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## **Evaluation of the Northern Ireland Wastewater System**

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# Executive Summary

Due to rising concerns over high profile impacts of nutrient pollution in Northern Ireland (NI) the Office for Environmental Protection (OEP) have a focus on the risk and impacts of the nutrient load delivered to surface water bodies from wastewater assets on sensitive habitats and water bodies. This has identified the need for a robust evidence base and risk assessment with which to understand the effectiveness of current environmental regulations. This report describes the datasets, methods and outcomes of an investigation aimed at identifying the types of wastewater asset that pose the greatest risks to aquatic ecosystems in NI and whether the current regulatory framework delivers the required regulation and protection.

There are several different categories of wastewater system which collate and treat, to a greater or lesser extent, raw sewage effluent before discharging treated effluent to the water environment in NI. In turn these discharge activities are governed by a number of regulatory frameworks (listed below).

<b>Wastewater Asset Category</b>	<b>Governing Regulation</b>
Population Equivalent (PE) of between 2000 and 20,000 and those with a Population Equivalent of over 20,000	Wastewater treatment works (WwTWs) consented under the Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR)
Discharge volumes above 5 cubic metres per day (PE of less than 2000)	WwTWs consented under the Water (Northern Ireland) Order 1999
Discharge volumes below 5 cubic metres per day including small sewage treatment works (domestic consents)	WwTWs consented under the Water (Northern Ireland) Order 1999
Septic Tanks for individual dwellings	WwTWs consented under the Water (Northern Ireland) Order 1999

Wastewater Asset Category	Governing Regulation
High nutrient loading industrial discharges i.e. abattoirs and milk processing plants that discharge directly to waterways (trade effluent)	Industrial discharges consented under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013

The objectives of this investigation were to carry out an assessment of the discharges from sewage and industrial wastewater systems in NI and to identify the magnitude and relative importance of the impacts of each of these wastewater asset categories on aquatic ecosystems.

An initial scoping and data collation task was undertaken, identifying information available, constraints on its use and extracting the data needed to develop a risk assessment model. Data was sourced from open access datasets and also through requests and engagement with Northern Ireland Water (NIW), the Northern Ireland Environment Agency (NIEA) and Department of Agriculture, Environment and Rural Affairs (DAERA). The data was collated and quality checked for gaps and robustness. A confidence level was assigned to each dataset, with the data being of high to low quality.

A risk assessment model was developed using the screened data. The developed model uses discharge criteria and receptor sensitivity criteria to score (numerically) the overall risk of pollution from different assets, and then to allocate a weighted risk rank (qualitative as high, medium, low or negligible).

Each wastewater asset and potential source of the nutrients nitrogen (N) and phosphorus (P) was linked to its receiving Water Framework Directive (WFD) water body, the Q50 flow in the water body from the nearest relevant National River Flow Archive (NRFA) flow gauging station and measured instream N and P concentrations. The permitted discharge flow rate and permitted N and P concentrations in the discharge were also linked to each asset. The emitted loads of in kg/day for N and P in discharges from sewage and trade effluent wastewater systems were quantified and the proportion of in-river load from each wastewater asset calculated. Septic tank discharged loads were calculated in a different manner to represent the indirect pathway to receiving surface water bodies. The load was calculated using the count of septic tanks registered with NIW within zones defined on soil permeability and proximity to water course, with an adjustment to account for losses to groundwater using baseflow index (BFI) made at the water body scale.

At the water body level information was sought on: the published WFD Ecological Status (Overall) for 2021<sup>1</sup>; the WFD status for P (river water bodies) and N (lakes and transitional

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<sup>1</sup> Current published status (2021) at the time of data gathering and writing



and coastal water bodies (TraCs))<sup>2</sup>; if the water body is within an Urban Wastewater Treatment Directive (UWWTD) Sensitive Area; and if the body contains, or is upstream of a Shellfish Water Protected Site. Protected site designations, their site conditions and any known reasons for deterioration were also obtained.

At the water body scale, the risk assessment model defines a risk score for the likelihood that a wastewater asset will impact a protected habitat or WFD water body based on discharge load (and other risk criteria) from each wastewater category. Receptor 'sensitivity' (ecology, WFD status and other risk criteria) is determined via a similar method. The rankings for risk and impacts are then combined to produce an outcome based on a Risk Matrix, calculated from weightings assigned to the determined risk criteria and receptor sensitivity criteria.

The outputs from the model indicate that, overall, wastewater assets typically display low or medium overall risk. The exception being septic tanks which have the highest proportion of assets which are of high risk compared to the other wastewater treatment categories.

<b>Wastewater Treatment Category</b>	<b>Percentage of High-Risk assets at the NI scale</b>
Population Equivalent of over 20,000	8.3%
Discharge volumes above 5 cubic metres per day	8.0%
Discharge volumes below 5 cubic metres per day including small sewage treatment works	1.4%
Septic Tanks	40%
Industrial / Trade Discharges	18.1%

High level climate change and population growth scenarios were also assessed using UKCP18 climate scenarios applied to the river flow and lake volumes and local authority data on population growth applied to nutrient concentrations. This did not account for wastewater system changes such as increased flow or upgrades to works as these scenarios were unknown at the time of writing. These scenarios both showed minor increased risk overall.

Overall, larger wastewater assets (WwTWs, domestic consents and trade discharges) tended to fall within low or medium risk categories. Septic tanks, however, present a substantially higher pollution risk, with around 40% classed as high risk, partly driven by their very high number compared to other wastewater assets (161,628 septic tanks were

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<sup>2</sup> For TraCs status linked to the environmental quality standards (EQS) for dissolved inorganic nitrogen (DIN) was not available and so Marine Chemistry subgroup A was used instead.



included in the model, approximately 13 times more than all of the consented WwTWs) and their presence in all water bodies. It is noted that the results presented here underestimate their true impact, as only septic tanks registered for annual de-sludging by NIW are included in the model. In contrast, the 24 largest WwTWs (>20,000 PE), typically serving densely populated areas and providing higher treatment levels, typically show low to medium pollution risk. When loading contribution was aggregated at the national scale, WwTWs with a PE < 2,000; and discharge > 5 m<sup>3</sup>/day (consented under the Water Order (1999)) were found to contribute the largest proportion of N and P loads to water bodies compared to other wastewater assets.

At the river basin scale, all three river basins had a low overall risk from wastewater assets. However, it is noted that there are 'hotspots' of high risk, particularly in the North Western River Basin which are related to protected areas in these water bodies which follow the river channel in the River Foyle, River Faughan, River Roe and Owenkilwey River.

Key components found to be contributing to high risk scores were individual assets with nutrient loading contributing greater than 10% above baseline to the water body, and also a lack of specific permits for N and P across all asset types. This indicates that regulations and consenting may need to consider stricter requirements for nutrients such as widening the circumstances when permitting is required and reviewing permitted nutrient loading quantities. Additionally, areas with numerous discharges with nutrient loading of under 3% or between 3-6% of the in-river load were also assessed to be high risk. Therefore, consideration of smaller discharges should also be taken and particularly where there are multiple discharges in a water body creating a combined risk. All water bodies at high risk due to septic tanks had N or P loadings of greater than 10% contribution from this discharge. Therefore, stricter regulations or more specific permit conditions on nutrient loading from septic tanks for both N and P are recommended.

For both the smaller WwTW discharges and septic tanks, new permits or updates to permits should take into account catchment scale assessment of the load rather than permitting on a site-by-site basis.

# 1 Introduction

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Across Northern Ireland (NI), the high-profile impacts of wastewater assets on the natural environment are of concern to regulators, operators, stakeholders, and communities alike. There is a need to deliver a healthy water environment and protect sensitive aquatic habitats for future generations. With a focus on the risk and impacts of the nutrient load (specifically Nitrogen (N) and Phosphorus (P)) delivered to surface water bodies from wastewater assets, the Office for Environmental Protection (OEP) have identified the need for a robust evidence base and risk assessment with which to understand the effectiveness of current regulations.

This report describes the datasets, methods and outcomes of an investigation which aimed to identify the types of wastewater asset posing the greatest risks to aquatic ecosystems in NI and whether the current regulatory framework delivers the required regulation and protection. This project forms part of the OEP's framework of prioritised work on nature recovery, water quality, nutrients and effective governance.

## 1.1 Project Context

### 1.1.1 Nutrient pollution of freshwater

Eutrophication, a process that can lead to algal blooms, is defined as one of the most significant environmental challenges affecting freshwater ecosystems globally.

Eutrophication occurs when excess nitrogen (N) and phosphorus (P), combined with warm temperatures, abundant sunlight, available carbon dioxide (CO<sub>2</sub>), and slow-moving water create ideal conditions for algal blooms to form. It is a naturally occurring, slow process in surface water bodies like lakes and ponds as part of ecological succession, though it occurs to a lesser extent in rivers due to flows dispersing nutrients.

Natural eutrophication, when occurring gradually over long periods, can support biodiversity by fostering habitat diversity and ecological succession. In a dynamic system, algal blooms eventually die off and become food for aerobic bacteria. However, excessive eutrophication, due to human activity, can very quickly become detrimental to ecosystems<sup>3</sup>. As dense algal blooms grow and decay, microbial decomposition consumes large amounts of dissolved oxygen (DO) leading to dead zones where oxygen levels are too low to sustain most aquatic life<sup>4</sup>. Alongside the formation of anoxic water conditions, the appearance, quality, and health

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<sup>3</sup> Rathore, S.S., Chandravanshi, P., Chandravanshi, A., Jaiswal, K. 2016. Eutrophication: Impacts of Excess Nutrient Inputs on Aquatic Ecosystem. IOSR Journal of Agriculture and Veterinary Science. Volume 9, Issue 10 Ver. I, PP 89-96

<sup>4</sup> Chislock, M. F., Doster, E., Zitomer, R. A. & Wilson, A. E. (2013) Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems. Nature Education Knowledge 4(4):10

of water bodies deteriorate significantly. The impacts of intensified eutrophication will only be exacerbated with climate change and population growth.

### **1.1.2 Nutrient pollution in the UK and NI**

Nutrient pollution of many lakes and rivers in the UK and NI has increased dramatically over the past 70 years as a result of increased nutrient loading from anthropogenic sources including industrial pollution, urban stormwater runoff and widespread agricultural intensification<sup>5</sup>. Whilst these are significant sources, wastewater system discharges also contribute to the overall nutrient load in surface water bodies through multiple sources, including municipal sewage, untreated or insufficiently treated wastewater, and poorly managed septic tank systems. Statutory obligations and changes in policy have greatly increased the emphasis for the control of nutrient levels in UK freshwater water bodies. Lough Neagh is the largest freshwater lake in the UK and Ireland, spanning around 380 km<sup>2</sup>. High levels of cyanobacteria have been recorded in many rivers, lakes, and coastlines in NI for several years, with Lough Neagh being particularly affected.

### **1.1.3 Wastewater systems in NI**

There are several different types of wastewater system which collate and treat, to a greater or lesser extent, raw sewage effluent before discharging treated effluent to the water environment in NI (Figure 1-1). These include:

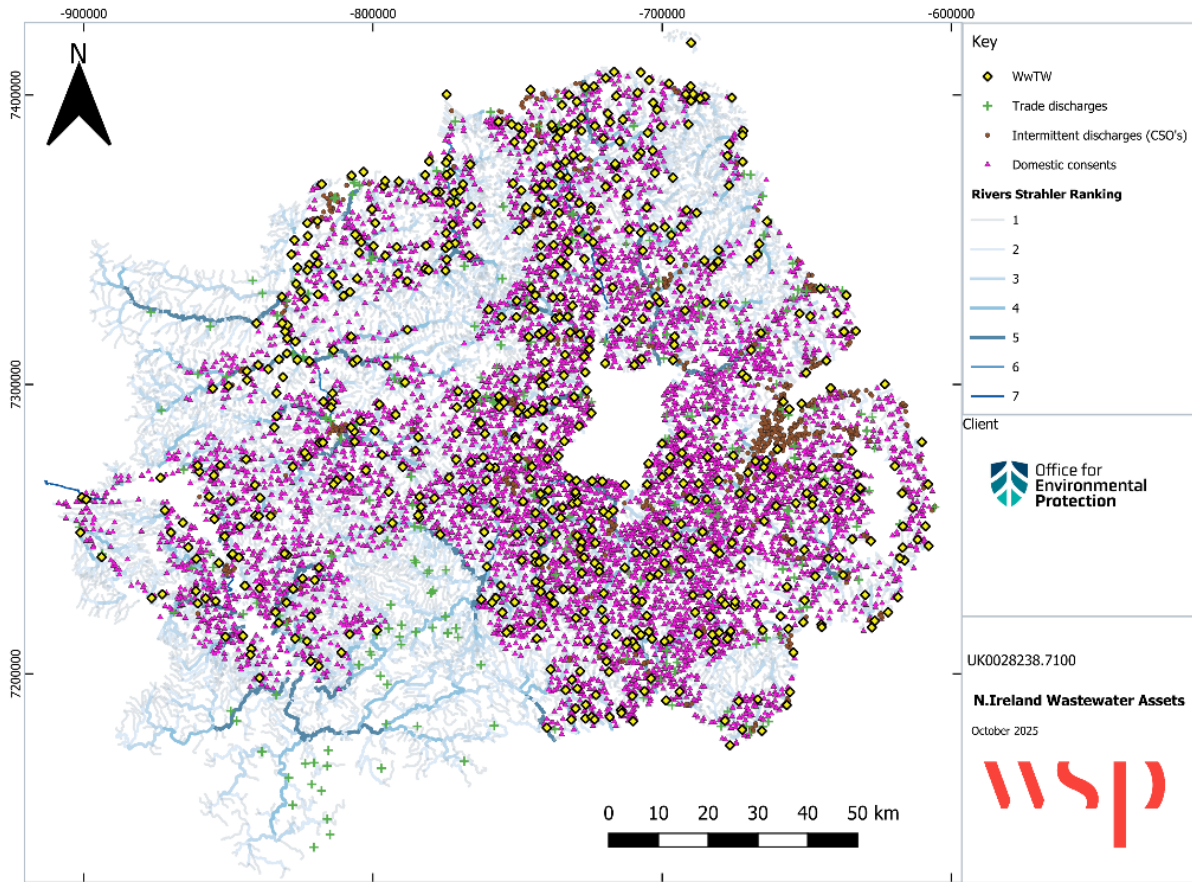
- Wastewater treatment works (WwTW) owned and operated by the publicly owned Northern Ireland Water (NIW) which receive domestic and trade wastewater.
- Privately owned treatment works which could serve multiple domestic properties or treat trade effluent from industrial, food and beverage or agricultural sectors.
- Septic tanks serving individual typically domestic properties.

Whilst the larger WwTW may have the capacity to treat large volumes of sewage to higher standards and are therefore easier to regulate, they still produce a high load of emitted pollutants to the water environment due to the volume of treated effluent produced. Smaller treatment works may have less stringent permit conditions for the quality of the released effluent and therefore there is less control over the nutrient pollution produced from these sites.

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<sup>5</sup> Mainstone, C. P., Parr, W. 2002. Phosphorus in rivers — ecology and management. *Science of The Total Environment*, Volumes 282–283, PP 25-47.

**Figure 1-1 - Wastewater assets in Northern Ireland (excluding septic tanks – note that ‘domestic consents’ refers to privately owned treatment works)**



Trade effluent with high nutrient inputs such as agricultural or food processing industries (i.e. dairy and abattoir) should be operated under permit but could still provide significant nutrient emissions to water bodies.

Individual septic tanks in NI typically serve isolated dwellings but there are many thousands of these sites across the region. Site owners need to register the discharge on a public register but are not required to meet any specific volumetric or water quality permit conditions. Septic tanks in the Republic of Ireland have been reported as having an overflow pipe where the drainage blanket is constructed into gley and other low permeability soils, to prevent the system backing up during periods of high saturation. The overflow would

discharge directly to a ditch or water course.<sup>6</sup> It is likely that this design is replicated in NI where similar soils occur. Therefore, whilst large WwTW may provide large point source emissions in specific locations, the higher number of much smaller septic tank discharges provide a much more distributed and less controlled source of nutrient emissions to the water environment.

#### **1.1.4 Regulation of wastewater emissions to the environment in NI**

Regulatory frameworks and policy instruments have previously been implemented to enhance and protect the aquatic environment and protect sensitive ecosystems.

Several regulatory frameworks are in place controlling the management of wastewater in Northern Ireland. The main regulatory frameworks are listed below including those that regulate discharge consents controlling the entry of wastewater in water bodies:

The Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR) which is an EU-derived set of regulations concerning the 'collection, treatment and discharge of urban wastewater and the treatment and discharge of wastewater from certain industrial sectors. It mandates wastewater collection and treatment in urban agglomerations with a population equivalent of over 2000.

The Water (Northern Ireland) Order 1999 affects wastewater management through the consents requirement for discharge of effluent into waterways or underground stratum. This concerns discharge volumes above 5m<sup>3</sup> and includes those below this such as septic tanks and small sewage treatment works.

The Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013 are a framework for controlling and reducing pollution from industrial activities including high nutrient loading industrial discharges i.e. abattoirs and milk processing plants that discharge directly to waterways.

The Water Environment (Water Framework Directive Regulations (Northern Ireland) 2017 provide an impetus for the general control of phosphorus and nitrogen, particularly focusing on priority areas. These include Special Areas of Conservation (SACs) under the EC Habitats Directive, Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act 1981, and 'sensitive areas' under the EC Urban Wastewater Treatment Directive (UWWTD).

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<sup>6</sup> Donohue, S., 2014. The Application of Geophysics to a Number of Threats to Irish Soil. Report 126 produced by UCD and Queens University Belfast for the Environmental Protection Agency under the STRIVE Programme. Available at [https://www.epa.ie/publications/research/land-use-soils-and-transport/STRIVE\\_126\\_web.pdf](https://www.epa.ie/publications/research/land-use-soils-and-transport/STRIVE_126_web.pdf) [Accessed 18/10/2025].

## 1.2 Project aim and objectives

The aim of this project was to assess the discharges from sewage and industrial wastewater systems in NI and identify the magnitude and relative importance of the impacts of each component of these systems on aquatic ecosystems.

The OEP had identified the different categories of wastewater assets which are shown in Table 1-1 with the relevant regulations under which they are permitted to discharge to the environment.

**Table 1-1 - Wastewater asset categories used in the project**

<b>Wastewater Asset Category</b>	<b>Governing Regulation</b>
Population Equivalent of between 2000 and 20,000 and those with a Population Equivalent of over 20,000	WwTWs consented for under the Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR)
Discharge volumes above 5 cubic metres per day (PE of less than 2000)	WwTWs consented for under the Water (Northern Ireland) Order 1999
Discharge volumes below 5 cubic metres per day including small sewage treatment works (domestic consents)	WwTWs consented for under the Water (Northern Ireland) Order 1999
Septic Tanks for individual dwellings	WwTWs consented for under the Water (Northern Ireland) Order 1999
High nutrient loading industrial discharges i.e. abattoirs and milk processing plants that discharge directly to waterways (trade effluent)	Industrial discharges consented for under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013

The project has been delivered through the following tasks:

- Development of a source pathway receptor based conceptual understanding of different wastewater assets in the NI system of wastewater discharges<sup>7</sup> and their impact on sensitive aquatic ecosystems;
- Development of a bespoke risk assessment model to assess the relative risk and impact each component poses to aquatic ecosystems, including future scenarios;

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<sup>7</sup> The project includes assessment and evaluation of wastewater defined as ‘any water from households, business and industry and runoff that enters wastewater treatment systems, whether directly or indirectly, treated or untreated’

- Collation and review of the regulations and legislative instruments under which the different wastewater assets are managed and their implementation in NI;
- Combination of the outcomes of the risk assessment and the review of regulations to understand their effectiveness.

The risk assessment model developed to assess the relative nutrient pollution risk and impact on aquatic ecosystems from discharges from the wastewater systems set out in Table 1-1 ) follows the environmental impact assessment approach of identifying:

- Sources (i.e. of wastewater derived N and P),
- Pathway (i.e. direct discharge to rivers or septic tank drainage blanket etc. and pathway processes such as attenuation / dilution),
- Receptor (considering sensitivity to nutrient pollution).

It is important to note that throughout this report it is assumed that all permit values are adhered to and the permit level itself is protective of the environment. In reality, some sites may over or under perform relative to permit conditions but this level of information was not available for the project.

### 1.3 Layout of this report

This report consists of the following Sections:

- Section 1 this introduction.
- Section 2 describes the datasets collated, review and processing to develop the evidence base and the development of a database in which the resultant model inputs are stored.
- Section 3 sets out the criteria and scores used in the risk assessment to understand the comparative risk posed by the different category of wastewater asset.
- Section 4 describes the overall outcomes of the application of the risk methodology and sensitivity testing. The application of the risk scoring is demonstrated for three catchments.
- Section 5 describes the regulatory framework and legislation relevant to the wastewater asset categories and implementation. The review results are discussed in the context of the results of the risk assessment.
- Section 6 provides a summary of the conclusions of the report and recommendations around datasets, next steps and any improvements to approach.

The supporting appendices include:

- Appendix A Glossary of terms;
- Appendix B Reference list for all data used in the assessment;
- Appendix C The developed risk scoring model and underlying datasets (provided electronically only);
- Appendix D three case studies developed to demonstrate the model and risk scoring for the Faughan River (Carmoney), River Lagan (Stranmills) and Arney River; and,
- Appendix E Further details of consent application requirement.

## 1.4 Design of project database

A requirement of the project was that the data used in the assessment should be provided in an easily searchable manner to the OEP. Datasets reviewed in the project to conceptualise the impacts of the wastewater system in NI on the water environment have been collated into an ArcGIS database using unique identifiers such as the Corporate Asset Register Identification (CARID) attribute for wastewater asset data to was collated using the to match the asset location, age and treatment type data to feed into the discharge risk assessment. Assets and their associated data were joined spatially to individual WFD water bodies, Local Management Areas<sup>8</sup> and River Basin District boundaries to enable results reporting at different scales. Assets were also grouped into the categories in Table 1-1 to allow analysis and reporting at this level.

The datasets were collated into an ArcGIS compatible geodatabase to link supporting tabulated data to spatial locations.

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<sup>8</sup> WFD management catchments are defined as the unit of geography for which action plans are drafted in implementing the WFD. These catchments are delineated using flow data and a digital terrain model run through a hydrological model, ensuring that WFD rivers do not intersect boundaries. The catchments are larger than operational catchments but smaller than river basin districts and contain multiple water bodies.

## 2 Data Collation, Review and Processing

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### 2.1 Scope of task

The initial scoping and data collation task formed provides the foundations of the project, identifying information available, constraints on use and extracting the necessary data for risk assessment model. This section provides a description of the sources and methods of data collation, the outcomes of a data gap analysis and the approaches taken to fill these gaps. Table 2-1 shows the list of collated datasets and their source organisation.

### 2.2 Data collation and review

#### 2.2.1 Data sources and requests

Most of the datasets related to NI protected sites, water quality and flow monitoring data, WFD water bodies and legislation are available online via DAERA, OpenDataNI, NFRA UK CEH, JNCC and legislation.gov websites. Project relevant datasets were downloaded into a folder system, in readily useable formats, such as shapefiles, Excel tables, CSVs and PDFs.

