2025

AQUALICENSE

SANITARY SURVEY AND SAMPLING PLAN FOR BALLYNESS BAY, CO. DONEGAL – JULY 2025

AN t-ÚDARÁS UM CHOSAINT IASCAIGH MHARA | SEA-FISHERIES PROTECTION AUTHORITY

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DISCLAIMER

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 Ballyness Bay was undertaken in 2025. This will provide an appropriate hygiene classification zoning and monitoring plan based on the best available information with detailed supporting evidence. Aqualicense Limited undertook the desktop component of the work on behalf of the SFPA.

STATEMENT OF USE

This sanitary survey has been prepared by Aqualicense for the specific purpose of informing shellfish classification in accordance with regulatory requirements. The report draws on data provided by the Sea-Fisheries Protection Authority (SFPA) through the shoreline survey, as well as other publicly available sources, including state and semi-state bodies, and interprets that data within the context of this assessment.

Every effort has been made to ensure that the data used are the most accurate and up-to-date available at the time of preparation. However, Aqualicense does not independently verify third-party datasets and cannot accept responsibility to any third party who may have access to this report for any errors, omissions, or inaccuracies arising from such sources.

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ABBREVIATIONS

BMPA	Bivalve Mollusc Production Area (i.e. “production area”)
COP	Code of Practice
CSO	Central Statistics Office or Combined Sewer Overflow
DWWTS	Domestic Waste Water Treatment System
E. coli	Escherichia coli
ED	Electoral Division
EPA	Environmental Protection Authority
EU	European Union
GPS	Global Positioning System
GSI	Geological Survey of Ireland
IE	Industrial Emissions
IFI	Inland Fisheries Ireland
IPC	Integrated Pollution Control
I-WeBS	Irish Wetland Bird Survey
MPN	Most Probable Number
NAP	Nitrates Action Programme
NPWS	National Parks and Wildlife Service
PSU	Practical Salinity Unit
Q	Volumetric Flow Rate of Water
RMP	Representative Monitoring Point
SAC	Special Area of Conservation
SFPA	Sea Fisheries Protection Authority
SPA	Special Protection Area
SPR	Source-Pathway-Receptor
UWWTP	Urban Waste Water Treatment Plant
WFD	Water Framework Directive
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

Faecal contamination in shellfish waters poses a significant public health risk, particularly for filter-feeding bivalve molluscs such as oysters and mussels, which can accumulate harmful bacteria and increase the risk of foodborne illness. To mitigate these risks, (Article 56 of EU Regulation, 2019/627) mandates that a sanitary survey be conducted before classifying a shellfish production or relay area.

In line with the regulation, Aqualicense was contracted by the Sea-Fisheries Protection Authority (SFPA) to prepare this Sanitary Survey report. Its purpose is to ensure compliance with the relevant legislation, refine the delineation of the Bivalve Mollusc Production Area (BMPA), and identify appropriate Representative Monitoring Point(s) (RMP).

This report sets out the findings of the sanitary survey for Ballyness Bay, undertaken to support the classification of waters within the Ballyness Bay Bivalve Mollusc Production Area (BMPA). Although aquaculture licences have been granted by the Department of Agriculture, Food and the Marine (DAFM) for the commercial cultivation of Pacific oysters (*Magallana gigas*) and Manila clams (*Ruditapes philippinarum*), inspections confirm that these operations are inactive.

This is the first sanitary survey for Ballyness Bay under the Regulation (EU) 2019/627 and provides the evidence base for classification and ongoing monitoring of the area to ensure that public health protections are maintained.

This report encompasses the following key components:

1. A desk-based assessment of the bay's hydrodynamics and the seasonal potential for faecal contamination sources using a Source–Pathway– Receptor (S-P-R) model;
2. A shoreline survey conducted by SFPA officers to confirm known risks and identify additional sources;
3. A bacteriological survey of selected inflows and runoff points;
4. A recommendation on the extent of the production area (geographic delineation) based on hydrodynamics, catchment influence, and aquaculture activity;
5. Species and location specific recommendations to support the development of appropriate sampling plans for the Representative Monitoring Points (RMPs) within the classified area; and Development of a species-specific sampling plan in line with EU and SFPA requirements.

The desk-based study employed a Source–Pathway–Receptor (S–P–R) model to assess contamination risks within Ballyness Bay. This assessment was based on the defined "Contributing Catchment," encompassing the river networks and associated sub-basins draining into the bay. This approach facilitated the identification of potential pollution sources, their transport pathways, and their circulation within the Bivalve Mollusc Production Area (BMPA), taking into account seasonal variability and microbial loading. Each key step and findings of the S-P-R model is outlined below.

1. The first step in the desk-based study was to characterise the Bivalve Mollusc Production Area (BMPA), i.e. the receptor and the shellfish activities or planned activities within the area.

   Key Finding: The BMPA spans approximately 5.91 km² within Ballyness Bay, Co. Donegal. While no production is currently active, licences for Pacific oyster and Manila clam have been applied

for; with an operator indicating an intention to commence production at two sites in the near future.

2. The desk-based study examined the movement of pollutants, hydrological pathways to, and hydrodynamics within the production area. It also assessed the influence of weather patterns on hydrography and hydrodynamics.

   Key finding: The findings indicate that the primary source of freshwater inflow, and consequently potential contamination, is via the Tullaghobegley river, which flows from Lough Altan and enters the BMPA to the south-east.

   Areas of greatest groundwater vulnerability were identified along the south and east of the bay from Gortahork (Glenna river) extending around towards Ballyness pier. Hydrodynamics indicates that semi-dirunal tides in the bay result in flushing time of ~1.8-4 days (spring to neap tides).

   Current speeds are at their highest at the bay's mouth and remain high in the northern and central region of the bay, where most of the licensed sites are located. Seasonal variations in surface water run-off were also noted, with heavy rainfall events in late summer likely to adversely influence microbial loads entering the bay.

3. An inventory of potential pollutants was compiled, identifying agricultural activity, urban areas and septic tanks as the primary sources of contamination.

   Key finding: Potential sources include agriculture, urban areas/UWWTPs, and DWWTS clusters. Seasonal variations are expected to influence pollutant levels, particularly in summer when higher livestock stocking densities may lead to increased faecal loads.

The overall S-P-R model determined that the key area of concern for organic pollutants is to the south and eastern sections of the BMPA. These regions are bordered by areas of agricultural land (primarily livestock farming), areas of "High" and "Extreme" groundwater vulnerability, and urban areas such as Falcarragh town.

The Source–Pathway–Receptor model indicated that the southern and eastern sectors of Ballyness Bay are at greatest risk of contamination. These areas are influenced by intensive livestock farming, high groundwater vulnerability, and inputs from Falcarragh town. The Glenna and Tullaghobegley rivers were identified as the principal pathways transporting faecal material into the bay. Seasonal pressures, particularly high rainfall in late summer combined with peak livestock densities, are expected to increase contaminant loading.

A shoreline survey was undertaken by SFPA officers to validate and refine the desk-based findings. Eighteen inflows, runoff points were recorded, ranging from agricultural drains and farmyard discharges to municipal and hotel outfalls. Several sites displayed visible indicators of faecal contamination, such as algal growth, stagnant water, or surface scum. These observations confirmed the influence of agriculture, wastewater treatment discharges, and urban drainage as key pressures on water quality in the BMPA. Bacteriological samples were collected from 12 shoreline observation points during dry weather conditions and a neap tidal cycle, factors which may have influenced the contaminant concentration and

detectability. Sampling targeted known and suspected discharge points, freshwater inflows, and areas exhibiting visible signs of potential contamination.

To assess the microbiological water quality and identify sources posing a risk to shellfish safety the analysis focused on *Escherichia coli (E. coli),* a key indicator of faecal contamination. Targeted bacteriological sampling at 12 locations provided further evidence of contamination risks. E. coli was detected at all sites, with results ranging from low to very high levels (135 to 6,100 MPN/100 mL) (Figure 4-1). The highest values were linked to riverine inflows and agricultural runoff, with additional elevated results adjacent to a wastewater treatment outfall and farmyard discharges. These findings highlight agriculture and municipal wastewater as the dominant contamination sources, with seasonal and weather-related variability influencing results. These findings were instrumental in refining the BMPA boundary and determining the placement of the Representative Monitoring Points (RMPs),thereby ensure accurate and protective classification of shellfish waters.

Considering the findings of the desk-based study (Section 2.7), shoreline survey (Section 3.2)and bacteriological sampling (Section 4.2), the BMPA boundary has been designated to encompass the entire bay, with delineation reflecting prevailing hydrodynamic flow patterns.

Species-specific Representative Monitoring Points (RMPs) have been designated to ensure effective monitoring of microbiological quality, aligned with contamination risks identified in the survey and with historic aquaculture licensing. While no active shellfish cultivation is currently in place, licences for Pacific oyster and Manila clam have been granted by the Department of Agriculture, Food and the Marine (DAFM). To ensure regulatory coverage for these licenses and potential future operations, RMPs for both species have been established with recommendations for inclusion in subsequent sampling plans (Sections 7.1(Pacific Oyster) and section 7.2 (Manila Clam))

In conclusion, a sanitary survey has been completed for Ballyness Bay on behalf of the SFPA in accordance with (Article 56 of EU Regulation, 2019/627). Drawing on the desk-based study, shoreline survey, and bacteriological monitoring, species-specific RMPs have been identified and associated sampling plan recommendations developed. These outputs provide an evidence-based framework for the classification and microbiological monitoring programme of Ballyness Bay and to support the ongoing annual review of classifications.

1 INTRODUCTION

The presence of faecal contamination in the marine environment can result in the accumulation of harmful microorganisms in shellfish, posing a public health risk. Bivalve molluscs such as oysters, mussels, and clams are filter feeders, meaning they draw in and process large volumes of water, which can lead to the concentration of microbial contaminants. *Escherichia coli* (*E. coli*) is a key indicator organism used to assess faecal contamination, as its presence suggests potential pollution from human or animal waste. If such contamination includes pathogenic bacteria or viruses, it can increase the risk of foodborne illness for consumers.

To mitigate these risks, the European Union has established a regulatory framework governing the classification and monitoring of shellfish production and relaying areas. EU Regulation 2019/627 outlines the requirements for sanitary surveys. Article 56 of the Regulation mandates that competent authorities (i.e. the SFPA in an Irish context) conduct a sanitary survey before classifying a production or relaying area. This survey must include:

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, waste-water 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*.

Furthermore, under the SFPA Code of Practice (SFPA, 2020), a sanitary survey may include four elements:

1. A desk-based study to identify pollution sources
2. A shoreline survey to confirm initial findings of the desk-based study
3. A bacteriological survey
4. Data assessment

In addition, ongoing monitoring is required under Article 57, ensuring that sampling programmes are informed by sanitary surveys and designed to produce representative data on water quality and potential contamination risks. Article 58 further stipulates that authorities must establish procedures to ensure that both sanitary surveys and monitoring programmes accurately reflect the conditions within shellfish production areas.

Ballyness Bay has not previously been classified as a Bivalve Mollusc Production Area (BMPA). Therefore, this report will form a basis for the first classification by examination of all potential sources of faecal contamination, pathways, circulation and seasonal variations, with particular consideration of the area's rural context. The report aims to inform classification decisions and provide the necessary evidence for effective monitoring in line with EU regulatory requirements.

2 Desk-Based Study

2.1 Introduction to the General Area

Ballyness Bay is a sheltered inlet located along the northwest coast of Co. Donegal, covering approximately 5.91km^2. The bay is characterised by predominantly shallow waters with gently sloping bathymetry that gradually deepens toward the main tidal channel linking it to Tory Sound and the Atlantic Ocean.

It is flushed by semi-diurnal tidal flows, with gentle to moderate tidal streams that reflect the wider tidal exchange between the bay and the adjacent coastal waters. These physical conditions underpin a mosaic of habitats which include intertidal sand and mudflats, fringing saltmarsh, pockets of machair grassland and rocky outcrops. Due to these physical features, Ballyness Bay is an ecologically rich haven for waders, wildfowl and a range of marine invertebrates (NPWS, 2013).

While bivalve aquaculture has previously been proposed for the bay through licence applications submitted by commercial operators and granted by the Department of Agriculture, Food and the Marine (DAFM), there is currently no active cultivation taking place. (*Figure 2-1)*.

No commercial inshore fishing targets have been identified by the (Marine Institute, 2025).

2.2 Characterisation of the Production Area

Key characteristics of the production area are outlined in *Table 2-1*.

Table 2-1. Characteristics of the Production Area

Criteria	Description
Location and extent	This Bivalve Mollusc Production Area (BMPA) is within Ballyness Bay, Co. Donegal. It covers an area of c. 5.91 km^2.
Bivalve species	Pacific oysters (*Magallana gigas*) and Manila clams (*Ruditapes philippinarum*) are identified as the proposed species for aquaculture activities in Ballyness Bay.
Aquaculture or wild stocks	At present there is no active production in the area. To date there have been seven shellfish licences granted in the area: T12-407B (Pacific oyster), T12-409A (Manilla clam), T12-515A- (Pacific oyster), T12-441A, B, & C (Pacific oyster), and T12-516A (Pacific oyster).
Seasonality of harvest	While no shellfish harvest is currently undertaken in Ballyness Bay aquaculture licences will typically provide for year-round harvest in accordance with market demand.

CRITERIA	DESCRIPTION
Growth and harvesting techniques	The growth and harvesting technique for Pacific oysters, as indicated in previous licences for the area and in line with customary practice, is the use of bags and trestles. In the case of Manilla Clam the preferred method is Bottom Culture.
Any conservation controls (e.g. closed season)	No conservation controls are currently employed.
Existing classification data	There is no historic classification data for this BMPA as this is a new shellfish production area. The established process for defining a BMPA boundary involves the SFPA proposing an initial boundary by assessing the maximum area suitable for aquaculture that can be effectively covered by a localised sanitary survey. This process is carried out in consultation with key stakeholders involved in aquaculture development and licensing, such as BIM, industry representatives, and the Department of Agriculture, Food and the Marine (DAFM). The boundary is then finalised based on the findings of the sanitary survey, ensuring it encompasses both the potential shellfish production area and the zones that may impact it through pollutant inputs. This approach ensures that the designated Representative Monitoring Point(s) (RMPs) provide reliable representation of the microbiological quality within the BMPA.
Norovirus data	There is no historic norovirus data for Ballyness Bay.

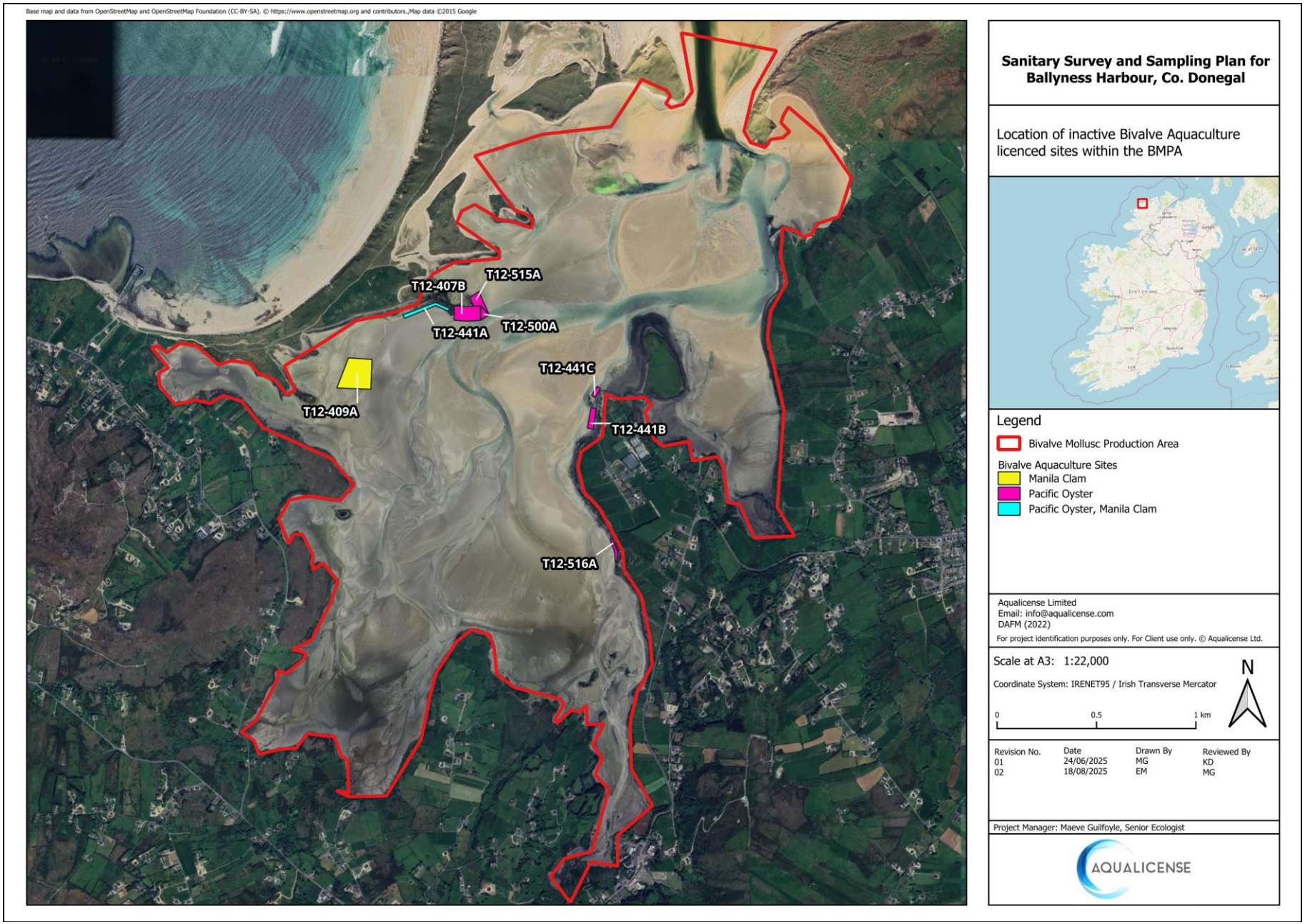

Figure 2-1. Location of granted but inactive bivalve aquaculture licences within the proposed BMPA

2.3 Bivalve Mollusc Production Area Delineation Process

The process for defining a Bivalve Mollusc Production Area (BMPA) boundary is that the SFPA proposes the BMPA boundary by assessing the maximum area suitable for aquaculture that can be effectively covered by a localised sanitary survey. This is done in consultation with key stakeholders involved in aquaculture development and licensing, such as BIM, industry representatives, and the Department of Agriculture, Food and the Marine (DAFM).

The boundary is then finalised based on the findings of the sanitary survey, ensuring it encompasses both the potential shellfish production area and the zones that may impact it through pollutant inputs. This approach ensures that the designated Representative Monitoring Point(s) (RMPs) provide reliable representation of the microbiological quality within the BMPA.

2.4 Assessment Methodology

The desk-based study follows SFPA guidelines (COP SH01) in accordance with (Article 56 of EU Regulation, 2019/627). It forms the first part of the sanitary survey, informing the shoreline and bacteriological surveys (if required).

Using a Source-Pathway-Receptor (S-P-R) model to determine and describe the flow of possible environmental pollutants from a source, through different pathways to the potential receptor, the study ensures a focused assessment by identifying contamination risks.

This assessment applies the S-P-R model to evaluate the ecological risk associated with faecal contamination within the BMPA (i.e. the receptor).

- **Source**:
  Faecal contaminants originate from identifiable inputs including but not limited to: agricultural runoff, wastewater treatment plant effluents, combined sewer overflows, and diffuse urban or wildlife sources. These inputs introduce microbiological pollutants such as *E. coli*, enteric viruses, and protozoan cysts into the aquatic environment.
- **Pathway**:
  Contaminants are transported via hydrological and tidal processes, surface water flows, and stormwater conveyance systems. Transport dynamics are influenced by rainfall events, land use, catchment topography, and the retention or resuspension of faecal material in sediments. Temporal variation is considered to identify peak contamination windows.
- **Receptor**:
  Shellfish species, particularly filter feeders, accumulate faecal contaminants present in the water column. These organisms serve as biological indicators and direct receptors of microbial loading.

If any element (source, pathway or receptor) is absent, no impact occurs, allowing targeted evaluation of the production area. Key S-P-R components are indicated in Figure 2-2.

