding river water bodies (see **Figure 8-11** for river sub-basins and **Figure 8-12** for river water bodies). As the drainage area calculated incorporates the river sub-basin which discharges partially outside of Oysterhaven contributing catchment, an approximation of the area which drains into the contributing catchment was made using QGIS to avoid an over-estimation of the area, returning a value of 98.45 km^2.

The contributing catchment is dominated by the Stick_010 WFD river sub-basin which drains *c.* 54% of the contributing catchment. The Farranamoy_010 WFD river sub-basin drains *c.* 27% of the contributing catchment and the Newborough_010 WFD river sub-basin, which partially drains into Oysterhaven Bay, drains *c.* 19% of the contributing catchment.

The 2016-2021 WFD ecological status of Oysterhaven and its associated freshwater, transitional, and coastal sources can be seen in **Figure 8-11**. Of the river systems flowing directly into Oysterhaven, all water bodies were of Good status. Oysterhaven transitional water body was of Moderate status and the Western Celtic Sea

coastal water body was of High status for the same monitoring period. Methods used in the assessment of water bodies for WFD ecological status are linked to biological parameters (*i.e.,* not *E. coli*)[52].

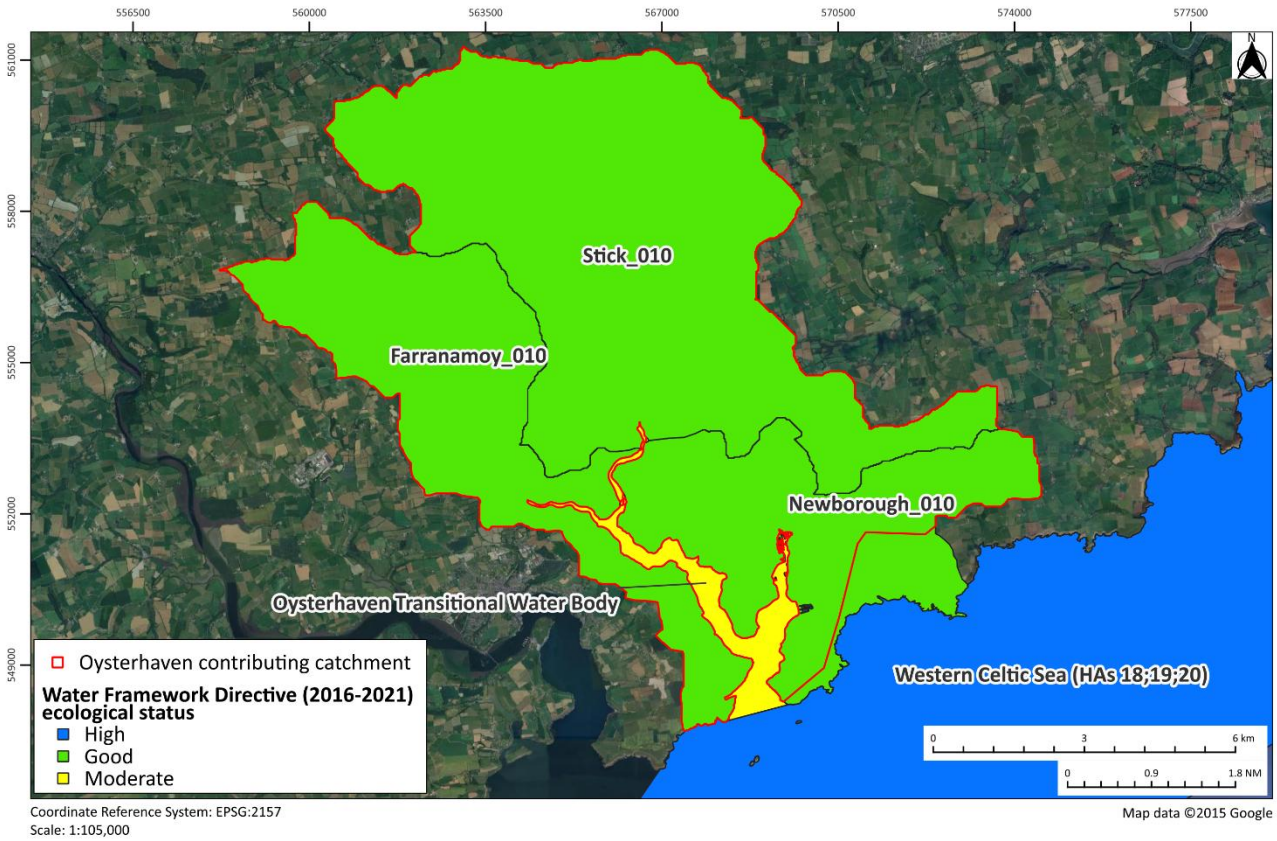

Figure 8-11: Water Framework Directive 2016-2021 ecological status for river-sub basins and transitional water bodies within Oysterhaven contributing catchment and for coastal water bodies outside the bay (source: EPA[49]).

There were no river flow or water level measurements available from monitored stations at the time of writing this report. The River Flow Estimates – Hydrotool[53] was developed by the EPA to estimate representative flows expected in rivers under natural conditions without the incorporation of artificial influences or discharges. There were several river flow estimates along the Stick and Farranamoy river water bodies and there was one estimate for the Newborough river water body[53]. The estimates located at the nearest point to where the river water body discharges into Oysterhaven Bay were used. The estimated natural annual mean flow for the Newborough river water body was 0.167 m^3/s, followed by 0.532 m^3/s and 0.974 m^3/s for the Stick and Farranamoy water bodies, respectively (see **Figure 8-12**; map IDs 1-3). The River Stick had the highest estimated annual mean flow and drained the largest proportion of the contributing catchment.