In cases where data was not available online, data requests were sent to the relevant organisations (Table 2-1). Where barriers to data collation were identified, such as sensitive information or age of data (and therefore format), storage and potential alternatives were discussed and any required workarounds agreed with the OEP (as detailed see Table 2-1). The data request to NIW, NIEA and DAERA was supported through an in-person workshop in March 2025, arranged by the OEP to present the project aims and discuss the data requests and agree data provision (see Section 2.2.3).

The three transboundary basins within NI (North Western international River Basin District (iRBD), Shannon iRBD, Neagh Bann iRBD) were also included within this data collation exercise, with requests made to the Irish Environmental Protection Agency for the same information.

#### 2.2.2 Gap analysis and confidence assessment

Once collated, the datasets were examined to determine the quality and condition of the acquired dataset, in addition to identifying unavailable datasets. A gap analysis was undertaken on the collated datasets to determine the data available to the project and identify any limitations (Section 4.6).

Where gaps were identified alternative approaches were developed where possible and a final confidence assessment was undertaken with confidence ratings assigned to each of the datasets. Ratings were determined by considering the following factors:

- The age of the data / information,
- Whether spatial information was provided and the accuracy of this data,
- Number of data points,

- Data format,
- Any gaps in timeseries data or missing values in other datasets,
- Appropriate units, and
- Where required, if it was possible to identify a suitable assumption to fill data gaps.

Confidence in the data was deemed either low, medium or high and is shown in Table 2-1. Whilst a sense check of numerical and spatial data has been undertaken, an assessment of the likely accuracy of all of the information provided is outside of the scope of the investigation. Whilst it is acknowledged that errors will still exist in datasets, it has been assumed that the organisations publishing and sharing numerical, spatial and descriptive data have applied best practise in data quality assurance and checking.

A reference list for all data sources used in the project is provided as an Excel spreadsheet database with date of download, date of publication, data format, data holder, data sensitivity and hyperlinks to any online location (Appendix B).

Transboundary data was provided by the Irish Environmental Protection Agency (EPA). However, although some data was received, the wastewater categories did not align directly with datasets from NI and therefore could not be combined to assess risk in transboundary bodies with confidence. For example, the wastewater asset category was not clear in the provided data (all sites were assigned as 'UWWT'). Therefore, the transboundary data was omitted from further assessment.

### **2.2.3 Stakeholder engagement**

In March 2026 the OEP held a one-day workshop with attendees from the main project stakeholders including NIW, NIEA and DAERA. The OEP's consultants WSP and DTA Ecology also attended. The aim and objectives of the project were presented by WSP with feedback from stakeholders on the planned conceptualisation and model creation received. Outstanding data requests were raised with NIW, NIEA and DAERA, including WwTW population served, Habitat sites, non NIW operated treatment works and septic tank locations. Other datasets such as climate change and population growth, and combined sewer overflows (CSOs) were also discussed.

After the workshop, WSP held follow up virtual MS Teams meetings with both the NIEA and NIW. The main topics for discussion were the remaining missing datasets and visualisations of the outputs:

- The follow-up meeting with NIEA built upon initial discussions from the workshop, addressing key challenges and insights related to data collection. NIEA outlined specific difficulties in gathering accurate environmental data and provided further details on the hydraulic connection methodology used in Water Regulation Assessments for new discharges or abstractions. Additionally, the meeting also explored various data requests and underlying assumptions (Section 4.6), including conditions of protected sites, reasons for unfavourable status, reasons for not achieving good status (RNAGS) based

on Common Standards Monitoring (CSM), and compliance history regarding NIW discharges (numeric consents). Focus was also placed on data related to septic tanks and trade consents, encompassing permit conditions and effluent quality.

- The follow-up meeting with NIW focused on addressing missing datasets and expanding discussions from the workshop. NIW provided insight into their available data for septic tanks and WwTW network catchment boundaries, confirming they could provide data in a format that protected sensitive address point information and noting other caveats and gaps. The conversation also covered WwTWs with a population equivalent (PE) below 2000. Building on discussions from the workshop, the meeting explored the implications of climate change scenarios, the categorisation of wastewater treatment facilities, model risk assessments, and the visualization of output data.

Additional dissemination workshops to stakeholders and the OEP are planned for January/February 2026 to demonstrate and hand-over the Risk Assessment model.

**Table 2-1 - Data collation and confidence assessment**

Dataset	Data description	Format	Source	Gap analysis	Confidence in dataset	Reason for confidence
NIW Wastewater Assets	WwTW discharge location, UWWTR permit conditions, Treatment, receiving environment, age and condition, population served (>2000), associated intermittent discharge locations, CSO and pumping station locations, CSO EDM data (where available).	Excel spreadsheet and shapefiles	NIW data request	<p>WwTW permit/ flow data: where discharges are covered by a descriptive consent and/or dry weather flow (DWF) is unknown, concentrations of P and N may be estimated either from in river concentrations or estimated based on known conditions for similar sized works across the UK.</p> <p>Wastewater asset locations: Information available for all 1,021 NIW assets. Discharge locations unavailable for 216 WwTW assets. 358 assets in this dataset are classified as septic tanks which have been processed in the septic tank workflow and four assets classified as reed beds were removed. 659 NIW WwTW assets were taken forward.</p> <p>Data provided for 1301 CSOs and 560 intermittent discharges associated with WwTWs, Assets were matched by CARID value and duplicated values between the two datasets removed creating a combined list of 1319 assets. Discharge locations were unavailable for 526 CSOs where asset location coordinates have been used instead.</p>	High / Medium	Medium confidence due to reliable asset and discharge location where provided, but gaps in permit conditions, DWF and discharge coordinates.
Trade effluent	Discharge location, type of effluent and process	Shapefile	DAERA	Trade discharges were supplied without permit conditions and therefore flows and loads were not available. Instead, typical values from the Environment Agency (England) Consented Discharges to Controlled Waters database. <sup>9</sup> are used.	Medium	Medium confidence is due to spatial accuracy of discharge points (high confidence) but uncertainty in permit conditions (low confidence), requiring application of flow and load estimates from Environment Agency database and guidance.
Domestic consents	Discharge location	CSV	NIEA	<p>DICAP domestic consents for 20,273 consents. Consents were filtered by receiving medium to only those discharging to waterways, coastal or estuarine. 4,255 shared the same coordinates and IGR which were removed from further processing. 5,064 records had IGRs but no coordinates, though coordinates were generated for 4,978 of these records using available postcode data.</p> <p>A total of 11,499 domestic consents were taken forward to the assessment.</p>	Medium	Medium confidence reflects spatial accuracy of domestic consents (coordinates either provided or derived for most records) but uncertainty in number of consents due to removal of duplicates, the lack of associated permit data so discharge flow assumptions have been made.
Septic Tanks	Septic tanks (and other <5m <sup>3</sup> /day registered sewage discharge) location, number of houses/population equivalent (PE) served, age	Excel spreadsheet / shapefile	NIEA / NIW	<p>Although the register of small sewage discharges is held by DAERA some of the databases behind the portal are from the 1970s and likely to be out of date. The dataset was requested from NIEA, but the age of the information leads to significant uncertainty in the accuracy of locations. The dataset contained 113,115 records, though only partial postcode and address location data was available rather than coordinates.</p> <p>NIW hold a register of septic tanks which they de-sludge annually. This information was used in the assessment as likely to be more up to date, although it only covers sites which are accessible and registered for this service.</p>	Low  Medium	<p>Low confidence in septic tank location data and completeness of the public register of septic tanks provided by NIEA.</p> <p>Medium confidence in NIW register of septic tanks: representative of the distribution and a significant proportion of sites in NI.</p>

<sup>9</sup> Environment Agency. Consented Discharges to Controlled Waters with Conditions. Website – Available at: <https://www.data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions1> [Accessed 12/09/25].

Dataset	Data description	Format	Source	Gap analysis	Confidence in dataset	Reason for confidence
WFD data	WFD River water bodies, Coastal interbasins, Marine water bodies, Lake water bodies, Local Management Areas, River Basin Districts, WFD 2021 Environmental Quality Standards (EQS)	Shapefile, CSV, KML	DAERA, OpenData NI	Reasons for not achieving Good Status were not provided. Instead, Ecological Status which depends on TP EQS limits (provided by DAERA) were used to identify water body sensitivity. Assumed that DAERA have provided accurate representation of protected site boundaries.	High	Datasets quality assured and maintained by DAERA and should be an accurate representation of the outcomes of their own assessments.
Water environment	Strahler river network, eFLAG data	Shapefile, Excel	DAERA, UKCEH	Full NI coverage with all water bodies included. The Strahler river network dataset was interrogated before use in the model and compared against available mapping.	High	The eFLAG dataset is widely used as a nationally consistent method for hydrological future flows.
Protected sites	Site boundaries (ASSIs, SACs, SPAs & RAMSAR), Surface, UWWTD sensitive areas, Shellfish Waters	Shapefile, CSV, KML	DAERA, OpenData NI, JNCC	Full NI coverage with all sites included. Assumed that DAERA have provided accurate representation of protected site boundaries.	High	Shapefiles were cross checked against available documentation for protected sites.
Flow Monitoring Data	River flow gauging station locations, River Q95, Q50 & Q10 flows	CSV	NRFA – UKCEH,	Flow data – there are 46 active NRFA flow gauges in NI, 450 WFD river water bodies and a further 58 coastal interbasins. Therefore, a method for deriving flow estimates for ungauged catchments at the water body is required to assign load values to feed into the discharge risk assessment.	Low – Medium - High	High confidence in river flow data in gauged catchments. Medium confidence in flow values assigned to ungauged water bodies which is the majority of WFD water bodies in NI. However, confidence improved to medium after assessment to improve spatial coverage of data across all NI water bodies
Water Quality Monitoring Data	Water Quality monitoring station locations, River water quality P and NO <sub>2</sub> /NO <sub>3</sub> /NH <sub>4</sub> /NH <sub>3</sub> (1990-2018) collated for use in WFD status assessment	Shapefile, CSV	OpenData NI, DAERA	Spatial coverage of monitoring data is good but no data available for the last seven years. No LoD or LoQ information provided so low concentration averages might be biased by LoD values which are unknown.	Low - Medium	No data available for the last seven years. No LoD or LoQ information provided. Confidence improved to medium after assessment to improve spatial coverage of data across all NI water bodies
Other Monitoring Data	Lake volume	PDF	DAERA	Lake volume data available for all lakes in NI that require statutory monitoring under the WFD.	High	Fol request to DAERA found online which lists lake volume of the lake WFD water bodies. Personal information of the original Fol requester is redacted in the version available online. Internal DAERA reference: DAERA/22-212.
Climate change predicted flows	Simulated daily flow 1982-2080 for nine NRFA river flow gauging stations	CSV	eFLAG project, UKCEH	eFLAG project is applicable to and covers NI. Only nine locations in NI.	Low	Simulation based on observed data, additionally only nine locations for all of NI.
Legislation	Regulations, Water Industry Act, Water & Sewerage	PDF	Legislation.gov,	The required most recent official legislation documents are publicly available and accessible.	High	The assessment was undertaken based on the current versions of

Dataset	Data description	Format	Source	Gap analysis	Confidence in dataset	Reason for confidence
	Orders, Fisheries Act		DAERA, NIW			legislative instruments and other documentation.
Transboundary water bodies	WFD River Basin Districts, WFD Catchments, WFD River sub-basins,  Trade discharges (Licensed facilities pollutants 2007-2023).  Urban Wastewater plant locations (2020) and permit conditions.	Shapefile	EPA	Trade effluent data did include permit conditions (unlike for NI)  The Irish Water and council WwTWs population and treatment type was provided but with no permit conditions.  No differentiation between Urban Wastewater plants on the basis of PE therefore the dataset could not be used.  No septic tank data was provided.	High  Medium  Low	High for trade effluent data with permit conditions.  Medium for WwTWs as no permit conditions were provided (as for NI).  Gaps in information compared to NIEA information and NIW data makes the datasets incomparable.
Soils	Hydrology of Soil Types (HOST) data	Shapefile	Agri-food and Biosciences Institute (AFBI) provided by OEP	Full dataset for soils available. Covers all of NI.	High	Published dataset quality checked by ABFI
Geology	Underlying Geology	Shapefile	AFBI	Full dataset for geology available. Covers all of NI.	High	Published dataset quality checked by ABFI / BGS
Population growth	Local Authority population growth projections	PDF	Northern Ireland Statistics and Research Agency (NISRA)	Population growth data available for all Local Authorities in NI.	Medium	Data based on NI Census data and quality checked by NISRA, predictions may be impacted by COVID19 and other world events

## 2.3 Data processing

The risk assessment model described in Section 1.2 was developed to assess the relative nutrient pollution risk and the significance of the impact on aquatic ecosystems by discharges from different categories of sewage and trade effluent wastewater systems in NI (Table 1-1).

### 2.3.1 Risk model development

As described in Section 2.2, spatial datasets representing sources, pathways and receptors were gathered and processed. These datasets were then collated in a Geographical Information System (ArcGIS) and reviewed to develop a conceptual and spatial understanding of the size of the sources and pathway processes for N and P released from the wastewater system to sensitive receptors.

Unique identifiers, either specific co-ordinates and/or individual asset codes (as supplied by NIW for specific assets) were used to collate all information for a specific asset into a catalogue. This not only allowed development of a national scale conceptual understanding of the wastewater system but also robust data processing. Where an asset did not have an individual asset code or a specific co-ordinate attached that asset was assigned at a water body level where the data allowed (e.g. postcode data for domestic consents). For septic tanks, where the exact location information could not be provided by NIW a count per water body and soil type / proximity to water course was calculated instead and assigned to the water body. Any asset with spatial data was excluded from the assessment.

This understanding was then used to develop the in water body baseline load, discharge load and receptor sensitivity criteria and calculations for the model. The discharge and receptor criteria and their supporting datasets are shown in Table 2-2 and Table 2-3 respectively.

**Table 2-2 - Discharge criteria for each asset type and datasets used to derive these**

Asset Type	WwTW/ Domestic Consents							
Criteria	Discharge Location	Treatment Category	Age of Asset	Permit Conditions	Population Served	Loading (N and P)	Associated intermittent discharge location	NIW WwTW Compliance
Dataset	NIW Wastewater Assets / Domestic consents / Water environment	NIW Wastewater Assets / Domestic consents	NIW Wastewater Assets / Domestic consents	NIW Wastewater Assets / Domestic consents	NIW Wastewater Assets / Domestic consents	NIW Wastewater Assets / Domestic consents / Flow Monitoring Data / Water Quality Monitoring Data / Other Monitoring Data / Population growth / Climate change predicted flows	NIW Wastewater Assets / Domestic consents	NIW Wastewater Assets / Domestic consents
Asset Type	Trade effluent							
Criteria	Discharge Location	Industry Type	Permit Conditions	Loading (N and P)				
Dataset	Trade effluent / Water environment	Trade effluent / Water environment	Trade effluent / Water environment	Trade effluent / Water environment / Flow Monitoring Data / Water Quality Monitoring Data / Other Monitoring Data / Population growth / Climate change predicted flows				
Asset Type	Septic Tanks							
Criteria	Discharge Location	Population Served	Loading (N and P)	Attenuation of N and P				
Dataset	Septic Tanks / Water environment	Literature values	Septic Tanks Flow Monitoring Data / Water Quality Monitoring Data / Other Monitoring Data / Population growth / Climate change predicted flows	Soils / Geology / Proximity to watercourse / Base flow index for loss to ground				

**Table 2-3 – Receptor sensitivity criteria and datasets**

Receptor	Dataset
WFD Surface Water Bodies Category	WFD Ecological Status
UWWTD Sensitive Area	Protected sites condition data or most sensitive habitat
Shellfish Water Protected Site	Protected sites water quality limits
Habitats Site Designation (Highest)	Protected sites condition data or most sensitive habitat
Habitats Site Condition (Lowest)	Protected sites
Habitats Site Ecological Impact	Protected sites condition data or most sensitive habitat

## 2.3.2 Calculating water body baseline load

Data processing of river and TraC flow, lake volume and nitrate (N) and phosphorus (P) concentration at the water body level was undertaken to feed into calculations of the water body level baseline nitrate and phosphorous loads. Note that nitrate ( $\text{NO}_3$ ) and phosphorus (monitored as determinand phosphate  $\text{PO}_4$ ) were used for rivers and lakes, while dissolved inorganic nitrogen (DIN) is the sum of nitrite ( $\text{NO}_2$ ), nitrate and ammonia (total as N) and is used for TraCs.

### 2.3.2.1 River flow gauging data

There are 46 active NRFA flow gauges in NI (Figure 2-1), with 310 of the WFD river water bodies in NI located within an NRFA gauged catchment. Where a flow gauge is available, the WFD river water bodies are assigned to this and an area weighted flow based on the NRFA gauged catchment in which they are located. For WFD river water bodies that are not located in an NRFA gauged catchment, the closest NRFA gauge with similar catchment characteristics has been used to calculate the area weighting.

For WFD river water bodies located in an NRFA flow gauged catchment, Q50 NRFA flows are area weighted by the areas of WFD river water bodies within them to derive flow estimates at the water body scale. Where multiple NRFA gauges are present in one catchment, Q50 flows and upstream gauged catchment area is subtracted from the downstream Q50 flow and catchment area, and area weightings are applied to the water body scale at the smaller upstream catchment scale. This approach is commonly used to fill data gaps in hydrological datasets.

WFD river water bodies that lie within the upstream area of the Movanager gauge (Station ID 203040)<sup>10</sup> and are upstream of Lough Neagh, have been assigned area weightings based on the closest flow gauge within their Local Management Area, as this was deemed to be more representative than an area weighting of the flow downstream of Lough Neagh at the Movanager gauge.

The Lough Neagh Peripherals river water body was ungauged and therefore in order to scale the river flows by an appropriate area weighting, the area of the Lough Neagh WFD lake water body was subtracted from the river water body and an average catchment area calculated using other small river water body catchments around Lough Neagh.

For Coastal Interbasin<sup>11</sup> catchments, an average flow and average area of the Grandmere (station ID 205015) and University of Ulster (station ID 203050) gauging stations was

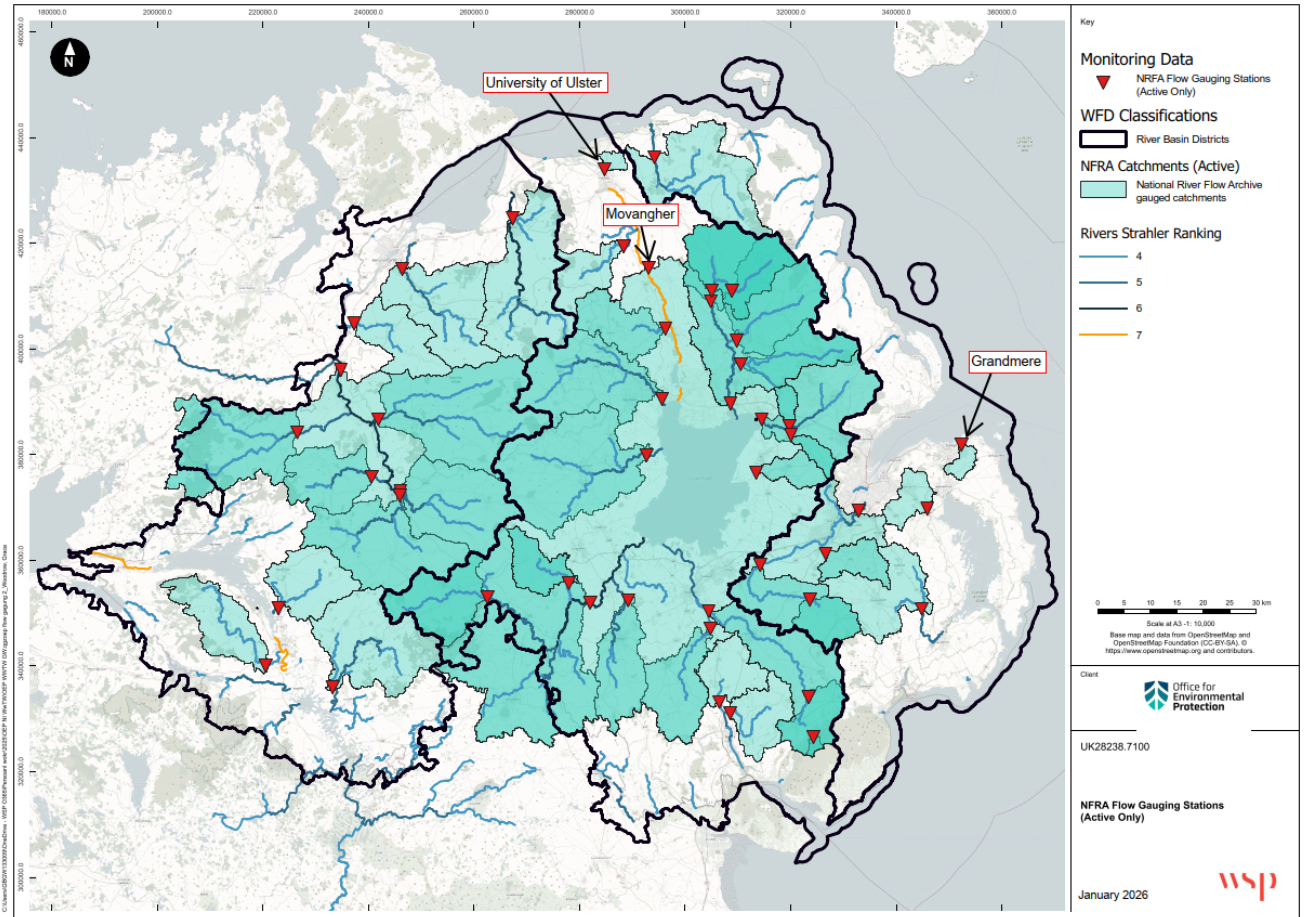
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<sup>10</sup> The Movanager gauge is located on the Lower Bann downstream of the outfall from Lough Neagh.

<sup>11</sup> Coastal interbasins are defined as areas of land adjacent to the coast which are not defined as water bodies under Article 2(7) of the Water Framework Directive (2000/60/EC) and have not formed part of the 1st or 2nd

calculated as these gauges are on the smallest gauged catchments, both only containing one WFD river water body.

**Figure 2-1 - NRFA gauged catchment distribution by WFD river water body**



### 2.3.2.2 TraC Flow Rates

Where gauging data was not available, flow rates for TraCs were derived from the flow rates from the adjacent upstream water bodies. This was done by summing the input flow rates to determine total freshwater input into the TraC. Note that tidal conditions were not accounted for so as to only determine flow (and therefore load) coming into the water body from the inland watercourses.

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river basin management cycle classification process. DAERA (2026). Coastal Interbasins – OpenData website : Available at: <https://opendata-daerani.hub.arcgis.com/datasets/coastal-interbasins/about> [Accessed 05/12/2025].

### 2.3.2.3 Lake Volumes

Baseline loads for lakes were calculated using lake volume data rather than a flow rate. This is due to residence time being unknown for lake water bodies. The mass balance equation multiplies lake concentration by lake volume' for both nitrate and soluble phosphorous.