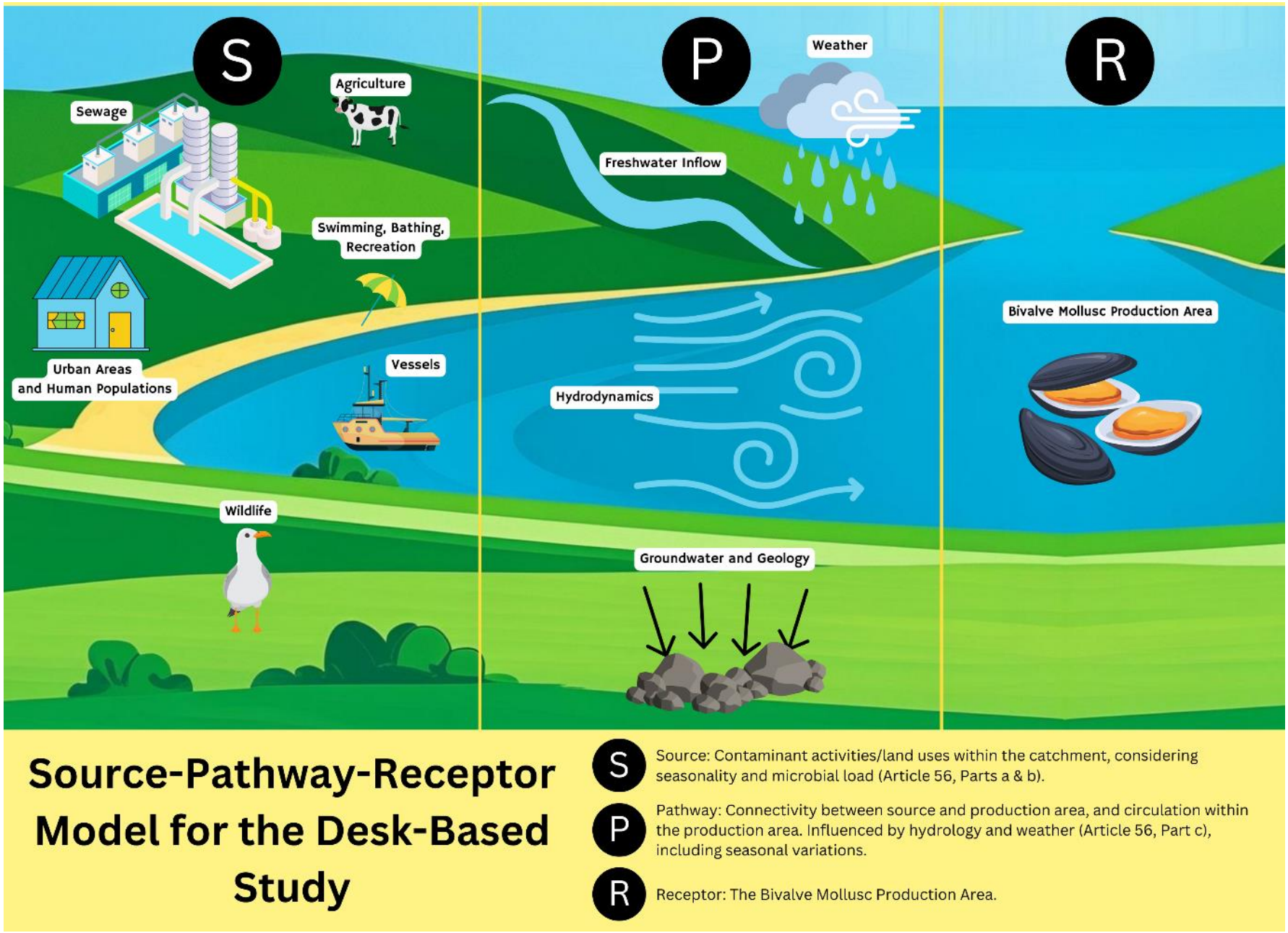

Figure 2-2. Key elements to be considered in this Desk-Based Study under the SPR Model

2.4.1 CONTRIBUTING CATCHMENT

The first step in assessing sources and pathways was to define the "Contributing Catchment", the area of land from which there is a hydrological connection to the proposed production area. A catchment is broadly defined as "an area of land that drains into a river, lake or other body of water" (EPA, 2025a). While the EPA identifies catchments and sub-catchments for Water Framework Directive (WFD) monitoring, these are at too large a scale for the specific requirements of a sanitary survey.

For the purposes of this assessment, a tailored "Contributing Catchment" was delineated. This was achieved by first identifying all river networks (EPA, 2022) entering the proposed BMPA and then including the EPA-defined sub-basins (EPA, 2022) through which these rivers flow to capture the full extent of land draining into the bay.

The resulting contributing catchment covers an area of 118.07 km² and incorporates six sub-basins. The defined contributing catchment and relevant sub-basins are shown in Figure 2-3.

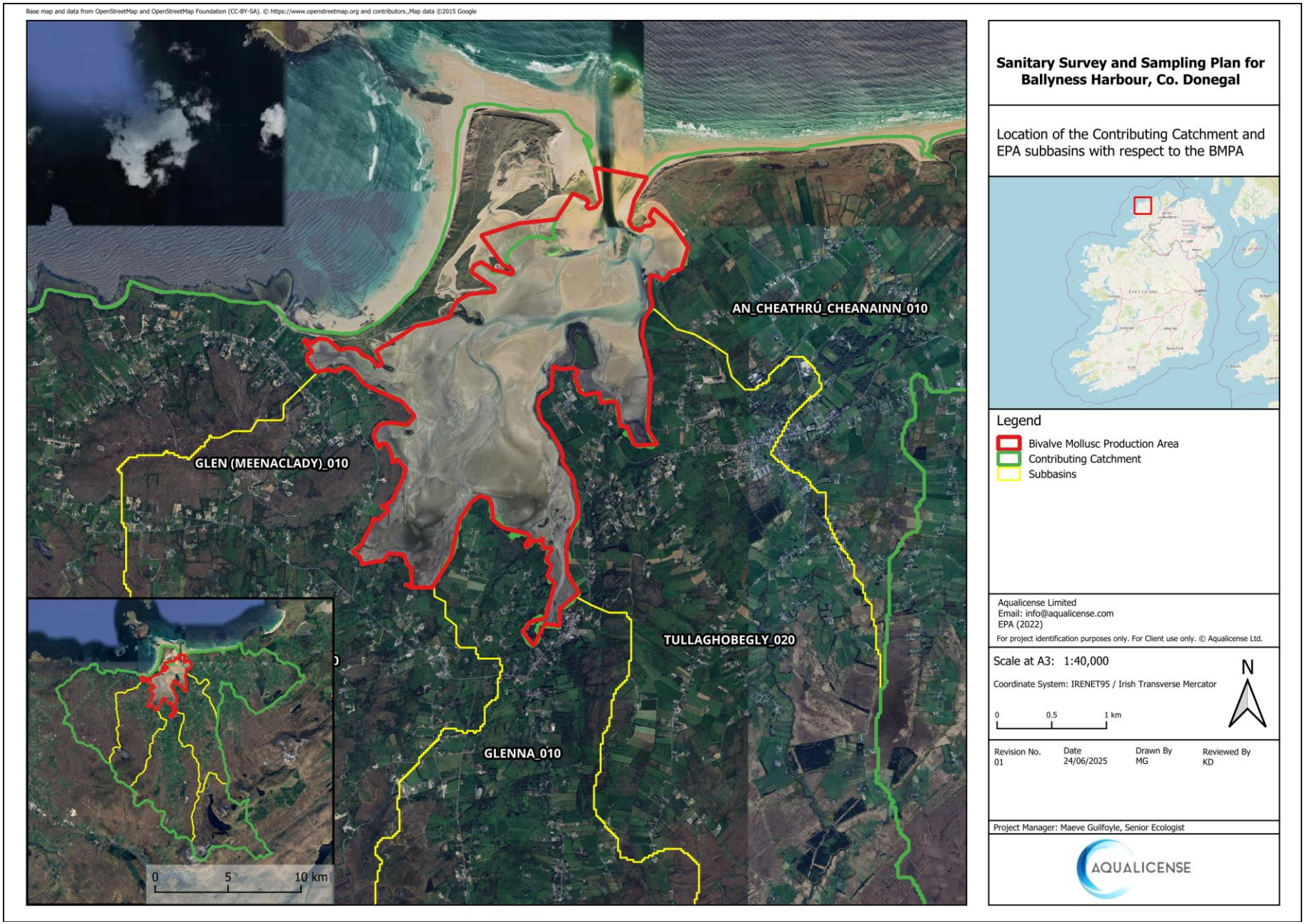

Figure 2-3. Location of contributing catchment and EPA subbasins with respect to the BMPA

2.5 CHARACTERISTICS OF CIRCULATION OF POLLUTANTS

Prior to identifying pollution sources and their seasonality, an examination of pollutant circulation within the production area was conducted. This analysis provided the foundation for the detailed pathway assessments presented in subsequent sections of this desk-based study. This section describes the movement of pollutants within the bay, outlining the hydrological pathways leading to the production area and the hydrodynamic processes operating within it. It also considers the influences of weather patterns, particularly their seasonal influences on hydrography and pollutant dispersion. These insights directly inform the delineation of the BMPA and placement of RMPs.

2.5.1.1 FRESHWATER INFLOWS

The contributing catchment (Figure 2-3) consists of the following six river subbasins and watercourses: Glen (Meenaclady)_010; Owenawillin_010; Glenna_010; Tullaghobegly_010; and Tullaghobegly_020, and An_cheathrú_cheannainn_010 (EPA, 2022). The principal sources of freshwater input to Ballyness Bay are the Glenna and Tullaghobegley rivers, which enter the bay to the south and east of the BMPA. These watercourses have been categorised based on their points of inflow to the production area (*Figure 2-4*). Assessing these inflows is the first step in understanding the entry of pollutants and provides the basis for further examination of pollutant circulation within the bay.

Two hydrometric gauges (one active and one inactive) are present within the contributing catchment (EPA, 2023). The first gauge is positioned at the outflow of Lough Altan (the source of the Tullaghobegley River) and the second is further downstream at station LA_Ref_Lwat26. The downstream gauge at LA_Ref_Lwat26 is currently inactive, and no flow records are available. The Lough Altan station data show that flow typically ranges between 1 – 6 Q m^3/s with peak flow of 15 Q m^3/s. The Tullaghobegley river represents the largest freshwater input into Ballyness Bay (*Figure 2-4*).

The Water Framework Directive (WFD) aims to protect and enhance the quality of rivers, lakes, transitional waters, coastal waters, and groundwater. WFD monitoring assesses biological, physicochemical, and hydromorphological parameters to determine the waterbody status. While not all WFD parameters are directly relevant to sanitary surveys, some, such as the assessment of nutrients (nitrogen and phosphorus) and dissolved oxygen, serve as key indicators of organic pollution, including faecal contamination. WFD monitoring also identifies pressures on water quality, such as nutrient enrichment, wastewater discharges, and diffuse pollution, which are further explored in *Section 2.6* in the context of their relevance as pollutant sources.

The WFD status of Lough Altan was classified as “Good” for the period 2016-2021 (EPA, 2023). The Tullaghobegley river is also classified as “Good” near its source, however, its status declines to “Poor” at Procklis, Falcarragh (*Table 2-2* and *Section 2.6.2.2*). It is considered “At Risk” of failing to meet its WFD objectives by 2027. The drainage area in the vicinity of the Tullaghobegley is extensive and encompasses areas of “Extreme” and “High” groundwater vulnerability, as well as agricultural land and urban areas. It enters the BMPA at inflow points 10 and 11 (*Figure 2-4*), which are approximately 1.2 km and 0.9 km southeast of the nearest historically licensed site T12-441C. This will be discussed in more detail in *Section 2.6* in respect of individual pollution sources.

Table 2-2. Locations of freshwater inflow to the production area (EPA, 2023)

Code	River Subbasin (EPA Code)	River Name (EPA Code)	WFD Status at Inflow Point
IE_NW_38G050200	Glen(Meenaclady)_010	Unnamed river	Moderate
IE_NW_38O100200	Owenawillin_010	Unnamed river	Good
		Unnamed river	Good
		Unnamed river	Good
		Unnamed river	Good
IE_NW_38G010200	Glenna_010	Unnamed river	Poor
		Glenna River	Poor
		Unnamed river	Poor
IE_NW_38T010100	Tullaghobegly_010	Tullaghobegley River	Poor
		Unnamed river	Poor
IE_NW_38T010400	Tullaghobegly_020	Unnamed river	Poor
IE_NW_38C180660	An_cheathrú_cheannainn_010	Unnamed	Moderate

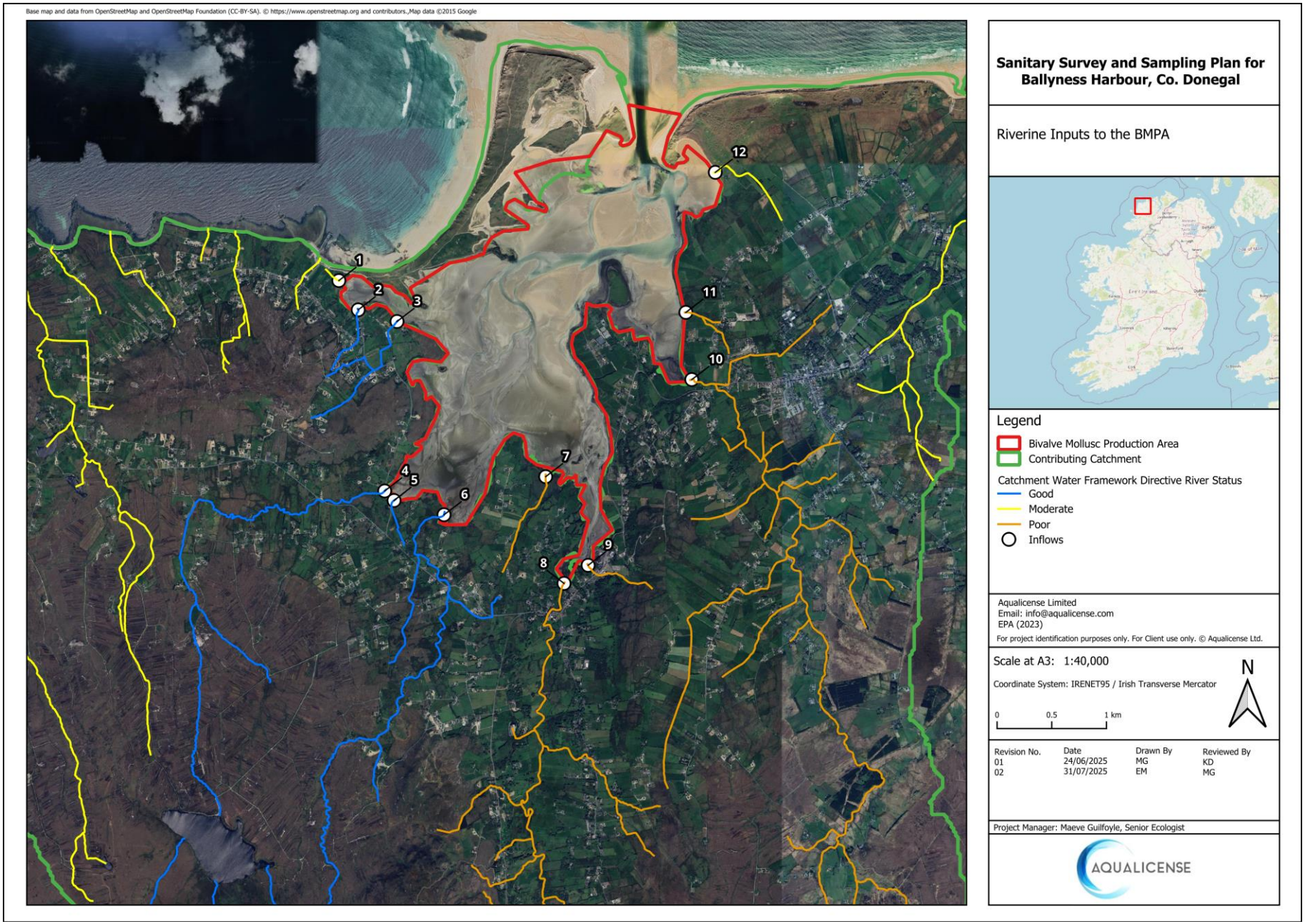

Figure 2-4. Riverine inputs to the production area

2.5.1.2 GEOLOGY AND GROUNDWATER

The movement of microbial pollutants, such as E. coli, within a catchment is influenced by the underlying geological conditions. In particular, groundwater vulnerability- determined by factors such as the depth to the water table, subsoil permeability and the nature of the bedrock, plays a critical role in assessing the potential for contaminants to reach the groundwater and subsequently the marine environment. The EPA methodology classifies areas into vulnerability categories (e.g. low, moderate, high, extreme) based on their permeability to the groundwater table.

Pollutants can enter the marine environment via groundwater through two primary pathways. The first is via surface water, where groundwater inflow contributes to rivers, lakes, and other surface waters that eventually discharge into the marine environment. The second pathway is direct submarine groundwater discharge, where groundwater seeps directly into the sea from the seabed, including the intertidal zone (Arévalo-Martínez *et al*., 2023). Further detail on groundwater conditions in relation to individual pollution sources is provided in Section 2.6.

The contributing catchment overlies a single groundwater body: "Northwest Donegal". Which was classified as having a "Good" WFD status from 2016-2021 (EPA, 2023).

An analysis of groundwater vulnerability (GSI, 2021) within the contributing catchment reveals that 20.4% of the area is categorised as “Rock at or near Surface or Karst” and 54.4% as “Extreme” vulnerability (*Figure 2-5*). These areas, located in the south of the contributing catchment and extending to the shoreline where they border the southern section of the BMPA, pose the highest risk for pollutant infiltration via groundwater, particularly where they intersect with surface water pathways.

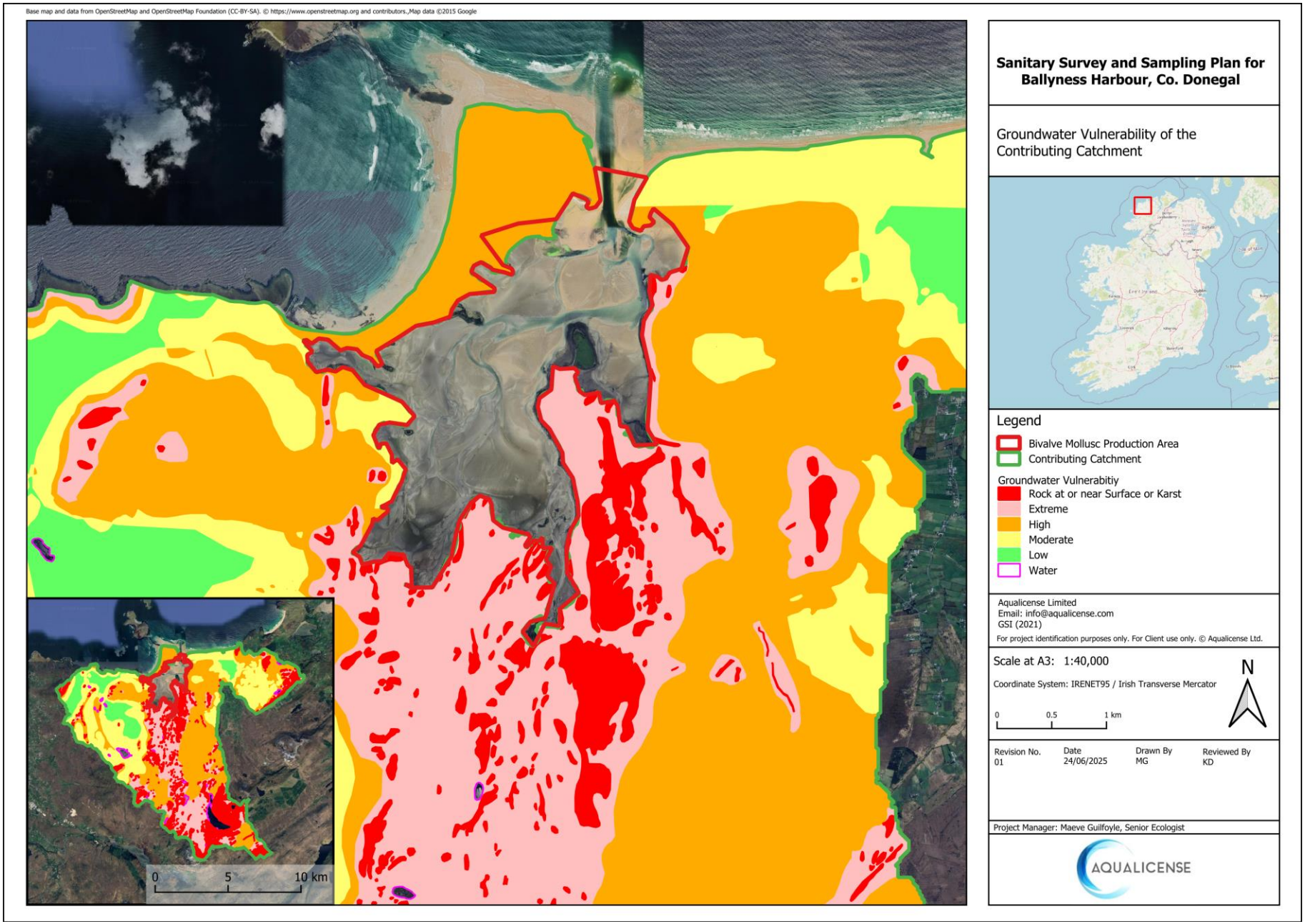

Figure 2-5. Groundwater vulnerability of the Contributing Catchment

2.5.1.3 HYDRODYNAMICS

In conjunction with a hydrographic survey undertaken in 2004 by Irish Hydrodata Limited (Irish Hydrodata Limited, 2004), additional insights were drawn from Admiralty Chart 2752 (UK Hydrographic Office, 2025) to describe the hydrodynamics of Ballyness Bay.

2.5.1.4 BATHYMETRY

Bathymetry was assessed through Admiralty Chart 2752. Ballyness bay is a very shallow, relatively enclosed and sheltered embayment with a narrow opening at the mouth between The Hook and Drumnatinny Point (*Figure 2-6*). The majority of the bay comprises intertidal flats with a drying height of ≤3 m. The dominant substrate is sand with small areas of reef close to the mouth of the bay. There is a natural shallow channel to Ballyness pier, and the rest of the bay is accessible at high tide.

2.5.1.5 TIDAL INFLUENCE

The tidal range in Ballyness bay is estimated at approximately 3.3m during spring tides and 1.4 m during neap tides (Jackson D.W.T., 2022). Tidal flow within the harbour is bi-directional, reversing at roughly six-hour intervals, with peak velocities estimated at approximately 1-2 knots during spring tides, reducing to 0.5-1.0 knots during neap tides.

The flushing time for the bay has been estimated at ~1.8 days (during spring tides) up to approximately 4 days (during neap tide periods) (Jackson D.W.T., 2022). Spring tides are typically associated with enhanced water exchange and increased flushing throughout the bay area. Conversely neap tides typically result in reduced water turnover, potentially influencing water quality, particular in the more sheltered or deeper zones.