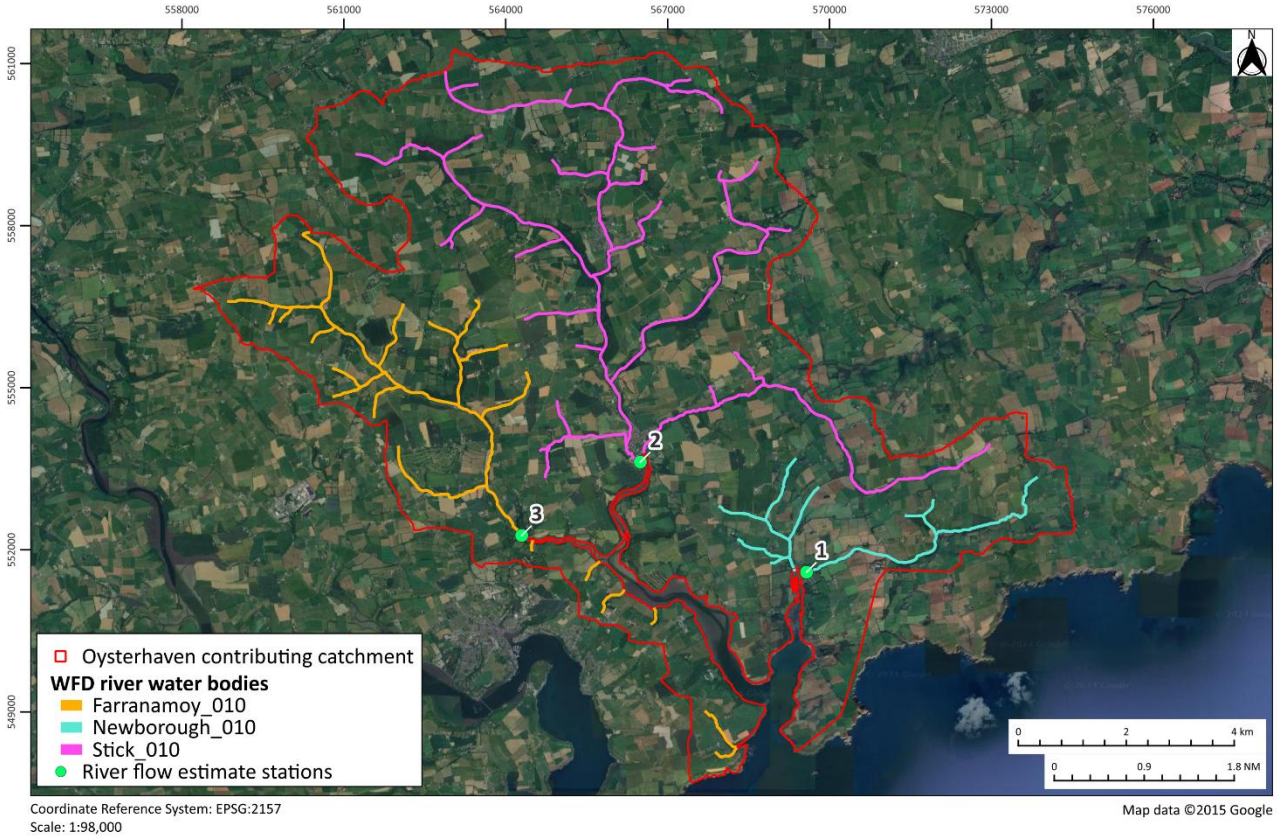

Figure 8-12: Water Framework Directive (WFD) river water bodies within Oysterhaven contributing catchment with corresponding river flow estimate stations presented (source: EPA[49], EPA Hydrotool[53]).

8.6. Rainfall Data

8.6.1. Amount and Time of Year

In this section, data from the Kinsale Met Éireann weather station, situated near Oysterhaven Bay, was used to investigate long term rainfall patterns, *i.e.,* over a 30-year period, and rainfall patterns over a recent five-year period, *i.e.*, 2019-2023 (**Table 8.5**). The Kinsale Met Éireann station is approximately five kilometres from Oysterhaven Bay. **Figure 8-13** shows the average monthly rainfall data for Ireland from 1991 to 2020. The wettest months overall during this period were October to January (<500 mm) and the driest months were over the period May to June (<150 mm).

Table 8.3 and **Figure 8-15** show average monthly rainfall from 1993-2023 recorded at the Kinsale Met Éireann station. During the period of 1993 to 2023, average rainfall at Kinsale was lowest in April (72.0 mm) and highest in December (141.2 mm). The greatest daily total ranged from a low of 160 mm in April to a high of 423.4 mm in December. Note that data was missing for several years and months within this period which may have skewed interpretation. **Table 8.4** shows the seasonal average rainfall data at the Kinsale Met Éireann station from 1993-2023. Lowest average rainfall over the 30-year period was in spring (79.5 mm) with the highest average rainfall experienced in winter (118.0 mm).

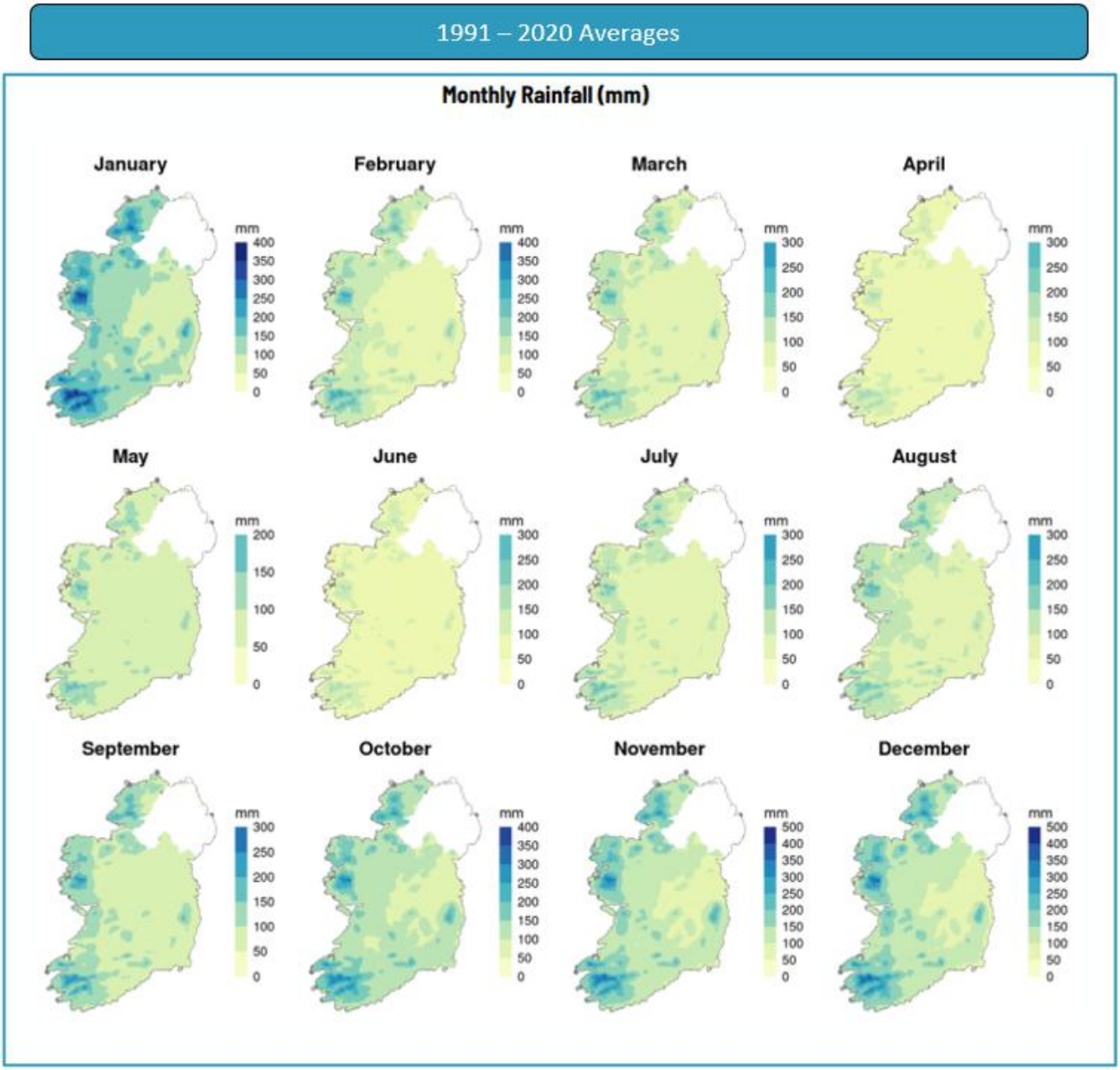

Figure 8-13: Average monthly rainfall (mm) data from 1991-2020 for Ireland (source: Curley *et al.,* 2023).