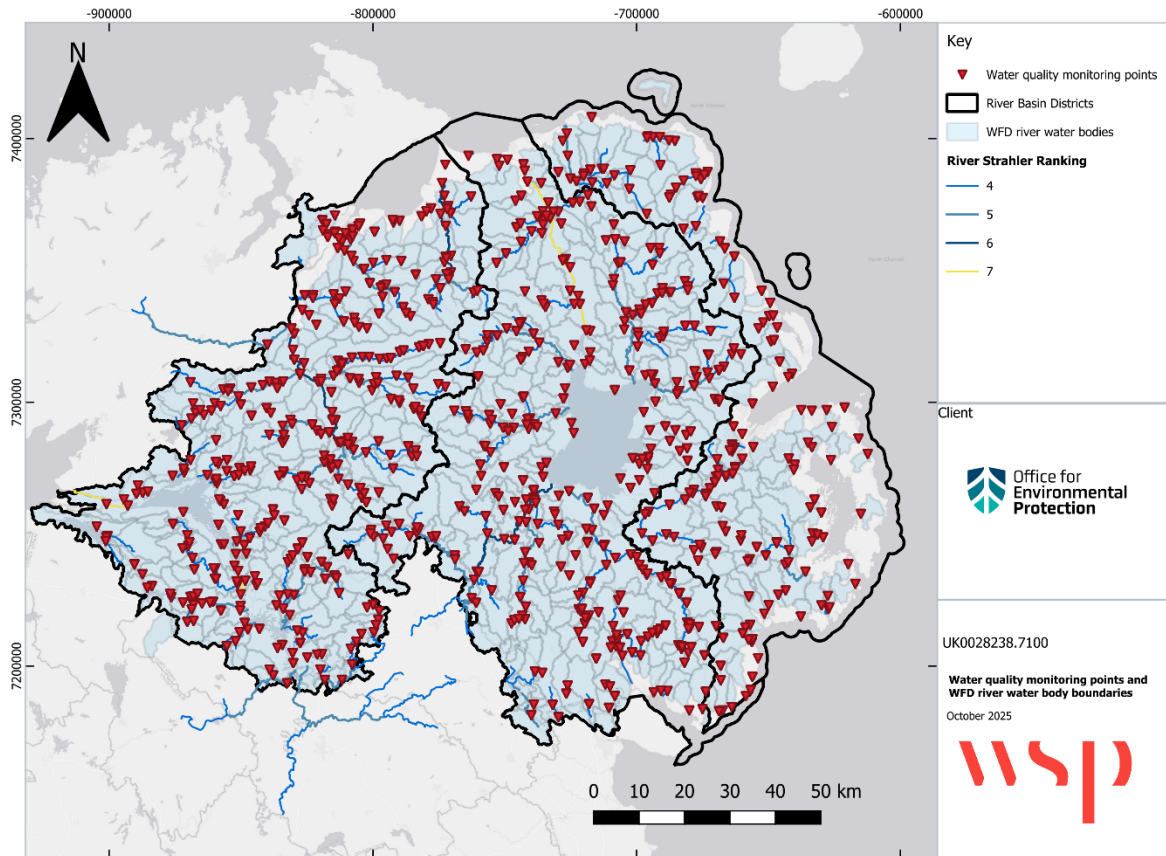
### 2.3.2.4 River and Lake Concentration Data

Concentration data for nitrate and soluble phosphorous for the water bodies was available from water quality monitoring stations from 1990 to 2018 (Figure 2-2). Data post 2018 was not available as the WFD classification for 2024 had not been published at the time of writing and 2021-2023 data will only be available once the 2024 WFD classification is published. All of the available nitrate and soluble phosphorous data was averaged (mean) for each water body. This was done to account for any inconsistencies in data sets from monitoring locations, for example;

- where monitored determinands changed across the collection period,
- where monitoring was undertaken and then paused or ceased,
- where monitoring inconsistently covered all seasons.

This allowed for a significant volume of data to be included in the model. Though it is acknowledged that the length of the water quality data set may therefore include data points from locations prior to any land use changes which altered the 'present day' baseline. It was considered that the average across the data sets would allow for this to be minimised. The water quality data sets also only included 'monitoring' data points and excluded any data marked as 'incident'. There were no water quality monitoring points in 24 water bodies and so monitoring data average values from neighbouring bodies were assigned based on catchment location (proximity) and a visual comparison of land use. For river and lake water bodies both N and P data was gathered and used for the calculations, however, for TraC water bodies only N (as dissolved inorganic nitrogen (DIN)) was used to align with WFD parameters and reporting.

**Figure 2-2 – Water quality monitoring points by WFD water body**



### 2.3.2.5 Calculating the water body baseline load

This baseline loading was calculated at the water body scale using derived flow or volume values and annual average concentrations for TN and TP from the 1990-2018 River Water Quality Monitoring dataset, which includes WFD monitoring sites. As a water body average represents a generalised baseline rather than an asset specific baseline, the load contribution for each asset was expressed as a percentage increase from the baseline to give a better indication of the relative change in total load at the water body scale from each asset. Expressing asset load as a proportion of the averaged baseline could misrepresent its influence on the water body baseline, particularly those assets located far upstream or downstream within a water body.

### 2.3.3 Discharge criteria data processing

In order to estimate the contribution of nitrate (N) and soluble phosphorus (P) from each discharge to the receiving water body an average baseline load for the water body itself was calculated using all active water quality monitoring points within a given water body.

The calculated discharge load used measured water quality data where available, permit limits where no measured concentrations were available and was assigned an assumed load based on data for assets with a similar PE and treatment level (using the Environment

Agency Consented Discharges<sup>12</sup>). This approach assumes that the assets are in good working order and maintained regularly and, therefore, operate in compliance with permit conditions or best practise.

The calculation of both water body baseline and discharge load values followed a simple mass balance calculation of flow or volume multiplied by concentration to give mass of TN or TP. The mass balance equation is not a nutrient balance model and does not account for environmental fate pathways. The load is calculated as an average snapshot in time based on available data. It is noted that this accounts for peaks and troughs in the data, including seasonal variation (through the average) but does not display maximum loading values, which will be higher.

The calculations of baseline loading were carried out by water body type (river, lake and transitional and coastal (TraC) to account for underlying differences in the load calculation. The discharge loading from each asset was then used to calculate the percentage increase from baseline caused by the asset to existing TN and TP load in the water body. The percentage increase from additional load from the wastewater discharges were also calculated at the water body scale and then proportioned to the input from an individual asset.

### 2.3.3.1 Assigning assets to receiving water bodies

Each wastewater asset was assigned one of the categories in Table 1-1 (WwTW, domestic consents and trade discharges) and a unique identifier assigned. To carry out loading calculations, assets were linked to receiving WFD water bodies based on asset location or discharge location (which may be different). This processing also linked the wastewater source term to the relevant receptor sensitivity criteria for the receiving water body which is used for the impact assessment.

For WwTWs where discharge location was not available, the asset location was used.<sup>13</sup> Coastal outfalls are represented within the relevant transitional or coastal water body.

As the exact location of septic tanks was not available to the project and only a count of the number of assets per pathway risk area was provided by NIW, the loading calculations were based on the number of septic tanks within soil and proximity zones defined within each water body (see Section 2.3.3.3).

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<sup>12</sup> Environment Agency. Consented Discharges to Controlled Waters with Conditions. Website – Available at: <https://www.data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions1> [Accessed 12/09/25].

<sup>13</sup> It is assumed that this is the case, as although we note that the waste may be tankered off site and therefore not discharged into the nearest water body, no information on this has been provided.

For the intermittent discharges associated with wastewater treatment works, discharge point coordinates were provided for 40 of 566 CSOs with the remaining CSO locations noted as unavailable and the asset coordinates provided instead<sup>14</sup>. A further 1,301 CSO locations was also provided by NIW, however, not all were associated with a WwTW. The asset CARID was used identify intermittent discharge CSOs from WwTW in this larger list. Duplicates between the two lists were removed from the dataset. It is understood that the duplicates occurred due to the two lists of CSOs being from different data sources within NIW.

The final combined list of 1,319 CSOs linked to WwTWs with location information for the discharge or the asset have been used in the assessment to represent these intermittent discharges. Counts of intermittent discharges within 10km upstream of each asset were calculated in GIS and assigned a risk score on this basis (see Table 3-1).

### 2.3.3.2 Calculating wastewater discharge loads

#### WwTW load calculations

Flow rates taken as dry weather flow (DWF) and N and P concentrations for discharges were obtained in one of the following ways:

- Where time series flow and/or concentration data were provided by NIW for the asset this was averaged (mean) across the dataset.
- If only permit conditions were provided (for DWF, N and P) then the permitted conditions were used.
- If no measured data or permit conditions were available, then assumed values based on known data for other works of similar population equivalent (PE) size were used (Table 2-2). This information was taken from the Environment Agency (England) Consented Discharges to Controlled Waters database.<sup>15</sup>

NIW have three types of discharge consents (permits):

- Numeric consents (a specific numerical permit value is available for water quality and flow parameters) are available for works with >250 PE;
- Descriptive consents (a numerically non-specific permit which is complied with if the downstream watercourse is not experiencing adverse effects from the discharge) are available for works with <250 PE; and

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<sup>14</sup> It is understood that NIW is publishing additional locations but the data presented is what was provided at the time of writing.

<sup>15</sup> Environment Agency. Consented Discharges to Controlled Waters with Conditions. Website – Available at: <https://www.data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions1> [Accessed 12/09/25].

- Collection System consents (only applies to septic tanks).

For the majority of sites that operate under a numeric consent, no condition was stipulated for P species or directly for TN. Therefore, for these sites and for sites operated under non-numeric permits (no water quality conditions and / or DWF values were not provided), the values for concentrations and flows set out in Table 2-4 were used and represent an average (mean) of concentrations and DWFs across a range of assets sizes (up to 20,000 PE) taken from the Environment Agency Consented Discharges to Controlled Waters database.<sup>16</sup>

**Table 2-4 – Assumed Phosphate and Nitrate concentrations and DWF values for WwTW**

	Nitrate (mg/l)	Phosphate mg/l	DWF m <sup>3</sup> /day
Assumed Value (Mean)	35	12	600
Minimum value	1	0.04	21
Maximum value	400	350	5984

The potential for the actual values for nitrate, phosphate and DWF to vary above or below these assumed values may be significant especially where information on the size of the works is unknown. Therefore, the values presented in Table 2-4 may under-represent larger works and over represent smaller works.

### **Trade effluent discharges**

Depending on the activity, treated trade effluent discharges which discharge directly to a watercourse under permit conditions, can also provide high nutrient point source emissions. Dairy, meat processing (abattoir), fish farms and landfill sectors produce wastewater or leachate with a high nutrient load, although the majority of landfill leachate is likely to go to a WwTWs for treatment prior to discharge.

To calculate the load emitted from these activities, the Compliance, Monitoring and Invoicing of Industrial Consents (CMIIC) for trade discharges were used. These were filtered to include only active consents and industry types shown in Table 2-5 which are highly likely

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<sup>16</sup> Environment Agency. Consented Discharges to Controlled Waters with Conditions. Website – Available at: <https://www.data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions1> [Accessed 12/09/25].

to have a high nutrient load. Other industry types were excluded from the discharge risk assessment. The CMIIIC dataset did not include permit limits for TN, TP or DWF. To fill these gaps in information for flows and permit limits the Environment Agency (England) Consented Discharges to Controlled Waters database and published literature were interrogated for representative values. In carrying out this data gap filling exercise the following assumptions made:

- More conservative higher permit limits or measured data (where available) was selected;
- Consented discharges data is an average across all data points.
- Only data points from 2010 onwards are used but revoked and/or revised permits are included.
- Where an average DWF is not available the maximum data point for the industry type is used.
- Where flows are assumed the values are taken from similar trade types.
- Where concentrations are assumed the values are taken from UK legislation<sup>17</sup>:
  - Total nitrogen (N): must be  $\leq 10$  mg/L in treated effluent—unless a site-specific condition applies; and
  - Total phosphorus (P): must be  $\leq 0.25$  mg/L—unless a different value is set in the plant's environmental permit.
- Private sewage effluent reported as residential is considered as 'not water company'.
- Assumed that commercial sewage is twice as risky as domestic sewage effluent.
- Consented Discharges section Food processing types linked to higher nutrient effluents were:
  - Abattoir – Livestock slaughter, processing and animal products,
  - Creamery – Assumed to be dairy operations and production,
  - Apple processing – assumed process water.
  - Fish Farm - Assume pond based aquaculture and discharges used for irrigation.
- Aquaculture - general values used as can vary between species being farmed.
- Landfill leachate effluent TN is converted from ammonium from UK data.
- Landfill leachate effluent TP is estimated as approximately a third of N in landfill leachate.

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<sup>17</sup> Part 7, on Nutrient Pollution Standards, of the Levelling-up and Regeneration Act 2023. Available at <https://www.legislation.gov.uk/ukpga/2023/55/contents> [Accessed 17/10/2025].

**Table 2-5 – Active CMIIC trade discharges impact water quality with nutrients**

Trade discharge type	Assumed permit limits (N, mg/l)*	Assumed permit limits (P, mg/l)*	Assumed daily flow (m <sup>3</sup> /day)
Fertiliser manufacturing <sup>18</sup>	10	0.25	3000**
Food processing: Abattoir	15 <sup>19</sup>	5 <sup>20</sup>	500 <sup>21</sup>
Food processing: Apple processor <sup>22</sup>	10	0.25	3000**
Food processing: Creamery <sup>23</sup>	15	2	100 <sup>24</sup>
Food processing: Fish farm <sup>25</sup>	4.5	0.16	3524 <sup>26</sup>
Food processing: Fish hatchery <sup>27</sup>	1.67	0.32	2200 <sup>28</sup>
Food processing: Shellfish fishery	10 <sup>29</sup>	0.055 <sup>30</sup>	2200 <sup>31</sup>
Paper manufacturing <sup>32</sup>	10	0.25	3000**
Waste disposal: Non-hazardous domestic waste <sup>33</sup>	130	10	132

\* Total nitrogen (N): must be ≤ 10 mg/L in treated effluent—unless a site-specific condition applies

Total phosphorus (P): must be ≤ 0.25 mg/L—unless a different value is set in the plant’s environmental permit

\*\* Flow rate assumed from similar consented trade types - Consented Discharges to Controlled Water with Conditions database – Manufacturing

<sup>18</sup> Part 7 Nutrient pollution standards of the section 96A of the Water Industry Act 1991 Available at <https://www.legislation.gov.uk/ukpga/1991/56> [Accessed 17/10/2025]

<sup>19</sup> Republic of Ireland Pollutant Release and Transfer Register (PRTR) facilities 2007-2023. Relevant individual consent data collated using Licence and Enforcement Access Portal (LEAP).

<sup>20</sup> Part 7 Nutrient pollution standards of the section 96A of the Water Industry Act 1991 Available at <https://www.legislation.gov.uk/ukpga/1991/56> [Accessed 17/10/2025]

<sup>21</sup> Lopez-Maldonado, E and Castro-Riquelme, C,L. (2025). Management of Wastewater from Abattoirs: Sustainable Practices for a Cleaner Environment. pp 127–151

<sup>22</sup> Environment Agency. Consented Discharges to Controlled Waters with Conditions. Website – Available at: <https://www.data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions1> [Accessed 12/09/25].

<sup>23</sup> Republic of Ireland Pollutant Release and Transfer Register (PRTR) facilities 2007-2023. Relevant individual consent data collated using Licence and Enforcement Access Portal (LEAP).

<sup>24</sup> Consented Discharges to Controlled Water with Conditions database - Making of Food Products/Dairy

<sup>25</sup> Bowley, D,G and Allan, G, L. (no date). Nutrients in Pond Based Aquaculture Discharge Water Used for Irrigation. NSW Department of Primary Industries, Port Stephens Fisheries Institute.

<sup>26</sup> Consented Discharges to Controlled Water with Conditions database - Agriculture - Fish Farming - Not Water Company

<sup>27</sup> Rensel, J. E. (2013). Quilcene Bay Shellfish Hatchery Discharge Study

<sup>28</sup> Consented Discharges to Controlled Water with Conditions database - Fish + Aquaculture/Fish Farm/Cress Farm

<sup>29</sup> CMIIC Database

<sup>30</sup> Consented Discharges to Controlled Water with Conditions database - Fish + Aquaculture/Fish Farm/Cress Farm

<sup>31</sup> Consented Discharges to Controlled Water with Conditions database - Fish + Aquaculture/Fish Farm/Cress Farm

<sup>32</sup> Environment Agency. Consented Discharges to Controlled Waters with Conditions. Website – Available at: <https://www.data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions1> [Accessed 12/09/25].

<sup>33</sup> CMIIC Database

## **Domestic consents**

The domestic consents database provided by the NIEA (separately to the NIEA septic tank data) formed the basis of the assessment of small non-septic tank discharges from single dwellings. As no permit information was provided, values for discharge volume and nitrate and soluble P concentrations were estimated based on a review of the NI Domestic Consents Public Register.

Domestic consents located at a range of distances from protected sites at multiple locations across NI were examined to establish a range of suitable values for discharge. Of the individual consents examined, a discharge value of 1m<sup>3</sup> per day was most often specified, or no specific condition for a discharge limit. A blanket assumption of 1m<sup>3</sup> per day for discharge from domestic consents has, therefore, been made. Values for N of 72.90 mg/l and a P 9.7 mg/l have been used based on values derived from Natural England's Nutrient Neutrality calculator for 'package treatment plants'<sup>34</sup>.

## **Septic tanks**

The large number of septic tanks in NI is well known with 17% of the population estimated to be served with 104,512 sites registered by NIEA in 2009. Their proliferation has been raised as an issue in terms of the risk of pollution to the water environment given the lack of information around their management and integrity.<sup>35</sup> Septic tank systems in the Republic of Ireland have been reported as having an overflow that discharges directly to surface water where the drainage blanket is constructed into less permeable soils (e.g. gley soils), as this avoids the system backing up during periods of high soil saturation.<sup>36</sup> Therefore the pathway for N and P from septic tank discharges could enter surface water directly as well as through a groundwater pathway.

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<sup>34</sup> Natural England, 2024. *Tools and resources for calculating nutrient neutrality*. Available at <https://www.gov.uk/government/collections/tools-and-resources-for-calculating-nutrient-neutrality> [Accessed October 2025].

<sup>35</sup> Northern Ireland Assembly, 2009. An investigation into the use of Septic Tanks in Northern Ireland. Available at: [https://archive.niassembly.gov.uk/regional/2007mandate/research/pdf/Septic\\_tank\\_enquiry\\_Submission.pdf](https://archive.niassembly.gov.uk/regional/2007mandate/research/pdf/Septic_tank_enquiry_Submission.pdf) [Accessed 18/10/2025].

<sup>36</sup> Donohue, S., 2014. The Application of Geophysics to a Number of Threats to Irish Soil. Report 126 produced by UCD and Queens University Belfast for the Environmental Protection Agency under the STRIVE Programme. Available at [https://www.epa.ie/publications/research/land-use-soils-and-transport/STRIVE\\_126\\_web.pdf](https://www.epa.ie/publications/research/land-use-soils-and-transport/STRIVE_126_web.pdf) [Accessed 18/10/2025].

### **2.3.3.3 Loading terms and attenuation**

A review of the literature for both NI and England was undertaken to identify what load value could be used and any information on attenuation along pathway and is summarised in Table 2-6.

**Table 2-6 – Septic tank and package treatment works discharge characteristics literature review**

Type of works	Head per household	Volume discharge	Final effluent P	Final effluent N	P load*	N load*	Evidence for attenuation in soils	Source
Septic Tank	2.4	120 l/person /day	11.6 (mg TP/l)	96.3 (mg TN/l)	2.9 kg/yr	24.3 kg/yr		Natural England <sup>37</sup>
Package Treatment plant	2.4	120 l/person /day	9.70 (mg/l TP)	72.90 (mg/l TN)	2.8 kg/yr	18.4 kg/yr		Natural England
Septic Tank		200 l/person/day	10 (mg/l P) (median - 49 studies)		2.9 kg/yr		Removal rate of TP between 6 to 25%.	Natural England <sup>38</sup>
Septic Tank		200 l/person/day	15.8 (PO <sub>4</sub> as P mg/l)	104 (NH <sub>4</sub> mg/l)	4.6 kg/yr	23.6 kg/yr		Environment Agency <sup>39</sup>
Package Treatment plant			10.5 (PO <sub>4</sub> as P mg/l)	84 (NH <sub>4</sub> mg/l)	3.1 kg/yr	19.1 kg/yr		Environment Agency
Septic Tank			8.9-25 PO <sub>2</sub> <sup>4</sup> mg/l		0.8-2.2 kg/yr		Removal to 0.001 mg P/l	River Nar (England) <sup>40</sup>
Septic Tank					0.3-0.88 kg/ person/year (1.2-3.5 kg/yr)		Wetter soils provide less attenuation	Septic tank discharges - NI <sup>41</sup>
Septic Tank	4				1.7 kg / household / year			SLAM <sup>42</sup>
Septic Tank							0.77 kg/yr N at 1 m depth in U/S zone. Good attenuation of TP. Permeable soils provide much less attenuation.	Ireland – septic tank percolation tests <sup>43</sup>

\*Values in red are calculated based on population of 2.4 and flow of 200 l/day and the reported concentration of P or N

<sup>37</sup> Natural England, 2024. *Tools and resources for calculating nutrient neutrality*. Available at <https://www.gov.uk/government/collections/tools-and-resources-for-calculating-nutrient-neutrality> [Accessed October 2025].

<sup>38</sup> Natural England, 2015. *A review of the effectiveness of different on-site wastewater treatment systems and their management to reduce phosphorus pollution*. Natural England Commissioned Report NECR179. Available at <https://publications.naturalengland.org.uk/publication/6636267020222464> [Accessed October 2025].

<sup>39</sup> Environment Agency, 2009. *Groundwater Vulnerability Activity Look-up Tables in Groundwater Vulnerability from Sewage Effluent Discharges to Infiltration Systems*. Report produced by Entec UK Ltd. for the Environment Agency.

<sup>40</sup> Speed, C. D., Fretwell, B.A., Davison, P S. 2018. *The role of septic tanks in the dissolved phosphorus budget of the Upper River Nar and possible implications for other catchments*. Quarterly Journal of Engineering Geology and Hydrogeology. Vol. 52 2019 pp. 23–37. Available at <https://doi.org/10.1144/qjegh2018-004>.

<sup>41</sup> Barry, C.D., McRoberts, C, 2016. *Septic tank wastewater discharges in two contrasting catchments: Identification, quantification and distribution of tracers to assess contribution to phosphorus inputs*. Unpublished Final Project report to the Department of Agriculture Environment and Rural Affairs.

<sup>42</sup> ABFI, 2022. *Overview of Source Load Apportionment Model (SLAM) Draft Final Report*.

<sup>43</sup> L.W. Gill, N. O'Lunaigh, P.M. Johnston, B.D.R. Misstear, C. O'Suilleabhain, 2009. *Nutrient loading on subsoils from on-site wastewater effluent, comparing septic tank and secondary treatment systems*. Water Research, Volume 43, Issue 10, 2009, Pages 2739-2749. ISSN 0043-1354. Available at <https://doi.org/10.1016/j.watres.2009.03.024>

The screened septic tank effluent discharging to a functioning drainage blanket should percolate through the blanket at a rate which allows microbial degradation of pathogens and chemicals and filtering / sorption of further matter from the effluent. P is mostly sorbed to the sediment particles in the drainage blanket and unsaturated soils and rock beneath it.