2.5.1.6 TEMPERATURE AND SALINITY

No detailed temperature studies specific to Ballyness bay or its environs are readily available, though the long-term records for nearby Malin Head indicate the temperature ranges between 7-16 °C (Met_Éireann, 2025).

Variations in salinity are more pronounced in the inner bay, where freshwater influence is more significant. Salinity increases during the flood tide as seawater enters the bay and decreases during the ebb tide due to freshwater input and saltwater leaving the bay. For comparison, Aquafact conducted a survey at Gweedore Bay (c. 14 km from Ballyness bay) in 2021, the river inflow represented the main source of salinity variation for the inner area, with salinities ranging from 31.34 to 33.22 ppt (AQUAFACT, 2021).

A similar trend is expected in Ballyness bay, as both bays are relatively enclosed, have similar bathymetric profiles and receive freshwater inputs to their inner regions.

2.5.1.7 CURRENT PATTERNS

The M2D hydrodynamic model (Irish Hydrodata Limited, 2004) was used to assess current patterns within Ballyness Bay. Due to its bathymetry, narrow inlet and channel system, current patters are strongly tide dominated.

On the flood tide, flow enters the inlet, progressing southward along the eastern shoreline, splitting around Ranghmore Island, and forming a slight anticlockwise eddy south of Ballyness Pier. Current speeds are highest at the bay's mouth, where the channel narrows and deepens (2–2.5 m/s). The model shows that current speeds decrease progressively into the bay but remain relatively high in

the northern and central regions (0.75–1.25 m/s). The one-way channel configuration forces the greatest volume of water exchange past Ballyness Pier, with current speeds decreasing to 0–0.25 m/s towards the southern bay at the outflows of the Tullaghobegley and Glenna rivers.

During the ebb tide, drainage from the intertidal flats converges into a northbound stream that accelerates seaward, reaching up to 1.7 m/s near the inlet approximately three hours after high water. Due to the comparable energies of the flood and ebb tides, low net riverine discharge, and the overall small size of the bay, the net residual circulation within Ballyness is relatively weak.

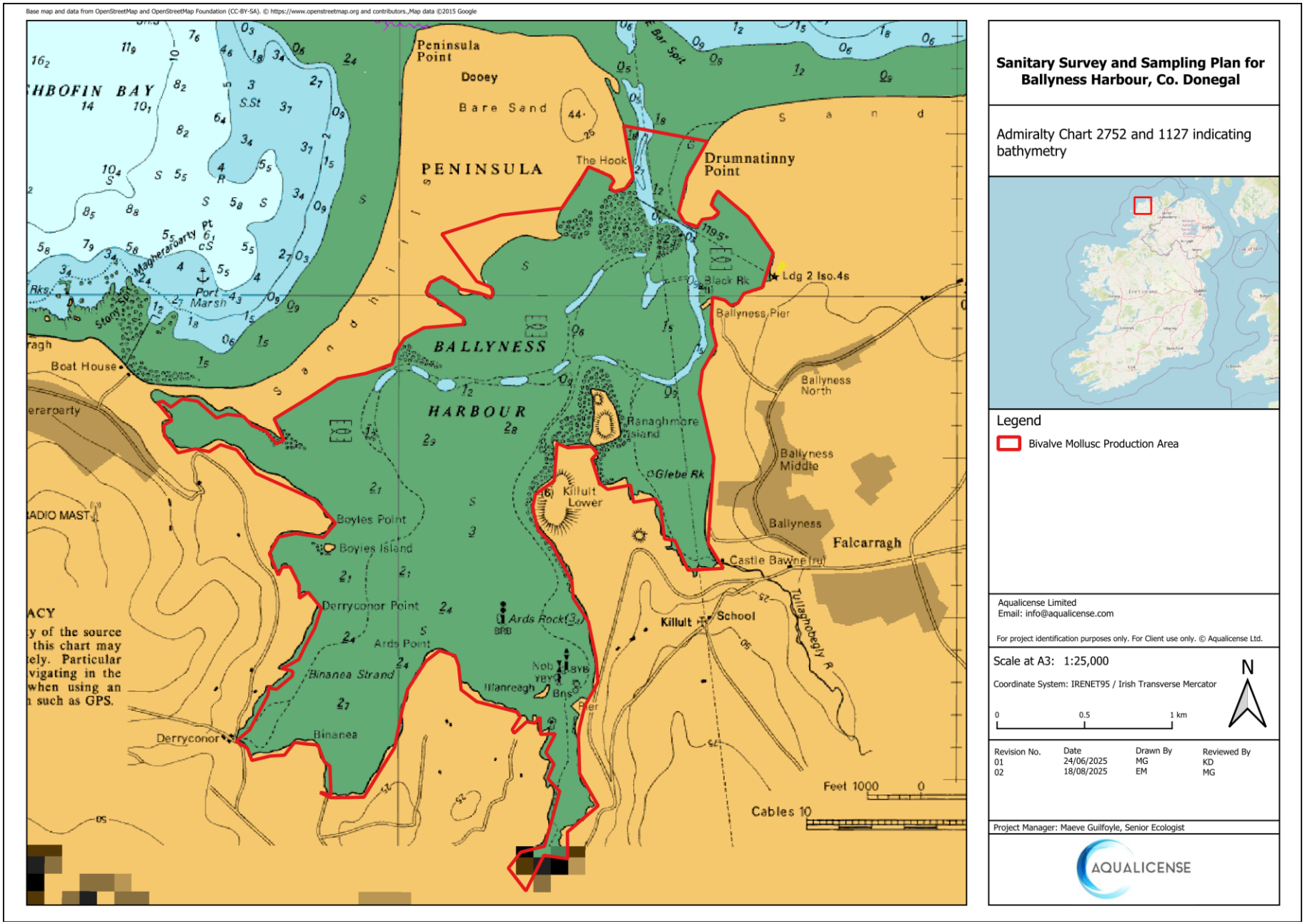

Figure 2-6. Admiralty Chart 2752 and 1127 indicating bathymetry

2.5.2 WEATHER

Weather patterns significantly influence the transport of organic pollutants. The nearest synoptic weather station to the production area is Malin head, located c. 48.72km northeast. Data from this station from June 2015 to May 2025 inclusive (Met Éireann, 2025a) (Met Éireann, 2025b)have been used to infer weather patterns and seasonality influencing pollutant circulation within the production area.

2.5.2.1 WIND AND WAVES

The prevailing wind direction is westerly, accounting for 20% of all winds (*Figure 2-7*). South-westerly winds have the highest mean wind speeds at 8.4 m/s, followed by westerly winds at 8.1 m/s. Winds from the south-west, which are more common in summer, autumn, and winter, also account for 16.9% of winds. Southerly winds make up 17.1% of the total, reaching a peak average wind speed of 15.8 m/s. Winds from the east are prevalent in spring and less common throughout the rest of the year. For further details refer to *Appendix 1* Summary Statistics for Weather.

Waves and currents play a crucial role in hydrographic conditions. Of particular relevance to sanitary surveys, wind-driven waves facilitate sediment resuspension and transport (Green and Coco, 2014). These waves are primarily generated by local prevailing winds and travel in the direction of those winds. Their characteristics are influenced by factors such as wind speed, duration, and fetch (Young, 1999).

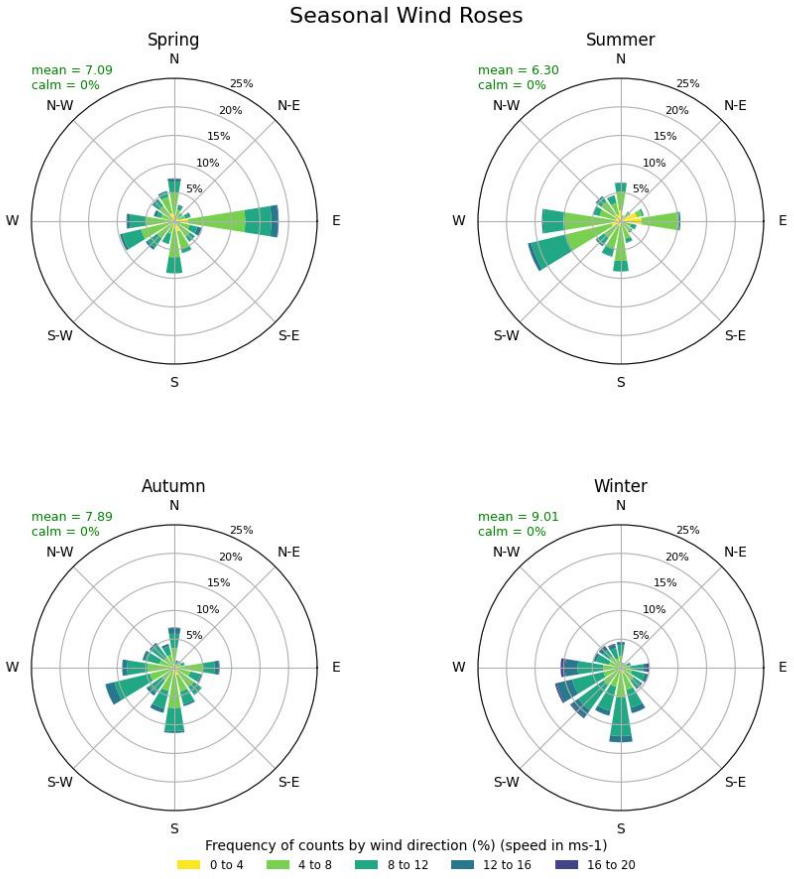

Figure 2-7. Seasonal wind roses for Malin Head (June 2015 to May 2025 inclusive)

The Inishowen Coastal Erosion Risk Management study (RPS, 2019) found that waves from the west and north-west are most prevalent in the region and the largest waves originate from these directions. The nearshore wave climate was assessed using data from 1996 to 2018 and areas in close proximity to the bay had a significant wave height (Hm0) value of over 8m.

2.5.2.2 PRECIPITATION

Heavy rainfall can lead to surface runoff, transporting organic pollutants from land-based sources, such as farms and wastewater overflows into surface water bodies and potentially to the production area. The mean monthly rainfall is at its lowest levels during the spring period, followed by summer, with rain fall peaking in autumn and winter (*Figure 2-8*). The driest period occurs from March to June, with precipitation reaching a peak during the winter months.

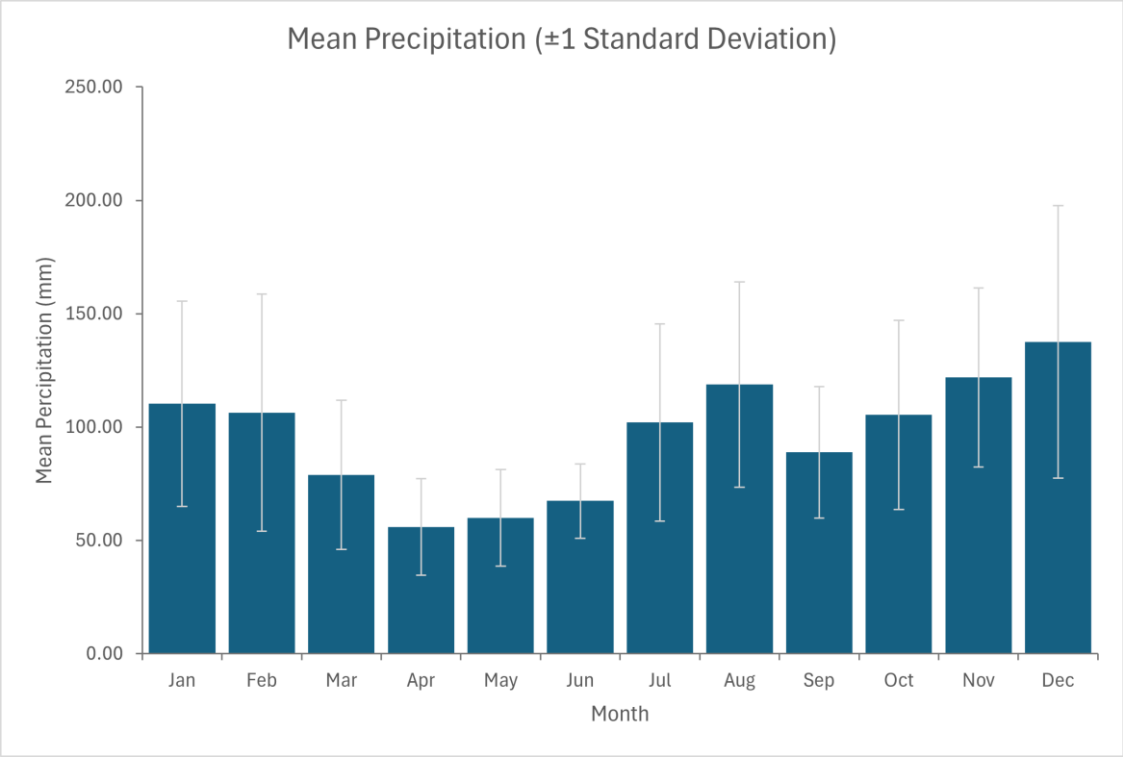

Figure 2-8. Mean monthly precipitation (± 1 standard deviation) at Malin Head (June 2015 to May 2025 inclusive)

Mean monthly rainfall levels are highest in December (130 mm), although heavy rainfall events occur throughout the year, with the exception of the summer months when precipitation drops to less than 50 mm per month.

Significant rainfall during the summer, when the land is dry and compacted, reduces the soil's ability to absorb water (Qiu, Shen, Leng, & Wei, 2021), leading to increased runoff. During this period, higher faecal loadings are likely due to increased livestock stocking densities and the accumulation of faecal contamination over the summer months. Therefore, the influence of precipitation on circulation of pollutants will be further discussed in *Section 2.6* in relation to each source of contamination.

2.5.3 SUMMARY OF THE CHARACTERISTICS OF CIRCULATION OF POLLUTANTS

For clarity at this stage of the Sanitary Survey, a brief summary of this sections findings is provided below. Key characteristics identified include:

- **Freshwater Inflows:** The major sources of freshwater inflow within the contributing catchment are the rivers Tullaghobegley and Glenna. These are considered to be the primary inflow of freshwater to the bay.
- **Groundwater:** Groundwater vulnerability is high in the southern areas of the contributing catchment extending towards the southern boundary of the BMPA. These are the areas at greatest risk in terms of groundwater infiltration.
- **Hydrodynamics:** Current and tidal patterns may lead to localised areas of pollutant concentration, particularly within the inner bay, though there is good potential for pollutant dilution due to the short flushing times within the bay (~1.8 - 4 days).
- **Weather:** Heavy rainfall may influence the seasonality of surface water run-off, particularly during the winter season. Most winds come from the west, and waves from the west and north-west are the largest and most common in this region.

Collectively, these factors influence the entry, movement, and dispersion of pollutants in the production area. Further detail on individual pollution sources is provided in subsequent sections.

2.6 Inventory of Pollution Sources and Seasonal Variations of Pollutants

An inventory has been compiled detailing potential pollution sources of human and animal origin, focusing solely on those containing faecal matter. All identified sources within the contributing catchment (Figure 2-3) have been assessed, considering seasonal variations where relevant. This assessment complies with Part 1a and 1b of Article 56 of Commission Implementing Regulation (EU) 2019/627 (see Section 1 for details).

2.6.1 Sewage Discharges

This section examines sewage discharges from human sources, primarily Urban Wastewater Treatment Plants (UWWTPs) and septic tanks. Contamination risk is influenced by factors such as location, size, treatment level, and discharge frequency. Using publicly available data sources (EPA, 2025a) (Uisce Eireann, 2023) the following sections provide a detailed analysis of all identified discharges within the contributing catchment.

2.6.1.1 Urban Waste Water Treatment Plants

Urban waste water treatment plants (UWWTPs) are linked to various discharges, primarily the continuous release of treated and untreated sewage. They also produce intermittent discharges, including rainfall-dependent releases via combined sewer overflows (CSOs), stormwater overflows, and emergency discharges under exceptional circumstances.

Following review of the available EPA data (EPA, 2025b), two UWWTPs were found to be serving the contributing catchment area (Figure 2-12):

Gortahork UWWTP: This facility provides primary wastewater treatment and is positioned to the southern side of Ballyness bay, located in close proximity to inflow 9 discharging directly into Ballyness Bay. The plant serves a population equivalent of <500. Primary treatment at this site removes solids, reduces biochemical oxygen demand and total suspended solids in the wastewater. There are three historically licensed aquaculture sites on the western side of the bay, with T12-516A (Pacific oyster) being the closest, located ~1.5 km north of the UWWTP outfall.

Falcarragh UWWTP: Located to the west of Falcarragh town, this facility discharges into the eastern part of Ballyness Bay, with a normal flow of 357 m^3/day (EPA, 2015). The site only carries out

preliminary treatment, which consists of the removal of large solids only, effectively making it a raw sewage discharge point. It serves a population equivalent of 1,001–2,000. This UWWTP was non-compliant with Emission Limit Values (ELVs) in 2023 due to inadequate screening measures (Uisce Eireann, 2023).

Given the non-compliance issues at Falcarragh UWWTP and the limited treatment capacity of Gortahork UWWTP, the eastern and southern limits of the harbour are considered the primary areas of concern for UWWTP-related discharges.

2.6.1.2 Septic Tanks and Other Sewerage Types

Ireland has nearly half a million Domestic Waste Water Treatment Systems (DWWTSs), primarily septic tanks (EPA, 2021). In 2023, 45% of these systems failed inspection, posing risks to household drinking water and the wider environment, including surface and groundwater. The EPA categorises DWWTS risk zones as follows:

- Zone 1: Higher risk to surface waters.
- Zone 2: Higher risk to household wells.
- Zone 3: Lower risk areas.

Currently, no comprehensive database exists for exact DWWTS locations. Therefore, this section relies on Census 2022 small-area statistics (CSO, 2023c). *Table 2-3* and *Figure 2-9* present the percentage of each small area overlapping the contributing catchment and its population density.

Table 2-3. Statistics for Small Areas overlapping the contributing catchment and corresponding population density (CSO, 2023c)

Small Area Code	Contributing Catchment Overlap	Population Density (People per km^2)
A057045001/A057045002	93.1%	0
A057045003	>99%	599
A057045004	12.4%	2
A057045005	95.1%	30
A057045006	75.6%	25
A057045007	>99%	833
A057045008	51.5%	24
A057045009	3.3%	16
A057045010	>99%	1380
A057045011	48.5%	61
A057045012	>99%	2230
A057045013	>99%	1028
A057057002/02/A057057004/A057057001	1.7%	0
A057057003	33.3%	18
A057060001	10.4%	2

Small Area Code	Contributing Catchment Overlap	Population Density (People per km^2)
A057060002	>99%	60
A057060003	>99%	63
A057060004	97.1%	9
A057081001/A057081008	65.8%	0
A057081002	>99%	164
A057081003	58.0%	12
A057081004	>99%	79
A057081005	>99%	35
A057081006	94.8%	19
A057081007	>99%	63
A057081010/A057081009	98.7%	0
A057114003	<1%	6
A057114006/A057114013	<1%	0
A057119006	83.0%	13
A057119008/01/A057119004	22.6%	0

Sewerage type estimates were also obtained from Census 2022 data (CSO, 2023c). These figures are presented as percentages for entire small areas, as individual data for overlapping catchments would not be representative (small areas do not directly align with the contributing catchment, see *Table 2-3. Figure 2-10* highlights the extent of reliance on septic tanks within the catchment.