Figure 8-14: Location of Kinsale and Roches Point Met Éireann stations in relation to Oysterhaven contributing catchment.

Table 8.3: Monthly average rainfall at Kinsale Met Éireann station, Co. Cork from 1993-2023 (source: Met Éireann[50]).

Month	Average rainfall (mm)	Greatest Daily Total (mm)
January*	122.3	238.7
February*	93.3	205.0
March	88.8	217.4
April	72.0	160.0
May	77.5	174.0
June*	78.3	192.1
July*	85.6	205.0
August	87.8	205.0
September*	91.5	215.2
October*	134.2	282.3
November*	119.2	262.4
December*	141.2	423.4

*Some data was missing for these months

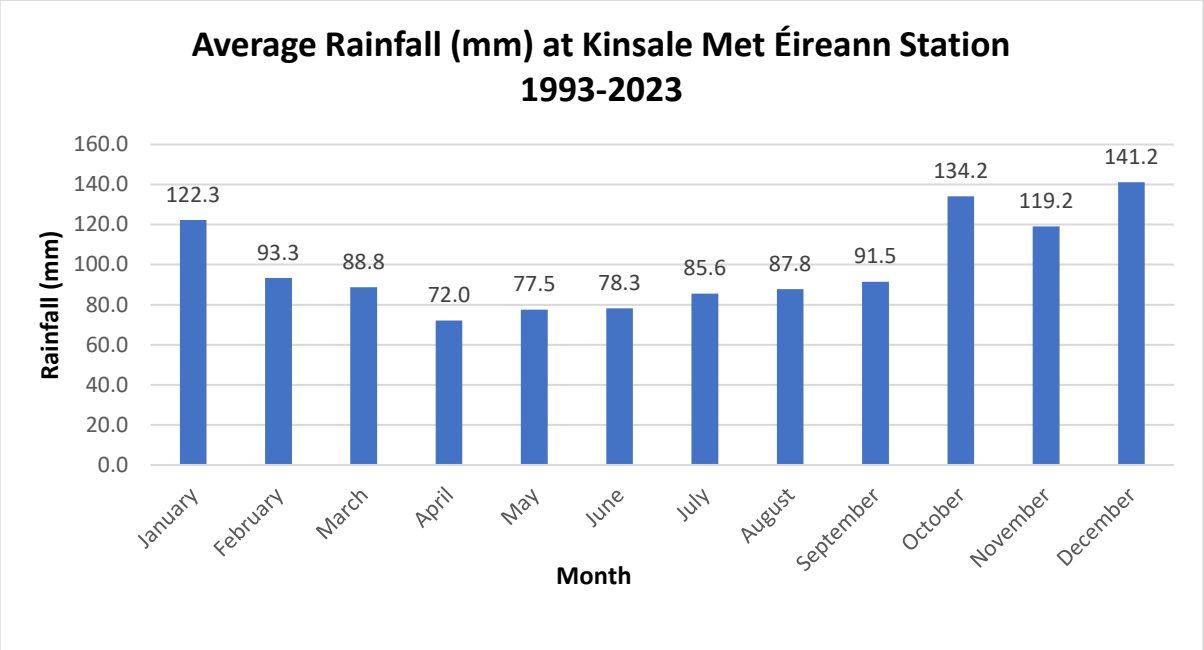

Figure 8-15: Average monthly rainfall (mm) at Kinsale Met Éireann station from 1993 to 2023 (source: Met Éireann[50]).

Table 8.4: Average seasonal rainfall values (mm) from 1993-2023 at Kinsale Met Éireann station, Co. Cork (source: Met Éireann[50]).

Season	Average Rainfall (mm)
Spring	79.5
Summer	83.8
Autumn	114.7
Winter	118.0

Table 8.5 shows total monthly rainfall at the Kinsale Met Éireann station from 2019-2023 and **Figure 8-16** graphs these data. The five-year average monthly rainfall ranged from a low of 14.3 mm in February 2023 to a high of 282.3 mm in October 2023. Annual average ranged from 90.7 mm in 2022 to 128.8 mm in 2023. The five-year monthly average was 107.1 mm.

Table 8.6 shows the total seasonal rainfall at Kinsale Met Éireann station from 2019-2023. The following seasonal fluctuations were observed: in 2019, summer was the driest season and autumn was the wettest. In 2020, spring was the driest and winter was the wettest. In 2021, summer was the driest and winter was the wettest. In 2022, summer was the driest and autumn was the wettest. In 2023, spring was the driest and autumn was the wettest. Over the five years, summer 2022 was the driest season and autumn 2023 was the wettest season.

Table 8.5: Total monthly rainfall (mm) at Kinsale Met Éireann station from 2019 to 2023 (source: Met Éireann[50]).

Year	2019	2020	2021	2022	2023	Monthly 5-year average
January	64.1	121.2	145.0	38.6	144.9	102.8
February	90.6	193.7	173.7	101.3	14.3	114.7
March	121.3	65.2	59.6	57.6	217.4	104.2
April	119.4	63.5	15.3	63.3	58.5	64.0
May	39.1	60.0	174.0	38.8	41.5	70.7
June	87.8	74.5	37.0	83.4	48.1	66.2
July	33.5	94.1	82.6	28.3	148.2	77.3
August	95.2	166.6	77.7	18.0	132.2	97.9
September	96.0	56.2	84.9	148.4	179.0	112.9
October	190.9	113.0	207.1	213.2	282.3	201.3
November	150.3	142.4	32.6	177.0	118.3	124.1
December	148.0	186.8	128.1	120.7	161.0	148.9
Annual Average	103.0	111.4	101.5	90.7	128.8	107.1