N which is mainly present as ammonium in the effluent, is oxidised to nitrate and percolates to the water table where it might discharge to surface water via shallow sub-surface flow or deeper aquifer pathways to emerge as baseflow to nearby water courses. However, a proportion of this N will not reach surface water in the same year and could remain in the aquifer. The proportion of N which does reach surface water via groundwater can be estimated from the catchment baseflow index (BFI). Reported BFI values for NI stations are typically between 20 to 50% of flow per year.<sup>44</sup>

A review of nitrate concentrations in groundwater in NI by the BGS suggested that septic tanks have a lower impact compared to slurry spreading and that lower groundwater nitrate in NI compared to England and Wales may be linked to less intensive arable agriculture and denitrification in low permeability soils.<sup>45,46</sup> The level of denitrification in gley (or gleyed) and peat soils is not reported by the BGS. Low permeability soil types are present over nearly 80% of NI (54% poorly drained gleyed and 24% peaty).<sup>47</sup>

Where a septic tank discharges to a drainage blanket in low permeability soils, there is a high risk of overland flow or the use of overflow pipes to avoid localised flooding by bypassing the drainage blanket to discharge to surface water. In such cases, the attenuation of N and P is likely to be small with the majority of load reaching the water course.

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<sup>44</sup> National River Flow Archive webpage. Information on the UK Gauging Station Network. Available at: <https://nrfa.ceh.ac.uk/data/search> [Accessed 18/10/2025].

<sup>45</sup> MACDONALD, A M and MCCONVEY P. 2003. *Nitrate concentrations in groundwater in Northern Ireland*. British Geological Survey Commissioned Report, CR/03/051. 28pp. Available at <https://nora.nerc.ac.uk/id/eprint/501505/1/CR03051N.pdf> [Accessed 18/10/2025]

<sup>46</sup> E. Clagnan, S.A. Rolfe, S.F. Thornton, D. Krol, K.G. Richards, G. Lanigan, P. Tuohy, O. Fenton, *Nitrogen transformation processes and gaseous emissions from a humic gley soil at two water filled pore spaces*, Soil and Tillage Research, Volume 198, 2020, 104543, ISSN 0167-1987, Available at <https://doi.org/10.1016/j.still.2019.104543>. [Accessed 18/10/2025].

<sup>47</sup> Crawford, J and Rawlins, B. 2007. *The Soils of Northern Ireland and their Environmental Significance*. TELLUS Conference Presentation 17-18 October 2007. Available at: <https://www2.bgs.ac.uk/gsni/tellus/conference/pdf/2.1a.CrawfordJordan%20-%20Tellus%20Conference.pdf> [Accessed 04/12/2025].

Where soils are more permeable the attenuation of P is likely to be high compared to N which will percolate to groundwater, a proportion of which eventually reaches surface water in baseflow.

### Data processing

Based on the literature values shown in Table 2-6, the concentrations for N of 96.30 mg/l and for P of 11.60 mg/l were multiplied by an assumed daily flow of 1 m<sup>3</sup> per day to calculate a total load of nitrate and soluble P for each septic tank. These values are derived from Natural England's Nutrient Neutrality calculator.<sup>48</sup> The conceptual understanding of pathway processes affecting septic tank discharges suggested that the level of attenuation of N and P depends on soil type and proximity to surface water.

The database behind the public register of septic tank locations for NI was not readily available to the project due to the age of the dataset and format in which it is held. NIEA provided a septic tank database containing 113,115 records but with inconsistent location information making it unusable within the project timescale. Therefore, it was decided that the dataset held by NIW on registered septic tanks for which they provide an annual desludging service was likely to be more up to date, representative of a wide area of the region (with over 161,000 sites registered) and already digitised. NIW note that the list is limited to those septic tanks which are safely accessible by NIW tankers, but the number and spatial distribution of registered locations provided much-improved approach compared to other approaches (e.g. making high level estimates of septic tank numbers based on population not served by mains sewer). Unfortunately, the location of registered septic tanks in this NIW dataset could not be shared with the OEP due to the inclusion of address data. A compromise was reached with a spatial dataset representing pathway risk developed and provided to NIW so that they could provide a count of septic tank locations in different risk areas. The pathway risk map was based on the following conceptual understanding of nutrient surface and sub-surface pathway processes in relation to soils and proximity to watercourse:

- Gley soils are unlikely to significantly attenuate P or N and all of the emitted load will reach water courses / lakes.

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<sup>48</sup> Natural England, 2024. *Tools and resources for calculating nutrient neutrality*. Available at <https://www.gov.uk/government/collections/tools-and-resources-for-calculating-nutrient-neutrality> [Accessed October 2025].

- For all other soil types, locations within 80 m of a water course or lake would pose a higher risk of P reaching the water body<sup>49</sup>. Sites located over 80 m away from a water course were assumed to pose a low risk of P or N reaching the water body.
- As nitrate is mobile in oxidizing conditions (noting that gley soils with anaerobic conditions may provide some attenuation) it was assumed that all N would eventually reach surface water either through direct discharge or sub-surface flow paths.

This conceptual model for the pathway for N and P transport was used to divide up each water body on the basis of water body proximity (an 80 m buffer) and soil type. NIW then provided a count of the septic tanks on their register within each of these zones.

The calculated load was adjusted on the basis of the pathway risk and the count of septic tank locations to identify the likely load reaching water courses and lakes at the water body scale (Table 2-7). For N these values assume that all emitted N will reach the surface water body either through overland flow, subsurface flow or via groundwater baseflow contributions. However, this does not account for any denitrification (reduction of N in soils), the lag time or residence time for N in groundwater and the fact that not all groundwater is discharged to surface water as baseflow. Baseflow index values, allocated based on values reported for flow gauging stations (or proxy values), were used to adjust the N and P load reaching surface water courses via shallow sub-surface flow.

The concentration values used in the model are towards the centre of the range reported for P and N and that the attenuation of P is typically reported to be very good in soils, although this is lower in saturated soils (such as gley soils).

**Table 2-7 – Septic tank discharge concentrations and attenuation factors used**

Septic tank effluent pathway to water body from drainage blanket	N (mg/l)	P (mg/l)	Flow rate	% N reaching water course	% P reaching water course
Non-gley soil outside of 80m river buffer	48.2	0	1 m <sup>3</sup> /d	50%	0%

<sup>49</sup> Speed, C. D., Fretwell, B.A., Davison, P S. 2018. *The role of septic tanks in the dissolved phosphorus budget of the Upper River Nar and possible implications for other catchments*. Quarterly Journal of Engineering Geology and Hydrogeology. Vol. 52 2019 pp. 23–37. Available at <https://doi.org/10.1144/qjegh2018-004>

Septic tank effluent pathway to water body from drainage blanket	N (mg/l)	P (mg/l)	Flow rate	% N reaching water course	% P reaching water course
Gley outside of 80m river buffer	72.2	2.9	1 m <sup>3</sup> /d	75%	25%
Gley inside of 80m river buffer	96.3	11.6	1 m <sup>3</sup> /d	100%	100%
Non-gley inside of 80m river buffer	96.3	8.7	1 m <sup>3</sup> /d	100%	75%
Non-gley inside Lake and river 80m buffer	96.3	8.7	1 m <sup>3</sup> /d	100%	75%
Gley inside lake 80m buffer	96.3	11.6	1 m <sup>3</sup> /d	100%	100%
Non-gley inside lake 80m buffer	96.3	8.7	1 m <sup>3</sup> /d	100%	75%
Gley inside Lake and river 80m buffer	96.3	11.6	1 m <sup>3</sup> /d	100%	100%

### 2.3.3.4 FacFuture Scenarios

Three scenarios were incorporated into the discharge loading calculations to quantify (at a high level) the future risk of nutrient pollution adjusted for:

- Climate change (less dilution);
- Population growth (higher loading); and
- Climate change and population growth combined.

#### Climate change data

Climate change impacts to river flow were modelled using data from the UK CEH Enhanced Future Flows and Groundwater (eFLaG), which simulated river flow at nine NI NRFA gauging stations with a variety of climatic models. For the purposes of modelling a worst-case low flow scenario, model GR6J was selected, and from that RCM1 was used, in light

of being most likely to provide extreme low flow values<sup>50</sup>. A Q50 value was calculated from this simulated data for 1982-2080, and the consequent loading proportion from the source calculated. For water bodies without a simulated flow, a combination of the nearest eFLaG gauging station, and water body similarity, was used to select the best fit eFLaG data.

The climate change impacts are modelled assuming a reduction in river flow, or lake volume, and therefore dilution, due to reduced rainfall. It is worth noting that the incorporation of any drought plan or other climate change related measures into the load calculation for the asset discharges was discussed with NIW. However, due to the complexity of these measures and their individual nature, it was agreed to assume no change to the asset discharges. It is acknowledged, therefore, that the risk posed from discharge loadings during climate change scenarios is higher than would be the case if these measures were represented.

### **Population growth**

Population growth has been estimated by identifying the relevant population projection by Local Government District using the 2018 sub-national population projections by the Northern Ireland Statistics and Research Agency (NISRA)<sup>51</sup>. This detailed population growth as a percentage for each council area for 2018-2028 (Table 2-8). Assets were assigned to the Local Government District (LGD) they are located in and then the asset discharge concentration was adjusted by the relevant percentage increase or decrease and the loading calculations run using this updated value. Population growth factors have been applied to all assets in the model, with the exception of septic tanks as the anonymised locations do not allow a LGD population factor to be accurately assigned.

**Table 2-8 – Population Growth by NI Local Government District**

<b>Council Area</b>	<b>Population Growth (%)</b>
Antrim and Newtownabbey	2.9
Ards and North Down	2.5

<sup>50</sup> Hannaford, J. et. al., (2023). The enhanced future Flows and Groundwater dataset: development and evaluation of nationally consistent hydrological projections based on UKCP18. *Earth System Science Data*. 15, 2391–2415. Available at: <https://doi.org/10.5194/essd-15-2391-2023> (Accessed 03/04/2025).

<sup>51</sup> Northern Ireland Statistics and Research Agency (2020). 2028-Based population projections for areas within Northern Ireland - summary. *Northern Ireland Statistics and Research Agency*. Available at: <https://www.nisra.gov.uk/files/nisra/publications/SNPP18-Summary.pdf> (Accessed 06/01/2026).

Council Area	Population Growth (%)
Armagh City, Banbridge and Craigavon	8.1
Belfast	1.3
Causeway Coast and Glens	0.7
Derry City and Strabane	-0.2
Fermanagh and Omagh	2.5
Lisburn and Castlereagh	9.5
Mid and East Antrim	1.9
Mid Ulster	7
Newry, Mourne and Down	5.4

### 2.3.3.5 Summary of discharge criteria data

Wastewater assets were assigned a unique identifier and a group category for asset type. Load values from asset types has been calculated slightly differently based on receiving water body type (river, lake or TraC). Assumptions have been made around flows and concentrations in discharges where information is not available, using literature values.

The information for the risk model for different asset types has been extracted as follows:

- Load values for N and P, age of asset, compliance information (if available), treatment in place, population served, and permit information were assigned to each WwTWs.
- Load values for N and P, permit conditions (assumed flow and N and P where not available) for trade effluent and domestic consents (assumed to be package treatment works discharging to surface water).
- Septic tank locations were grouped depending on discharge location relative to receiving water body and presence or absence of gley soils to estimate attenuation before reaching surface water. Load values for N and P (assumed values) were calculated at the “attenuation zone” scale, adjusted for attenuation, and then aggregated at the water body level. The split of the emitted load which is likely to reach surface water is calculated using the BFI for the catchment (or a proxy value).

Summed discharge load (calculated from existing or assumed flow and N and P concentration values) has been compared to instream baseline load (calculated from flow and average concentrations) at the water body scale.

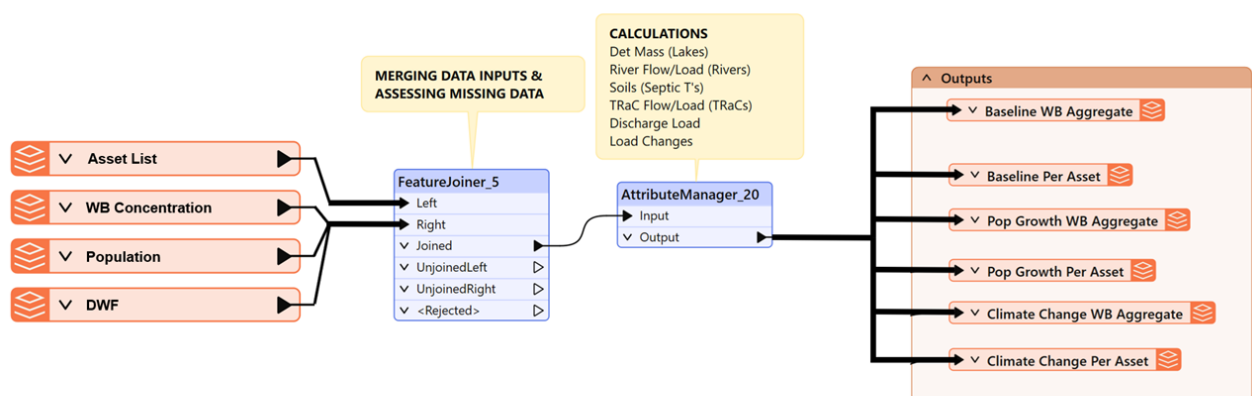
Climate change scenarios are applied through decreasing the dilution available in receiving water courses and population growth to 2047 is represented through increased population and associated load. As climate change scenarios are considered unlikely to affect trade discharges or septic tanks the climate change scenario is only applied here to WwTWs.

### 2.3.3.6 Loading calculations in FME

Due to the number and complexity of the datasets for the loading calculations, Feature Manipulation Engine (FME) software was used to perform the mass balance calculations. FME is a standard ETL (Extract – Transform – Load) desktop application used to conduct spatial and data analytics and enabling users to automate and manipulate data by building visual workbenches that can be easily updated and annotated throughout the course of a project.

FME was chosen for this work as it allowed quick inspection and testing of the model input data under various conditions. The tool was also used to check results and update the data where gaps and inaccuracies were easily identified. As FME was the software used to speed up the generation of the input data for the model, the scripts were checked by testing the accuracy of the outputs against known values and spot checking the outputs both on an asset and water body scale.

**Figure 2-3 – Loading calculations overview of script logic**



The FME data transformation workflow consisted of the following 'building blocks':

- **Readers** which input from multiple data sources and data types (csv, shp, gdb etc.).

- **Transformers** to manipulate, transform and analyse the data as required for the mass balance.
- **Writers** to output the data in a format which could then be read in by the Risk Assessment Model (described in Section 3).

### 2.3.4 Receptor sensitivity criteria data

The sensitivity of all water bodies in the assessment was determined based on WFD surface water body ecological status, the presence of an UWWTD sensitive site, protected site condition (where the Habitats Site was water dependant) and the presence of ecosystems which are likely to be impacted by nutrient pollution.

The datasets used in the receptor sensitivity assessment were assigned at the water body level using unique WFD water body codes linking the corresponding sensitivity criteria information at the body level.

#### 2.3.4.1 WFD water body sensitivity

Published (Cycle 2, 2021) WFD Ecological Status (Overall) and the current status for P (river water bodies) and N (for lakes and TraCs the relevant species is dissolved inorganic nitrogen or DIN) was extracted. Designations for each water body including UWWTD Sensitive Areas, Shellfish Water Protected Site (contains or is upstream of) were identified (Table 3-5).

#### 2.3.4.2 Protected sites sensitivity

Protected sites were first screened to exclude purely terrestrial sites with only aquatic sites or hydrologically connected sites taken forwards. For the remaining sites the designations were ordered at the water body scale, with the protected site with the highest designation (from international, national or local) used for the Risk Assessment model. The following order of highest to lowest importance was applied: SAC; RAMSAR; SPA; ASSI; Local and None. SAC has been determined to be the 'highest' designation in discussion with the OEP due to the prevalence and importance of these sites in NI.

The protected site condition was also identified with the sensitivity based on the condition from high to low sensitivity as follows:

- Destroyed, Completely
- Destroyed, Partially
- Unfavourable, Declining
- Unfavourable, No Change
- Unfavourable, Un-classified
- Favourable, Declining
- Favourable, Maintained
- Favourable, Un-classified
- Unfavourable, Recovering
- Favourable, Recovered

- Not assessed
- None.

#### 2.3.4.3 Ecological sensitivity

The ecological sensitivity of the protected sites was also determined by collating the designating features for each SAC, SPA and ASSI. Protected sites data were filtered by species and habitat type (Annexes I/II of the Habitats Directive (92/43/EEC)) for SAC and SPA, and by feature for ASSI. The species and habitats which are aquatic or hydrologically connected and/or may have a direct or indirect impact<sup>52</sup> from nutrient pollution acting on them include bird, plant, invertebrate, fish and other aquatic animals. All unique habitats and species were assigned individual weightings according to the ecological impact categories used in the model (Table 3-5) in order to rank them. Protected sites with multiple designated features are assigned the highest relevant (aquatic or hydrologically connected) weighting.

Protected sites which did not meet these criteria were excluded from the impact risk assessment and not taken forward.

#### 2.3.4.4 Summary of receptor sensitivity criteria data

Data used in the receptor sensitivity assessment (described in Section 3.3) includes WFD ecological status, water dependant protected sites at less than favourable condition (including hydrologically connected downstream sites), UWWTD sensitive areas, and protected aquatic species sensitive to nutrient pollution.

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<sup>52</sup> Note that in this context, a direct impact would refer to a disruption or termination of an ecological end point of a specific habitat or species, such as increased nutrients causing accelerated growth of macrophytes, an indirect impact would refer to an impact on an adjacent habitat or species, such as accelerated growth of macrophytes causing a community shift and subsequent disruption of a food source for a wading bird species.

## 3 Assessment of Risk and Impact

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The conceptual model and geodatabase described in the previous section was used to develop and run a risk assessment model which scores the datasets against discharge risk and receptor sensitivity criteria. The model was developed in Excel for ease of use and transparency with a dashboard created to display water body level data and results, however, the complexity of the underlying loading calculations meant that an FME tool was required to link together successive calculations and ensure outputs could be re-run and tested easily. This section sets out the design of the risk model and scoring criteria.

### 3.1 Risk model design

The risk model design is based upon methods which have been successfully utilised across the water sector in the UK, to identify and quantify risks for aspects such as raw water transfers (Northumbrian Water Group (2020-2025), Anglian Water (2022)), risks from invasive non-native species (APEM, 2021), and risks from discharges (National Highways, 2025). The assessment of risk of pollution and its impact follows the environmental impact assessment method whereby the following are identified:

- Sources, i.e. asset or discharge origin (WwTWs, trade effluent, septic tank) and annual load of N and P;
- Pathway, i.e. the route to the receptor i.e. direct discharge, via upstream discharge or tidal reach (with reversal of flow), river overtopping, or via groundwater for septic tanks with any change in impact due to pathway processes such as attenuation / dilution;
- Receptor, i.e. water body type, habitat, ecology, designated site and sensitivity to nutrient pollution.

The model then defines a risk score of likelihood that a wastewater discharge will impact a protected habitat or water body based on discharge ‘magnitude’ (load and other risk criteria such as age of works and compliance) for each sub-category of wastewater system (Figure 3-2). Receptor ‘sensitivity’ (ecology and other risk criteria) is determined via a similar method.

The rankings for discharge risk and impacts on receptors are then combined to produce an outcome based on a Risk Matrix, the risk and impact for each assessed discharge is ranked as “Negligible”, “Low”, “Medium” or “High” (Figure 3-1), calculated from weightings assigned to the determined risk criteria and receptor sensitivity criteria (Table 3-1 to Table 3-5).

**Figure 3-1 –Risk Matrix combining discharge risk and receptor sensitivity**

		Receptor Sensitivity			
		Negligible	Low	Medium	High
Discharge Magnitude	Negligible	Negligible	Negligible	Low	Medium
	Low	Negligible	Low	Low	Medium
	Medium	Low	Low	Medium	High
	High	Medium	Medium	High	High

### 3.2 Risk scoring of discharge criteria


As set out in Section 2.3.2, each wastewater asset was assessed for discharge location, treatment type, permit conditions, population, and loading both N and P, against an agreed criteria for each source type (WwTW, Table 3-1; Trade Effluents, Table 3-2; Domestic Consents Table 3-3). Septic tanks have been dealt with slightly differently (Table 3-4). The criteria were developed to fit with the data collated e.g. individual septic tank locations were not available so counts by pathway risk area incorporating attenuation and discharge proximity to watercourses were used.

Each criterion was divided into six possible risk categories allowing a numerical score of 0-5 depending on which category the asset sits in. These criteria level scores were then summed to give an overall risk score per asset and a risk magnitude ranking, from Negligible, through Low and Medium to High as shown in **Figure 3-2**. The greatest amount of data available to inform risk scoring was for WwTW resulting in a wider range of score values for this asset type compared to others.

**Figure 3-2 – Risk magnitude rankings per source**

Discharge Magnitude	Score (summed risk criteria ranking)			
	WwTW	Trade discharges	Domestic consents	Septic tanks
Negligible	0-9	0-1	0-3	0
Low	10-19	2-4	4-7	1
Medium	20-29	5-7	8-11	2-3
High	30-40	8-10	12-15	4-5

**Table 3-1 – Risk Scoring Criteria, WwTW**


Criteria	Highest risk (5)					Lowest risk (0)
<b>Discharge Location</b>	Headwater Stream	Canal or standing waters	2nd order tributary	3rd order tributary	Main river stem	Main river stem (inc TRaCs)
<b>Treatment Category</b>	No treatment	Primary treatment only	Secondary treatment	Tertiary treatment or NBS	Tertiary treatment and NBS	Additional Targeted Treatment
<b>Age of Asset</b>	>100 years old	51 - 100 old	11 -50 years old	6-10 years old	3-5 years old	New / <2 years old
<b>Permit Conditions</b>	No permit for N or P	Descriptive permit for P OR N	Numeric permit for P OR N	Descriptive permit for both N AND P	Numeric permit for both N AND P	No permit required
<b>Population Served</b>	>15,000 people	10,000-15,000 people	4,000-10,000 people	2,000-4,000 people	<2,000 people	0 people
<b>N&amp;P load contribution to water body</b>	>10% contribution from discharge	6-10% contribution from discharge	3-6% contribution from discharge	Up to 3% contribution from discharge	No change in load value with discharge	Reduction in baseline load value with discharge
<b>Associated intermittent discharges location</b>	>10 within 10km upstream	8-10 within 10km upstream	5-7 within 10km upstream	3-5 within 10km upstream	1-2 within 10km upstream	None within 10km upstream
<b>NIW WwTW Compliance</b>	5 or more fails, or non-	4 fails, or non-assessment in 6 years	3 fails, or non-assessment in 6 years	2 fails, or non-assessment in 6 years	1 fail, or non-assessment in 6 years	No fails or non-assessment in 6 years

<b>Criteria</b>	<b>Highest risk (5)</b>					<b>Lowest risk (0)</b>
	assessment in 6 years					


**Table 3-2 – Risk Scoring Criteria, Trade Effluent**

<b>Criteria</b>	<b>Highest risk (5)</b>					<b>Lowest risk (0)</b>
<b>Discharge Location</b>	Headwater Stream	Canal or standing waters	2nd order tributary	3rd order tributary	Main river stem	Main river stem (inc TRaCs)
<b>Loading (N and P)</b>	>10% contribution from discharge	6-10% contribution from discharge	3-6% contribution from discharge	Up to 3% contribution from discharge	No change in load value with discharge	Reduction in baseline load value with discharge
<b>Industry type</b>	Food Processing : Apple Processor; Private sewage: Commercial – 10 m <sup>3</sup> +	Waste Disposal Site : Non-Inert; Private sewage: Commercial - 5-10 m <sup>3</sup> and Residential – 10 m <sup>3</sup> +	Paper Manufacturing; Fertilizer Manufacturing; Private sewage: Commercial - 3-5 m <sup>3</sup> ; Private sewage: Residential - 5-10 m <sup>3</sup>	Food Processing: Fish Farm, Shell Fishery, Fish Hatchery; Private sewage: Commercial - less 3 m <sup>3</sup> and Residential - 3-5 m <sup>3</sup>	Food Processing: Abattoir and Creamery; Private sewage: Residential less 3m <sup>3</sup>	N/A

**Table 3-3 – Risk Scoring Criteria – Domestic Consents**

Criteria	Highest risk (5)					Lowest risk (0)
<b>Discharge Location</b>	Headwater Stream	Canal or standing waters	2nd order tributary	3rd order tributary	Main river stem	Main river stem (inc TRaCs)
<b>Loading (N and P)</b>	>10% increase in load value from baseline	6-10% increase in load value from baseline	3-6% increase in load value from baseline	Up to 3% increase in load value from baseline	No change in load value from baseline	Reduction in load value from baseline

**Table 3-4 – Risk Scoring Criteria – Septic Tanks**

Criteria	Highest risk (5)					Lowest risk (0)
<b>Loading (N and P)</b>	>10% increase in load value from baseline	6-10% increase in load value from baseline	3-6% increase in load value from baseline	Up to 3% increase in load value from baseline	No change in load value from baseline	Reduction in load value from baseline

Note discharge location and attenuation for septic tanks is already accounted for as part of the loading calculation (Table 2-7).