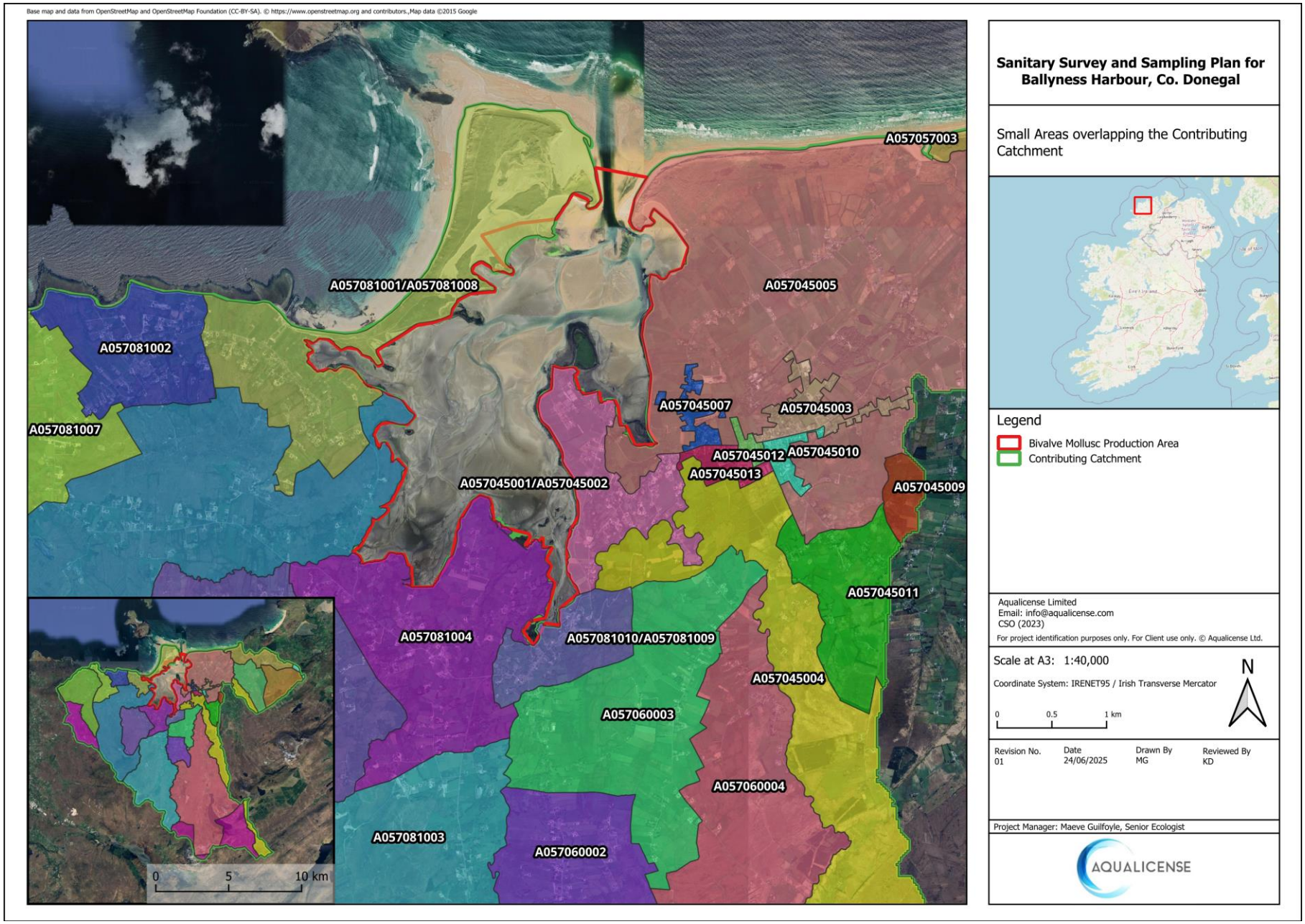

Figure 2-9. Small areas overlapping the contributing catchment

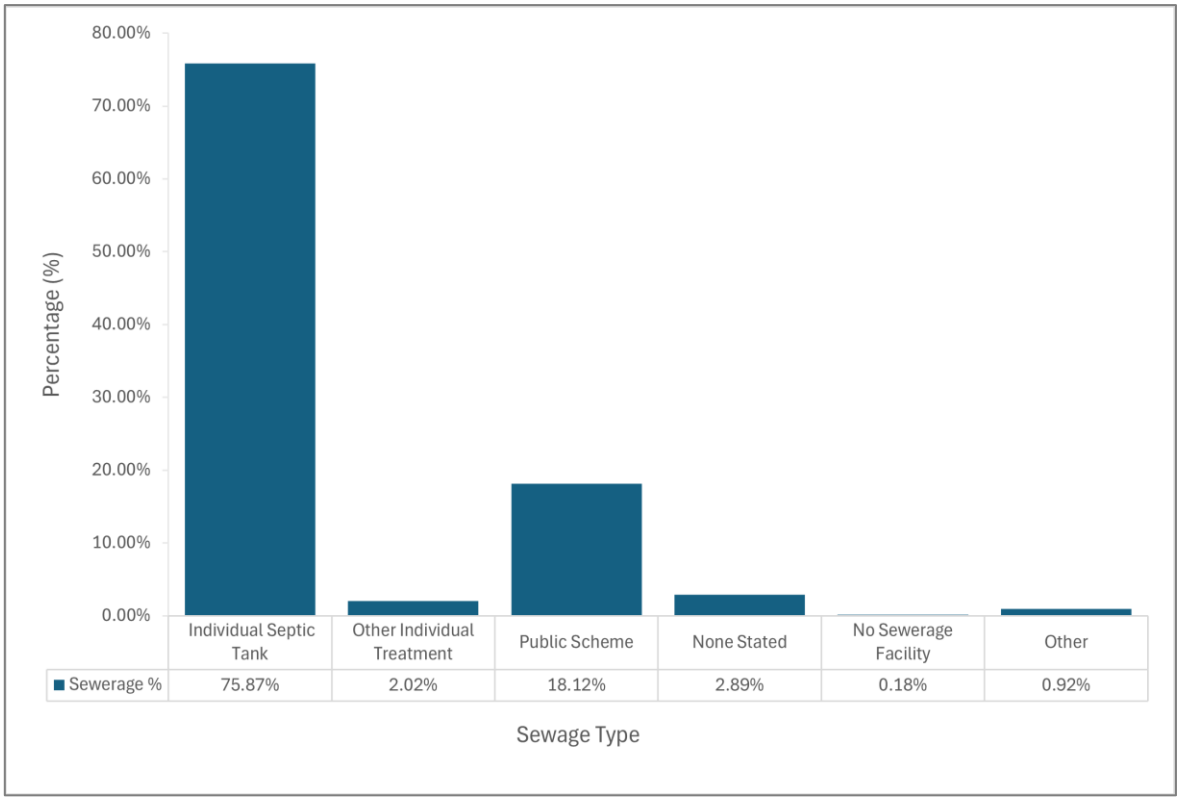

Figure 2-10. Percentage estimates of sewerage types for permanent private households according to the 2022 census

No areas within the contributing catchment are designated as Zone 1 (high environmental risk). The majority of the catchment falls within Zone 3 Low (EPA, 2021). Several small areas that fall into Zone 2 (potential risk to human health) in the south part of the catchment; however, these are not located in close proximity to the BMPA (*Figure 2-11*). The exception is a Zone 2 area to the southeast of Gortahork town approximately 500 m south of the BMPA. While these risk zones indicate potential contamination, other factors must be considered when assessing susceptibility to DWWTS failure or non-compliance.

While Zone 2 areas are present within small area A057060003, its relatively low population density (63 people/km²) and lack of visible houses within the Zone 2 boundary (review of satellite imagery on 24/06/2025) suggest minimal risk. However, it should be noted that this area is located in a region of “extreme” groundwater vulnerability (GSI, 2021). The highest population density in the catchment occurs in small area A057045012, which corresponds to Falcarragh town, and it is located in an area of “high” groundwater vulnerability.

Surface water hydrology also plays a crucial role in contamination risk. The river Glenna flows in proximity to several of the small Zone 2 areas in the catchment and enters the south of the BMPA, potentially increasing contamination risk in this area.

Considering groundwater vulnerability, surface water pathways, and population density, the southernmost region of the BMPA is assessed as the area most susceptible to sewage-contaminated discharges from DWWTSs.

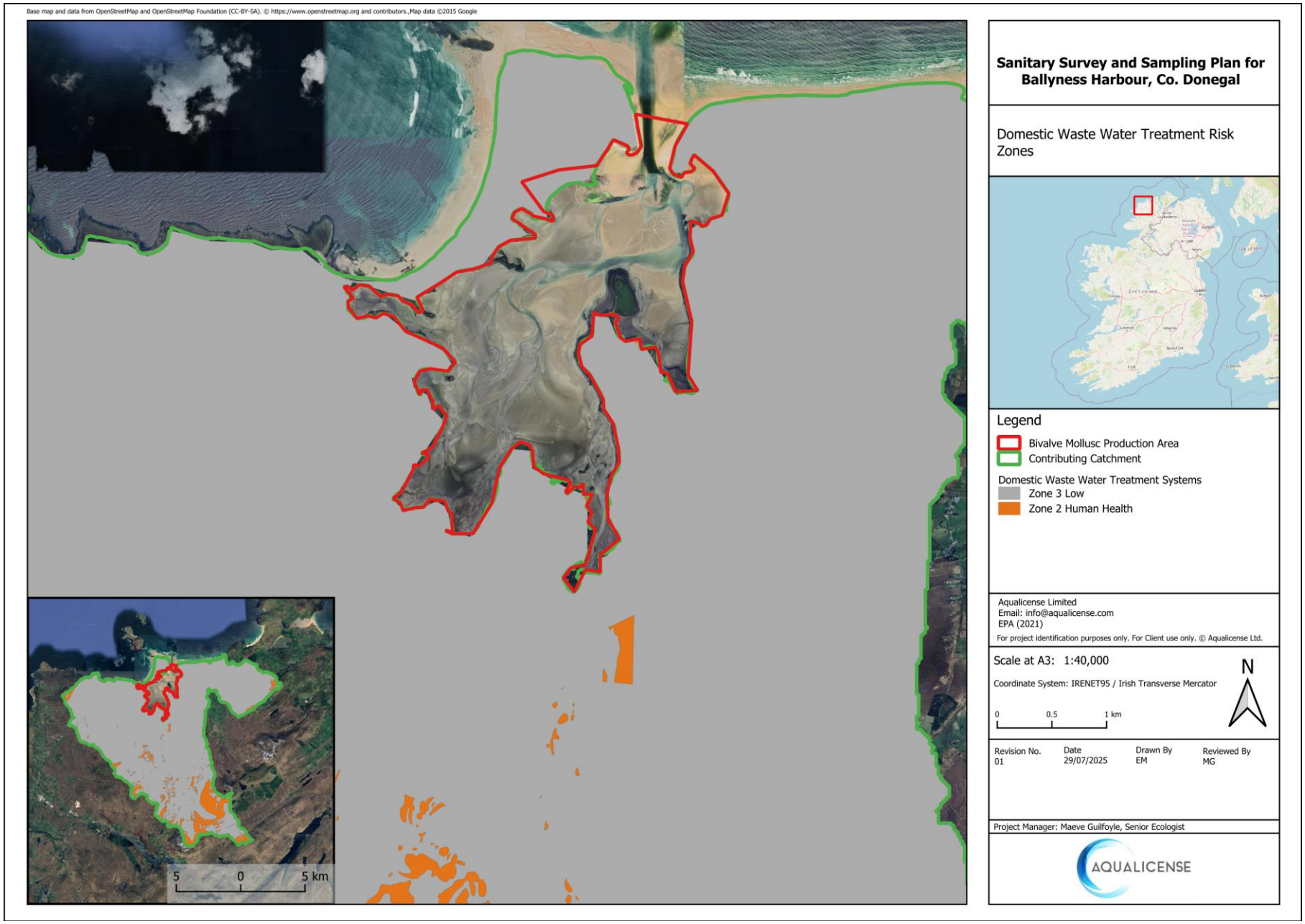

Figure 2-11. Domestic Waste Water Treatment System Risk Zones

2.6.2 Industrial Emissions

2.6.2.1 IE and IPC Licences

The EPA regulates specific industrial and agricultural activities in Ireland through Industrial Emissions (IE) licences and Integrated Pollution Control (IPC) licences. While these cover a broad range of activities, only those relevant to potential faecal contamination from human or animal sources are considered in this desk-based study. The key categories assessed include:

- Food and Drink
- Waste
- Intensive Agriculture (Poultry and Pigs)
- Other Activities (including wastewater treatment)

There are no IE/IPC licenses granted within the contributing catchment (EPA, 2024a), therefore emissions from such facilities will not be further considered in this desk-based study.

2.6.2.2 Section 4 Discharges

Discharge licences issued under Section 4 of the Local Government (Water Pollution) Act 1977 (as amended in 1990) regulate the release of trade and sewage effluent into surface and groundwater. These licences set conditions to ensure effluent is treated and controlled to protect the receiving environment.

A total of two Section 4 discharges are present within the contributing catchment (EPA, 2024b) (*Figure 2-12*):

- LA_Ref_Lwat_6: A stone and concrete supplier serving Ireland and the UK. Licensed in 2001 to discharge trade effluent from its quarry operation in Fanmore, Falcarragh, Co. Donegal, to the Ray River, which discharges onto Falcarragh Beach to the east of the BMPA (55.152113N, -8.0333043W [55° 9' 7.6068'' N, 8° 1' 59.8944'' W]).
- LA_Ref_Lwat_26 A smolt fish farm located in Procklis, Falcarragh, Co. Donegal. Licensed in 1993 to discharge wastewater, following primary treatment, to the River Tullaghobegley (55.082770N, -8.0987064W [55° 4' 57.972'' N, 8° 5' 55.3416'' W]).

2.6.3 Land Use

According to the Corine data as provided by the EPA (2018), land cover within the contributing catchment is dominated by Peat bogs (62.2 km^2, 52.6%). Pastures is the next most dominant land cover type (27.3 km^2, 23.1%). Other land use types within the contributing catchment are: Land principally occupied by agriculture, with significant areas of natural vegetation (7.7 km^2, 6.5%); Complex cultivation patterns (5.7 km^2, 4.9%); Moors and heathland (3.2 km^2, 2.7%); Beaches, dunes, sands (2.9 km^2, 2.4%); Sparsely vegetated areas (2.5 km^2, 2.1%); Water bodies (1.6 km^2, 1.4%) and Bare rocks (1.4 km^2, 1.2%) (*Figure 2-13*).

A number of land cover types cover areas of less than 1%, namely: Transitional woodland-shrub; Discontinuous urban fabric; Intertidal flats; Sport and leisure facilities; Coniferous forest; Mineral extraction sites; Sea and ocean and Estuaries.

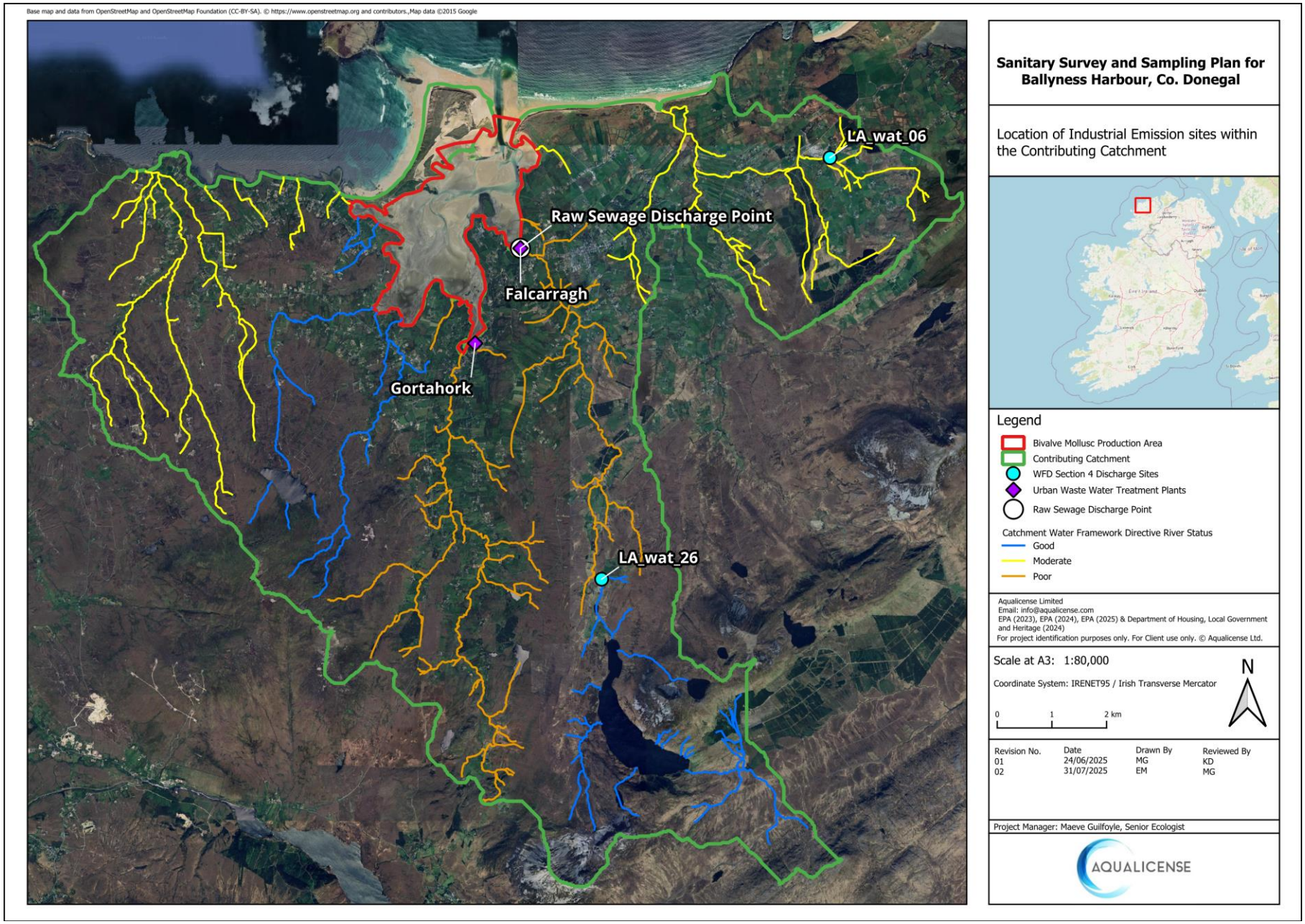

Figure 2-12 Industrial Emissions within the Contributing Catchment

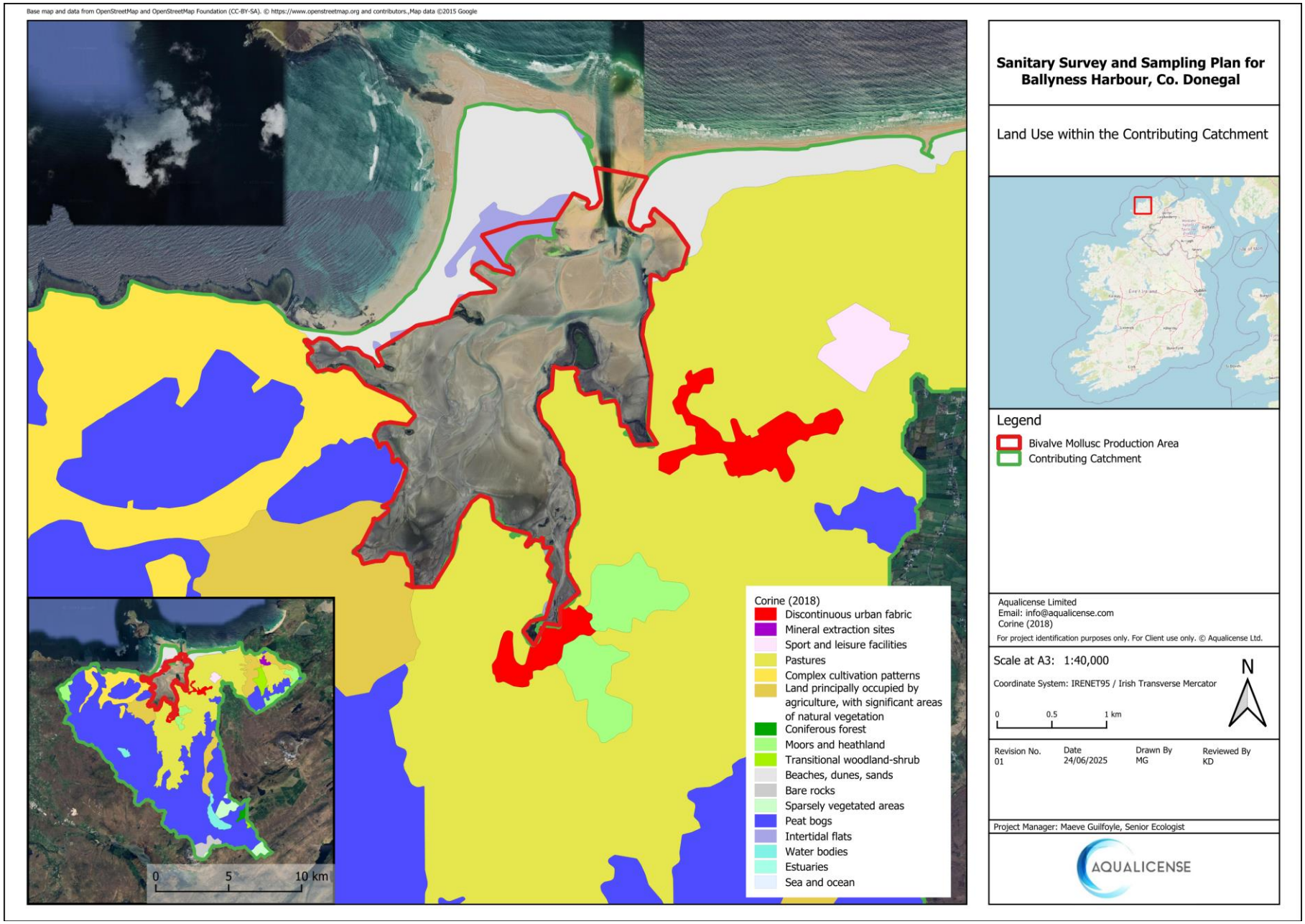

Figure 2-13. Land Use within the Contributing Catchment

2.6.3.1 AGRICULTURE

Animals

Faecal production and *E. coli* loads from domestic animals are often comparable to or greater than those from humans (Jones and White, 1982 as read in Taylor (2003)) (Table 2-4). Sheep have the highest daily *E. coli* load, followed by pigs, cows, humans, and chickens. Contamination can occur through direct deposition into watercourses or run-off following rainfall, with seasonal patterns influencing agricultural contamination (see Section 2.5.2.2). Stocking densities also play a role, with higher faecal contamination typically observed during summer months (Hunter, Perkins, Tranter, & Gunn, 1999).

Table 2-4. Estimated faecal production and *E. coli* loadings of selected domestic animals in comparison with humans (Jones and White, 1982 as read in (Taylor, 2003))

	FAECAL PRODUCTION (G/DAY)	AVERAGE NUMBER (*E. COLI*/G)	DAILY LOAD (*E. COLI*)
Man	150	13 x 106	1.9 x 109
Cow	23600	0.23 x 106	5.4 x 109
Sheep	1130	16 x 106	18.1 x 109
Chicken	182	1.3 x 106	0.24 x 109
Pig	2700	3.3 x 106	8.9 x 109

The most comprehensive agricultural data available is derived from 2020 Census of Agriculture (CSO, 2020) with the smallest reporting unit being the Electoral Division (ED). While data are not provided on smaller quantities of chickens or pigs, intensive poultry farms (>40,000 places[1]) and pig farms requiring licences (>750 sows or >3,000 production pigs) that fall under EPA licensing control are discussed in *Section 2.6.2.1*.