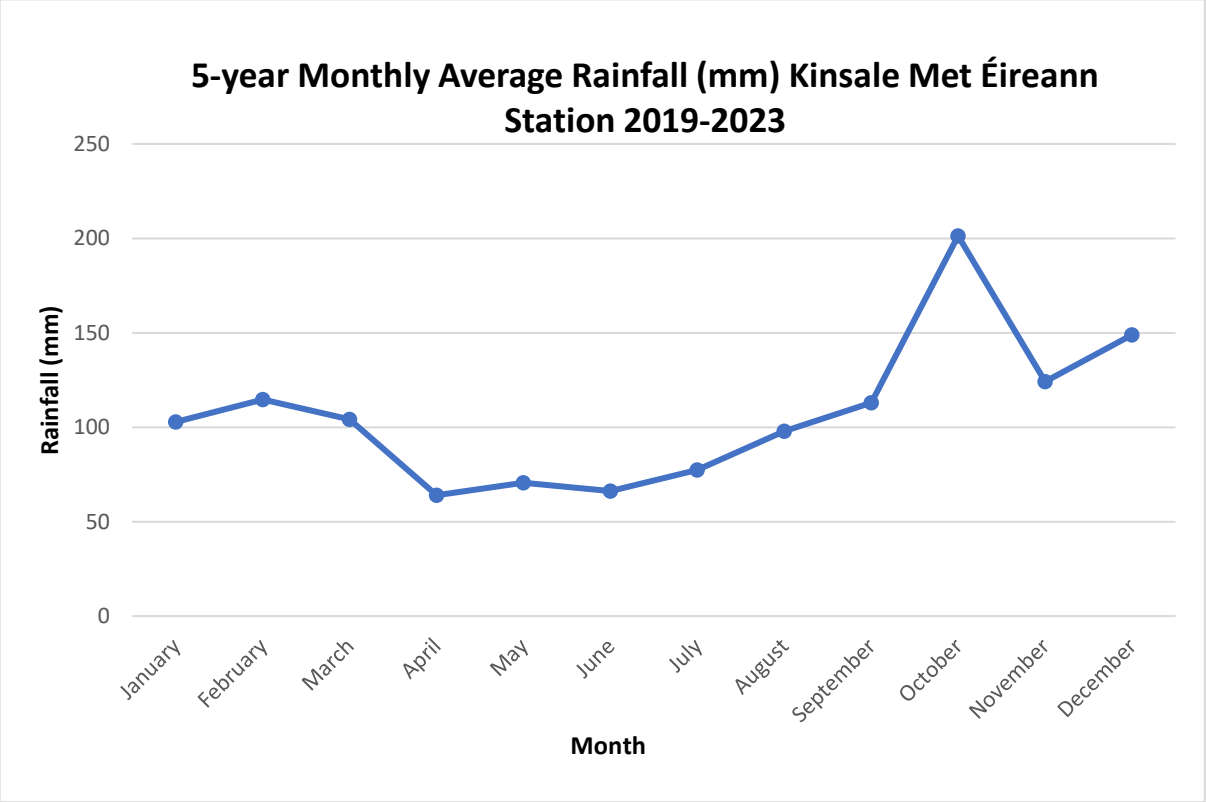

Figure 8-16: Five-year monthly average rainfall (mm) at Kinsale Met Éireann station from 2019 to 2023 (source: Met Éireann[50]).

Table 8.6: Total seasonal rainfall (mm) at Kinsale Met Éireann station, Co. Cork, from 2019 to 2023 (source: Met Éireann[50]).

Month/Year	2019	2020	2021	2022	2023
Spring	559.6	377.4	497.8	319.4	634.8
Summer	433	670.4	394.6	259.4	657
Autumn	874.4	623.2	649.2	1077.2	1159.2
Winter	605.4	1003.4	893.6	521.2	640.4

8.6.2. Frequency of Significant Rainfalls

Met Éireann has developed a depth duration frequency model to estimate point rainfall frequencies (Fitzgerald, 2007). For a one in 100-year return period, 30.3 mm of rain would be expected over a one-hour period and 99.8 mm over 24 hours. While these would be extremely uncommon events, the model predicts that once a year 13.5 mm of rain would fall in one hour and 52.9 mm over a 24-hour period. Data from the Kinsale Met Éireann station show there have been five 24-hour periods within which more than 52.9 mm of rain fell over the 30-year period from 1993-2023. For this same period, the 13th of October 2023 had the greatest daily rainfall with 81.3 mm falling over the 24-hour period. Over the five-year period 2019-2023, data from the Kinsale Met Éireann station show there has been one 24-hour period within which more than 52.9 mm of rain fell. A significant rainfall is considered to be ≥ 120 mm of rain within a 24-hour time period (Tony Cawley, *pers. comm*).

Increased faecal contamination of coastal waters is typically associated with high rainfall and storm events through surface water run-off from livestock or other animals present, and through sewer and wastewater treatment plant overflows (Mallin *et al*., 2001; Lee & Morgan, 2003). It is therefore expected that run-off due to rainfall will be higher during the October to January period. However, as can be seen in the rainfall data in **Table 8.7**, heavy rainfall events leading to episodes of high run-off can occur in most months of the year and, therefore, it is not just the winter months that are at risk of increased faecal contamination. When these out of season heavy rainfall events occur during generally drier periods in spring and summer months, they are likely to carry higher loadings of faecal material which have accumulated on pastures where greater numbers of livestock are present.

Table 8.7: Rainfall events greater than 52.9 mm within a 24-hour period over a 30-year period (1993-2023), recorded at the Kinsale Met Éireann station (source: Met Éireann[50]).

Date	Rainfall
17-Oct-23	81.3
23-Jul-05	64.9
16-Jun-13	59.1
27-Oct-21	59.1
03-Aug-97	58.4

8.7. Salinity

Oysterhaven is a transitional waterbody, with freshwater flowing directly from Rivers Stick, Farranamoy and Newborough into Oysterhaven Bay, a designated shellfish water zone. Data from the Marine Institute in 2012 of ambient water analysis[54] shows that the salinity within the Oysterhaven area ranges from 30.04 – 34.96.

8.8. Turbidity

Turbidity is the measure of how cloudy or clear a liquid is, and is caused by suspended solids, particulate matter, and microorganisms. It can affect water clarity as high concentrations of particulate matter can have effects on light penetration and habitat quality, with particles providing attachment for pollutants such as bacteria[55]. Higher turbidity can be caused by heavy rainfall resulting in increased land runoff, anthropogenic discharges, and phytoplankton blooms.

High turbidity has been found to have a negative effect on oyster feeding as it leads to algal cells or phytoplankton, the primary food source of oysters, becoming diluted with inorganic matter (Snyder *et al.*, 2017). Analysis of turbidity data within Oysterhaven Bay, provided by the Marine Institute, across three seasons indicates that winter months exhibited the highest turbidity levels and variability, with values starting at 7.3 Nephelometric Turbidity Units (NTU) and reaching 95.4 NTU, excluding outliers (**Figure 8-17**). The summer season contained more data points than the other seasons but displayed a narrower range of turbidity, *i.e.*, 0.8 to 27.4 NTU. Spring demonstrated the lowest variability, with turbidity ranging from 2.6 NTU to 16.5 NTU. The median turbidity values were 4.8 NTU for spring, 3.6 NTU for summer, and 13.1 NTU for winter. The elevated turbidity and high variability during winter months may indicate increased runoff and a potential increase in pollution sources, *i.e.*, higher *E. coli* counts, negatively impacting shellfish quality and production. The lower and more stable turbidity observed in spring and summer suggests a reduced contamination risk for this period.