### 3.3 Receptor Sensitivity Criteria and Impact Scoring

There are seven criteria in the model used to assess the impact of assets on receptors within water bodies. These were developed to fit with the data collated e.g. the WFD Surface Water Body Status criteria are derived from status classes from less than Poor through to High Status. For Shellfish Areas and UWWTD sensitive sites the supporting dataset only described these as Yes or No or Present or Absent and so only a high or low category could be assigned (Table 3-5).

Four categories of the impact assessment are applied at the water body scale. These are WFD Surface Water Body Status, Surface Water Body P Status, UWWTD Sensitive Area presence/absence, and whether a water body is upstream of a TraC containing a shellfish water. As these categories are applied at the water body level, they apply uniformly to all assets within a given water body.

Three categories relate to the presence of protected sites (SAC, SPA, Ramsar, ASSI) within a water body. In this part of the impact assessment, asset location within a given water body relative to the location of protected sites is considered to account for the presence or absence of a pollution pathway from asset to receptor. Impact scores for assets within a given water body will vary depending on their location (upstream or downstream) relative to the protected sites within the water body they are located in.

For the protected site highest designation impact scoring, if an asset is upstream of multiple designations (e.g. if there were multiple overlapping designated sites) it is scored based on the highest water dependent designated site present. Similarly, for Lowest site condition, the lowest scoring condition score is applied where multiple site designations apply. This score is applied independent of the highest designation. For example, an asset upstream of a SAC at Unfavourable, recovering condition and an ASSI at Unfavourable, declining condition would be assigned an impact of 'five' for the SAC in the Highest Designation scoring and a score of 'four' for the Unfavourable, declining condition for the ASSI. The ecological impact weighting is also scored independently of the designation and condition weightings. Where overlapping sites are present the highest ranked ecological impact of all sites present is used for the ecology impact score.

As specific septic tank location data was not available it is not possible to assess individual septic tank impact on protected sites. Septic tanks have therefore been assessed at the water body scale rather than the asset scale which means that the protected site scores are applied at the water body scale. As all impact assessment criteria are assessed for septic tanks at the water body scale, septic tank impact scores have been used as a metric of general water body 'receptor' sensitivity. Differences in a water body impact rank and receptor sensitivity rank will be driven by asset specific location of other (non-septic tank) asset types.


Each criterion was also divided into six possible impact categories, giving a numerical score of 0-5, which could then be summed to give an overall impact score per receptor. This was

then given an impact magnitude ranking, from Negligible, through Low and Medium to High (Figure 3-3).

**Figure 3-3 – Impact magnitude ranking scores**

Impact Magnitude	Score
Negligible	0-8
Low	9-17
Medium	18-26
High	27-35

**Table 3-5 - Impact Scoring Criteria (wording used as in datasets provided)**

Criteria	Highest Impact (5)					Lowest Impact (0)
<b>WFD Surface Water Body Status</b>	Failing to achieve good / Bad / Bad potential (BEP)	Poor / Poor potential (PEP)	Moderate / Moderate potential (MEP)	Good / Good potential (GEP)	High	None reportable / No data
<b>Protected Site Designation (highest)</b>	SAC	Ramsar	SPA	ASSI	Local	None
<b>Protected site lowest condition</b>	Destroyed, Completely; Destroyed Partially	Unfavourable, Declining; Unfavourable, No Change; Unfavourable, Un-classified	Favourable, Declining; Favourable, No Change; Favourable, Un-classified	Unfavourable, Recovering	Favourable, Recovered	Not Assessed; None
<b>Shellfish Waters Protected Area</b>	Yes					No
<b>Ecological Impact</b>	Direct impacts to named habitats/species in Annex I/II	Indirect impacts to named habitats/species in Annex I/II	Direct impacts to communities only	Indirect impacts to communities only	No impacts identified	No relevant habitats or species
<b>UWWTD Sensitive Areas</b>	Present					Absent

### 3.4 Sensitivity Testing

To understand the effect of the uncertainty in the model inputs shown by the medium to low confidence in 50% of the datasets in Table 2-1, sensitivity testing of the model was completed with the aim of understanding how assumptions made for some assets and receptors influence the overall water body risk rating.

The model design already removes bias in the developed criteria (i.e. where there is more information for asset types such as WwTW when compared to septic tanks) by making each criteria equally important in the magnitude rankings through mathematical proportion.

Therefore, the magnitude of risk and impact are not sensitive to any particular criteria.

Sensitivity testing was performed in two ways:

- Loading values are a key component driving asset risk. DWF forms part of all loading values (including a flow value for septic tanks) and was reduced by 50% to test the model sensitivity to loading (rather than adjusting individual asset type discharge concentrations) (Table 3-6).
- Altering the scoring weights for discharge and receptor sensitivity criteria i.e. the numerical ranges within high, medium and low risk by reversing the scores (Table 3-7).

This was tested against the selected case studies (see Section 4.6).

**Table 3-6 – Sensitivity testing for DWF**

Criteria /dataset tested	Water body name	Water body ID	Original overall water body risk	Test overall water body risk
DWF	Faughan River (Carmoncy)	UKGBNI1NW020208259	High	Medium
	Arney River	UKGBNI1NW363604059	Low	Low
	River Lagan (Stranmillis)	UKGBNI1NE050503108	Medium	Medium

**Table 3-7 – Sensitivity testing for scoring weights**

Criteria /dataset tested	Water body name	Water body ID	Original overall water body risk	Test overall water body risk	Original receptor risk	Test receptor risk
<b>Site Designation (highest)</b>	Faughan River (Carmoney)	UKGBNI1NW020208259	High	High	High	Medium
	Arney River	UKGBNI1NW363604059	Low	Low	Medium	Medium
	River Lagan (Stranmillis)	UKGBNI1NE050503108	Medium	Medium	Medium	Medium
<b>UWWTD Sensitive Areas</b>	Faughan River (Carmoney)	UKGBNI1NW020208259	High	High	High	Medium
	Arney River	UKGBNI1NW363604059	Low	Low	Medium	Medium
	River Lagan (Stranmillis)	UKGBNI1NE050503108	Medium	Low	Medium	Low
<b>Permit Conditions</b>	Faughan River (Carmoney)	UKGBNI1NW020208259	High	High	N/A	N/A
	Arney River	UKGBNI1NW363604059	Low	Low	N/A	N/A
	River Lagan (Stranmillis)	UKGBNI1NE050503108	Medium	Medium	N/A	N/A
<b>Loading</b>	Faughan River (Carmoney)	UKGBNI1NW020208259	High	High	N/A	N/A
	Arney River	UKGBNI1NW363604059	Low	Low	N/A	N/A
	River Lagan (Stranmillis)	UKGBNI1NE050503108	Medium	Medium	N/A	N/A

The sensitivity test for the DWF flow dataset (dividing the flow value by 50%) showed some sensitivity for this parameter with the High risk scores decreasing to Medium for Faughan River (Carmony) but not for the two other catchments. This was due to the Faughan River (Carmony) having a higher number of High risk assets with a >10% contribution from discharge relative to the baseline load

The sensitivity testing for scoring weights showed some change overall, where altering the scoring for UWWTD areas slightly lowered overall risk in one instance. There was more change noted at receptor sensitivity level, though only between high and low risks.

### 3.4.1.1 Septic tanks sensitivity testing

It is noted through the testing that some datasets are more likely to give a higher weight to the overall risk score (an increased risk or impact) than others.

As septic tank asset risk is determined predominantly by the loading criteria, sensitivity testing on the discharge load from this asset type was undertaken by septic tank pathway risk area. The discharge volume and concentration values described in Table 2-7 were varied as set out in Table 3-8 to understand how sensitive the model is to these input values. Run 1 is the baseline scenario (as run in the model) and Runs 2 and 3 reduce the load to represent the lower flows and concentrations as suggested by some data sources in Table 2-6. In all cases the adjustment for losses to ground using the BFI is applied.

**Table 3-8 - Septic tank sensitivity results for overall risk**

Scenario	Description	High	Medium	Low	Negligible
Run 1	Baseline discharge concentrations for N and P and discharge volume of 1m <sup>3</sup> per day	40.1%	31.4%	27.7%	0.8%
Run 2	Baseline discharge concentrations for N and P and discharge volume of 0.5m <sup>3</sup> per day	26.7%	31.7%	40.6%	0.9%
Run 3	50% of baseline discharge concentrations for N and P and discharge volume of 0.5m <sup>3</sup> per day	12.6%	31.3%	54.9%	1.2%

The results of the sensitivity testing show that the proportion of High risk septic tanks reduces as the concentration and discharge volume decrease (and therefore load) and the proportion of Low risk septic tanks increases. The proportion of Medium risk septic tanks



remains similar between all three runs, which is an indication that a high number of septic tanks are near the High-Medium and Medium-Low thresholds. The proportion of Negligible septic tanks remains small in all runs.

It is also noted that the number of septic tanks used in the model is likely to be an underestimation. This is due to the dataset only taking into account the septic tanks which are registered with NIW and the exclusion of records for which any spatial information was not provided. Improvements in the septic tank dataset, especially in the location data, would provide increased confidence in the septic tank risk categorisation.

## 4 Results of wastewater asset risk assessment

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In this section the calculated discharge risk of pollution posed by different assets, the sensitivity scores for the receiving water bodies and protected sites and the combined overall risk of pollution at the water body and river basin scale are presented.

### 4.1 Wastewater Asset category overall pollution risks

Overall, wastewater assets, especially those serving larger populations, typically have a Low or Medium overall risk. This is likely to reflect assets predominantly being located away from sensitive areas, as the presence of a pollution pathway to sensitive areas would drive a higher impact score and higher overall risk score for a particular asset.

Septic tanks sit within the Low, Medium or High overall risk of pollution, with the majority sitting in the High risk category (Table 4-1). This probably reflects the large number and wide distribution of this asset type.

The population served by septic tanks was estimated in 2009 at 17% of the population.<sup>53</sup> Based on the number of sites reported by NIW (Table 4-1) with a reported average households of between 2.4 and 4 people (Table 2-6) the 2024 population served by septic tank may have increased to 20-30% of the population which is not insignificant. Sensitivity testing (Section 3.4) suggests that the majority of these sites would still sit in the Medium overall risk group if lower loads based on reported values were used. There is some uncertainty in the impact risk scoring for septic tanks as they are assessed at the water body scale (on the basis of their location within different pathway risk areas) rather than using individual asset locations in relation to receptors e.g. to understand if all septic tanks in a water body are located downstream of a sensitive receptor. It is difficult to understand the scale of this uncertainty or how to reduce it without septic tank site location data in relation to receptors.

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<sup>53</sup> Northern Ireland Assembly, 2009. An investigation into the use of Septic Tanks in Northern Ireland. Available at: [https://archive.niassembly.gov.uk/regional/2007mandate/research/pdf/Septic\\_tank\\_enquiry\\_Submission.pdf](https://archive.niassembly.gov.uk/regional/2007mandate/research/pdf/Septic_tank_enquiry_Submission.pdf) [Accessed 18/10/2025].

**Table 4-1 – Count of overall risk per asset category**

Wastewater Treatment Category	Count of Negligible Risk Assets	Count of Low Risk Assets	Count of Medium Risk Assets	Count of High Risk Assets	Total count by category
WwTW with Population Equivalent of over 20,000	0	15	7	2	<b>24</b>
WwTW with Population Equivalent of between 2000 and 20,000	0	43	9	6	<b>58</b>
WwTW with discharge volumes above 5 cubic metres per day (PE of less than 2000)	3	403	126	45	<b>577</b>
Discharge volumes below 5 cubic metres per day including small sewage treatment works (domestic consents)	677	9,837	824	160	<b>11,498</b>
Septic Tanks for individual dwellings	1,225	44,759	50,810	64,834	<b>161,628</b>
Industrial / Trade Discharges	4	159	66	44	<b>273</b>
<b>Total count by risk</b>	<b>1,909</b>	<b>55,201</b>	<b>51,835</b>	<b>65,089</b>	<b>174,034</b>

As shown in Figure 4-1 septic tanks and trade effluent have the highest proportion of sites with a high-risk score in terms of their combined discharge magnitude and impact on the environment. The larger WwTWs (PE of above 20,000) are scored with a low risk of an

impact, as are smaller sites below 5 m<sup>3</sup>/day which are assumed to connect to package treatment works<sup>54</sup>.

The reasons for this distribution of risks scores for septic tanks are likely to be caused by the large number of sites distributed over a wide area (so are present in all catchments), whilst there are a smaller number of large WwTWs with a much higher level of treatment. As noted previously sensitivity testing confirms that a High to Medium risk level, which includes attenuation for losses to ground for N (by applying the BFI), is likely to be representative.

Figures 4-2 to Figure 4-7 spatially present the overall water body risk by asset type. Septic tanks and domestic consents are present in most water bodies throughout NI, whereas there are many water bodies without trade discharges, WO WwTW (<2,000 PE and >5m<sup>3</sup>), UWWTR WwTW >2,000 PE and <5m<sup>3</sup> and UWWTR WwTW <20,000 PE, as shown by “no risk”. For septic tanks the majority of water bodies have an overall high risk, spread throughout NI, whereas for other asset types there tend to be “hot spots” of high risk water bodies, particularly in the North-Western river basin, as discussed further in Section 4.3.

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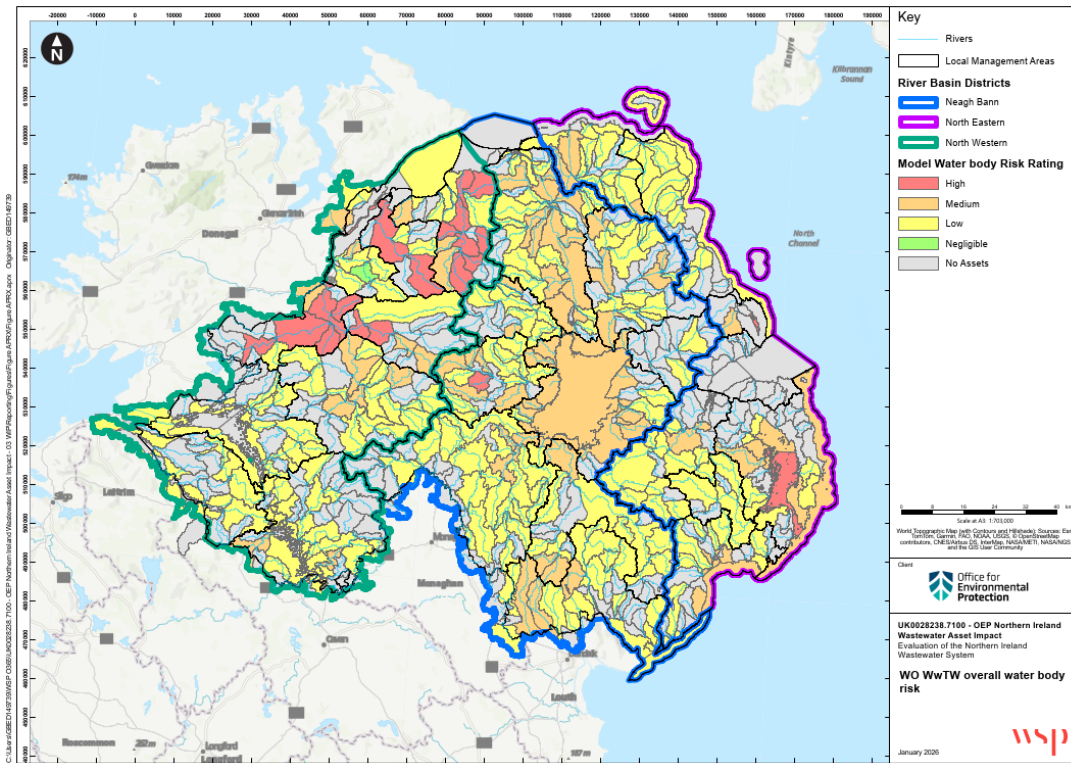
<sup>54</sup> This assumes that the asset is performing at its consent conditions and not above or below.

**Figure 4-1 - Comparison of wastewater asset overall risk scores (septic tank data presented for pathway risk areas not assets)**

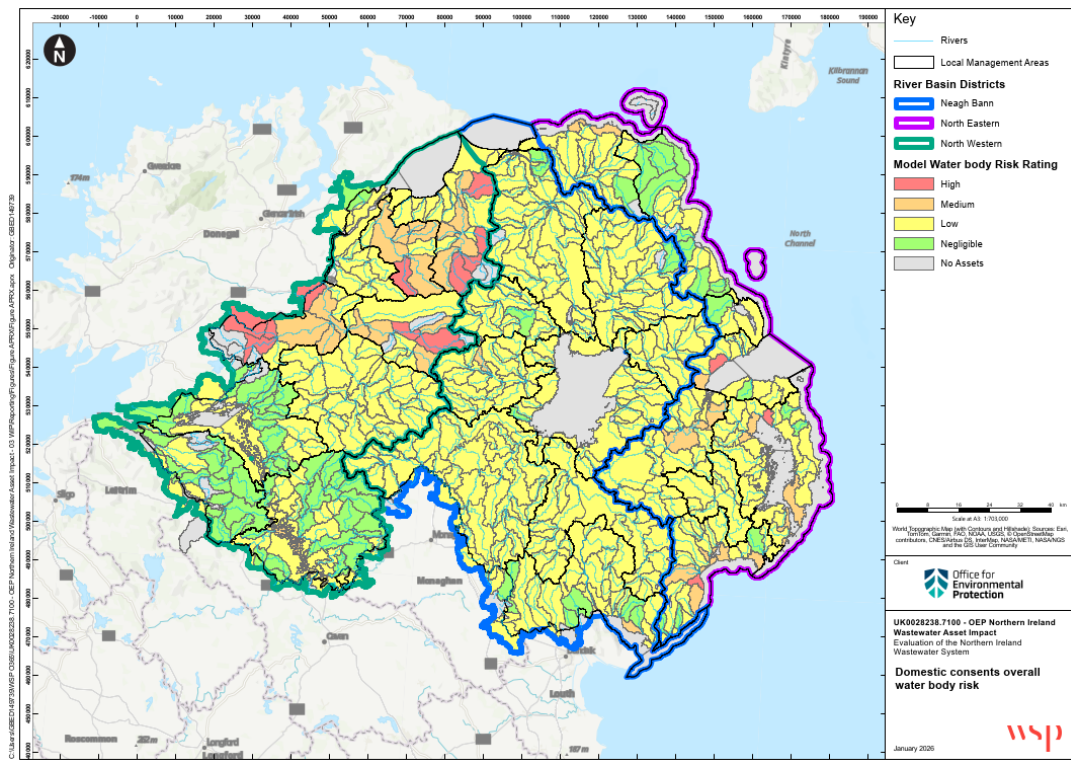




**Figure 4-4 - WO WwTW <2,000 PE and >5m3 asset overall risk by water body**



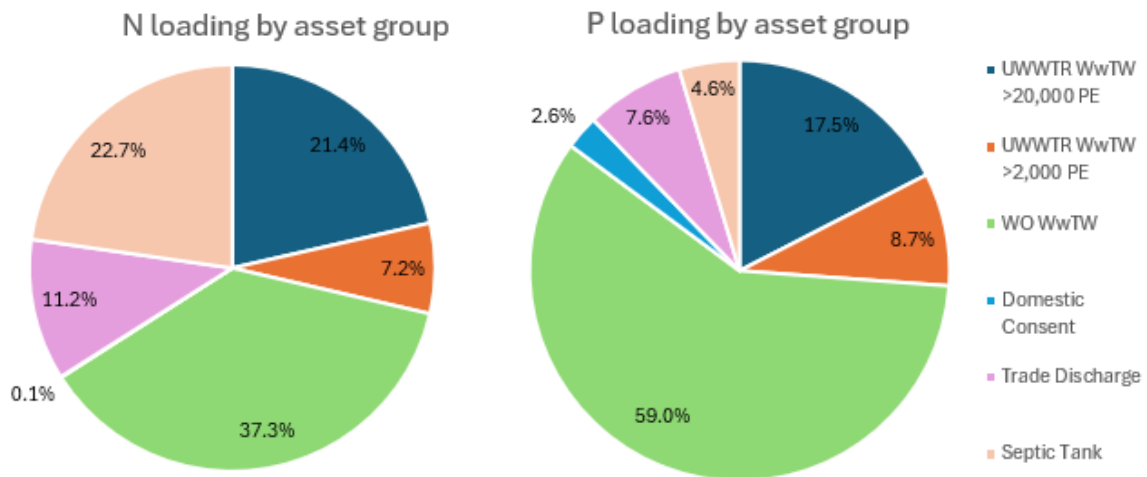
**Figure 4-5 - Domestic Consents asset overall risk by water body**





When load contribution by asset group is aggregated at the national level (all asset load contribution to water bodies for N and P in NI) WwTW consented under the Water Order (1999) (sites with PE<2000 and discharge >5m<sup>3</sup>) contribute the greatest proportion of load for N and P from wastewater assets (Figure 4-8).

**Figure 4-8 - Northern Ireland proportional loading by asset group**



## 4.2 NI Water Body scale results

Individual asset overall risk was generated by multiplying the asset risk score by the asset impact score to generate an overall risk score using the risk matrix (Figure 3-1). Water body scale results have been derived for all water bodies which contain assets (510 of a total 554 water bodies), presented in Table 4-2. To generate an overall risk rating for a water body the count of asset risk and asset impact ratings for each asset type was aggregated by water body. A weighted average was applied to counts of asset risk and asset impact ratings (High – 4 to Low – 1; Figure 3-1) to generate water body scale risk ratings for asset risk and asset impact. The water body asset risk and asset impact ratings were then multiplied using the risk matrix to generate the overall risk rating for a given water body.