A total of 6 Electoral Divisions (EDs) overlap with the contributing catchment (*Figure 2-14*). However, these EDs do not directly correspond to the contributing catchment boundary, requiring an estimation of the percentage overlap (Table 2-5). Table 2-5 also presents grazing animal census data for each ED, including both total livestock numbers and corrected estimates based on an assumed even distribution of animals across the ED.

Table 2-5. Statistics from the Census of Agriculture 2020 relating to grazing farm animals within the Electoral Divisions overlapping the contributing catchment

ELECTORAL DIVISION (ED)	PERCENTAGE OVERLAP OF CONTRIBUTING CATCHMENT	TOTAL (CORRECTED) DAIRY COWS	TOTAL (CORRECTED) LIVESTOCK	TOTAL (CORRECTED) OTHER COWS	TOTAL (CORRECTED) CATTLE	TOTAL (CORRECTED) SHEEP
Cross Roads	30.1%	0 (0)	1332 (400)	358 (108)	853 (256)	7869 (2365)

[1] Refers to places for birds e.g. broilers, layers, etc.

Electoral Division (ED)	Percentage Overlap of Contributing Catchment	Total (Corrected) Dairy Cows	Total (Corrected) Livestock	Total (Corrected) Other Cows	Total (Corrected) Cattle	Total (Corrected) Sheep
Dunfanaghy	9.4%	0 (0)	2060 (193)	396 (37)	1271 (119)	11990 (1124)
Dunlewy	36.6%	0 (0)	933 (342)	171 (63)	422 (154)	6591 (2413)
Gortahork	76.7%	0 (0)	692 (531)	105 (81)	308 (236)	4748 (3642)
Magheraclogher	<1%	0 (0)	756 (0)	106 (0)	292 (0)	5593 (1)
Meenaclady	25.0%	0 (0)	320 (80)	22 (5)	85 (21)	2662 (665)

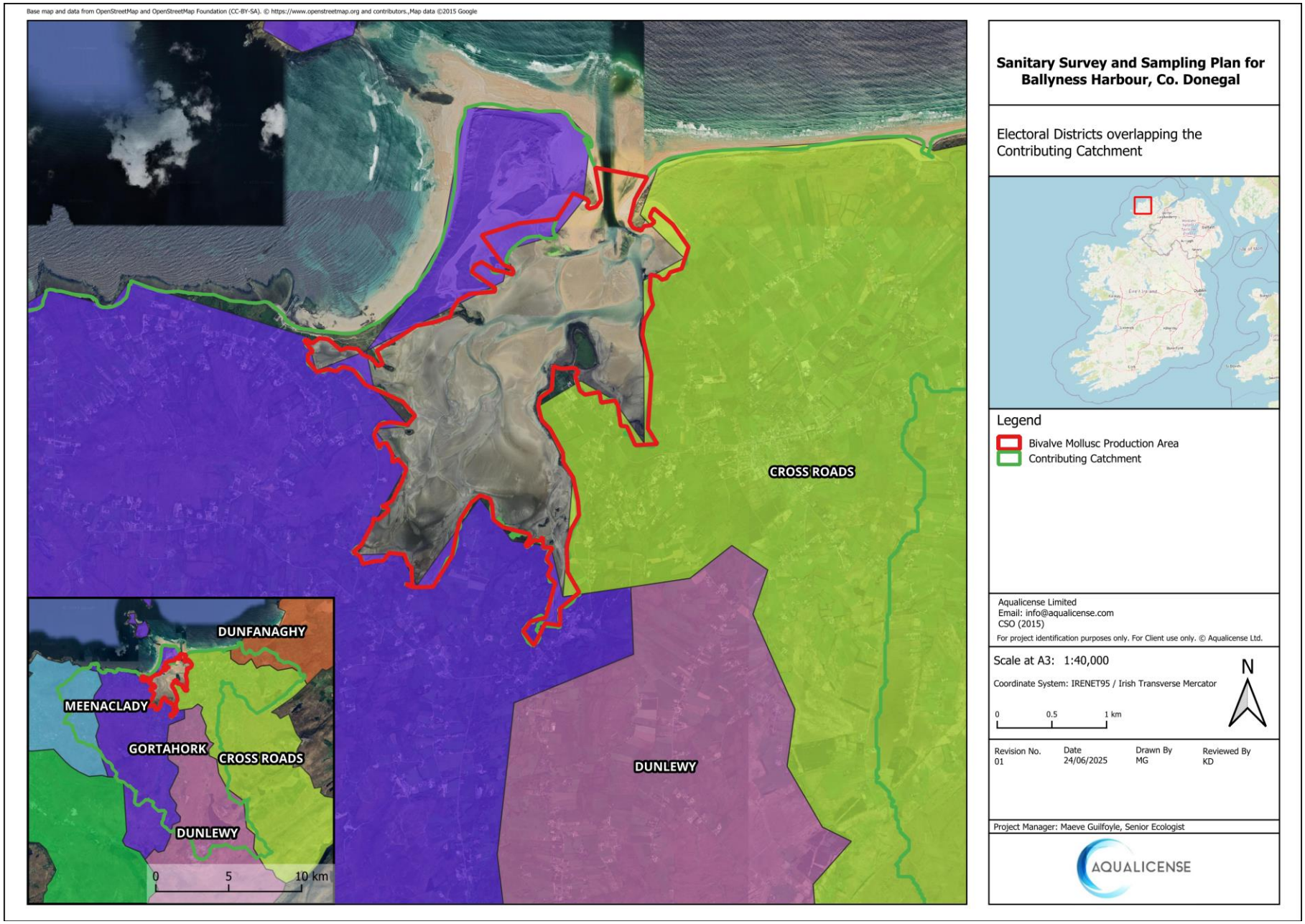

Figure 2-14. Electoral Divisions overlapping the Contributing Catchment

Under Ireland's Water Framework Directive (WFD) monitoring programme, waterbodies classified as "At Risk" of failing to meet their water quality objectives undergo assessment for significant pressures that must be addressed. Of particular relevance to this section are pressures from agriculture[2]. As part of the third WFD cycle, the groundwater body underlying the contributing catchment (Northwest Donegal) is not considered "At Risk" and therefore has not been classified for agricultural pressures.

Two EDs border the BMPA, Gortahork and Cross Roads, while Dunlewy ED extends close to the BMPA but does not reach it. Areas with "extreme" groundwater vulnerability which overlap agricultural land are found primarily in the Gortahork ED, as well as Dunlewy and the northwest of Cross Roads. This agricultural land is primarily composed of pastures, which border the BMPA extensively to both the south and east. At the south-west border of the BMPA there is also land principally occupied by agriculture with significant areas of natural vegetation.

Surface-waters that flow into the BMPA are vulnerable to faecal contamination from agricultural sources, particularly from rainfall driven runoff and direct deposition of waste into watercourses. The Glenna river is a pathway to the BMPA which is of "Poor" status under the WFD. It crosses through a significant portion of the aforementioned pastures in Dunlewy and Gortahork EDs which have "Extreme" groundwater vulnerability prior to entering the BMPA from the south.

The river Tullaghobegley is another major pathway to the BMPA, which is of "Poor" status under the WFD, and it flows through pastures with "High" groundwater vulnerability before entering the BMPA from the east.

Of the three EDs, Gortahork has the greatest number of livestock, particularly sheep, which have the highest daily *E. coli* load among domestic animals (*Table 2-4*). This has the potential to be a significant issue in spring, as breeding season combined with heavier precipitation could result in increased faecal runoff and bacteriological growth (Hunter, Perkins, Tranter, & Gunn, 1999).

Therefore, considering grazing animal densities, groundwater vulnerability, and surface water inflows, the pastures that border the south of the BMPA in Gortahork are the most likely location for pollution discharges from farm animals. The potential for contamination is likely to be greatest during the summer months and following periods of high precipitation.

Land

In addition to the direct source of organic pollution from animals, agricultural land use contributes to organic pollution through the spreading of slurry and soiled water. To provide a clearer understanding of agricultural land use, the 2020 Census of Agriculture (CSO, 2020) can again be consulted, with a correction to account for the percentage overlap of each ED in the contributing catchment (Table 2-6). The largest assumed area of farmed land is in the Gortahork, followed by Dunlewy. Cereal farming is absent across all EDs, and all recorded farmland is grassland, indicating a landscape used for grazing rather than arable farming.

Under the 5th Nitrates Action Programme (Government of Ireland, 2022), the contributing catchment is designated Zone C. In this zone, slurry spreading is prohibited from the 1st of October

[2] Not all parameters from WFD apply, please refer to *Section 3.4*.

to the 31st of January inclusive, while the spreading of soiled water is also prohibited throughout December. Therefore, providing these restrictions are observed, the greatest risk to the BMPA arises outside the closed period. Additional restrictions on spreading of soiled water apply in areas designated as "Extreme Vulnerability Areas on Karst Limestone Aquifers" under S.I. No. 113/2022. The contributing catchment itself does not overlie a karst limestone aquifer (GSI, 2023) however, a portion of the catchment coincides with zones of “extreme” groundwater vulnerability- where bedrock is at or near the surface (Figure 2-12)-suggesting potential karst vulnerability.

Considering the 2020 Agriculture Census, c. 28% of the contributing catchment is farmed. As there are no refined spatial data available for the Census, Corine mapping has been used to calculate areas of higher groundwater vulnerability overlapping agricultural land. Approximately 37% (c. 4068.59 ha) of agricultural land overlaps areas classified as having "extreme" or "rock-at-surface" groundwater vulnerability (GSI, 2021).

Pastures with “extreme” groundwater vulnerability are located along the eastern, south-eastern, and southern borders of the BMPA, directly bordering the coastline. Similar vulnerability zones on the south-west and western margins of the coastal BMPA where they border predominantly agriculture land. Additionally, 20 EPA-mapped rivers (Figure 2-3) flow through agricultural land in the contributing catchment before discharging into the BMPA.

Therefore, considering the agricultural land use and groundwater vulnerability, accounting for all riverine inputs, the southern and south-eastern regions of the bay are the most likely locations for pollution discharges from spreading of slurry and soiled water. Considering the regulatory restrictions in place, this risk is likely to be greatest from February to September inclusive.

Table 2-6. Statistics from Census of Agriculture 2020 relating to land utilisation within the Electoral Divisions overlapping the contributing catchment

Electoral Division	Percentage Overlap of Contributing Catchment	Total (Corrected) Number of Holdings	Average Size of Holdings	Total (Corrected) Area Farmed (Hectares)	Total (Corrected) Cereals	Total (Corrected) Grassland
Cross Roads	30.1%	143 (43)	15.9	2268.4 (681.7)	0.0 (0.0)	2268.4 (681.7)
Dunfanaghy	9.4%	103 (10)	27.9	2876.9 (269.7)	0.0 (0.0)	2875.9 (269.6)
Dunlewy	36.6%	91 (33)	32.6	2969.9 (1087.2)	0.0 (0.0)	2969.9 (1087.2)
Gortahork	76.7%	102 (78)	14.1	1436.3 (1101.9)	0.0 (0.0)	1436.3 (1101.9)
Magheraclogher	<1%	84 (0)	23.5	1974.3 (0.2)	0.0 (0.0)	1974.3 (0.2)
Meenaclady	25.0%	56 (14)	9.9	555.5 (138.8)	0.0 (0.0)	555.1 (138.7)

2.6.3.2 URBAN AREAS AND HUMAN POPULATIONS

Human populations contribute to contamination from sewerage, as previously discussed in *Section 2.6.1*. However, examining urban areas and population dynamics can provide further insight into pollution sources and the seasonality of contamination.

The contributing catchment contains three urban areas: Falcarragh, Gortahork and Meenlaragh (Tailte Éireann, 2023)[3]. The highest population density is recorded in Small Area A057045012, which includes Falcarragh town (*Table 2-3, Figure 2-9*), and exceeds the national average of 73 persons/km² (CSO, 2023b).

During the most recent census (3rd April 2022), 31% of houses within the contributing catchment were identified as unoccupied holiday homes which is higher than the national average of ~11% (CSO, 2023a). This high share of holiday properties likely contributes to seasonal spikes in organic pollution during the summer see *Section 2.6.1.2* for further detail relating to septic tanks.

Facilities such as nursing homes, schools, hospitals, and other large developments(e.g. schools, universities, nursing homes, hospitals, barracks, and prisons) can also be potential sources of pollution, though an Environmental Impact Assessment (EIA) database search found no projects requiring an EIA there since 2017 (Department of Housing, 2024).

A relevant facilities search for existing developments, yielded two facilities of note. These included Pobalscoil Chloich Cheannfhaola, a secondary school approximately 1.4km east of the BMPA in Falcarragh town, and An Scoil Beag, a primary school approximately 160m east of the southern section of the BMPA in Gortahork village.

Tourist facilities can contribute to organic pollution, particularly in peak seasons. While hotels and B&Bs typically use domestic or urban wastewater treatment, campsites and caravan parks may pose additional pollution risks. The contributing catchment lies within a very low-density area of accommodation providers, including hotels, B&Bs, and campsites (Fáilte Ireland, 2018).

2.6.4 OTHER POLLUTION SOURCES

2.6.4.1 MARINE VESSELS

Marine vessels, including ferries, cargo ships, fishing boats, and recreational craft can contribute to faecal contamination depending on passenger volume, onboard waste management practices, treatment systems, and compliance with discharge regulations.

Under S.I. No. 492/2012 (which transposes MARPOL Annex IV into Irish law), treated sewage can be discharged at a minimum of 3 nautical miles from shore, while untreated sewage must be released no closer than 12 nautical miles. As a result, most vessel sewage is discharged offshore or stored onboard for appropriate disposal, and vessels within or near Ballyness Bare are therefore unlikely to represent a major source of organic contamination. However, localised risk may arise in areas of

[3] The CSO classifies urban areas based on the following “Buildings in Urban Areas are within a group of at least 100 buildings and buildings need to be within 65 meters of another building. Building groups of 100 buildings or more must be within 500 meters of each other.”(CSO,2023) (Tailte Éireann, 2023)”.

vessel convergence, particularly from small craft without holding tanks or where compliance varies, as well as from accidental discharges.

Satellite imagery (reviewed on the 20th of June 2025) identified one pier and three private slips (Figure 2-15). Kitty's Kayaks a canoe and kayak rental business uses one slip, while the others appear to be for private use. Ballyness pier is mainly a scenic viewpoint (Falcarragh Tidy Towns, 2019).

There are no commercial ports located in the BMPA (Marine & Institute, 2010). However, Magheraroarty Harbour is located outside of but in proximity to the BMPA, approximately 265 m from its most westerly point (Figure 2-15). This harbour is the primary link for the Tory Island Ferry which runs at regular intervals throughout the day/week.

Given the lack of significant commercial marine traffic within the Bay, the small scale of recreational use, and expected compliance with S.I. No. 492/2012, the overall risk of vessel derived faecal contamination is assessed as low. In addition, the bathymetry of the bay would only allow vessels to gain access to the Ballyness pier section of the bay, where the hydrodynamic assessment demonstrated that the flushing times are fastest (refer to Section 2.5.1.7). As such marine vessels are not considered further within this report due to lack of potential sources or probable pathways.

In contrast, land-based discharges including wastewater treatment plants and domestic systems present a more significant and sustained contamination risk.

2.6.4.2 Swimming, Bathing and Recreation

Recreational use of beaches and shorelines can act as a source of faecal contamination. Bathers are considered to be a non-point source of faecal bacteria, including *E. coli*, due to the shedding of microbes from skin (Elmir, et al., 2006). Dog walking is also a contamination source in recreational waters and may contribute up to 20% of faecal indicator bacteria in urban Irish areas (Martin, et al., 2024). Such contamination is expected to peak during the summer months, coinciding with warmer weather.

A review of the EPA bathing water dataset, supplemented with and satellite imagery check (20th of June 2025), was undertaken to identify beaches and coastal walkways in the vicinity of the BMPA. No bathing waters within the BMPA satisfy the blue flag criteria. However, two designated bathing waters are located outside the BMPA, flanking Ballyness Bay to the immediate east and west.

Drumnatinney Designated Bathing Waters is located north of Falcarragh town at the outfall of the Ray River, bordering the north-east of the BMPA. Drumnatinney beach has regularly achieved Excellent water quality over several years of monitoring (*E. coli* ≤250 MPN and intestinal enterococci ≤100 cfu/100mL) (EPA, 2017; EPA, 2024c).

Magheraroarty Designated Bathing Waters is located to the north-west of the BMPA and it has achieved Excellent water quality since monitoring began at the site in 2018 (EPA, 2018; EPA, 2024c). Due to the rural nature of the area, absence of designated bathing waters within the BMPA and the extremely high-water quality found in the surrounding beaches, it is likely that swimmer and dog walker numbers are low, resulting in minimal source of contamination to the BMPA.

2.6.4.3 Wildlife

Wildlife, including birds and aquatic animals, has been shown to act as a source of faecal contamination in the marine environment (Alderisio and Deluca, 1999; Godino Sanchez *et al.*, 2024). To identify key areas of wildlife-related faecal contamination, a search was conducted for locations

with potentially high densities of animals in proximity to the BMPA (*Figure 2-16*, *Table 2-7*). This search included Special Protection Areas (SPAs), Special Areas of Conservation (SACs), and Irish Wetland Bird Survey (I-WeBS) sites (Birdwatch Ireland, 2025; NPWS, 2025). Only SACs where fauna are listed as a qualifying interest were examined further.

Geyer's whorl snail is listed as 'vulnerable' in the Irish Red List and its habitat is located onshore in the surrounding fen grassland, relatively diminutive size (<2mm), and overall low density of numbers, mean it is highly unlikely to contribute to contamination in the bay (Byrne, Moorkens, Anderson, Killeen, & Regan, 2009). In addition, there are relatively low numbers of birds recorded at the two SPAs nearest to the BMPA, Falcarragh to Meenlaragh SPA and Inishbofin, Inishdooey and Inishbeg SPA. This indicates minimal potential for contamination from these sites.

However, Tory Island SPA and Horn Head to Fanad Head SPA are also located in proximity to the BMPA and have large seabird populations which forage across wide areas during the breeding season, including the fulmar, razorbill, kittiwake and guillemot. As a result, the potential contribution of wildlife to contamination in this area is not insignificant, particularly from March to September during the breeding season.

Table 2-7. Wildlife areas within or bordering the BMPA.

TYPE	NAME (CODE)	SPECIES	LOCATION
SPA	Falcarragh to Meenlaragh SPA (004149)	Corncrake	Mid-bay section of the BMPA to the East and West
	Inishbofin, Inishdooey and Inishbeg SPA (004083)	Corncrake, Common Gull, Lesser Black-Backed Gull, Arctic Tern	Northern boundary of the BMPA as it meets the sea
	Tory Island SPA (004073)	Fulmar, Corncrake, Razorbill	North of the BMPA at Tory Island
	Horn Head to Fanad Head (004194)	Fulmar, Kittiwake, Shag, Peregrine, Guillemot, Razorbill, Chough	West of the BMPA at The Ross
	West Donegal Islands SPA (004230)	Shag, Barnacle Goose, Corncrake, Common Gull, Herring Gull	West of the BMPA at Gola Island, Inishmeane, Inishsirrer, Umfin Island
SAC	Ballyness Bay SAC (001090)	Geyer's Whorl Snail	Overlapping the entire BMPA
I-WeBS	Ballyness Bay (0A412)	Oystercatcher, Ringed Plover, Light-bellied Brent Goose, Herring Gull, Dunlin, Wigeon, Mallard, Red-breasted Merganser, Great Northern Diver, Cormorant, Little Egret, Curlew, Redshank, Greenshank, Turnstone, Black-headed Gull, Common Gull, Lesser Black-backed Gull, Great Black-backed Gull	Overlaps the entire BMPA and also includes the Drumnatinney and Magheraroarty beaches