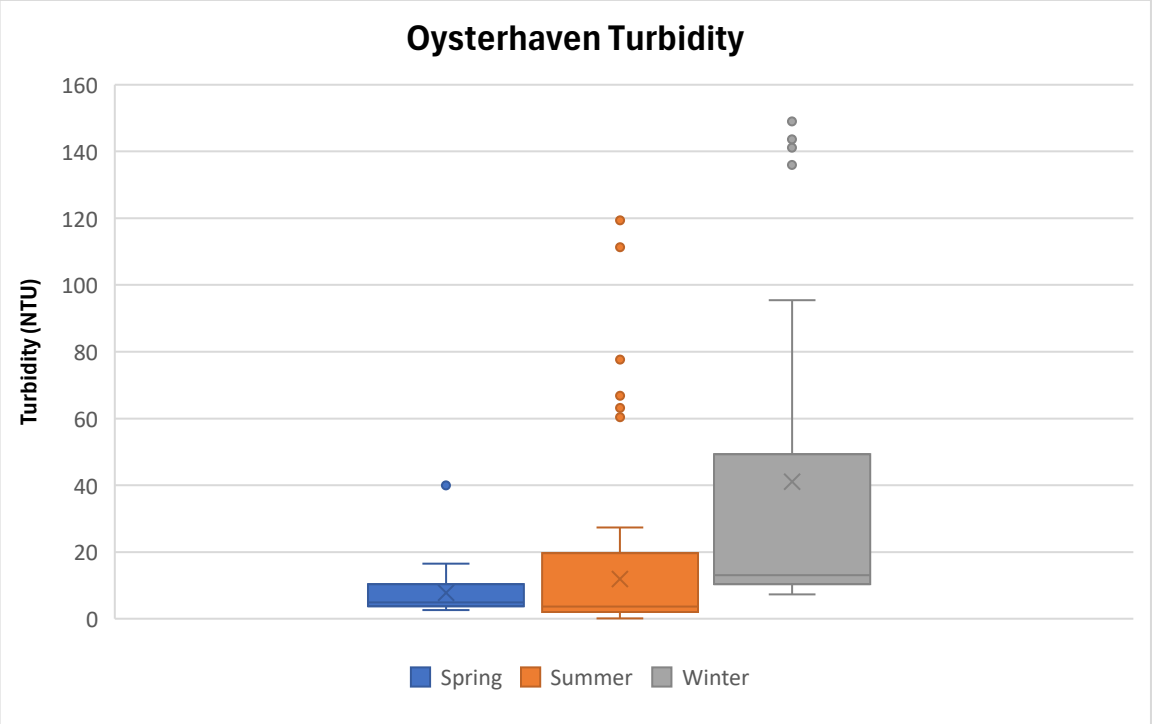

Figure 8-17: Turbidity values (NTU) plotted against season for Oysterhaven Bay. These data, provided by the Marine Institute, were collected between 2012 and 2021. Note that there was no available data for the autumn months.

8.9. Flushing time

Flushing time can be defined as the time it takes to replace a certain water mass in a coastal system. Flushing times are important because of how they explain water exchange and how this governs productivity rates as well as the vulnerability to water quality degradation. The Marine Institute calculated residence times for Oysterhaven using the Hartnett method to be 10.9 days, with a mean tidal range of 2.65 metres (Hartnett *et al*. 2011).

8.10. Discussion

Oysterhaven Bay is situated in the Southwestern River Basin District, with an area encompassing approximately 3.6 km^2 [(1)]. The bay complex includes the Stick Estuary and Ballinaclashet Creek. The DSW in Oysterhaven Bay cover 1.5 km^2.

Due to the semi-diurnal nature of the tide, there is a typical cycle of two high tides and two low tides per day, between two and 3.5 metres, with the maximum recorded tidal height being 4.37 metres. Based on data from Roches Point Met Éireann station, the prevailing wind direction comes from the south, with seasonal trends showing the strongest winds in the winter months, and less wind in the summer.

Using data from the Kinsale Met Éireann weather station, the wettest months were found to be October to February over the five-year period (2019-2023), which sometimes extended into March (in 2019 and 2023).

Over the same five-year period, the lowest average monthly rainfall occurred in February 2023 (14.3 mm) while the highest average monthly rainfall was in October of the same year (282.3 mm). The five-year monthly average rainfall was 107.1 mm. Autumn 2023 was the wettest season over the five-year period and summer 2022 the driest. Over the 30-year period (1993-2023), the wettest months were generally October to January.

A transitional waterbody, Oysterhaven Bay had a salinity range of 30.04–34.96 according to data from the Marine Institute ambient water analysis[54]. The highest turbidity levels (NTU) and variability were seen over the winter months, which is to be expected due to typically higher rainfall levels during this season.

9. Appendix 3: Shellfish and Water Sampling

9.1. Historical Data

9.1.1. Shellfish Flesh Quality

In accordance with Regulation (EU) 2017/625 and the subsequent implementing regulation (EU) 2019/627, the SFPA is required to classify BMPAs and to fix the boundaries thereof. The process involves regular sampling of shellfish from each area to be classified in order to establish levels of microbiological contamination which subsequently determines the classification that should be awarded for that particular area.

The regulations stipulate that the competent authority must monitor the levels of *E. coli* within the harvesting area and that according to the sample results, must classify the area as being one of three categories: **A**, **B** or **C**. An **A** classification allows for the product to be placed directly on the market, whereas a **B** or **C** classification requires the product to go through a process of depuration, heat treatment, or relaying before it can be placed on the market. **Table 9.1** summarises this system[31]. **Table 9.2** states the likely classification that would be assigned for shellfish beds in Oysterhaven, these data are based on the historical microbiological results taken by the SFPA at their sampling point (51.705158, -8.461041).

Table 9.1: Classification system for shellfish harvesting areas.

Classification			Permitted Levels	Outcome
	A	<230	Not exceeding 230 *E. coli*/100 g flesh/liquid in 80% of samples. Not exceeding 700 *E. coli* 100 g in remaining 20% of samples.	May go directly for human consumption if end product standards met.
	B	<4600	Not exceeding 4,600 *E. coli*/100 g flesh/liquid in 90% of samples. Not exceeding 46,000 *E. coli* 100 g in remaining 10% of samples.	Must be subject to purification, relaying in Class A area (to meet Category A requirements), or cooked by an approved method.
	C	<46000	Not exceeding 46,000 *E. coli*/100 g flesh in all samples.	Must be subject to relaying for a period of at least 2 months or cooked by an approved method.
	Above 46,000 *E. coli* per 100 g flesh/liquid.			Prohibited. Harvesting not permitted.

Table 9.2: Historical *E. coli* results from Pacific oysters in Oysterhaven Bay. Shellfish flesh samples were collected from an SFPA sampling point from January 2020 to December 2023 (source: SFPA). Note: an indicative classification is provided based on historical results; colour coded per Table 9.1. Sampling point coordinates:

Sample Date	*E. coli*/100 g	Indicative Classification	Sample Date	*E. coli*/100 g	Indicative Classification Category
15-Jan-20	490	B	04-Jan-22	130	A
11-Feb-20	170	A	01-Feb-22	61	A
10-Mar-20	140	A	21-Mar-22	78	A

Sample Date	*E. coli*/100 g	Indicative Classification	Sample Date	*E. coli*/100 g	Indicative Classification Category
07-Apr-20	68	A	19-Apr-22	490	B
06-May-20	110	A	16-May-22	45	A
08-Jun-20	18	A	14-Jun-22	170	A
06-Jul-20	18	A	13-Jul-22	130	A
04-Aug-20	45	A	15-Aug-22	330	B
02-Sep-20	790	B	12-Sep-22	3500	B
05-Oct-20	130	A	11-Oct-22	20	A
16-Nov-20	130	A	08-Nov-22	230	A
14-Dec-20	490	B	12-Dec-22	68	A
11-Jan-21	170	A	10-Jan-23	68	A
15-Feb-21	210	A	07-Feb-23	61	A
15-Mar-21	18	A	06-Mar-23	18	A
12-Apr-21	20	A	04-Apr-23	230	A
10-May-21	110	A	08-May-23	45	A
14-Jun-21	110	A	06-Jun-23	490	B
12-Jul-21	18	A	04-Jul-23	230	A
09-Aug-21	78	A	01-Aug-23	700	B
06-Sep-21	2200	B	04-Sep-23	78	A
05-Oct-21	330	B	03-Oct-23	3500	B
08-Nov-21	330	B	13-Nov-23	78	A
06-Dec-21	170	A	12-Dec-23	18	A

9.1.2. Norovirus (NoV)

The following section on norovirus in Oysterhaven has been provided by the Fish Health Unit of the Marine Institute for inclusion in this report.