Receptor sensitivity, also presented in Table 4-2, is a metric of water body sensitivity and is based on WFD status or potential, the mix of protected sites, presence of UWWTD sensitive areas and whether the water body is upstream of a designated shellfish water. Receptor sensitivity differs from the Impact assessment as it considers water body receptors in isolation and does not account for asset impact on receptors. Assessment of the impact a particular asset has on receptors is accounted for as part of asset impact scoring for WwTW, domestic consents and trade discharges. This information is available at the water body scale as provided in the accompanying model spreadsheet (Appendix C), the summary dashboard for which is shown for the Faughan River (Carmony) in Figure 4-9.

At the water body scale the majority of water bodies have a Medium (81%) discharge risk (Figure 4-10). Water body (receptor) sensitivity shows that most water bodies are either Low (42%) or Medium sensitivity (39%) (Figure 4-11). When looking at receptor impact risk at the water body scale, the majority of water bodies are assessed as having a Low (58%) or Negligible (25%) impact from discharges. This indicates that assets with High and Medium risk are more likely to be located in water bodies where they are having a Low or Negligible impact due to factors such as size of water body (dilution) and/or a lack of sensitive receptors.

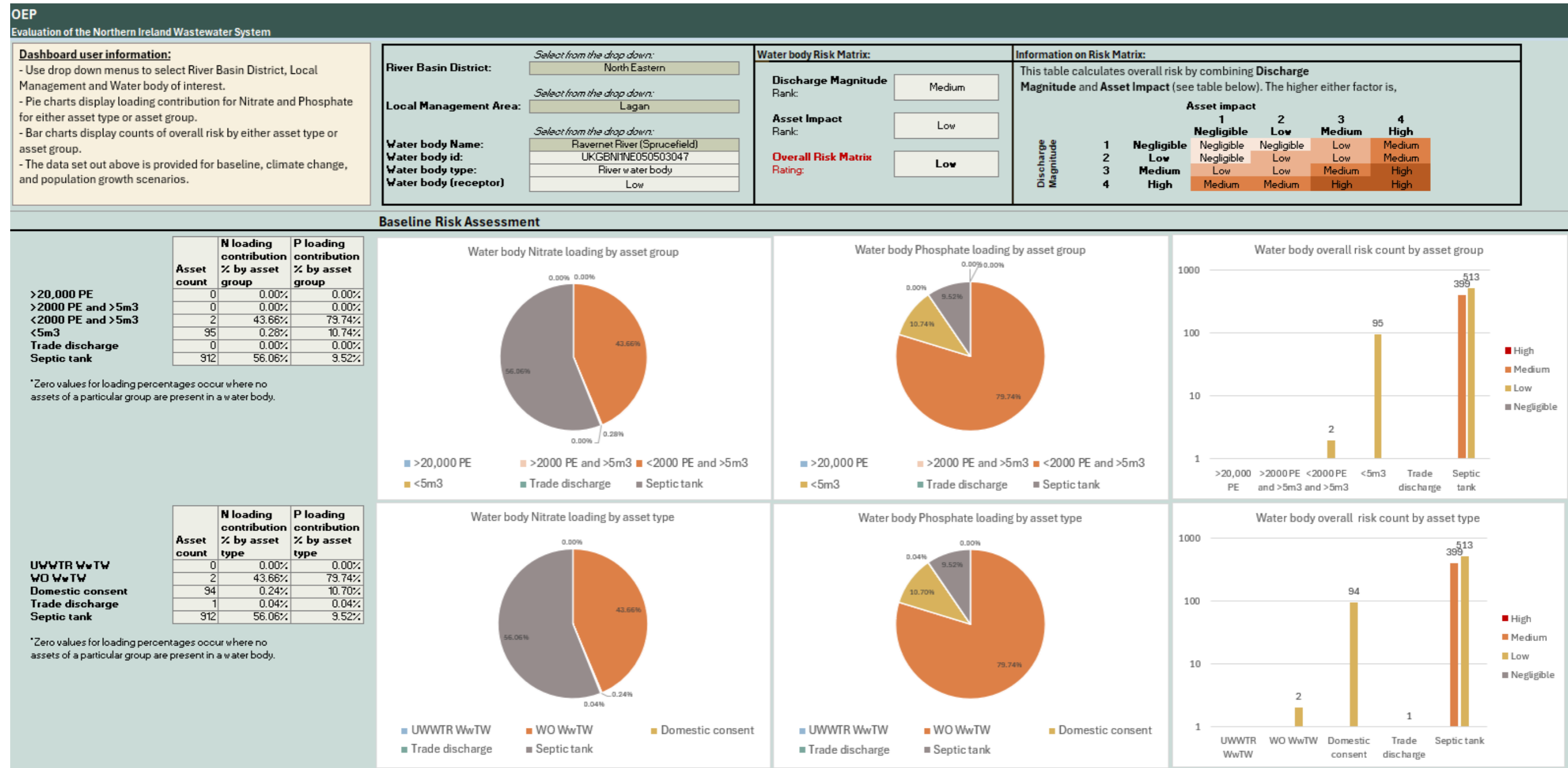
Overall water body risk uses the combined discharge risk and receptor impact scores at the water body level to produce an overall water body risk of pollution. The majority of water bodies are classified as at Low risk (71%), with 18% at Medium and 11% at High risk of pollution from wastewater assets.

**Table 4-2 – Water body scale ranking for asset risk, receptor sensitivity, asset impact and overall risk**

	<b>Negligible</b>	<b>Low</b>	<b>Medium</b>	<b>High</b>
<b>Discharge risk</b>	0	55	414	41
<b>Water body (receptor) sensitivity</b>	25	214	198	73
<b>Asset impact</b>	128	298	54	30
<b>Overall water body risk</b>	13	402	62	33

\* Note that results presented are for the 510 water bodies which have wastewater assets discharging to them.

Figure 4-9 - Model dashboard showing baseline water body level data



### 4.3 NI River Basin scale results

To generate results at the river basin scale, the count of overall asset risk rating by water bodies was aggregated by river basin and the counts of overall risk by water body assigned a weighted average (High – 4 to Low -1) to generate an overall risk rating for each River Basin District. All three basins in NI had a Low overall risk. However, it is noted that there are ‘hotspots’ of High risk, particularly in the North Western River Basin (Figure 4-13). This is partly due to the presence of a high number of designated sites in the north and west of the North Western River Basin, notably River Foyle and Tributaries (UK0030320), Owenkillew River (UK0030233), River Faughan and Tributaries (UK0030361), and River Roe and Tributaries (UK0030360) which are long, linear designations focussed around the river network and as a result intersect multiple water bodies from headwater catchments to main river stem catchments. The presence of Urban Waste Water Sensitive Areas also leads to increased receptor sensitivity of the water bodies within the catchment areas of the Rivers Foyle, Roe and Faughan. Both of these factors result in high receptor sensitivity (Figure 4-11) which drives high impact from assets (Figure 4-12) and leads to a high risk ‘hotspot’ of overall wastewater asset risk in the north west.

Figure 4-10 also shows that a number of coastal interbasins on the east and north coast within the North Eastern River Basin District have High asset risk. This is likely to be in part due to numerous small discharges (septic tanks and domestic consents) to relatively small water bodies resulting in a larger percentage load increase from baseline from assets rather than individual contributions from larger assets.



Figure 4-12 - Asset impact by water body

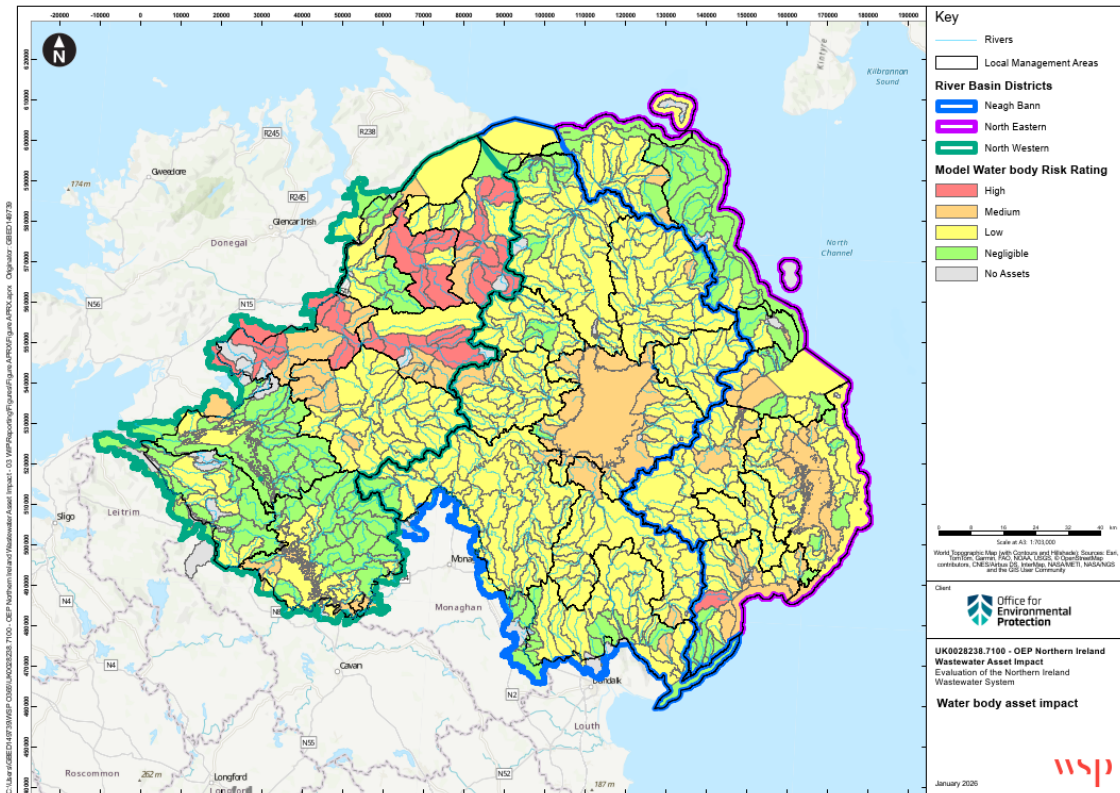
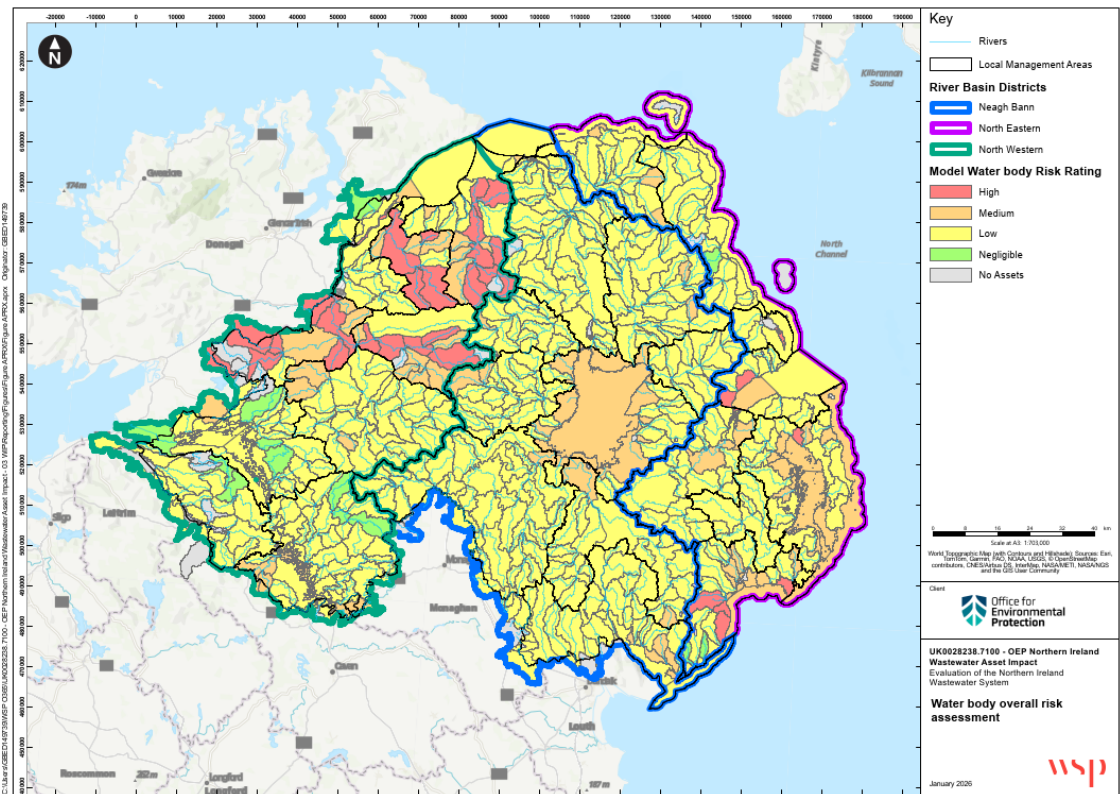


Figure 4-13 - Overall risk by water body



## 4.4 Climate change and population growth scenarios

The climate change scenario to 2080 (reduction in river flows and lake volumes) showed little difference to the baseline risk model, with 125 water bodies out of 510 (24.5%) increasing in risk score. The population growth scenario showed even fewer results with only 30 (5.9%) water bodies showing an increase in risk.

The combination of climate change and population growth assessment showed an additional 83 (16.3%) water bodies with an increased risk score compared to the baseline model.

As described above in Section 2.3.3.3, the climate change impacts are modelled assuming a reduction in river flow, or lake volume, and therefore dilution, due to reduced rainfall and the incorporation of any drought plan or other climate change related measures into the load calculation for the asset discharges was not incorporated. It is acknowledged, therefore, that the risk posed from discharge loadings during climate change scenarios is higher than would be the case if these measures were represented.

## 4.5 Confidence in results

As noted previously, there is Medium to Low confidence in nearly half of the datasets which were available to the project (Table 4-3), with 10 of 18 datasets at High or High/Medium confidence level. The key datasets around which there is uncertainty include smaller discharges such as septic tanks, small wastewater treatment works and trade effluent where there is no information on permit conditions so flow and load values have been assumed based on reported values for England or from the literature. Sensitivity testing for the septic tank loading values suggests that the model outcomes would still place the majority in the Medium risk category even if load values towards the lower end of reported values are used.

The information provided for inputs from the Irish EPA were incomplete and therefore unsuitable for use and so calculations for transboundary bodies are partly missing input loading values. In addition, the calculation of flows and in-river loads was based on available data (i.e. water quality data from 1990 to 2018 with incomplete coverage of this and flow gauging in all catchments). However, as noted in Section 2, the methods used to infill the datasets are also commonly used in WFD assessments and so follow standard approaches.

**Table 4-3 – Count of dataset confidence**

Confidence Level	Number of datasets	Dataset type
High	8	WFD data, water environment, protected sites, other monitoring data, legislation, transboundary water bodies (WFD), soils, geology
High/Medium	2	NIW wastewater assets, domestic consents
Medium	3	Trade effluent, transboundary water bodies (trade discharges), population growth
Medium/Low	1	Septic tanks
Medium/Low	4	Flow monitoring data, water quality monitoring data, climate change predicted flows, transboundary water bodies (UWWTR WwTW)

The sensitivity testing revealed no significant sensitivities that are not accounted for in the model design, and the case study ground truthing has returned reasonable confidence in the model outputs for most asset types. However, the trade discharge values were found to be inaccurately estimated for the case study catchments based on the assumption that assets are operating within their permit conditions. The transboundary data provided by the EPA did not align with the NIW / NIEA datasets and could not be incorporated without skewing results. The lack of this dataset therefore led to reduced confidence in assessments for the downstream NI water bodies.

A number of assumptions have been made throughout the model development. Some of these assumptions helped to increase confidence in the data, particularly where low confidence had been originally assigned to due to lack of spatial coverage. For example work to improve the spatial coverage of the flow monitoring data and water quality monitoring datasets was undertaken using commonly used and accepted methods to assign values to water bodies which sit outside of the current monitoring network. These assumptions include:

- Where no river flow gauges were available, flow was area weighted using data from a neighbouring gauged catchment;
- Baseline loading in rivers uses the annual average concentration at WFD river and lake quality monitoring points for water bodies over the period 1990 to 2018. Monitoring is representative of river quality as opposed to point source pollution. Where no monitoring data is available, data from neighbouring catchments is appropriate for use.

- Septic tank locations were not available therefore a count based on areas of the water body defined by proximity to watercourse and soil type were used. Only septic tanks managed by NIW are included.
- Attenuation of N from septic tank discharges is represented by applying the BFI for losses to groundwater. Attenuation in low permeability soils due to sorption of ammonium or denitrification of nitrate in gleyed soils has not been applied.
- Where flow and concentration data for permitted wastewater discharges (domestic consents and WwTWs) was not available, data from similar sized works in England has been used.
- There is very little specific data around discharge flow and N and P concentrations for trade discharges or for septic tanks and a literature review was undertaken to assign values where there were gaps in data for these two types of asset as described in Section 2.3.2.

At least one assumption, however, reduced confidence in the results:

- All permit values are adhered to and the permit level itself is protective of the environment. In reality, sites will operate above or below permit conditions and the permit may not be fit for purpose if it has not been reviewed for a long period of time.

In addition, though no attempt has been made to ground truth the entirety of the overall data provided, evidence from the more detailed investigations for the case studies (see below in Section 4.7) suggests that some permits may not be being used or may be significantly exceeded. This type of information is very difficult to collect at the national scale without extensive stakeholder consultation.

## 4.6 Case study examples

Three catchments were selected to ground truth the model with the results of these case studies provided in Appendix D. These catchments were selected on the basis of having at least one wastewater asset and representing high, medium and low risk outcomes.

The water bodies selected were:

- The Faughan River (UKGBNI1NW020208259) which scored medium risk from wastewater assets and high sensitivity risk and so was an overall high-risk of pollution example,
- The River Lagan (UKGBNI1NE050503108) was a medium overall risk example, based on medium risk from discharges and medium sensitivity; and
- The Arney River (UKGBNI1NW363604059) which has medium risk from wastewater assets and negligible sensitivity and therefore low risk of pollution.

When completing the three case studies, the model identified that the wastewater assets within the catchments were not the largest contribution of N within the catchments, but were the largest contributor of P. This therefore suggests that there are other considerations

within the catchments that in combination with wastewater discharges, are leading to the risk of N and P pollution.

These three catchments were heavily ground truthed and the results are fully presented in the Appendices. This comprised including expert knowledge on the catchments against the gathered data to identify any inputs that 'on the ground knowledge' knew to be a discrepancy in some way.

For example, in the Faughan River Catchment the trade data identifies the presence of three food processing trade effluents. However, based on local knowledge the three food processing trade discharges are not currently operational. This increases the current risk of trade effluents in the catchments, though those discharges are not currently active.

Based on the ground truthing outcomes of the three case studies, it can be concluded that modelled asset risk may be elevated above the current situation, particularly for trade discharges where the data are more likely to be presence/absence. It is also worth noting that numerical discharge data for trade discharges is sparse (see Section 4.6 above). However, it may be assumed that this represents a future risk as these discharges may come back into operation.

## 5 Linking with Regulations

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### 5.1 Objectives

The objectives of this task were to:

- Collate the regulations and legislative instruments in NI relevant to wastewater; and
- Review their implementation and to what extent they consider wastewater nutrient pollution risks.

This section sets out the approach taken, the review outcomes and links the outcomes to the risk assessment model findings. Following the risk assessment, high-risk discharges were more frequently identified in the smaller discharge categories (i.e. types with discharge volumes below 5 m<sup>3</sup> per day including small sewage treatment works, and septic tanks). Key components contributing to high risk were high nutrient loading contributing greater than 10% to the water body, and lack of permit conditions for N and P.

### 5.2 Methodology

Regulations that impact wastewater or are impacted by wastewater were collated and reviewed to provide a summary of the regulation and its articles which impact or are impacted by wastewater management. Links between regulations were identified and the consents processes defined by the regulations were identified. The regulations were linked with the risk components identified in earlier tasks by mapping medium-risk or high-risk components with relevant articles in the regulations.

### 5.3 Relevant regulations

A summary of the relevant regulations is provided below:

<b>The Urban Waste Water Treatment Regulations (Northern Ireland) 2007</b>
<p><b>Link to regulations:</b> <a href="https://www.legislation.gov.uk/nisr/2007/187/contents/made">https://www.legislation.gov.uk/nisr/2007/187/contents/made</a></p> <p><b>Overview of regulations:</b> Protects human health and the environment from the effects of untreated urban wastewater by requiring wastewater to be properly collected and treated.</p> <p><b>Role in wastewater management:</b> Key provisions include standards for the collection and treatment (primary, secondary and tertiary) of urban wastewater. The regulations mandate the implementation of treatment systems for areas based on population size, sensitivity of the area (based on water quality), control of industrial discharges, and monitoring and reporting of water quality. The minimum standards for treatment are set according to the population equivalent (p.e.) served by the treatment works and the sensitivity of receiving waters. For discharges with a p.e. of &gt;10,000, secondary treatment is required and more stringent treatment is required if discharging into sensitive areas (reduction of nitrogen and phosphorus). For discharges with a p.e. of 2,000 – 10,000, secondary treatment is required for discharges to fresh waters and estuaries. For</p>

discharges with a p.e. of <2,000 appropriate treatment is required (ensuring water quality objectives are met). In high natural dispersion areas, less stringent treatment is permitted (at least primary treatment) if studies show no adverse environmental impact.

**Consents:** Entities must apply for consent to discharge treated wastewater. This involves submitting detailed information about the nature and volume of the discharge, the treatment processes used, and the receiving waters. Once consent is granted by authorities, monitoring of the discharge is required to ensure ongoing compliance with the conditions set.

**Consideration of risks and receptors:** Schedule 1 (Part 1) defines the criteria for the identification of sensitive areas. This includes water bodies which are eutrophic or may become eutrophic without preventative action (e.g. in areas where there is poor water exchange or where high quantities of nutrients are being received, surface water bodies used for abstraction with may contain high nitrate levels and areas where further treatment than secondary or equivalent treatment is necessary). Schedule 1 (Part 2) defines the criteria for identification of high natural dispersion areas. A marine water body or area can be identified as a high natural dispersion area if the discharge of wastewater does not adversely affect the environment as a result of morphology, hydrology or specific hydraulic conditions which exist in that area. When identifying high natural dispersion areas, the risk that the discharged load may be transferred to adjacent areas where it can cause detrimental environmental effects must be considered.

The identification of sensitive areas and high natural dispersion areas are to be reviewed at intervals of no more than 4 years.

### The Water (Northern Ireland) Order 1999

**Link to regulations:** <https://www.legislation.gov.uk/nisi/1999/662/contents/made>

**Overview of regulations:** Provides a framework for the management and regulation of water resources in NI including water quality, abstraction, and pollution control. The order applies to discharge volumes above and below 5 cubic metres including septic tanks and small sewage treatment works

**Role in wastewater management:** Defines that without the relevant consent, discharge of trade or sewage effluent or other pollution shall not be discharged into waterways. In case of pollution emergencies, discharges can be prohibited (which can override consents). Anti-pollution works may also be required if polluting matter is likely to enter or has been present in waterways.

**Consents:** Schedule 1 defines the processes for applications for consents, consideration and determinations, public enquiries, revocations, and transfer of consents. If the Department has consented to receive matter discharged into a public sewer or sewage treatment works, the discharge of matter is not an offence. Exemptions are also defined.

**Consideration of risks and receptors:** The pollution prevention provisions relate to: a) discharge of poisonous noxious or polluting matter so that it enters a waterway or water contained in any underground strata; and b) discharge of matter that impedes water flow which can lead to or aggravate pollution. In terms of risk assessment and monitoring, the Department shall maintain maps of freshwater limits of every waterway. The Department

may adopt water management programmes to assess the quality of water resources in an area.