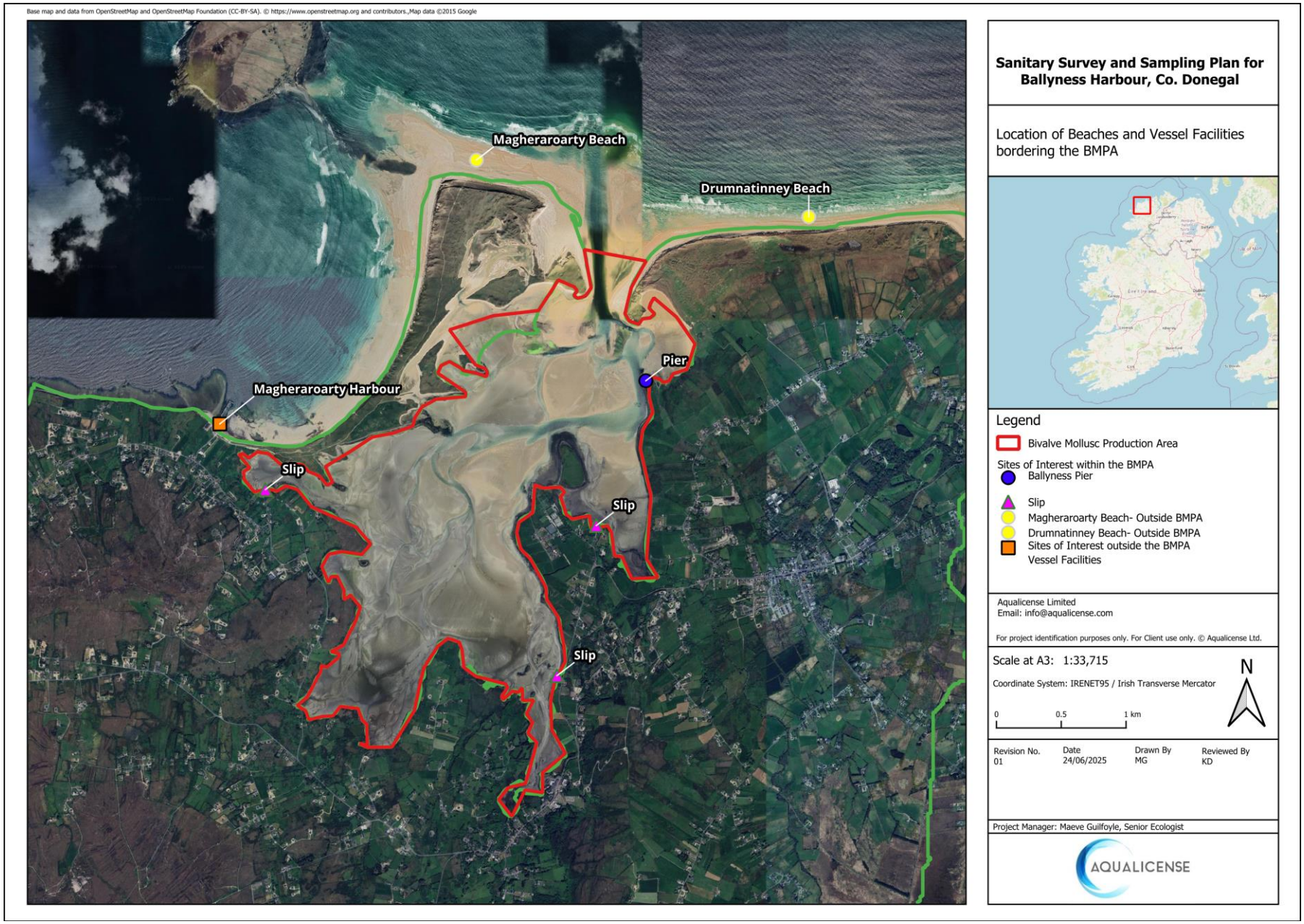

Figure 2-15. Location of beaches and vessel facilities bordering the BMPA

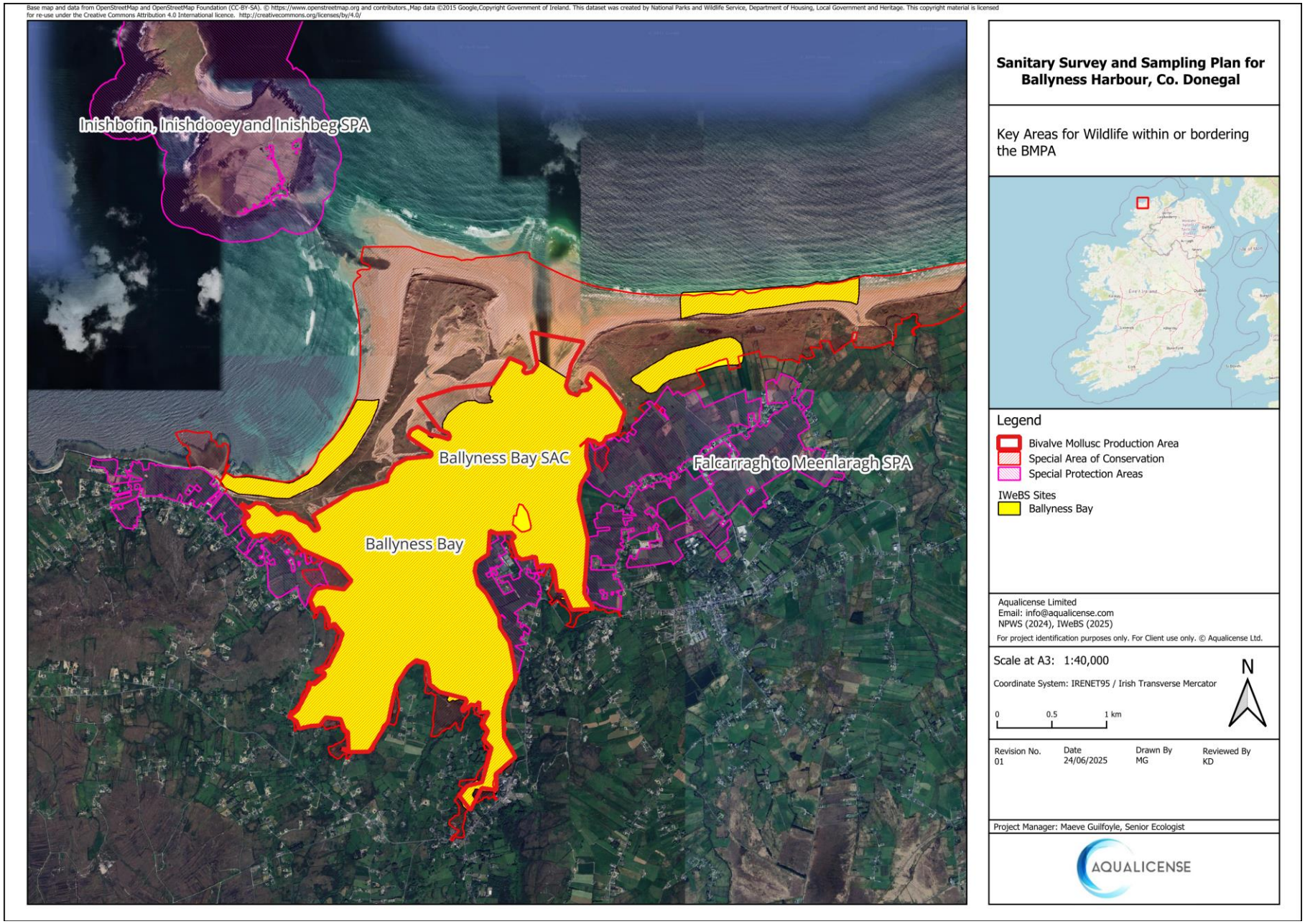

Figure 2-16. Key areas for wildlife within contributing catchment and within or bordering the BMPA

2.6.5 Summary of Pollution Sources and Relative Risk

Considering the details in the above section, the S-P-R model was used to assess the relative risk of faecal contamination in Ballyness Bay by identifying potential contamination sources and transport pathways to the receiving environment (*Table 2-8*).

The model evaluates each source based on its likelihood of contributing to contamination, potential contamination volumes, and entry pathways into the production area. The assessment also considers seasonal variations, such as increased agricultural runoff in winter and higher human activity in summer. This risk is assigned qualitatively considering potential volumes of pollution and the existence of pathways to the production area and licensed sites.

Table 2-8. Source-Pathway-Receptor Model and Relative Risk to the Production Area and Licensed Sites

SOURCE	SOURCE DESCRIPTION	PATHWAY TO PRODUCTION AREA	PATHWAY TO LICENSED SITES*	DETAILS	IMPACT
UWWTPs	Falcarragh UWWTP in the east of the BMPA, to the immediate west of Falcarragh town Gortahork UWWTP in the southeast of the BMPA	Both UWWTPs discharge directly to the BMPA.	The Falcarragh UWWTP discharges into the BMPA into a small embayment the intervening distance of which is ~1.9 km around the promontory of Killult. Gortahork UWWTP discharges into the BMPA c. 1.5 km to the south of the proposed T12-516A	UWWTP-related discharges present a risk of contamination in the east and south of the BMPA, which has the potential to impact previously licenced aquaculture site locations T12-441B, T12-441C and T12-516A The remaining four previously licenced aquaculture sites are located on the west side of the BMPA and are less likely to be impacted by the UWWTPs	**Yes,** the presence of two discharge points into the BMPA close to 3 previously licenced aquaculture sites and non-compliance issues at the Falcarragh plant all contribute to a possibility of risk
Septic Tanks and Other Sewerage Types	DWWTSs, primarily septic tanks, are the main sources of human sewage discharges. There are areas of higher population density in Falcarragh town	Surface water via River Glenna. Elevated groundwater vulnerability in the area south of the BMPA	River Glenna flows to the south of the BMPA. The closest proposed sites with licences granted: T12-441C and T12-441B lie c. 1.8 km east of Falcarragh town	Sewage discharges are likely highest in the southern and southeast region of the bay, adjacent to Falcarragh town and due to outflow from the river Glenna Contaminants from Falcarragh village have the potential to flow into the BMPA in the direction of previously licenced aquaculture sites T12-441C and T12-441B via the Tullaghobegley river Contamination risk increases in summer due to holiday home use	**Yes,** Presence of discharge points, known surface water runoff and higher population densities all contribute to a significant possibility of risk

SOURCE	SOURCE DESCRIPTION	PATHWAY TO PRODUCTION AREA	PATHWAY TO LICENSED SITES*	DETAILS	IMPACT
IE and IPC Licenses	No IE/IPC licenses granted within the contributing catchment	NA	NA	No potential risk from industrial or commercial licensed discharges	**No** potential impact from this source
Section 4 Discharges	LA_Ref_Lwat6 located in Fanmore, Falcarragh, Co. Donegal, c. 5 km from the BMPA border. LA_Ref_Lwat26 located in Procklis, Falcarragh, Co. Donegal, c. 5 km from the BMPA border	LA_Ref_Lwat6 discharges into the Ray River which terminates at Falcarragh beach outwith the boundary of the BMPA to the east. Elevated groundwater vulnerability at the LA_Ref_Lwat26 and to the south of the BMPA. Surface water via Tullaghobegley river	Although the Ray river is within the catchment for Ballyness, it discharges to the east outwith the BMPA boundary. Therefore, there is no pathway to the licenced sites from this source The Tullaghobegley river discharges into Ballyness bay at inflow points 10 and 11, which are c. 0.9 km and c. 1.2 km from the nearest licenced site, respectively	There is no pathway to the licenced sites from the Cassidy brothers Section 4 area. The River Tullaghobegley transitions from "Good" status (coming from Lough Altan) to "Poor" status (under WFD) at downstream of LA_Ref_Lwat26. It flows directly to the BMPA approximately 1 km from two of the previously licenced aquaculture sites (T12-441B and T12-441C)	**Yes,** the presence of a discharge point and known surface water run-off contribute to a possibility of risk. Due to the licence restrictions in place for Section 4 discharges there would be a moderate level of risk
Agriculture	Sheep, which have the highest *E. coli* loading of assessed grazing animals, are the dominant livestock in the EDs that border the BMPA (Gortahork and Cross Roads)	Surface water via the Glenna and Tullaghobegley rivers, which lies in the Gortahork and Cross Roads EDs, respectively. Elevated groundwater vulnerability in the south of the catchment	Previously licenced aquaculture site T12-516A is c. 1.5 km from the outflow from the Glenna river. The nearest previously licenced aquaculture sites to the outflow from the	Given the rural nature of the area, agriculture is the most significant potential contamination source Highest risk areas are the south of the bay and eastern coast towards Ballyness Pier	Yes**,** The presence of grazing livestock (sheep), known surface water runoff, and river Tullaghobegley and Glenna outflow all contribute to the possibility of risk The high precipitation levels, movement of livestock and variable numbers would

Source	Source Description	Pathway to Production Area	Pathway to Licensed Sites*	Details	Impact
			Tullaghobegley river are T12-441B and T12-441C	Contamination is likely to be directed from the Tullaghobegley outflow in the direction of previously licenced aquaculture sites T12-441C and T12-441B. Previously licenced aquaculture site T12-516A is near to areas of elevated groundwater vulnerability, potentially introducing contamination in the immediate vicinity of the site	indicate an elevated level of risk (*Table 2-4*)
Urban Areas and Human Populations	Falcarragh town is the primary settlement along the southern, inner shore of the bay. Contamination mainly via septic systems (as described above). Minimal tourism-related discharges	Surface water via the river Tullaghobegley	Previously licenced aquaculture site T12-516A lies c. 1.6 km east of Falcarragh town, while proposed sites T12-441C and T12-441B lie 1.9 km from this urban area and approximately 1 km from the outflow points of the river	Due to the small size of Falcarragh town, additional pollution from urban areas is minimal and localised to the south-east of the bay Dispersed settlement exists around the bay beyond the borders of Falcarragh town, particularly in areas of elevated groundwater vulnerability in proximity of the site. This may pose a risk of contamination to previously licenced aquaculture site T12-516A	Yes, the presence of Falcarragh town and riverine pathways to the BMPA represent a possible risk of contamination for the site
Marine Vessels	The only active pier is the Ballyness pier to the east of the BMPA and three slips that would cater to the	Ship sewage entering Ballyness bay, with subsequent circulation	Previously licenced aquaculture sites T12-441C and T12-441B lie c. 1.2 km south-west of Ballyness pier	Given the scale of operations and regulatory controls, the risk posed by marine vessels is considered minimal.	**No** potential impact from this source, refer to section *2.6.4.1* for further details

SOURCE	SOURCE DESCRIPTION	PATHWAY TO PRODUCTION AREA	PATHWAY TO LICENSED SITES*	DETAILS	IMPACT
	individuals' small vessels and tenders.			Additionally, MARPOL dictates that no blackwater or greywater discharges may be allowed within 3 nm of the shore	
Swimming, Bathing and Recreation	There are no Blue Flag-listed bathing waters in the contributing catchment, however there are two designated bathing waters in close proximity, outwith both the BMPA and the Catchment: Drumnatinney beach and Magheraroarty beach	Contamination from beach users along the bay	Previously licenced aquaculture sites T12-409A and T12-441A lie c. 0.6 km from Maghera Roarty beach	Contaminants from Magheraroarty beach have the potential to impact nearby previously licenced aquaculture sites T12-409A and T12-441A Due to the rural setting and low visitor numbers, contamination from recreational activities is assumed to be minimal. Risk increases during summer with increased tourism levels to the area and assumed usage of the holiday homes.	No potential impact from this source, refer to 2.6.4.2 for further details.
Wildlife	Falcarragh to Meenlaragh SPA, with corncrakes Inishbofin, Inishdooey and Inishbeg SPA, with corncrakes, common gulls, lesser black-backed gulls and arctic terns Tory Island SPA, with fulmars, corncrakes and razorbills	Direct input from wildlife into bay waters	Previously licenced aquaculture site T12-516A, T12-441B, and T12-441C are located within c. 45 m, c. 94 m, c. and 130 m respectively of the Falcarragh to Meenlaragh SPA Inishbofin, Inishdooey and Inishbeg SPA is c. 2.4 km from the nearest previously	There is a risk of contamination from Tory Island SPA and Horn Head to Fanad Head SPA during March to September as these sites have large breeding populations. However, risk is considered minimal as these sites are located >6 km from any licensed site	**No** potential impact from this source, refer to *section 2.6.4.3* for further details.

Source	Source Description	Pathway to Production Area	Pathway to Licensed Sites*	Details	Impact
	Horn head to Fanad Head SPA, with fulmars, kittiwakes, shags, peregrines, guillemots, razorbills and choughs Donegal islands SPA, with shags, barnacle geese, corncrakes, common gulls and herring gulls Ballyness Bay SAC, with Geyer's whorl snail Ballyness Bay I-WeBS site, with oystercatchers, ringed plovers, light-bellied brent geese, herring gulls, dunlins, wigeons, mallards, red-breasted mergansers, great northern divers, cormorants, little egrets, curlews, redshanks, greenshanks, turnstones, black-headed gulls, common gulls, lesser black-backed gulls, great black-backed gull		licenced aquaculture site T12-441A Tory Island SPA and West Donegal Islands SPA lie c. 12 km and c. 9.7 km respectively from the BMPA boundary Horn Head to Fanad Head SPA is c. 6.6km from the nearest licensed site, T12-441C. All the previously licenced aquaculture sites are located within Ballyness Bay SAC and within the Ballyness Bay I-WeBS site	Falcarragh to Meenlaragh SPA is unlikely to result in significant contamination as bird populations are small There is minimal to no contamination risk from Ballyness Bay SAC as the only listed species is the Geyer's whorl snail. This is a vulnerable, red listed species whose habitat is in the fen grassland around the bay There is a small risk of contamination at the I-WeBS site during the months when bird numbers are at their peak (from November to January). However, risk is considered minimal, as the average numbers of birds recorded at the site are relatively low (the exception to this is the light-bellied brent goose)	

2.7 Conclusions of the Desk-Based Survey

This desk-based component of the sanitary survey employed the S-P-R model to assess the principal potential impacts from the possible sources of faecal contamination identified during the desktop study *(Sections: 2.5.1.2 – 2.6.4.3),* the mechanisms by which these contaminants are transported, and their circulation dynamics within the production area. The analysis identified the south-east of the bay—particularly the outflow of the river Tullaghobegley (two UWWTPs) as the principal areas of contaminant inflow, supplemented by minor contributions from diffuse discharges, other rivers such as the Glenna, and small tributary streams distributed throughout the bay.

The predominant potential sources of faecal pollution were attributed to the widespread use of domestic septic tank systems and the extensive agricultural activity in the catchment, particularly livestock farming. Seasonal dynamics are expected to significantly influence contaminant loading, with potential for elevated faecal inputs during summer months driven by increased animal stocking densities.

Hydrodynamic modelling and existing data suggest that the bay experiences regular tidal flushing (~1.8 - 4 days), which influences contaminant dispersion and dilution patterns. This is particularly evident in the upper region of the bay close to its mouth, in which current speeds are high, and the influence of freshwater inflow is reduced.

These sources and pathways will be further examined, refined, and expanded upon following the completion of the shoreline survey.

3 SHORELINE SURVEY

This section of the sanitary survey relates to the shoreline survey, which has been undertaken by the SFPA following receipt of the desk-based study conducted by Aqualicense. The purpose of this shoreline survey is to confirm the findings of the desk-based study and identify any sources of contamination previously unidentified.

3.1 SHORELINE SURVEY METHODOLOGY

The SFPA Code of Practice for the Classification and Microbiological Monitoring of Bivalve Mollusc Production Areas identifies the methodology for carrying out shoreline surveys under Appendix 9.1 (SFPA, 2020). Any identified pollution risks was clearly documented, including GPS coordinates, photographs, and detailed descriptions. Photographs were also obtained for all identified risk locations.

Evidence of faecal contamination, such as odours, discolouration, or algae growth, were documented. Surveyors recorded observations even in situations where there was uncertainty regarding potential contamination. Where faecal contamination of an inflow, waterbody, or discharge location was suspected, bacteriological samples were obtained in accordance with the COP. Details of bacteriological sampling are provided in *Section 4.2*.

3.2 SHORELINE SURVEY RESULTS

The entire shoreline of the BMPA was surveyed by SFPA personnel over a two-day period, from 16th to 17th July 2025. Weather conditions during the survey were initially dry and calm, facilitating observations of runoff and discharge points. However, conditions deteriorated significantly on the second day, with heavy precipitation and increased wind speeds, potentially enhancing the dispersion of runoff and associated contamination sources. Surveys commenced shortly after early morning low tides on both days.

Table 3-1 and *Figure 3-1* present all observations recorded during the shoreline survey. Photographs for each observation have been provided in *Appendix 3*, with the numbering of the photographs corresponding to the ID number in *Table 3-1*.