9.1.2.1. Background

Norovirus is a leading cause of viral gastroenteritis in the human population and is commonly present in municipal wastewater. When shellfish production areas are contaminated by municipal wastewater bivalve molluscs will become contaminated with norovirus. Generally, the peak of community infection occurs during the winter. Norovirus concentration occurring in bivalve molluscs generally reflects this peak of community infection with highest concentration in bivalve shellfish occurring between October to March. However, this seasonal distribution of norovirus may change in the future due to climate change or the introduction of new genotypes (strains) of norovirus.

Currently, reliable detection and quantification of norovirus in bivalve molluscs relies on the use of an internationally standardised molecular biology method (ISO 15216-1:2017). The Marine Institute is currently the only laboratory in Ireland undertaking testing of bivalve molluscs using this method and has been ISO17025

accredited for its use since 2010. This method does not distinguish between infectious and non-infectious norovirus particles. Therefore, the infection risk associated with an individual norovirus result is difficult to assess. As yet no acceptable norovirus concentration for norovirus exists in legislation although discussions regarding an acceptable limit for norovirus in bivalve molluscs are progressing at an EU level.

9.1.2.2. Assessment of Norovirus Monitoring Data

No structured national monitoring programme for norovirus in bivalve molluscs has been conducted nationally since a two-year survey was completed in 20 production areas in October 2018. However, the Marine Institute does undertake norovirus testing for a limited number of producers to assist them in implementing their existing food safety management plans. Therefore, data on the occurrence and concentration of norovirus in bivalve shellfish from production areas in Ireland is limited. Data may also exist from research projects and food safety incident investigations. Therefore, when assessing norovirus data, the following factors must be considered:

- age of norovirus data available. Older data may not be relevant to the current situation.
- samples supplied by producers may originate from unknown locations within the production area and potentially not in the production area that the producer is situated.
- sampling protocols are not supervised

Despite these issues an assessment of available norovirus data during the sanitary survey for a production area may be useful for the following reasons:

- norovirus detection in bivalve molluscs using the standardised method is indicative of human faecal contamination. Higher concentrations of norovirus may be indicative of significant inputs from wastewater treatment plants.
- norovirus data could inform producers of food safety risks associated with products harvested from their production areas.

9.1.2.3. Assessment of Norovirus Data in Oysterhaven

The following assessment of data has been made by the MI considering all relevant data available. Only data obtained from samples tested using the standard ISO method are included in the assessment. Relevant datasets are available covering the period between April 2017 to March 2018 (n=28) collected for a research project and covering the period from January 2024 to September 2024 (n=19) collected by a producer in the

production area for risk management purposes. The available data indicates that the production area is impacted by a moderate level of norovirus contamination with a high degree of certainty.

Table 9.3: Explanation of contamination levels of norovirus; adapted in table format from a statement provided by the Fish Health Unit in the Marine Insitute.

Contamination Level	Details
Low	Generally, concentrations are below the limit of quantification of the method (100 norovirus genome copies per gram) and not exceeding 500 genome copies per gram throughout the year.
Moderate	Concentrations regularly above the limit of quantification of the method (100 norovirus genome copies per gram) and generally not exceeding 1,000 norovirus genome copies per gram during the high-risk winter period.
High	Concentrations regularly exceeding 500 norovirus genome copies per gram during the high-risk winter period.

Shellfish producers are reminded that guidance on the risk management of norovirus in oysters is readily available (see **endnote 56**). For further information on norovirus levels in Oysterhaven or norovirus testing more generally the Marine Institute can be contacted directly at norovirus.testing@Marine.ie.

9.2. Current Data

9.2.1. Sampling Sites and Methodology

Eleven water samples were taken within Oysterhaven Bay from nine locations during the bacteriological survey which was conducted on the 17th of September and the 2nd of October 2024. Water sampling during both sampling periods occurred after dry weather conditions as this is what was logistically feasible at the time. Nonetheless, sampling after a spell of wet weather is preferrable as it better represents the worst-case scenario regarding *E. coli* levels. The locations of these sites can be seen in **Figure 9-1** and **Table 9.4** shows the station coordinates. Duplicate samples were taken from two stations over the two survey periods (station 4 and 5; **Table 9.4**) and station 9 and 10 (**Table 9.4**); this was to investigate a high *E. coli* result and due to human error, respectively. All water samples were collected using sterile plastic water bottles. These samples were stored in a cool box until delivery to the laboratory for analysis (within 24 hours of collection).

Table 9.4: Water sample results and coordinates from the Oysterhaven bacteriological survey. Numbering cross-referenced to Figure 9-1. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[32].

Station ID	Observation	Waterbody type	*E. coli* cfu/100 ml	Latitude	Longitude	Easting	Northing
1	Slip	FW	1	51.6935	-8.4425	569408.45	549104.02
2	Activity centre stream adjacent to bridge and Oysterhaven Beach	FW	110	51.7023	-8.4382	569711.59	550081.15
3	Ballinaclashet Bridge	FW	700	51.7145	-8.4420	569464.07	551439.83
4	Stream and drain at north Oysterhaven Bay bridge	FW	14,000	51.7168	-8.4440	569323.26	551694.32
5	Stream and drain at north Oysterhaven Bay bridge	FW	400	51.7168	-8.4440	569323.26	551694.32
6	Stream	FW	500	51.7082	-8.4589	568284.94	550746.26
7	Outflow	FW	200	51.6980	-8.4615	568098.08	549612.74
8	Brownmills stream	FW	1,600	51.7210	-8.5141	564480.06	552195.57
9	Belgooly GAA river #2	FW	0	51.7350	-8.4870	566339.34	553740.26
10	Belgooly GAA river #2	FW	100	51.7350	-8.4870	566339.34	553740.26
11	River Stick	FW	800	51.7589	-8.4963	565738.56	556403.1

Figure 9-1: Location and magnitude of *E.coli* (cfu/100 ml) results from the water samples taken during the shoreline survey (numbering cross referenced to Table 9.4).

9.2.2. Bacteriological Analysis Results

The water sample results listed in **Figure 9-1** and **Table 9.4** show the magnitude of *E. coli* in the water samples, measured as the colony forming units per 100 ml (cfu/100 ml). All nine stations were sampled on the 17th of September 2024 and were taken from freshwater sources, with two stations re-sampled on the 2nd of October. Station 4 was resampled as it initially returned a very high *E. coli* count; resampling gave rise to station 5. As station 9 resulted in no *E. coli* being found, this station was resampled to account for human error, yielding station 10 **Table 9.4**).