### **The Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013**

**Link to regulations:** <https://www.legislation.gov.uk/nisr/2013/160/contents/made>

**Overview of regulations:** Establish a framework for controlling and reducing pollution from industrial activities. They set emission limits, monitoring requirements, and best available techniques for preventing and minimising emissions and waste. The regulations apply to high nutrient loading industrial discharges i.e. abattoirs and milk processing plants that discharge directly to waterways

**Role in wastewater management:** Independently operated wastewater treatment facilities must comply with the legislation if they are not covered by the UWWTD. Other industries must also minimise emissions to water. This involves applying best available techniques to reduce emissions to water. Best available techniques may include advanced wastewater treatment processes. Wastewater emissions must be monitored and reported (also in line with best available techniques). Compliance is assessed on a 95-percentile basis, i.e. a discharge must be within its consent conditions 95% of the time to comply.

**Consents:** Permits must be obtained to carry out the industrial activities under scope of the regulation. The general principles for determining the conditions of a permit establish that installations and mobile plants must take all appropriate preventative measures against pollution through the application of best available techniques.

**Consideration of risks and receptors:** The aim of the regulation is to reduce pollution risks (including to waterbodies). Schedule 5 sets out an indicative list of the main polluting substances to be taken into account for fixing emission limit values to water. This list includes substances which contribute to eutrophication (in particular, nitrates and phosphates).

### **The Water and Sewerage Services (Northern Ireland) Order 2006**

**Link to regulations:** <https://www.legislation.gov.uk/nisi/2006/3336/contents>

**Overview of regulations:** Provides the framework for the provision of water and sewerage services in Northern Ireland. It outlines the functions and responsibilities of NI Water.

**Role in wastewater management:** This is the main regulation for duties of sewerage undertakers. The chapters of Part VI cover: principal duties and standards of performance; provision of sewerage services; and trade effluent.

**Consents:** The occupier of any trade premises in the area of a sewerage undertaker may discharge trade effluent into the public sewers only if given consent by the undertaker. The application shall include information on the trade effluent and the steps to be taken to minimise the polluting effects, among other things. Transfer of consent, appeals, and variations are also described in the Order.

**Consideration of risks and receptors:** Pollution risks are recognised broadly.

## The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017

**Link to regulations:** <https://www.legislation.gov.uk/nisr/2017/81/contents/made>

**Overview of regulations:** The Water Framework Directive Regulations provide a framework for managing the water environment. They set objectives for waterbodies which include the achievement of good ecological and chemical status in surface water and good quantitative and chemical status in groundwater. They also set a no deterioration of status objective for waterbodies.

**Role in wastewater management:** The regulations apply to water services, including wastewater collection and treatment facilities which subsequently discharge into surface water. The Programmes of measures (PoMs) must be established by authorities, aiming to help water bodies meet environmental objectives (including related to pollution). PoMs must include basic measures addressing a range of environmental pressures. In the context of pollution, PoMs must include emission controls for point source and diffuse source discharges liable to cause pollution, prohibitions of direct discharges of pollutants into groundwater, and measures to eliminate pollution of surface waters by priority substances. These measures could involve wastewater treatment methods.

**Consents:** Where environmental objectives are unlikely to be achieved, any relevant permits and authorisations should be examined and reviewed as appropriate.

**Consideration of risks and receptors:** Risks to shellfish and other economically significant aquatic species, risks to recreational waters, risks to nutrient-sensitive areas, and risks to habitats and species are acknowledged in the context of registers of protected areas. Risks from pollution and other risks are acknowledged in the environmental objectives and PoMs provisions.

## The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995

**Link to regulations:** <https://www.legislation.gov.uk/nisr/1995/380/contents/made>

**Overview of regulations:** Protect natural habitats and habitats of species including designated sites (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)).

**Role in wastewater management:** The requirements for assessing the implications of plans or projects likely to have a significant effect on a designated site may affect water management (if the plan or project relates to water management).

**Consents:** Consideration of designated sites should be made when giving and reviewing discharge consents under the Water Act.

**Consideration of risks and receptors:** Various threats of degradation / destruction of habitats are acknowledged and considered.

## The Groundwater Regulations (Northern Ireland) 2009

**Link to regulations:** <https://www.legislation.gov.uk/nisr/2009/254/contents>

**Overview of regulations:** These regulations provide a framework for the protection of groundwater resources in NI by preventing or controlling the discharge of hazardous substances and limiting the input of non-hazardous pollutants to groundwater.

**Role in wastewater management:** Pollutants must not be discharged in circumstances which may lead to an indirect input of the pollutant into groundwater, unless an authorisation has been granted.

**Consents:** Regulation 19 defines the application for an authorisation for discharges. Necessary measures must be made to limit the input of input of non-hazardous pollutants into groundwater.

**Consideration of risks and receptors:** Threshold values for substances are provided.

### Fisheries Act (Northern Ireland) 1966

**Link to regulations:** <https://www.legislation.gov.uk/apni/1966/17>

**Overview of regulations:** This act regulates the conservation, management, and development of fisheries in NI, including licensing, fishery districts, and protection of fish stocks.

**Role in wastewater management:** Sets out a procedure for when an application for consent to discharge effluent (under the Water Order) is made and the waterway is in connection with the operation of a fish farm.

**Consents:** Regulation influences the consents process under the Water Order in some cases (when the waterway is in connection with a fish farm).

**Consideration of risks and receptors:** Risks to fish are considered, but in an economic and food safety sense, rather than environmental in an environmental perspective.

### Foyle Fisheries Act (Northern Ireland)

**Link to regulations:** <https://www.legislation.gov.uk/apni/1952/5/section/41>

**Overview of regulations:** Sets out the procedures for the rights, licensing, and permits, and regulations related to fishing in the transboundary Foyle and Carlingford areas

**Role in wastewater management:** Includes penalties for pollution by deleterious matter into rivers.

**Consents:** Includes aquaculture applications but not consents to discharge.

**Consideration of risks and receptors:** Considers the entry of deleterious matter into rivers.

### The Environment (Northern Ireland) Order 2002

**Link to regulations:** <https://www.legislation.gov.uk/nisi/2002/3153/contents>

**Overview of regulations:** Establishes the Northern Ireland Environment Agency (NIEA) and outlines its powers and responsibilities in relation to environmental protection and regulation.

**Role in wastewater management:** Permits the Department to establish regulations to implement the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013)

**Consents:** Not defined in this Order.

**Consideration of risks and receptors:** Not defined in this Order.

**The Environmental Liability (Prevention and Remediation) Regulations (Northern Ireland) 2009**

**Link to regulations:** <https://www.legislation.gov.uk/nisr/2009/252/made>

**Overview of regulations:** Has the objective of making operators of activities which cause environmental damage financially liable for that damage (the ‘polluter pays’ principle). It imposes duties on operators to take immediate steps to prevent damage if there is an imminent threat, and if damage occurs, they must act to limit its effects.

**Role in wastewater management:** Covers damage to water systems, including damage caused by wastewater

**Consents:** Not defined in these regulations but water discharge consent under the Water (Northern Ireland) Order 1999 are mentioned in Schedule 3 in relation to Regulation 16 (appeals against liability to remediate).

**Consideration of risks and receptors:** Damage includes adverse effects on the ecological, chemical, or quantitative status of water bodies.

## 5.4 Consents processes

### 5.4.1 Consent applications

Under the Water (Northern Ireland) Order 1999, the discharge of trade or sewage waste to any waterway, or groundwater requires consent from DAERA. This includes waste from any commercial, industrial or domestic premises not connected to the public sewer. This includes treated wastewater as per the UWWTD.

The application for a discharge consent differs based on the type of discharge. The different types of discharge regulated under the Water (Northern Ireland) Order 1999, and links to the relevant consent applications are summarised in the table below. The permit required for activities regulated under the Pollution Prevention and Control (Industrial Emissions) Regulations (NI) 2013 is also provided at the end of the table.

Table 5-1 – Discharge types and consent applications under the Water (Northern Ireland) Order 1999

Type of discharge	Description of discharge	Link to consent application
Domestic	Single dwelling related discharges	<a href="https://www2.dardni.gov.uk/dca">https://www2.dardni.gov.uk/dca</a>
Private Sewage Infrastructure	Sewage related discharges for two or more dwellings and commercial activities.	<a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf</a> + <a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-consent-to-discharge-sewage-effluent-2010.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-consent-to-discharge-sewage-effluent-2010.pdf</a>
Wastewater Utility Discharges	Wastewater infrastructure operated by a Public Water Utility Company	<a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf</a> + <a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-consent-to-discharge-sewage-effluent-2010.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-consent-to-discharge-sewage-effluent-2010.pdf</a>
Trade / Process	Discharges of trade effluent	<a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf</a> + <a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-trade-effluent-or-site-drainage-discharge-consent-2010.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-trade-effluent-or-site-drainage-discharge-consent-2010.pdf</a>
Site Drainage	Discharges associated with works affecting a watercourse	<a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf</a> + <a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-trade-effluent-or-site-drainage-discharge-consent-2010.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/water-form-application-for-trade-effluent-or-site-drainage-discharge-consent-2010.pdf</a>
Emergency discharge	Sewage discharged under emergency conditions	<a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf</a> + <a href="https://www.daera-ni.gov.uk/publications/application-emergency-discharge-sewage-pumping-station-wo1-annex1">https://www.daera-ni.gov.uk/publications/application-emergency-discharge-sewage-pumping-station-wo1-annex1</a>
Fish farms	Discharges from fish farms	<a href="https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/dae/Application%20form%20Trade%20-%20Jan%202017.pdf</a>

Type of discharge	Description of discharge	Link to consent application
		+ <a href="https://www.daera-ni.gov.uk/sites/default/files/publications/doe/water-form-application-for-discharge-consent-fish-farming-effluent-2010.pdf">https://www.daera-ni.gov.uk/sites/default/files/publications/doe/water-form-application-for-discharge-consent-fish-farming-effluent-2010.pdf</a>
Industrial processes and activities	Emissions from industry that can cause harm to the surrounding environment.	<a href="https://www.daera-ni.gov.uk/sites/default/files/2024-12/Part%20A%20%E2%80%93%20Application%20for%20a%20p%20permit%20variation%20transfer%20or%20surrender.pdf">https://www.daera-ni.gov.uk/sites/default/files/2024-12/Part%20A%20%E2%80%93%20Application%20for%20a%20p%20permit%20variation%20transfer%20or%20surrender.pdf</a>

## 5.4.2 Details required in consent applications

An overview of the requirements in the various consent applications is provided below. Further details of the requirements of the online application form can be found in Appendix C.

### Domestic consents

The domestic consent process in Northern Ireland requires the completion of an online application form. The information required to be provided on the discharge includes availability of nearby NI Water sewer; number of houses; planning permission; proposed or existing discharge; details of waterway or soakaway; and documents such as map and site plan. Applications are reviewed by Water Quality Inspectors who assess the details in line with current standards and all existing systems are inspected.

### Non-domestic consents

Non-domestic consents require the completion of a main application form accompanied by a separate application form depending on the type of discharge. The main application form (WO1) requires details of the premises; source of water supply; amounts/volumes of chemicals and fuels stored on the premises; details of receiving environment; whether a foul sewer is available and why it is not practical to connect to it (for example due to distance or flow). The application must be submitted along with relevant annexes depending on the type of discharge. Site plans and location map must be provided.

### Private sewage infrastructure and wastewater utility discharges

For sewage effluent discharges, the WO1 form must be accompanied by an Annex 5 application form. This requires information to be provided on discharge quantity; discharge rate; flow; type of treatment plant; treatment processes; timing of discharge; receiving medium; sub-surface irrigation; and details of percolation tests.

### Trade effluent and site drainage

For trade effluent and site drainage discharges, the WO1 form must be accompanied by an Annex 2 application form. This requires information to be provided on details of the trade effluent and the processes from which it arises; treatment; discharge quantity; discharge rate; location of discharge; location of sampling; flow; measurement facilities; discharge timing; receiving medium; sub-surface irrigation systems; details of percolation tests; rainfall dependence/independence; monitoring and sampling; and presence of dangerous and additional substances (substances are specified). Nutrients are not specified in the substance list although there is a section to specify “other substance(s) that should be taken into account”.

### **Aquaculture**

For discharges from aquaculture, the WO1 form must be accompanied by an Annex 4 application form. This requires information to be provided on the activities; the species, age range, and annual production; food used; chemicals used or stored; timing of discharge; abstraction; receiving waterway; composition of effluent (BOD, suspended solids, NH<sub>4</sub>); volume and flow; and treatment.

### **Emergency sewage discharge**

For emergency sewage discharges, the WO1 form must be accompanied by an Annex 1 application form. This requires information to be provided on location; receiving waterway; the drainage system; the pumping station; evidence of Rivers Agency approval; evidence of Pre Development Enquiry; details of pumps; and details of design features.

### **Industrial processes and activities regulated under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013**

For Part A activities (releases to air, water and land), a Part A permit, variation, transfer or surrender application form is required. This requires information to be provided on sites, emissions and receiving environment.

## **5.5 Linking with identified risks and impacts**

The table below details the high-risk components associated with each discharge type identified under task B and C. These have been compared against the consents processes to understand the extent to which these risks are considered in consenting.

Table 5-2 – High-risk and high-impact components identified in the risk assessment model and link with regulation and consenting

Type of discharge	High-risk discharge components identified in risk assessment	High-impact sensitivity components identified in risk assessment	Consideration in regulations and consenting
Population Equivalent of between 2000 and 20,000 and those with a Population Equivalent of over 20,000. WwTWs consented for under the Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR)	<p>No discharges with a PE of over 20,000 were identified as high-risk. 21 (out of 24) were identified as medium risk. Of these 21:</p> <ul style="list-style-type: none"> <li>10 were over 100 years old</li> <li>6 did not have permit conditions for N or P</li> <li>19 had an N loading of greater than 10% contribution to the water body</li> <li>11 had a P loading of greater than 10% contribution to the water body</li> </ul> <p>No discharges with a PE of 2,000 to 20,000 and over 5m<sup>3</sup>/day were identified as high risk. 54 (out of 58) of these were identified as medium risk. Of these 54:</p> <ul style="list-style-type: none"> <li>33 were over 100 years old</li> <li>47 did not have permit conditions for N or P</li> <li>33 had an N loading of greater than 10% contribution to the water body</li> <li>44 had a P loading of greater than 10% contribution to the water body</li> </ul>	<p>2 (out of 24) discharges with a PE of over 20,000 were identified as high impact. Of these 2:</p> <ul style="list-style-type: none"> <li>1 was located within a RAMSAR site and 1 was located within a SAC</li> <li>1 had direct impacts and 1 had indirect impacts to named/habitats and species in Annex I/II</li> <li>1 was within an UWWTD sensitive area</li> <li>2 were upstream of Shellfish Waters</li> </ul> <p>6 (out of 58) discharges with a PE of over 2,000 and over 5m<sup>3</sup> were identified as high impact. Of these 6:</p> <ul style="list-style-type: none"> <li>All 6 were in water bodies at high or good WFD status for P</li> <li>All 6 were in water dependent SACs</li> <li>All 6 had direct impacts to named/habitats and species in Annex I/II</li> <li>6 were within an UWWTD sensitive area</li> <li>6 were upstream of shellfish waters</li> </ul>	<p>While no discharges with a PE of over 20,000 or with a PE of over 2,000 and over 5m<sup>3</sup> were identified as high risk, several were identified as medium risk. The key contributing reasons were the age of the assets, lack of permit for N or P, and nutrient loadings greater than 10% contribution from discharge.</p> <p>The Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR) do not mention the age of an urban wastewater treatment works nor is it a specific element in the consent application.<sup>55</sup></p> <p>Permits for N and P are required by the Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR) under specific circumstances, i.e. in areas of large agglomerations and/or poor water exchange. Given that lack of permit conditions and high nutrient loading is contributing to the modelled risk, stricter permitting requirements for N and P could be needed.</p>
Discharge volumes above 5 cubic metres per day (PE of less than 2000). WwTWs consented for under the Water (Northern Ireland) Order 1999	<p>129 (out of 577) WwTW discharges with volumes above 5m<sup>3</sup>/day with a PE of less than 2,000 were identified as high risk. Of these 129:</p> <ul style="list-style-type: none"> <li>126 had a discharge location in a headwater stream</li> <li>127 had a treatment type of 'screening only'</li> <li>126 were over 100 years old</li> <li>All 129 had no permit for N or P</li> <li>127 had a population of over 15,000 people</li> <li>62 had an N loading of greater than 10% contribution to the water body</li> <li>125 had an P loading of greater than 10% contribution to the water body</li> </ul>	<p>40 (out of 577) WwTW discharges with volumes above 5m<sup>3</sup> with a PE of less than 2,000 were identified as having a high impact. Of these 40:</p> <ul style="list-style-type: none"> <li>10 were in water bodies at good ecological status</li> <li>32 were in water bodies at high or good WFD status for P</li> <li>All 40 were in water dependent SACs</li> <li>All 40 had direct impacts to named/habitats and species in Annex I/II</li> <li>37 were in UWWTD sensitive areas</li> <li>39 were upstream of Shellfish Waters</li> </ul>	<p>Many discharges with volumes above 5 cubic metres per day with a PE of less than 2000 were identified as high risk. Key contributing reasons were discharge location in a headwater stream, screening only treatment, old age, no permit for N or P, high population and nutrient loadings greater than 10% contribution from discharge.</p> <p>The Water (Northern Ireland) Order 1999 does not consider age of the works. All those at high risk had no permit for N or P and the majority had high nutrient loading. Therefore, stricter permitting requirements on nutrients could be needed in the regulations. Secondary treatment may be required for discharges with a population above 15,000 people as those with a population higher than this were identified as high risk.</p>
Discharge volumes below 5 cubic metres per day including small sewage treatment works (domestic consents). WwTWs consented for under the Water (Northern Ireland) Order 1999.	<p>148 (out of 11,498) domestic consents were identified as high risk. Of these 604:</p> <ul style="list-style-type: none"> <li>All 148 had an N loading of up to 3% contribution to water body</li> <li>36 had a P loading of over 10% contribution and 112 had a P loading of 6-10% contribution to the water body</li> </ul>	<p>295 (out of 11,498) domestic consents were identified as high impact. Of these 295:</p> <ul style="list-style-type: none"> <li>96 were in water bodies at good ecological status</li> <li>248 were in water bodies at high or good WFD status for P</li> <li>All 295 were in water dependent SACs</li> <li>294 had direct impacts to named/habitats and species in Annex I/II</li> <li>All 295 were in UWWTD sensitive areas</li> <li>292 were upstream of shellfish waters</li> </ul>	<p>Numerous discharges with N loading of under 3% assessed to be high risk. Therefore, the regulations for discharge volumes below 5 cubic metres per day may need to take greater consideration that nutrient loadings even at lower contribution levels can be high-risk particularly where there are multiple discharges in a water body creating a combined risk.</p>

<sup>55</sup> The age of the works has been used to assign a risk score on the basis of integrity, however this does not account for the fact that very old works may have undergone significant upgrades in recent years.

<p>Septic Tanks for individual dwellings. Consented for under the Water (Northern Ireland) Order 1999.</p>	<p>Septic tanks assessment was carried out in zones of differing levels of soil and river proximity pathway risk to reflect attenuation and the results aggregated to water body level.</p> <p>725 (out of 1,849) septic tank risk areas were identified as high risk. Of these 725:</p> <ul style="list-style-type: none"> <li>• 127 had N loadings and 689 had P loadings of greater than 10% contribution to the water body</li> </ul>	<p>82 (out of 554) of water bodies with septic tanks were identified as having a high risk of impact of pollution.</p> <p>Of these 82:</p> <ul style="list-style-type: none"> <li>• 21 were water bodies at good ecological status</li> <li>• 48 were water bodies at high or good WFD status for P</li> <li>• 71 were in water dependent SACs, 6 were in water dependent ASSIs, and 5 were in water dependent RAMSAR sites.</li> <li>• 78 had direct impacts and 4 had indirect impacts to named/habitats and species in Annex I/II</li> <li>• 80 were in UWWTD sensitive areas</li> <li>• 78 were upstream of shellfish waters</li> </ul>	<p>All water bodies at high-risk due to septic tanks had N and P loadings of greater than 10% contribution from discharge. Therefore, stricter regulations on nutrient loading from septic tanks for both N and P could be required, specifically in high risk soils such as gley soil areas.</p>
<p>High nutrient loading industrial discharges i.e. abattoirs and milk processing plants that discharge directly to waterways (trade effluent). Industrial discharges consented for under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013</p>	<p>69 (out of 273) trade discharges were identified as high risk. Of these 76:</p> <ul style="list-style-type: none"> <li>• 33 were non-hazardous domestic waste disposal sites (non-inert), 11 were fish farms, 4 were fish hatcheries, 3 were shell fisheries, 1 was paper manufacturing, 1 was apple processing, 2 were private sewage: commercial 3-5m<sup>3</sup>, 6 weas private sewage: commercial – 5-10m<sup>3</sup>, 6 were private sewage: commercial – 10m<sup>3</sup>, 1 were private sewage: residential – 5-10m<sup>3</sup>, 1 was private sewage: residential – 10m<sup>3</sup>.</li> <li>• 34 had an N loading of greater than 10% contribution to the water body</li> <li>• 63 had a P loading of greater than 10% contribution to the water body</li> </ul>	<p>36 (out of 273) trade discharges were identified as high impact. Of these 36:</p> <ul style="list-style-type: none"> <li>• 7 were in water bodies at good ecological status</li> <li>• 18 were in water bodies at good WFD status for P</li> <li>• 32 were in water dependent SACs, 3 were in water dependent RAMSAR sites and 1 was in a water dependent ASSI</li> <li>• 35 had direct impacts and 1 had indirect impacts to named/habitats and species in Annex I/II</li> <li>• All were in UWWTD sensitive areas</li> <li>• 34 were upstream of shellfish waters</li> </ul>	<p>All high risk trade discharges had an N loading of greater than 10% contribution from discharge and the majority had a P loading of greater than 10% contribution from discharge. Therefore, stricter permitting requirements on nutrients could be needed in the regulations for trade discharges.</p> <p>It is also noted that in the assessment, the permit ranges for several trade discharges were not available so assumed values from literature or equivalent information from the Environment Agency in England Consented Discharges database were used in many cases.</p>

## 5.6 Compliance

### 5.6.1 Summary of compliance

The Northern Ireland Environmental Statistics Report<sup>56</sup> provides figures on private and trade discharge consent compliance, and compliance of Water Utility Sector Wastewater Treatment Works. A summary of the available compliance data is shown in Table 5.3. Private sewage compliance shows the lowest values with compliance being below 80% and decreasing in recent years. Trade effluent compliance and Water Utility Sector WWTW compliance have been above 90% in recent years.

Following the data collection and risk assessment undertaken in this study, it is noted that many discharges consented for under the Urban Wastewater Treatment Regulations (Northern Ireland) 2007 (UWWTR) and under the Water (Northern Ireland) Order 1999 did not have permit conditions for N and P. Regulations and consenting may need to consider stricter requirements for nutrients such as expanding the range of circumstances where permit conditions for nutrients are required to be set. This is especially important for discharges with high nutrient loading.