Table 3-1. *Locations and details of observations made during the Shoreline Survey for Ballyness Bay in July 2025.*

Date	Low		High		ID	Latitude*	Longitude*	Feature	Comment
	Time	Height (m)	Time	Height (m)		(WGS84)	(WGS84)		
16/07/2025	04:14	0.75	10:21	3.24	1	55.15139	-8.1166	Sea	Run off from land near sheep grazing. Heavily stocked area with sheep and water travelled a large surface area underground through a pipe with potential pooling The sample from that site was particularly murky, with a lot of sediment that could not be avoided due to the low water level and substrate. Potentially contained faecal matter from grazing sheep or invertebrates & decomposing matter
					2	55.14972	-8.12211	Sea	Ballyness pier - brown scum on surface
					3	55.14959	-8.12014	Drainage	Run off from agricultural land, no evidence of contamination
					4	55.14161	-8.12172	Stream	Stream of agricultural land-green algae evident
					5	55.13693	-8.12233	Outfall pipe	WWTP potentially actively diffusing through emission point
					6	55.13616	-8.12137	River	No evidence of contamination
					7	55.13723	-8.12573	Drainage	Stagnant water running from farm yard
					8	55.12465	-8.13285	Creek bed	Dry creek- could not access from shore to get sample
					9	55.121881	-8.135447	Outfall pipe	Óstan Loch Altan
					10	55.12134	-8.13735	Drainage	Marsh with run off from urban area
17/07/2025	05:01	0.84	11:11	3.15	11	55.12485	-8.15708	Stream	Stream-no evidence of contamination
					12	55.12439	-8.15624	Outfall pipe	Outfall- small growth of green moss but no strong indication of contamination

Date	Low		High		ID	Latitude*	Longitude*	Feature	Comment
	Time	Height (m)	Time	Height (m)		(WGS84)	(WGS84)		
					13	55.12713	-8.16469	River	River- No evidence of contamination
					14	55.12626	-8.16333	River	River-green carpet indicating enrichment
					15	55.13075	-8.15995	Outfall pipe	Outfall/stream - sheep grazing
					16	55.14022	-8.16433	Stream	No evidence of contamination
					17	55.14233	-8.1676	Stream	No evidence of contamination
					18	55.14445	-8.17189	Stream	No evidence of contamination

**Further comparative table for latitude and longitude is provided in Appendix 2*

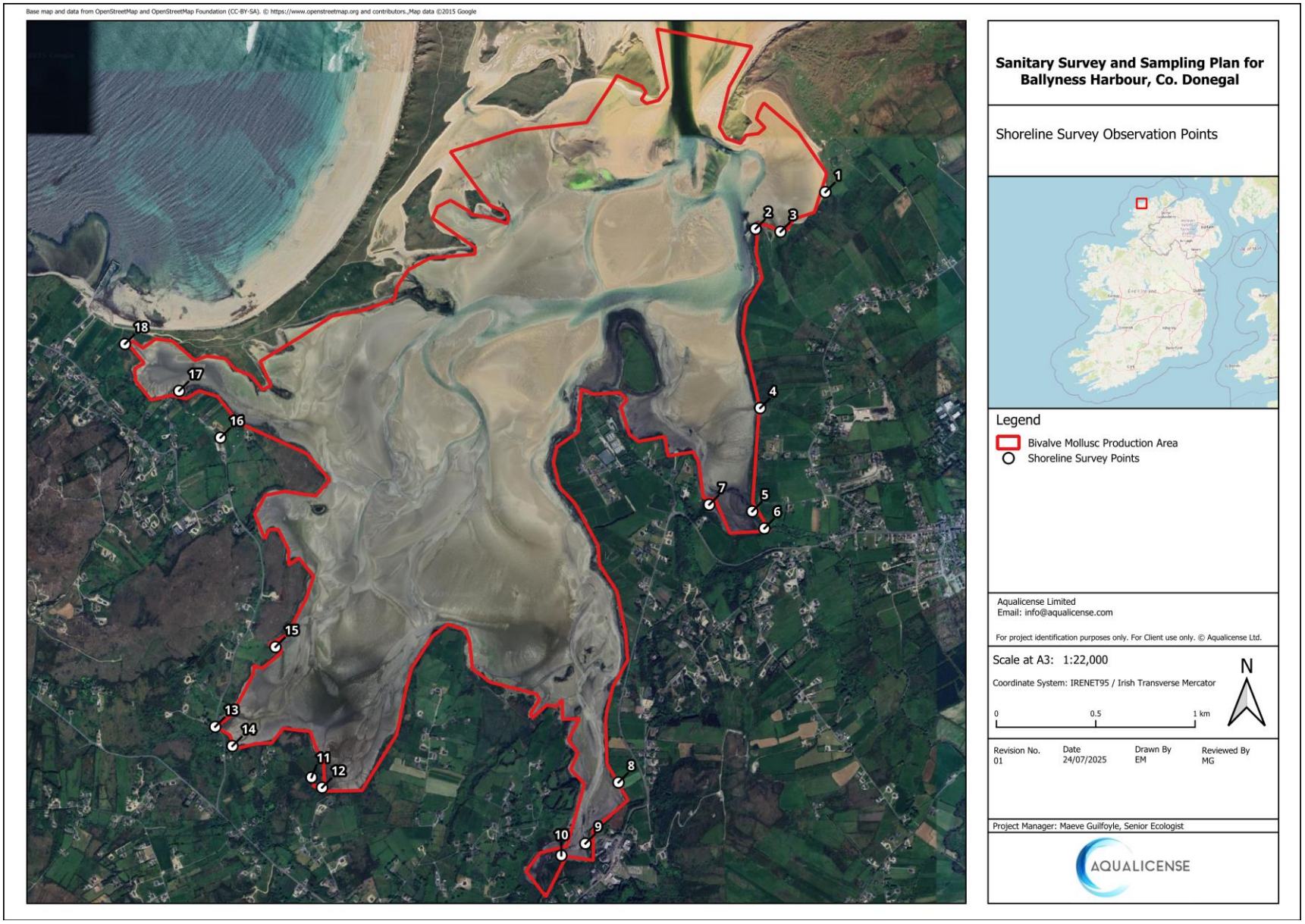

Figure 3-1. Location of observations made during the shoreline survey for Ballyness Bay in July 2025

Initial observations identified significant runoff at station 1, it appeared to be stemming from heavily grazed sheep areas, accompanied by murky, sediment laden water flow. Stations 2 and 3 reflected both agricultural and marine pressures, including visible scum at Ballyness Pier (Station 2), while Station 3 exhibited agricultural drainage without direct evidence of faecal contamination.

Station 4 exhibited agricultural influence, evidenced by the presence of green algae growth, while Station 5 corresponded with the municipal discharge point adjacent to a UWWTP. Stations 6 and 7 revealed minimal impacts, although station 7 noted farmyard drainage with stagnant water. Station 8 was inaccessible on the day and was therefore relocated the eastern side the BMPA. Site 9 identified urban discharge from hotel facilities, with site 10 in an area of marsh drainage.

Observations on the second day commenced with no visible contamination evidence at sites 11,16 - 18, though sites 12 through 15 included additional discharge points and areas of runoff, with 14 showing clear signs of nutrient enrichment through green carpeting.

A summary of each observation, its contamination risk level, and sampling location is included in *Table 3-2*. These findings informed both the delineation of the BMPA and the selection of the most appropriate Representative Monitoring Points (RMP).

Table 3-2 Summary of inflows, observations, contamination levels and proposed bacteriological sampling locations

INFLOW ID	SURVEY ID	LATITUDE (WGS84)	LONGITUDE (WGS84)	FEATURE	COMMENT	SAMPLE TAKEN (Y/N)
N/a	1	55.15139	-8.1166	Sea	Run off from land where sheep are grazing. Heavily stocked area with sheep and water travelled a large surface area underground through a pipe with potential pooling	Yes
N/a	2	55.14972	-8.12211	Sea	Ballyness pier - brown scum on surface	Yes
N/a	3	55.14959	-8.12014	Drainage	run off from agricultural land, no evidence of contamination	No
11	4	55.14161	-8.12172	Stream	Stream of agricultural land-green algae evident	Yes
N/a	5	55.13693	-8.12233	Outfall pipe	WWTP actively diffusing through emission point	Yes
10	6	55.13616	-8.12137	River	No evidence of contamination	No
N/a	7	55.13723	-8.12573	Drainage	stagnant water running from farm yard	Yes
N/a	8	55.12465	-8.13285	Creek bed	Dry creek- could not access from shore to get sample	No
9	9	55.121881	-8.135447	Outfall pipe	Óstan Loch Altan	No
N/a	10	55.12134	-8.13735	Drainage	Marsh with run off from urban area	Yes

INFLOW ID	SURVEY ID	LATITUDE (WGS84)	LONGITUDE (WGS84)	FEATURE	COMMENT	SAMPLE TAKEN (Y/N)
6	11	55.12485	-8.15708	Stream	Stream-no evidence of contamination	No
N/A	12	55.12439	-8.15624	Outfall pipe	Outfall- small growth of green moss but no strong indication of contamination	Yes
4	13	55.12713	-8.16469	River	River- No evidence of contamination	No
N/a	14	55.12626	-8.16333	River	River-green carpet indicating enrichment	Yes
N/a	15	55.13075	-8.15995	Outfall pipe	Outfall/stream - sheep grazing	Yes
3	16	55.14022	-8.16433	Stream	No evidence of contamination	No
2	17	55.14233	-8.1676	Stream	No evidence of contamination	No
1	18	55.14445	-8.17189	Stream	No evidence of contamination	No

4 BACTERIOLOGICAL SURVEY

Where possible, the COP (SFPA, 2020) recommends that water samples for E. coli should be taken from inflows or watercourses discharging near the shellfish harvesting areas. Shellfish sampling may also be conducted if uncertainty regarding RMPs remains following the desk-based survey and shoreline survey.

For the purposes of this sanitary survey, bacteriological surveys and analysis are the responsibility of the SFPA, with Aqualicense relaying the relevant results within the report.

4.1 BACTERIOLOGICAL SURVEY METHODOLOGY

To complement shoreline observations and better understand contamination risks under current conditions, a bacteriological survey was carried out by SFPA at 12 targeted locations where faecal contamination was suspected. The sampling was undertaken at low tide using protocols outlined in Appendix 9.2 of the SFPA Code of Practice (2020). While the COP recommends sampling under worst-case conditions (e.g. heavy rainfall), samples were collected under dry (Day 1) and wet (Day 2) conditions for logistical reasons. Each sample is assigned a clear identification code, with location codes following the format SS1, SS2, etc., to designate them as sanitary survey shellfish samples.

Samples are gathered in sterile plastic bottles. All samples are transferred to the testing laboratory within 48 hours of collection and are maintained at a temperature below 15ºC during transport to ensure sample integrity.

4.2 BACTERIOLOGICAL SURVEY RESULTS

A total of 12 water samples were obtained at areas where faecal contamination was suspected. Samples were obtained at low tide. While it is recommended within the COP to obtain samples under worst-case environmental conditions, samples were obtained during both dry and wet weather conditions for logistical reasons. Sampling results are presented in *Table 4-1*.

Table 4-1. Results of water sampling for E. coli in Ballyness Bay. Corresponds with observations from the shoreline survey (*Figure 3-1* and *Table 3-1*)

WATER SAMPLE	OBSERVATION (ID)	MPN/100ML*	DATE	LATITUDE (WGS84)	LONGITUDE (WGS84)
1	Area of intense agricultural activity [ID:1]	2600	16/07/25	55.15139	-8.1166
2	Ballyness pier – brown scum noted at surface [ID:2]	135	16/07/25	55.14972	-8.12211
3	Stream through agricultural land, green algae evident [ID:4]	260	16/07/25	55.1416	-8.12172
4	Falcarragh UWWTP actively diffusing through emission point [ID:5]	1800	16/07/25	55.13693	-8.12233
5	No visible evidence of contamination though sample recommended [ID:6]	460	16/07/25	55.13616	-8.12137
6	Stagnant water running from farm yard [ID:7]	570	16/07/25	55.13869	-8.1273
7	Marsh with run off from urban area [ID:10]	690	16/07/25	55.12134	-8.13735

Water Sample	Observation (ID)	MPN/100ml*	Date	Latitude (WGS84)	Longitude (WGS84)
8	Outfall noted, small growth of green moss but no strong indicators [ID:12]	1600	17/07/25	55.12439	-8.15624
9	Riverine system with a green algae carpet, indication of enrichment [ID:14]	6100	17/07/25	55.12626	-8.16333
10	Outfall from a stream- sheep around the outfall with black anoxic mud present [ID:15]	1200	17/07/25	55.130175	-8.15995
11	No obvious evidence of contamination though sample recommended [ID:16]	1600	17/07/25	55.14022	-8.16433
12	No obvious evidence of contamination though sample recommended [ID:18]	1400	17/07/25	55.14445	-8.17189

*Most Probably Number of *E. coli* per 100 millilitres of a sample.

Bacteriological water sampling results across the surveyed area demonstrated varying levels of contamination, with E.coli concentrations measured at all twelve locations.

Minimal to moderate contamination was identified at sample 2 (Ballyness Pier), where concentrations of 135 MPN/100mL indicated minimal faecal contamination despite observed surface scum. At sample 3, a stream flowing through agricultural land, exhibited moderate contamination (260MPN/100mL), likely influenced by nutrient runoff from agricultural activities, supported by visible green algae growth. Sample 5 and 6 recorded moderate contamination levels (460 MPN/100ml and 570 MPN/100ml respectively), with sample 6 specifically linked to the farmyard runoff as observed in the shoreline survey.

Elevated contamination levels were identified at several sites. Sample 1, located in an area of intensive agricultural activity, showed high contamination (2600 MPN/100mL), likely associated with agricultural runoff. Sample 4, at the emission point (Falcarragh UWWTP emission point) recorded elevated contamination (1800 MPN/100ml) likely from municipal wastewater given proximity of the sample. Sample 8 despite minimal visible indicators, registered elevated contamination (1600 MPN/100mL), suggesting an intermittent source as there are minimal visible indicators. Sample 9 (river system) displayed significant contamination (6100 MPN/100mL), consistent with nutrient enrichment from agriculture, evidenced by extensive algae growth. Sample 10, livestock grazing outfall, had high contamination (1200 MPN/100mL). Samples 11 and 12 showed elevated contamination (1600 and 1400 MPN/100ml) without a clear indicator, suggesting diffuse or subsurface drainage sources.

It is further noted that contamination patterns are subject to seasonal variability, influenced by factors such as rainfall intensity, river flow fluctuations, and variations in agricultural practices. Although sampling was conducted predominantly under dry weather conditions, it is acknowledged that preceding rainfall events may have mobilised contaminants, thereby contributing to elevated E. coli concentrations observed during the survey period.

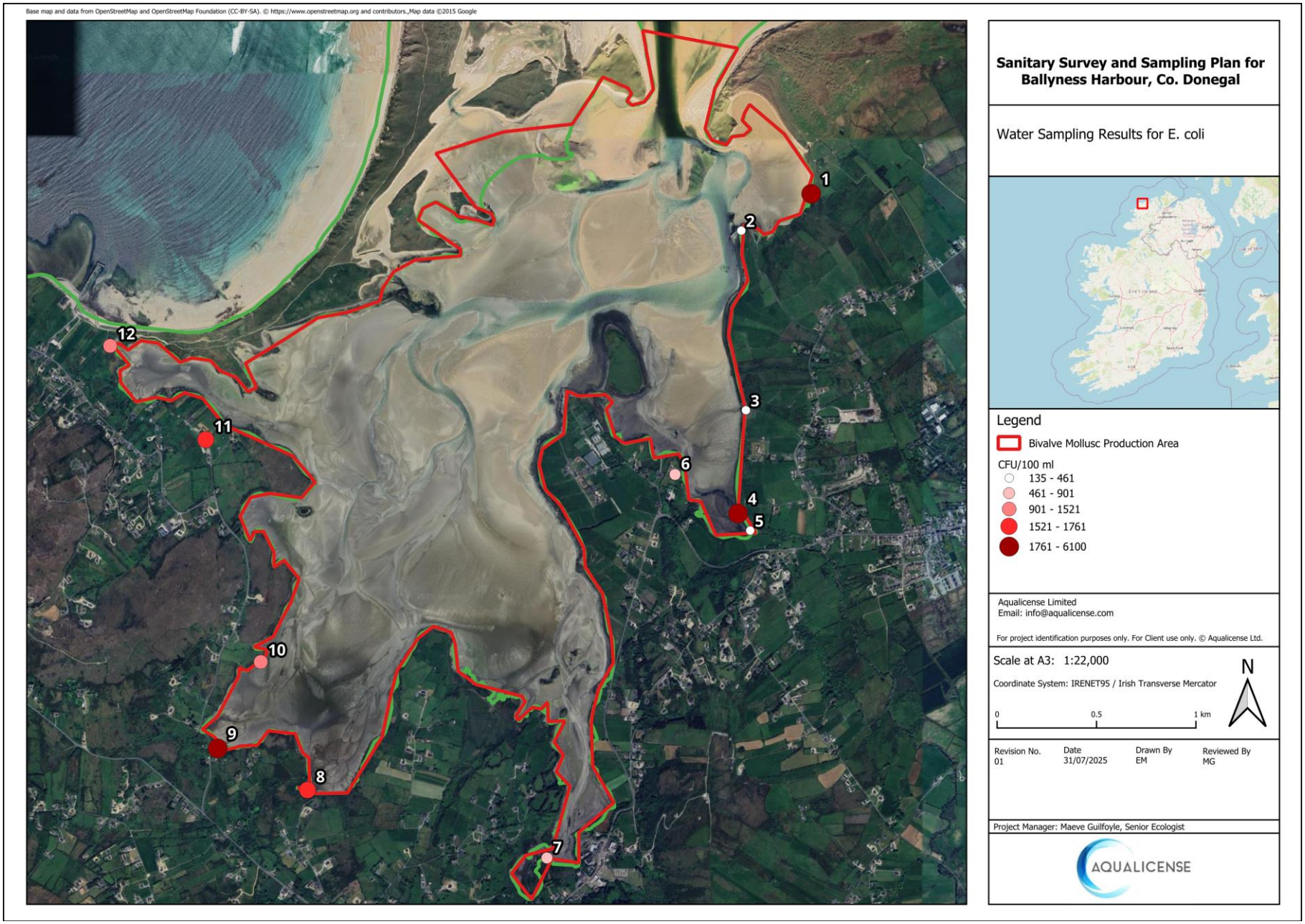

Figure 4-1. Water sampling results for E. coli

5 SANITARY SURVEY CONCLUSIONS

The sanitary survey findings were synthesised through the integration of three primary data sources: a desk-based study using the Source–Pathway–Receptor (S–P–R) model, on-site shoreline inspections, and targeted bacteriological analysis. Each component contributed distinct and complementary insights to the overall assessment of contamination risks within the Ballyness Bay Bivalve Mollusc Production Area (BMPA).

The desk-based study identified potential faecal contamination during the desk-based study were broadly validated by the shoreline survey and bacteriological sampling. Agricultural runoff, driven by intensive livestock farming, emerged as the dominant source of contamination. The sample point closest to the Falcarragh UWWTP, at the time of sampling also had high levels of contaminants recorded. Potential seasonal variations, particularly fluctuations in livestock densities and rainfall patters were observed to influence contamination intensity, with increased risk noted during periods following extended dry spells and subsequent heavy rainfall.

Hydrodynamic considerations indicate that contaminant dispersion within Ballyness Bay is primarily governed by semi-diurnal tidal cycles, characterised by moderate-strength ebb currents, resulting in flushing times between 1.8 and 4 days *(refer to sections 2.5.1.3, 2.5.1.5, and 2.5.1.7).* Consequently, contaminants entering during low- flow periods or dry conditions can persist, especially in sheltered intertidal and shallow embayment areas.

The shoreline survey provided critical on-site validation of contamination sources identified in the desk-based study. Specific sites exhibited visible evidence of contamination such as agricultural runoff (sites 1,4, and 15), UWWTP discharge (site 5) and suspected urban runoff (site 10). The bacteriological data indicate that the principal sources of faecal contamination within the study area are associated with agricultural runoff, particularly from livestock farming activities, as well as localised land-based inputs, including land drainage and discharges from urban wastewater treatment plants (UWWTPs). Areas with notably high contamination – sample 9 (6100 MPN/100mL) and sample 1 (2600 MPN/100mL).

Although sampling was conducted predominantly under dry weather conditions, it is acknowledged that preceding rainfall events may have mobilised contaminants, thereby contributing to elevated E. coli concentrations observed during the survey period.

These locations represent the areas of greatest risk for shellfish contamination within the BMPA, it should be noted that these locations are effectively “upstream” of previously licenced aquaculture sites, as such during a flushing period the contaminants are likely to pass over the established sites.

The integration of these findings has directly informed the delineation of the BMPA boundary and the selection of Representative Monitoring Points (RMPs), ensuring that the sampling programme reflects contamination pathways and provides a protective classification framework in line with Regulation (EU) 2019/627.

6 BIVALVE MOLLUSC PRODUCTION AREA (BMPA)

The shoreline survey results contributed to defining this boundary by identifying previously undocumented contamination sources. In collaboration with the SFPA, the proposed boundary has been defined to establish a Bivalve Mollusc Production Area (BMPA) for the existing mussel licences and any future bivalve production sites. The BMPA extends across the mouth of Ballyness Bay and encompasses the full extent of the bay (*Table 6-1*)

Table 6-1. The coordinates of the Ballyness BMPA

	Latitude (WGS 84) (Decimal)	Longitude (WGS 84) (Decimal)	Latitude (WGS 84) (DMS)	Longitude (WGS 84) (DMS)	Easting (ITM)	Northing (ITM)
Western Corner	55.15876027	-8.1299240056	55°9'31.54"N	008°7'47.73 W	591719.9809	934612.9088
Eastern Corner	55.15796744	-8.1224185435	55°9'28.68 N	008°7'20.71 W	592198.14684	934523.7975

7 RECOMMENDATIONS FOR RMPS FOR CURRENTLY LICENCED SPECIES (IN THE EVENT OF FUTURE PRODUCTION)

The delineation of the Bivalve Mollusc Production Area (BMPA) and the selection of the Representative Monitoring Point (RMP) are critical components of this report, as they provide the basis for protecting public health by ensuring that shellfish harvested for human consumption are effectively monitored for contamination risks, including E. coli.

The RMP represents the location within the BMPA most likely to reflect the highest contamination risk to shellfish production, thereby providing a conservative and protective basis for classification. In determining the RMP and BMPA boundaries, multiple factors were considered in line with established regulatory guidance, including hydrographic conditions, contaminant sources and pathways, historical and current bacteriological data, historic aquaculture activity and granted licences, and practical accessibility for sampling.

A spatial tolerance is applied around the RMP to ensure that the monitoring point remains representative of the wider production area while maintaining sufficient proximity to potential shellfish production sites. These determinations are therefore central to ensuring that the classification accurately reflects the sanitary quality of shellfish production waters and supports the safe commercial harvesting of bivalve molluscs, in accordance with Regulation (EU) 2019/627 and relevant Food Standards Agency (FSA) sanitary survey protocols.

In accordance with Article 61 of Regulation (EU) 2019/627, the following recommendations are made for incorporation into future sampling plans. It should be noted that these recommendations, based on the completed sanitary survey (desktop review and shoreline visit), relate specifically to the positioning of RMPs and should not be misconstrued as a full sampling plan.

7.1 REPRESENTATIVE MONITORING POINT (PACIFIC OYSTERS)

In the event that commercial production starts one RMP has been recommended which is located at WGS_84 coordinates RMP 1: 55.141320 N, -8.137062 W, (55°8’28.76” N 008°8’13.42” W) , within the

licensed site T12-441B (

Figure 7-1). Pacific oyster harvesting in the area is contingent upon the availability of stock. In the absence of Pacific oyster production, the RMP will remain inactive until harvesting activities begin.

Considering the size of the BMPA, prevailing circulation patterns, and the distribution of licensed sites, one Representative Monitoring Points (RMP) is recommended. Based on the findings of the desk based current pattern analysis *(Section 2.5),* S-P-R outcome *(Table 2-8)* sanitary survey and bacteriological results, summarised in *Section 4*, site T12-441B has been identified as the area most at risk of contamination under worst-case scenarios in the event of production commencing.