The first four stations sampled coincided with the Newborough_010 WFD river sub-basin. Station 1 was located at a small stream flowing near the lifeboat slip on the shoreline of Oysterhaven Bay (map ID 22; **Figure 7-20**). Station 2 was located at the stream running by the Oysterhaven activity centre (map ID 41; **Figure 7-20**). Station 3 water sample was taken at Ballinaclashet Bridge (map ID 42; **Figure 7-20**). The highest *E. coli* count was found at station 4, the North Oysterhaven Bay Bridge, with 14,000 cfu/ 100 ml being recorded (map ID 25; **Figure 7-20**). Station 5 was a resample of station 4, taken during the second bacteriological survey, giving a much lower *E. coli* count. Station 6 also occurred within the Newborough sub-basin (map ID 43; **Figure 7-20**). Stations 7 and 8 were situated within the Farranamoy_010 WFD river sub basin, with station 7 located towards the mouth of the bay on the western shore near an outflow (map ID 1; **Figure 7-20**). While a modest *E. coli* level was measured at station 7 (200 cfu/100 ml, **Table 9.4** and **Figure 9-1**), the SFPA have previously observed a significant input of *E. coli* from this station. This reinforces the necessity for repeated sampling over a longer time period, as noted in **section 4.9**. Station 8 was situated at Brownmills further up the inlet on the Farranamoy River (map ID 44; **Figure 7-20**). Station 9 was placed where the River Stick meets Oysterhaven inlet, with station 10 being a resample of this taken on the 2nd of October (map ID 45 and 46 respectively; **Figure 7-20**). Station 11 is the furthest point up the River Stick from Oysterhaven Bay (map ID 47; **Figure 7-20**).

9.2.3. Shellfish Flesh Quality Sampling

No shellfish flesh is currently being sampled by the SFPA in Oysterhaven Bay. Nonetheless, Oysterhaven Bay BMPA maintains a B classification (> 230 but must not exceed 4,600 *E. coli* per 100 grams of flesh and intra-valvular liquid)[57]. This classification was based on historic shellfish flesh sampling data.

10. Appendix 4: Shoreline Survey Images

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11. Appendix 5: Pacific Oyster Monitoring Information

Oysterhaven Bay Production Area

Site Name: Oysterhaven Bay

Site Identifier: CK-ON-ON

Monitoring Point Coordinates:
RMP 1 **Latitude:** 51.70653 **Longitude:** -8.46071

Species: *Magallana gigas*

Sample Depth: Samples should be taken within the first one metre of surface water.

Sample Frequency: Monthly

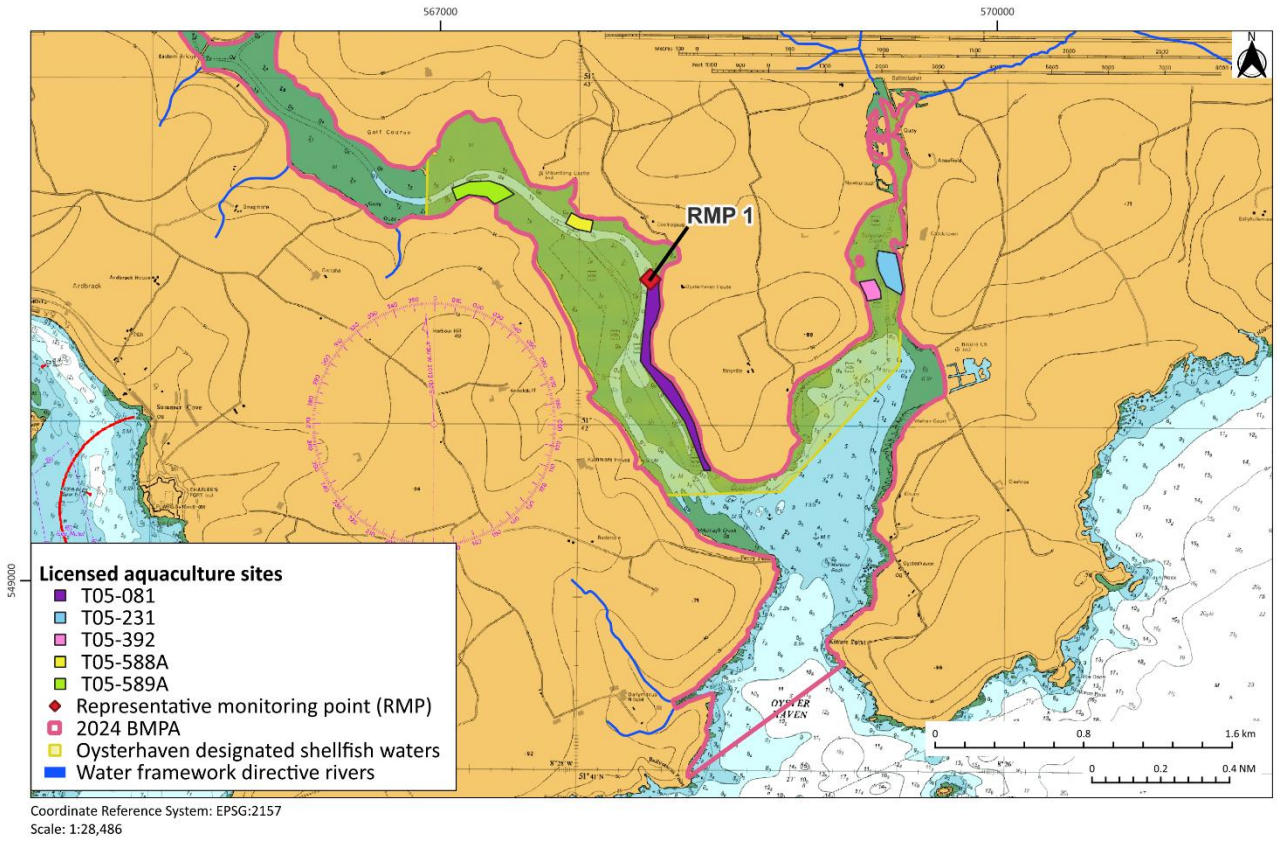
Responsible Authority: Sea Fisheries Protection Authority

Authorised Samples: SFPA Castletownbere Port Office

Maximum Allowed Distance from Sampling Point: The sample must be taken from within 100 m of the sampling point (RMP 1).

Sampling Size: Minimum 10 market sized shellfish.

Sampling Method: Taken from trestles at sampling point RMP 1.



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13. List of Endnotes

[1] EPA Catchment: 20 Bandon-Ilen catchment WFD

[2] Microbiological Monitoring of Bivalve Mollusc Harvesting Areas – Guide to Good Practice: Technical Application: https://www.cefas.co.uk/media/jyzhl1si/good-practice-guide-issue-6.pdf

[3] European Commission 2017: Community Guide to the Principles of Good Practice Microbiological Classification and Monitoring of Bivalve Mollusc Production

[4] Corine Land Cover 2018 geopackage may be downloaded and CORINE Land Cover colour scheme imported: https://land.copernicus.eu/en/products/corine-land-cover/clc2018 - it can also be viewed at: https://clc.gios.gov.pl/doc/clc/CLC_Legend_EN.pdf

[5] EPA Catchments: Catchments.ie - Water, from source to sea.

[6] See Kinsale Sediment Classification: https://www.infomar.ie/maps/downloadable-maps/charts

[7] National Biodiversity Data Centre: https://biodiversityireland.ie/

[8] See Seagrass Cover in Europe 2020: https://emodnet.ec.europa.eu/geoviewer/

[9] Irelands Marine Atlas: https://atlas.marine.ie/

[10] From Farm to Fork: Haven Shellfish

[11]Report supporting Appropriate Assessment Screening of Extensive Aquaculture in Oysterhaven, Co. Cork: www.gov.ie/pdf/?file=https://assets.gov.ie/292186/cfbdbe45-1e74-4bb5-9b9a-dea6059190a2.pdf#page=null

[12] See statistics tab on CSO website for census of population 2022; see census interactive map for small area population statistics and agricultural data: https://www.cso.ie/en/

[13] Oysterhaven Activity Centre: https://www.oysterhaven.com/about-oysterhaven/

[14] See EPA Licence and Enforcement Access Portal (LEAP) for 2022 AER (Ref. No. LR085729), 2023 AER (Ref. No. LR078299), 2024 Site Visit Report (SV29705), D0541-01 Final Decision, and D0541-01 Recommended Amendment - A for Belgooly WWTP (D0541-01): https://leap.epa.ie/

[15] See EPA Licence and Enforcement Access Portal (LEAP) for 2023 AER (Ref. No. LR060572), D0433-01 Recommended Amendment – A, 2024 Site Visit (Ref. No. SV29704), D0433-01 Final Decision, and Site Updates/Notifications (Ref. No. LR031167) all relating to Riverstick WWTP: https://leap.epa.ie/

[16] Rotating biological contractors (RBC) is a secondary treatment system used after primary sedimentation of domestic grey/black water and provides aerobic treatment of a fixed-film of biomass. The microbial community are exposed to the wastewater and the atmosphere, alternatively, to allow aeration and assimilation of the dissolved organic pollutants and nutrients.

[17] See EPA Licence and Enforcement Access Portal (LEAP) for EPA Licence Documents for Final Decision and Notification for D0433-01 and Final Decision for D0541-01 at: https://www.epa.ie/our-services/licensing/licencesearch/

[18] Domestic wastewater treatment systems registration: https://www.protectourwater.ie/

[19] Water Services (Amendment) Act 2012: https://www.irishstatutebook.ie/eli/2012/act/2/enacted/

[20] Domestic wastewater treatment systems regulations 2012: https://www.irishstatutebook.ie/eli/2012/si/223/made/en/

[21] EPA Maps: https://gis.epa.ie/EPAMaps/Water

[22] As defined by the CSO, other cows are female beef cattle. Total cattle are comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.

[23] See Irish Resident Travel by County 2023 at: https://www.failteireland.ie/Research-Insights/Regional-Statistics-and-Reports.aspx

[24] See 'Failte Ireland Tourism Facts 2022' at: https://www.failteireland.ie/Research-Insights/Current-Tourism-Performance.aspx

[25] See Fáilte Ireland website for West Cork Coast – Destination and Experience Development Plan: west-cork-coast-destination-and-experience-development-plan.pdf (failteireland.ie)

[26] For Oysterhaven Beach statistics: https://www.beaches.ie/find-a-beach/#/beach/BPNBF050000300001

[27] Blue Flag Beaches and Marinas 2024: https://beachawards.ie/blue-flag/sites-2-2/

[28] National Heritage Monuments and Sites: https://www.arcgis.com/home/item.html?id=434869bbfeb8466cacadb78d77ae3cf6#overview

[29] See 'Publications' tab on gov.ie website for Fifth Nitrates Action Programme Overview document: gov - Fifth Nitrates Action Programme 2022-2025 (www.gov.ie)

[30] See Statutory Instrument [S.I.] No. 113/2022: https://www.irishstatutebook.ie/eli/2022/si

[31] See SFPA 'Code of Practice for the Microbiological Monitoring of Bivalve Mollusc Production Areas': Publications | Sea Fisheries Protection Authority (sfpa.ie)

[32] Tailte Éireann co-ordinate converter GridInQuestII: https://gnss.osi.ie/new-converter/

[33] Household travel survey quarter 4 and year 2023 at CSO: https://www.cso.ie/en/releasesandpublications/ep/p-hts/householdtravelsurveyquarter4andyear2023/

[34] See Nohoval to Oysterhaven, Belgooly River, and Curra Wood trails at: https://www.alltrails.com/

[35] See type of sewerage for permanent private households 2022: https://data.cso.ie/

[36] Search for an IE/IPC application, licence or environmental information for P0943-01 and view EPA documents, specifically the Final Determination 2012 for licence details: https://www.epa.ie/our-services/licensing/licencesearch/

[37] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control): https://eur-lex.europa.eu/eli/dir/2010/75/oj

[38] Search for P0934 Belview Egg Farm Limited on LEAP Online Portal and see most recent site visits and non-compliance records: https://leap.epa.ie/

[39] See Section 4 discharges, Cork for licence information: https://irishriverproject.com/category/section-4-discharges/

[40] See 'Publications' tab on gov.ie website for Fifth Nitrates Action Programme Overview document: https://www.gov.ie/en/publication/f1d01-fifth-nitrates-action-programme-2022-2025/

[41] See groundwater vulnerability at: https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef

[42] Karst in Ireland: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-irish-karst/karst-in-ireland/Pages/default.aspx#:~:text=Most%20karst%20landforms%20in%20Ireland,or%20shale%2Drich)%20limestones.

[43] Water Framework Directive data: https://www.catchments.ie/data/#/dashboard/overview?_k=ad7i3s

[44] See 'Final Act of the International Conference on Marine Pollution, 1973 (MARPOL, 1973) and Convention: https://www.imo.org/en/KnowledgeCentre/ConferencesMeetings/Pages/Marpol.aspx

[45] Oysterhaven at eOceanic: https://eoceanic.com/sailing/harbours/21/oyster_haven

[46] See the site synopsis for Sovereign Island SPA at: https://www.npws.ie/protected-sites/spa/004124

[47] I-WeBS sites, subsites, and count boundaries can be viewed on the I-WeBS sites map viewer: https://birdwatchireland.ie/our-work/surveys-research/research-surveys/irish-wetland-bird-survey/

[48] See site peak counts for Stick Estuary (Oysterhaven) 0L464: https://birdwatchireland.ie/our-work/surveys-research/research-surveys/irish-wetland-bird-survey/

[49] EPA Geoportal: https://gis.epa.ie/GetData/Download

[50] See climate tab for current and historical data: https://www.met.ie/

[51] See Marine Institute data server for wave height data: Marine ERDDAP

[52] See 'How marine water quality is assessed': About the Water Framework Directive - Catchments.ie - Catchments.ie

[53] See 'River Flow Estimates – Hydrotool': https://gis.epa.ie/EPAMaps/Water

[54]See EPA Licence and Enforcement Access Portal (LEAP) for Site Updates/Notifications (Ref. No. LR031167): https://leap.epa.ie/

[55] Turbidity and water: Turbidity and Water | U.S. Geological Survey (usgs.gov)

[56] See FSAI statement on Risk Management of Norovirus in Oysters: https://www.fsai.ie/getmedia/0780ad8e-a014-4c59-a408-189e1bd6e676/norovirus-opinion-paper-2013-final.pdf?ext=.pdf

[57] SFPA classified areas: https://www.sfpa.ie/What-We-Do/Molluscan-Shellfish/Classified-Areas