RMP 1 is positioned within a key hydrodynamic pathway that is likely to transport possible contaminants from the inner and outer sections of the bay. This site is also in close proximity to inflow, runoff and discharge points to the south where evidence of contamination and elevated *E. coli* levels were recorded during the shoreline surveys and bacteriological monitoring. This site is positioned in

the area that was identified as an area that would be influenced by the circulation of the potential pollutants within the bay during the ebb/drainage periods.

While a specific RMP has been identified for Pacific Oyster, it is recognised that, due to the intermittent growth at the site, a sample may not always be available within 100 metres of the RMP. In such circumstances, the SFPA sample coordinator and local industry representatives should be informed, and an alternative sampling location agreed. This alternative location should be selected with reference to the findings of the sanitary survey and should continue to represent a worst-case scenario for contamination risk.

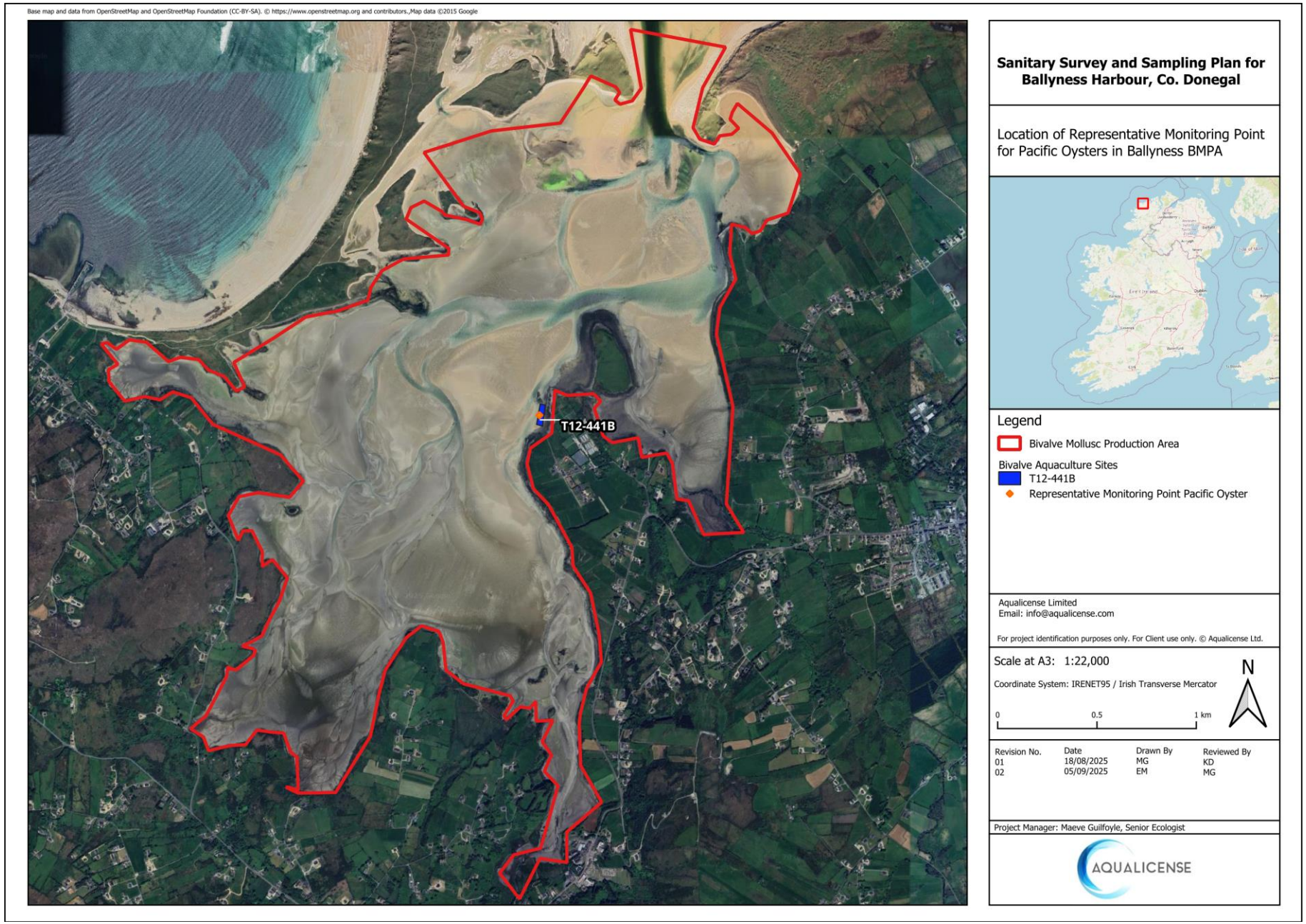

Figure 7-1. Location of the RMPs for Pacific Oysters in Ballyness Bay BMPA

7.1.1 Sampling Plan for Pacific Oysters

A species-specific sampling plan has been developed in line with EU Regulation 2019/627 and the SFPA Code of Practice (2020). Key features of the plan are detailed in *Table 7-1*:

Table 7-1. Sampling Plan for Pacific Oysters

Species	*Magallana gigas*
Site Name	Ballyness Bay BMPA
Sample Point Identifier	DL-BN-ME
Geographical location of sampling point (RMP)	RMP1 at site T12-441B: 55.141320 N, -8.137062 W, (55°8'28.76" N 008°8'13.42" W))
Sampling Frequency	Samples shall be taken monthly upon classification of Ballyness BMPA. Sampling will occur throughout the year.
Sampling Depth	Samples should be taken as close to the surface as possible, within the top one metre of the water column.
Maximum Allowed Distance from Sampling Point	Samples are to be collected within 100m of the RMP. Where this is not possible, the SFPA sample coordinator and local industry shall be informed to agree an alternative sampling location.
Sampling Method	Sampling will be conducted in accordance with the SFPA Code of Practice for the Classification and Microbiological Monitoring of Bivalve Mollusc Production Areas (SFPA, 2020), specifically in accordance with Appendix 9.2.
Sample Size	A minimum of 10 oysters of market size (minimum length of 8 cm).
Authorised Samplers	It is the responsibility of the SFPA Greencastle Port Office & SFPOs to arrange sampling.

These recommendations ensure the data collected will be representative of contamination affecting the production area, supporting both initial classification and ongoing official controls.

7.2 Representative Monitoring Point for Manila Clams

In the event that commercial production starts a single RMP is recommended located at WGS_84 coordinates 55.143343 N, -8.155521 W (55°8'36.04"N, 008° 9'19.88" W) , within the licensed site T12-409A. Manila clam harvesting in the area is contingent upon the availability of stock. In the absence of Manila Clam production, the RMP will remain inactive until harvesting activities begin

Based on the findings of the desk based current pattern analysis *(Section 2.5),* S-P-R outcome *(Table 2-8)* sanitary survey and bacteriological results, summarised in *Section 4*, site T12-409A is identified as the most representative sampling location. Considering the size of the BMPA, prevailing circulation patters, a single RMP is recommended.

This location is closest proximity to the areas that are likely to be influenced by contamination from the areas of agricultural run-off areas to the south and west which, from the site surveys and subsequent analysis were highlighted as areas of concern with elevated levels of *e.coli* recorded during the shore line survey. It's proximity to the coast further ensures its suitability as the most representative location for the Manila clam RMP.

While a specific RMP has been identified for Manila Clam, it is recognised that, due to the unpredictable nature of Manila clam supply, intermittent growth at the site, a sample may not always be available within 100 metres of the RMP. In such circumstances, the SFPA sample coordinator and local industry representatives should be informed, and an alternative sampling location agreed. This alternative location should be selected with reference to the findings of the sanitary survey and should continue to represent a worst-case scenario for contamination risk.

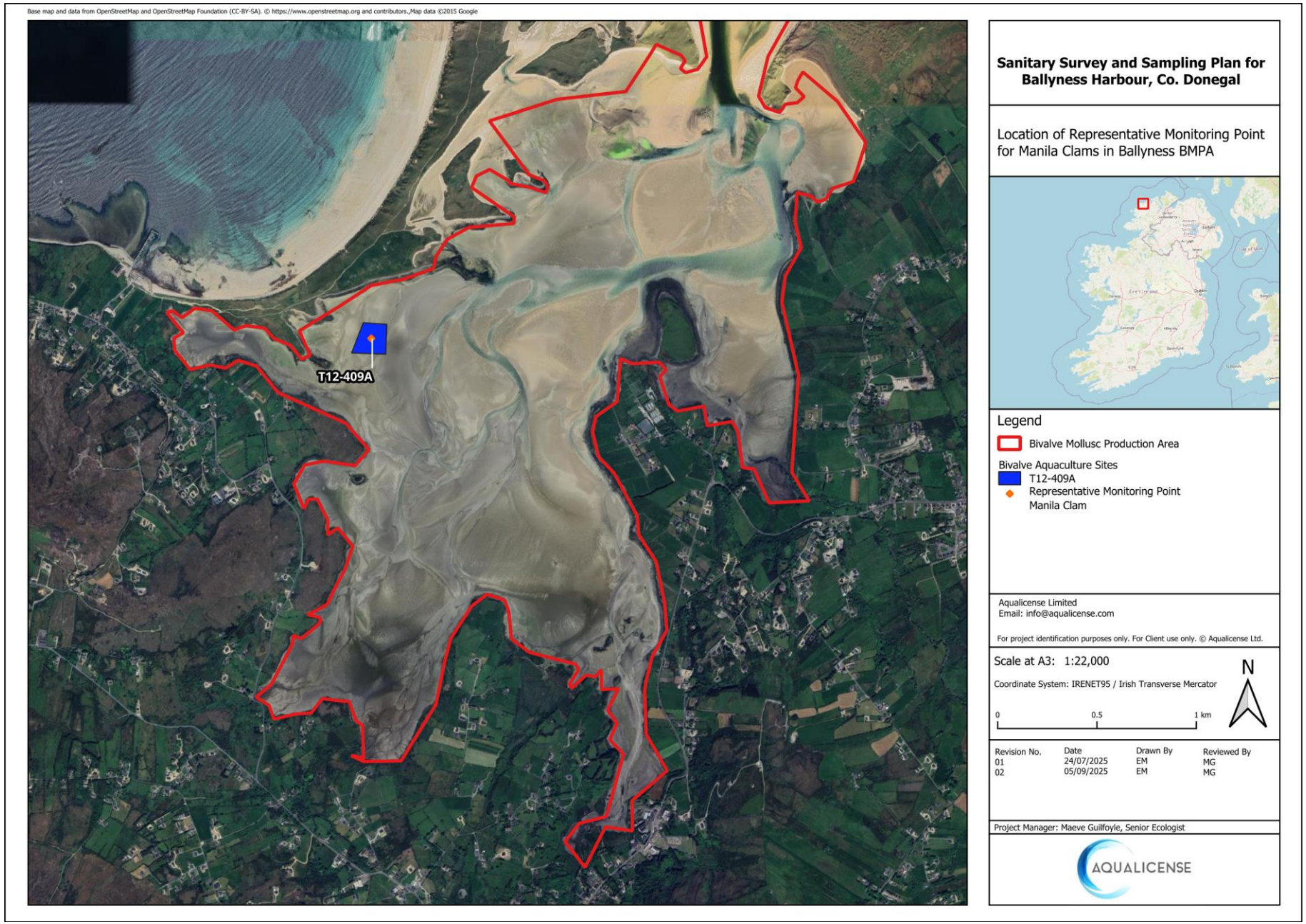

Figure 7-2. Location of the RMP for Manila Clams in Ballyness Bay BMPA

7.2.1 Sampling Plan for Manila Clams

A species-specific sampling plan has been developed in line with EU Regulation 2019/627 and the SFPA Code of Practice (2020). Key features of the plan are detailed in (*Table 7-2*).

Table 7-2. Sampling Plan for Manila Clams

Species	*Ruditapes philippinarum*
Site Name	Ballyness Bay BMPA
Sample Point Identifier	DL-BN-WT
Geographical location of sampling point (RMP)	At site T12-409A (55.143343 N, -8.155521 W (55°8'36.04"N, 008° 9'19.88" W)
Sampling Frequency	Samples shall be taken monthly upon classification of Ballyness BMPA. Sampling will occur throughout the year.
Sampling Depth	Samples should be dredged from the bottom.
Maximum Allowed Distance from Sampling Point	Samples are to be collected within 100m of the RMP. Where this is not possible, the SFPA sample coordinator and local industry shall be informed to agree an alternative sampling location.
Sampling Method	Sampling will be conducted in accordance with the SFPA Code of Practice for the Classification and Microbiological Monitoring of Bivalve Mollusc Production Areas (SFPA, 2020), specifically in accordance with Appendix 9.2.
Sample Size	A minimum of 15 clams of market size (minimum length of 4 cm).
Authorised Samplers	It is the responsibility of the SFPA Greencastle Port Office to arrange sampling, with designated sampling officers assigned to collect samples.

These recommendations ensure the data collected will be representative of contamination affecting the production area, supporting both initial classification and ongoing official controls

8 CONCLUSIONS

A sanitary survey has been conducted in accordance with Article 56 of Regulation (EU) 2017/625 and Regulation (EU) 2019/627 (European Commission, 2024). The survey integrated a catchment-scale desk assessment, field-based shoreline verification, and bacteriological sampling to evaluate faecal contamination risks in Ballyness Bay.

These findings informed the delineation of the Bivalve Mollusc Production Area (BMPA), identification of a Representative Monitoring Points (RMPs), and the development of recommendations for a microbiological sampling plan.

The outputs of the survey are as follows:

- A geographically defined BMPA boundary of approximately 5.91 km².
- To capture the dominant contamination pressures two RMPs have been created located at the following:
  - Pacific Oyster
    - RMP 1 at site T12-441B (55.141320 N, -8.137062 W, (55°8’28.76” N 008°8’13.42” W)
  - Manila Clam
    - RMP 2 at site T12-409A (55.141292 N, -8.136954 W (55°8’28.65”N, 008° 8’13.04” W),
- Recommendations for a species-specific sampling plan for, Pacific Oyster (*Magallana gigas)* and Manila Clam (*Ruditapes philippinarum)* in line with SFPA COP (2020) and EU (2019/627) regulatory requirements.

These components provide the scientific basis for the classification and ongoing monitoring of Ballyness Bay BMPA as a shellfish production area.

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Appendix 1 Summary Statistics for Weather

Appendix A – Summary statistics for wind derived from Malin Head weather station (June 2015 to May 2025 inclusive)

Direction	Frequency (%)	Max. Mean Wind Speed (m/s)	Mean Wind Speed (m/s)
W	20	17.6	8.1
S	17.1	15.8	7.3
SW	16.9	20.1	8.4
E	14.7	18.9	6.9
NW	10	21	7.4
SE	8.9	16.8	7.1
N	8.8	19.4	7.5
NE	3.6	16.1	6.4

Appendix 1B – Summary statistics for daily rainfall derived from Malin Head weather station (June 2015 to May 2025 inclusive)

Month	Max. Daily Rain (mm)	Mean Daily Rain (mm)	Median Daily Rain (mm)
January	26.1	3.56	1.8
February	26.9	3.76	1.9
March	31.1	2.55	1
April	23.2	1.86	0.5
May	35	2.18	0.3
June	19.2	2.25	0.6
July	25.2	3.29	1.2
August	77.2	3.86	1.5
September	32.4	2.96	1.3
October	34.6	3.4	1.6
November	35.4	4.06	2.25
December	80.6	4.44	2.65

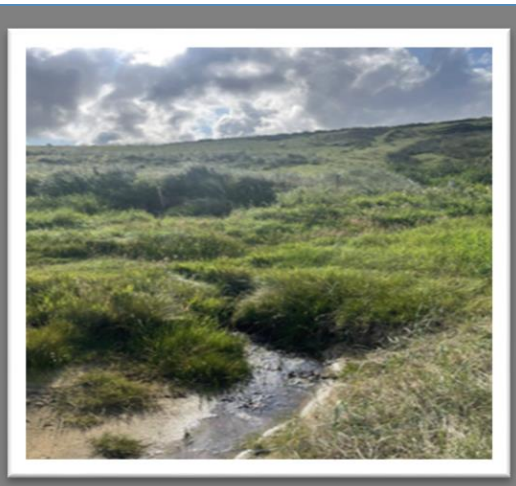
Appendix 2 Comparative Coordinates

Appendix 2 Comparative Coordinates for Survey Locations

ID	Easting (ITM)	Northing (ITM)	Latitude (WGS 84) (Decimal)	Longitude (WGS 84) (Decimal)	Latitude (WGS 84) (DMS)	Longitude (WGS 84) (DMS)
1	592567	933791	55.15139	-8.1166	55°9’5.00”N	8°6’59.76”W
2	592216	933605	55.14972	-8.12211	55°8’58.99”N	8°7’19.60”W
3	592341	933591	55.14959	-8.12014	55°8’58.52”N	8°7’12.50”W
4	592239	932703	55.14161	-8.12172	55°8’29.80”N	8°7’18.19”W
5	592199	932182	55.13693	-8.12233	55°8’12.95”N	8°7’20.39”W
6	592260	932096	55.13616	-8.12137	55°8’10.18”N	8°7’16.93”W
7	591982	932215	55.13723	-8.12573	55°8’14.03”N	8°7’32.63”W
8	591526	930816	55.12465	-8.13285	55°7’28.74”N	8°7’58.26”W
9	591359	930508	55.12188	-8.13545	55°7’18.77”N	8°8’7.61”W
10	591238	930448	55.12134	-8.13735	55°7’16.82”N	8°8’14.46”W
11	589980	930842	55.12485	-8.15708	55°7’29.46”N	8°9’25.49”W
12	590034	930790	55.12439	-8.15624	55°7’27.80”N	8°9’22.46”W
13	589496	931096	55.12713	-8.16469	55°7’37.67”N	8°9’52.88”W
14	589582	930999	55.12626	-8.16333	55°7’34.54”N	8°9’47.99”W
15	589799	931499	55.13075	-8.15995	55°7’50.70”N	8°9’35.82”W
16	589522	932553	55.14022	-8.16433	55°8’24.79”N	8°9’51.59”W
17	589314	932789	55.14233	-8.1676	55°8’32.39”N	8°10’3.36”W
18	589041	933025	55.14445	-8.17189	55°8’40.02”N	8°10’18.8”W

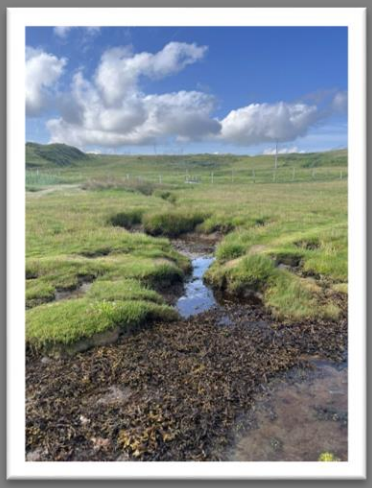
APPENDIX 3 SHORELINE SURVEY PHOTOGRAPHS

1

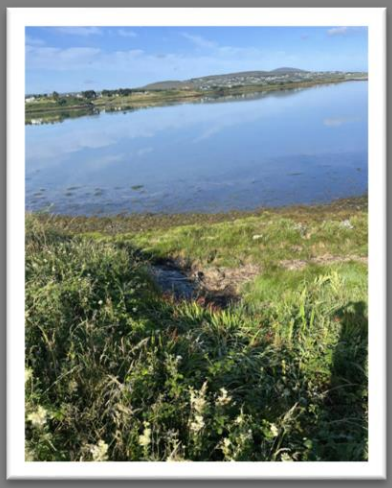


2

3



4



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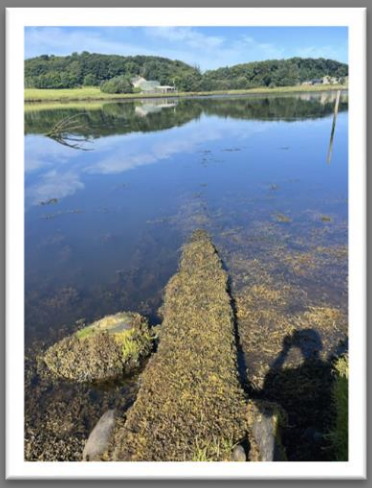

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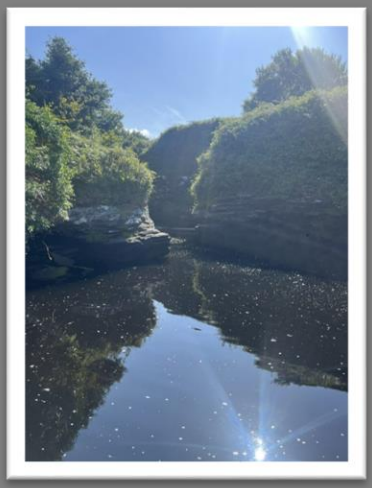

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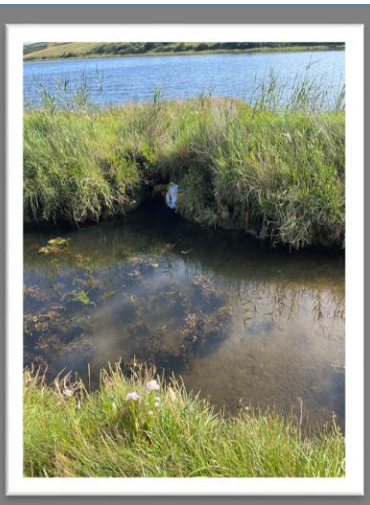

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APPENDIX 4 : INDUSTRY ENGAGEMENT SUMMARY (PREPARED BY SFPA)

Date of circulation of draft report: 24.09.25

Stakeholders contacted: BIM, IFA Aquaculture, Local Producers

Method of engagement: Email

Period for responses: 24.09.25- 01.10.25

Summary of feedback received: No Response

Outcome: This report is recommended for publication and finalisation.