**Table 5-3 – Compliance summary of private sewage, trade effluent and water utility sector.**

	Private sewage compliance (percentage)	Trade effluent compliance (percentage)	Overall Water Utility Sector WWTW compliance with numeric standards (percentage)	Overall Water Utility Sector WWTW compliance with UWWTR Regulations (percentage)
<b>2001</b>	81	76	Not available	Not available
<b>2002</b>	77	81	Not available	Not available
<b>2003</b>	73	80	Not available	Not available
<b>2004</b>	75	83	Not available	Not available
<b>2005</b>	77	84	Not available	Not available
<b>2006</b>	82	87	Not available	Not available
<b>2007</b>	77	88	84	86
<b>2008</b>	86	87	86	92

<sup>56</sup> 2025 report available at: [https://www.daera-ni.gov.uk/sites/default/files/2025-06/NI%20Environmental%20Statistics%20Report%202025\\_1.pdf](https://www.daera-ni.gov.uk/sites/default/files/2025-06/NI%20Environmental%20Statistics%20Report%202025_1.pdf)

	Private sewage compliance (percentage)	Trade effluent compliance (percentage)	Overall Water Utility Sector WWTW compliance with numeric standards (percentage)	Overall Water Utility Sector WWTW compliance with UWWT Regulations (percentage)
<b>2009</b>	82	88	87	93
<b>2010</b>	88	91	89	94
<b>2011</b>	78	91	93	96
<b>2012</b>	79	90	93	98
<b>2013</b>	82	94	92	98
<b>2014</b>	75	92	92	96
<b>2015</b>	75	95	93	97
<b>2016</b>	Not available	Not available	94	97
<b>2017</b>	76	95	94	94
<b>2018</b>	76	98	95	99
<b>2019</b>	72	93	95	99
<b>2020*</b>	85	92	95	99
<b>2021*</b>	73	92	94	99
<b>2022</b>	79	94	94	99
<b>2023</b>	75	94	94	96
<b>2024</b>	69	92	94	100

*Note: The report does not specify how the private sewage compliance or trade effluent compliance is assessed.*

A compliance summary report is available online<sup>57</sup> but the latest available report is from 2015<sup>58</sup>. This report provides details on enforcement which shows that in 2015, 27 advisory and warning letters were issued, 14 postal cautions were issued and 8 enforcement notices were issued.

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<sup>57</sup> Available at: <https://www.daera-ni.gov.uk/sites/default/files/publications/daera/regulation-of-water-utility-sector-discharges-2014-and-2015.pdf>

Data on storm overflows has been published online by NI Water<sup>59</sup>. It is stated that there are 2,440 storm overflows as of February 2025. Approximately half of these have been modelled and this has resulted in 39% being assessed as 'unsatisfactory' based on NIEA criteria<sup>60</sup>. Whilst some inland storm overflows have been modelled, most of those modelled are coastal storm overflows. A summary document on Northern Ireland's Wastewater System is provided online<sup>61</sup>. This states that, according to the modelling, the ten largest spilling storm overflows account for approximately one third of the total volume of forecast spills.

## 5.6.2 Comparison with England

The compliance of water companies with licenses and permits is provided in the Environment Agency's Environmental Performance Report<sup>62</sup>. The latest report provides data up to 2023. This report states that in 2023, 98.8% of Sewage Treatment Works (STW) and Water Treatment Works (WTW) were compliant, compared to 99.0% in 2022, 98.7% in 2021, 99.2% in 2020 and 98.7% in 2019. It further states that out of 3,800 STW and WTW permitted discharge outlets, there were 45 non-compliant sites compared to 38 in 2022, 49 in 2021, 31 in 2020 and 49 in 2019. There was no water company achieving 100% compliance with their permits. The percentages provided in this Environmental Performance Report are higher than those presented in the Northern Ireland Environmental Statistics Report, indicating higher compliance rates in England compared to Northern Ireland.

It is worth noting that England has a more comprehensive monitoring programme than NI with more data available. A review and subsequent increase in monitoring would be required to compare to England. As discussed in recommendations (Section 6.2).

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<sup>59</sup> Available at: <https://www.niwater.com/about-your-water/storm-overflows>

<sup>60</sup> According to the summary document on Northern Ireland's Wastewater System, the criteria assesses whether the wastewater that is being spilled exceeds normal levels of concentration of foul water or the receiving water is too small to sufficiently absorb what it receives; storm overflow is exceeding acceptable spills in sensitive water courses, there is insufficient emergency storage in place at pumping station or treatment works to retain storm water; and absence of adequate screens that capture solids and other materials.

<sup>61</sup> Available at: <https://www.niwater.com/media/b45br0kt/northernirelandswastewatersystemmay2024.pdf>

<sup>62</sup> Available at: <https://www.gov.uk/government/publications/water-and-sewerage-companies-in-england-environmental-performance-report-2023/water-and-sewerage-companies-in-england-environmental-performance-report-2023#compliance-with-licences-and-permits>

## 6 Conclusions and recommendations

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### 6.1 Conclusions

The developed risk model was used to assess overall wastewater asset risk at the water body scale by assigning a combined risk of pollution based on the discharge magnitude (discharge risk) and receptor sensitivity (impact risk). The model calculates how both discharge and impact risk contribute to the overall risk of N and P pollution of water bodies within NI. The model dashboard provides catchment level information regarding the contribution of all wastewater assets within the catchment to the overall N and P load within the water body.

#### 6.1.1 Model outcomes

When load contributions by asset group are aggregated at the national level (all asset load contributions to water bodies for N and P in NI), WwTWs consented under the Water Order (1999) (sites with PE<2000 and discharge >5m<sup>3</sup>/day) contribute the greatest proportion of load for N and P. Septic tanks make the second highest contribution of N, closely followed by WwTWs with a PE> 20,000. The latter are also calculated as contributing the second greatest load of P.

When considering overall risks, wastewater assets serving larger populations (WwTWs, domestic consents and trade discharges) typically have Low or Medium overall risks, whilst septic tanks are typically of high overall risk with 40% of septic tanks falling in the High overall risk category. Sensitivity testing suggests that the overall risk of High for septic tanks could reduce to Medium (if concentration or flow is reduced within reported ranges), however, given the small size of load for individual assets compared to other types, this is still a significant risk.

The large number of septic tanks compared to all other assets (at 161,628 this is 13 times more than that WwTWs consented under the Water Order (1999)) and their presence in all water bodies would support the hypothesis that this asset type poses a higher risk of pollution as there is greater likelihood of impact as sensitive receptor. However, as location information at the site scale was not available, an assessment of whether a septic tank or cluster of septic tanks was upstream or downstream of a sensitive receptor (and therefore a source of pollution) was not attempted. The number of septic tanks represented in the model is an underestimate as this only includes sites which NIW de-sludge on an annual basis meaning that the model is likely to be calculating a lower load than is released in reality. For comparison, the risk of pollution from the 24 large >20,000 PE WwTWs, linked to more densely populated areas mainly in the east and north, with a known higher level of treatment which reduces the load term, the risk of pollution is typically Low or Medium.

Furthermore, at the river basin scale, all three river basins had a Low overall risk, but “hot spots” of High-risk clusters were noted, particularly in the North Western River Basin. This is likely due to the presence of a high number of designated sites within the north and west

areas of the river basin, with long and linear designations around river networks which intersect multiple water bodies, as well as the presence of UWWTD sensitive areas that combined lead to increased receptor sensitivity.

As previously noted, there is high confidence in approximately half of the datasets which were available for this project, and therefore there are key datasets with some uncertainty around them. Whilst assumptions have been generated by following appropriate methods and datasets used in England and for WFD assessment, there are a few key possible improvements that should be considered and these are listed in section 6.2.1

### **6.1.2 Links to the regulatory framework**

The review of relevant wastewater regulations and comparison with the findings of the model suggested that there were gaps in the regulations, especially around smaller sites. Key model components contributing to medium and high risk were aging treatment works (although the date of the latest upgrade was not available), high nutrient loading contributing greater than 10% to the overall load in the water body, and lack of numerical permits for N and P.

This indicates that regulations and consenting may need to consider stricter requirements for nutrients including expanding the range of circumstances where permitting is required and reviewing permitted nutrient loading quantities. Age of assets (or latest upgrade) and integrity / performance may also need to be considered in the consenting process. Reported compliance data, suggests that wastewater assets operated by NIW are 94% compliant with numerical permits whilst those operated privately have 69% compliance which is low compared to prior years. The reason for this change and method of private site compliance check is unknown. This latter group will mainly comprise smaller sites and these were identified as posing a high risk in this assessment.

## **6.2 Recommendations**

### **6.2.1 Model Improvements**

Based on the confidence in the model results, the following improvements are suggested:

- Inclusion of transboundary data for discharges in the Irish Republic. This would involve discussion with the Irish Environmental Protection Agency and Irish Water to allow for dataset integration.
- Inclusion of actual monitoring data for trade and domestic discharges in NI.
- A more complete dataset for septic tank locations (e.g. from NIEA combined with that from NIW).
- A check of flow gauging data with information from catchment investigations.
- Use of water quality data for the more recent period when published (i.e. 2018 to 2024).

- Improved information on CSOs and discharge frequency as this is now being published by NIW (at the time of project inception only coastal outfalls were published).
- Inclusion of NIW climate change plans for the climate change scenarios.
- A detailed pilot for one catchment with source apportionment to compare to the results of the model.

These recommendations are focused on information which is either already available or being published in the near future. In addition, further ground truthing of model results through stakeholder consultation (i.e. NIW and NIEA) would be sensible.

### **6.2.2 Further research**

A cumulative assessment of loading to downstream receptors (i.e. TraCs and lakes) would be a logical next step in the modelling. This could be designed to assess the relative impact of wastewater assets on water body end points i.e. the most downstream water body along a freshwater flow path or string of water bodies. These downstream water bodies are all TraCs, but it would be recommended that this also include Lough Neagh due to its size and the large number of water bodies (141) flowing into it. This assessment could sit alongside the risk assessment model and use the loading calculation data to calculate cumulative increases in N and P in the end water bodies.

A high-level method could include:

- Using geospatial data to identify water body strings (upstream water bodies from a specific water body) for cumulative assessments.
- Calculating the overall N and P load from assets for each end point by summing the total contribution from each upstream water body as determined from the loading calculations.
- Water quality data for DIN would be converted from  $\mu\text{Mol}$  to N kg/day for the loading calculations.
- Each water body's contribution would then be proportioned against the overall asset load in the water body end point to identify which water bodies upstream of a particular end point were contributing the greatest amount of loading from assets.

As for the loading calculations, the high-level cumulative assessment would represent dilution, but processes such as in channel attenuation and cycling or plant uptake of nutrients would not be represented.

Finally, as evidenced from the case studies, extensive stakeholder engagement would be required to fully ground truth the model. This would likely be required at a granular scale to investigate all assets but could be done at a larger scale for more general investigations or focused on the water bodies and receptors modelled as being at highest risk of pollution from wastewater assets.

# Appendix A

## Glossary





## Glossary

AFBI - Agri-food Biosciences Institute

ASSIs - Areas of Special Scientific Interest

BOD - Biochemical Oxygen Demand

CARID - Corporate Asset Register Identification

CMIIC - Compliance, Monitoring and Invoicing of Industrial Consents

CSM - Common Standards Monitoring

CSO - Combined Sewer Overflows

DAERA - Department of Agriculture, Environment and Rural Affairs

DWF - Dry Weather Flow

EDM - Event Duration Monitoring

eFLAG - Enhanced Future Flows and Groundwater

EPA - Environmental Protection Agency

EQS - Environmental Quality Standards

GIS - Geographical Information Systems

HOST - Hydrology of Soil Types

iRBD - River Basin District

LoD - Limit of Detection

LoQ - Limit of Quantification

NI - Northern Ireland

NIEA - Northern Ireland Environment Agency

NISRA - Northern Ireland Statistics and Research Agency

NIW - Northern Ireland Water

NRFA - National River Flow Archive

OEP - Office for Environmental Protection

PDE - Pre Development Enquiry

PE - Population Equivalent

PoMs - Programmes of Measure

RCM - Regional Climate Model

SACs - Special Areas of Conservation



SPAs - Special Protection Area

SSSIs - Sites of Special Scientific Interest

STWs - Sewage Treatment Works

TraC - Transitional & Coastal Waters

UKCEH - UK Centre for Ecology and Hydrology

UWWTD - Urban Wastewater Treatment Directive

UWWTR - Urban Wastewater Treatment Regulations

WFD - Water Framework Directive

WO - Water Order

WwTW - Wastewater Treatment Work

# Appendix B

## Data Reference List

Provided electronically only



# Appendix C

## **The developed risk scoring model and underlying datasets**

Provided electronically only



# Appendix D

## Case Study Examples



## Faughan River (Carmoney)

The Faughan River (Carmoney) (UKGBNI1NW020208259), is located in NI near the border with the Republic of Ireland, flowing northeast towards the coast, on the eastern side of Londonderry, NI’s second largest city. The Faughan River (Carmoney) typically has low phosphorus concentrations (0.01 mg/l) and relatively low nitrate concentrations (1.19 mg/l) (data from NIEA from 1990 to 2018). The Faughan River catchment has records for six wastewater treatment works (WwTW), four trade discharges, 55 domestic consents and 903 septic tanks within it (Figure D-2). The Carmoney potable intake (operated by NIW) is also situated on the Faughan River and supplies the city of Derry.

Each asset has been assigned a discharge magnitude rank and receptor impact rank, to provide an overall risk score. In this context, the term “risk” refers to the risk of nutrient pollution from wastewater assets to the receiving water body. The parameters feeding into the discharge magnitude and impact ranks are described by asset category in this technical note. The overall risk score is used to determine an overall risk rating, ranging from negligible to high. The scoring matrix for risk rating is shown in Table D-1.

**Table D-1 – Overall risk of nutrient pollution matrix rating boundaries from model**

	Lower Boundary	Upper Boundary
<b>Negligible</b>	1	2
<b>Low</b>	3	6
<b>Medium</b>	7	9
<b>High</b>	10	16

## Asset Groupings

### WwTW

Of the six WwTW, five of the six assets fall under the “<2000 PE and >5m<sup>3</sup>” asset category and one is in the “>2000PE and >5m<sup>3</sup>” asset category. None numerical permits for N or P. The age of all the WwTWs is unknown and the discharge locations of three WwTW (Ardground, Killaloo and Legahory) are situated in headwater streams whilst the remaining three WwTW (Claudy, Gosheden Two and Knockbrack) are positioned in main river stems.

All of the WwTWs fall under the category of “no intermittent discharges within 10 km upstream” apart from Ardground WwTW which has 1-2 intermittent discharges within 10 km



upstream and Legaghory WwTW which has 3-5 intermittent discharges within 10km upstream. In this context, “no intermittent discharges within 10 km upstream” has been assumed based on available data.

Table D-2 identifies 12 wastewater pumping stations (WwPS) and one combined sewer overflow (CSO) with spills in 2024 (based on NIW spills spreadsheet), although three assets are yet to be determined with an update to the data likely as further modelling is completed. Therefore, as this spill dataset is incomplete and only available for 2024, it has not been included within the risk assessment model reported here.

**Table D-2 – Spills from storm overflows discharging into Faughan River (Carmoney) in 2024**

<b>CARID</b>	<b>Name</b>	<b>Predicted Spill Frequency / Year</b>	<b>Predicted Spill Volume / Year (m<sup>3</sup>)</b>	<b>Storm Overflow Classification</b>
SP002021917	Bleach Green WwPS	80	2280	Unsatisfactory
SP002021892	Lettershendony 2 WwPS	45	1453	Unsatisfactory
SP002641421	Drumahoe WwPS	1	343	Satisfactory
SP003019680	Three Mile WwPS	1	151	Satisfactory
SP002021919	Gortree Road WwPS	19	120	Unsatisfactory
SP002021948	Berryburn Ardkill WwPS	5	28	Unsatisfactory
SP002021913	Cross Drumahoe WwPS	1	4	Unsatisfactory
SP002021916	Beeches Drumahoe WwPS	0	0	Unsatisfactory
SP002021920	Old Mill Mews Drumahoe WwPS	0	0	Unsatisfactory

CARID	Name	Predicted Spill Frequency / Year	Predicted Spill Volume / Year (m <sup>3</sup> )	Storm Overflow Classification
SP002021912	Templetown Park WwPS	0	0	Unsatisfactory
SP002578113	Claudy WwPS			To be determined
CO000984148	Pinewood Crescent CSO			To be determined
SP002021895	Cregg WwPS			To be determined

The criteria outlined in paragraph 1 of Section 2.2.1, along with the N and P loading categories, result in the discharge magnitude score of High risk for Ardground WwTW, Legaghory WwTW and Killaloo, with all remaining WwTWs discharging to the Faughan River catchment having a discharge magnitude of Medium. Based on the discharge magnitude score and impact rating, a risk rating has been assigned to all WwTWs (Table D-3). The outcomes highlight that all WwTW have a risk rating of High

**Table D-3 - WwTW risk ratings for Faughan River (Carmoney)**

CARID	Asset Name	Discharge Magnitude		Asset Impact		Overall Risk Rating	
		Score	Rank	Score	Rank	Score	Rank
WW002063597	Ardground WwTW	4	High	4	High	16	High
WW002063397	Claudy WwTW	3	Medium	4	High	12	High
WW002063596	Gosheden Two WwTW	3	Medium	4	High	12	High

WW002063396	Killaloo WwTW	4	High	4	High	16	High
WW002063598	Knockbrack WwTW	3	Medium	4	High	12	High
WW002063594	Legaghory WwTW	4	High	4	High	16	High

## Trade Discharges

There are four trade discharges within the Faughan River catchment, including three food processing trade effluents and one non-inert waste disposal sites. Of the three food processing trade effluents, there are two fish hatcheries and one fish farm. The discharge location of both fish hatcheries is within a second order tributary, whereas the fish farm and waste disposal site have discharge locations situated in the main river stem.

The model carries the assumption that all trade discharges are operational, operating in compliance with their permits and that their permits are fit for the purpose of protecting water quality of the receiving water bodies. However, based on local knowledge the three food processing trade discharges are not currently operational and therefore their risk is based on if these were to come back into operation. Furthermore, the waste disposal site discharging into Faughan River via groundwater was identified as breaching its permit limits seven times between 2007 and 2013, considered one of Europe’s largest environmental dumps.<sup>63</sup>

Based on the information provided by the model, including industry type, discharge location and N and P loading calculations, all trade effluent discharges have been categorised with a discharge magnitude rank of Medium.

**When considering the impact score and discharge magnitude combined, the overall outcome for each trade effluent is a High risk rating (**

Table D-4).

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<sup>63</sup> Page, C. (2025). Mobuoy: Two jailed over one of Europe’s largest illegal dumps. *BBC News*. [online] 6 Jun. Available at: <https://www.bbc.co.uk/news/articles/c365yn4d907o>.

**Table D-4 - Trade discharge risk ratings for Faughan River (Carmoney)**

Trade discharge unique ID	Industry Type	Discharge Magnitude		Impact		Overall Risk Rating	
		Score	Rank	Score	Rank	Score	Rank
11386/90_60205	Food Processing: Fish Hatchery	3	Medium	4	High	12	High
33/05_60204	Food Processing: Fish Farm	3	Medium	4	High	12	High
1924/16/1_60205	Food Processing: Fish Hatchery	3	Medium	4	High	12	High
225/82_61652	Waste Disposal Site: Non-Inert	3	Medium	4	High	12	High

## Domestic Consents

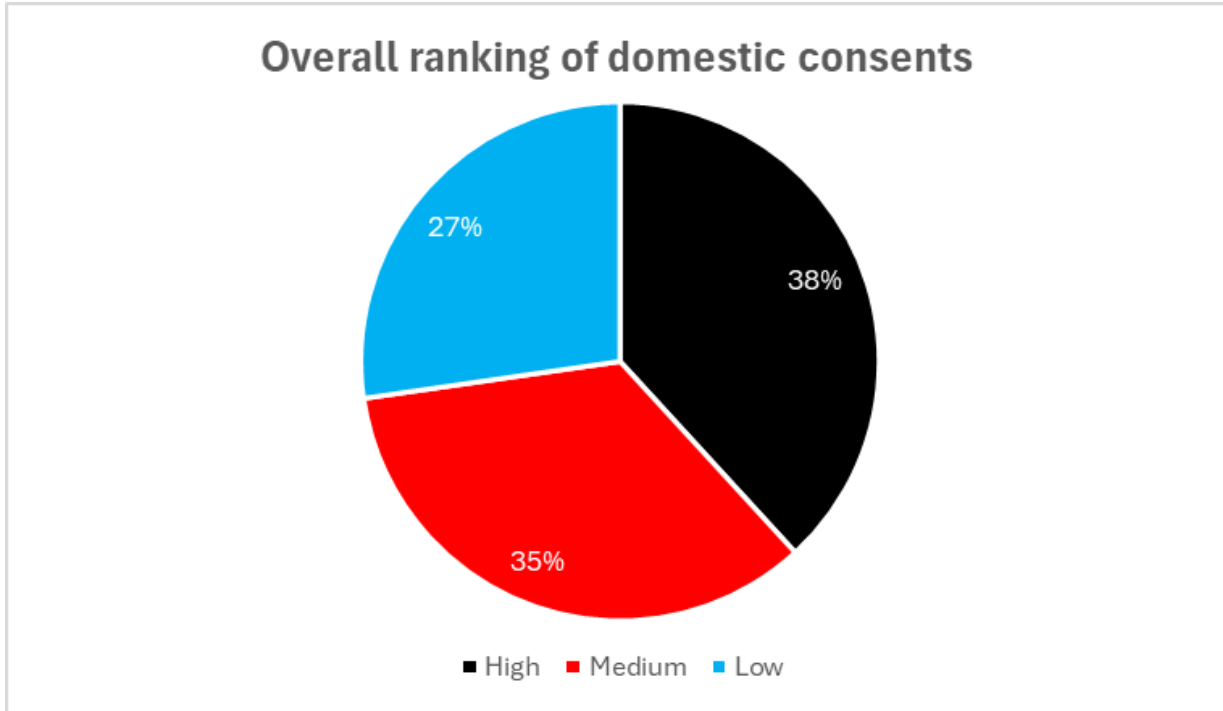
There are fifty-five domestic consents within the Faughan River catchment, with most discharge locations located in headwater streams (thirty of the fifty-five), fourteen located in second order tributaries and eleven with discharge locations within the main river stem.

Based on this information as well as N and P loading calculations, thirty-three domestic consents have a discharge magnitude rank of Medium, whilst the remaining twenty-five have a discharge magnitude rank of Low.

Using the discharge magnitude and impact scoring, a risk rating has been assigned to each of the discharge consents. Twenty-one of the discharge consents (38%) have been

assigned a High risk rating, nineteen (35%) have been assigned a Medium risk rating, and fifteen (27%) have been assigned a Low risk rating (Figure D-1). The overall risk rating for domestic consents is Medium.

**Figure D-1 - Overall ranking of domestic consents for Faughan River (Carmoney)**



## Septic Tanks

The overall risk ratings for septic tanks were completed using a different methodology than what was used for the other asset groupings, which is discussed in section 2.3.3.2. As there are no specific locations known for septic tanks, the septic tank risk is assessed at water body scale, using a buffer from lakes and rivers, and soil type.

Both the asset risk and the receptor sensitivity risk are scored as High, therefore the overall risk score for septic tanks is High (Table D-5).

**Table D-5 - Septic tank risk ratings for Faughan River (Carmoney)**

	No. of septic tanks in this category	Discharge Magnitude Risk	Receptor sensitivity risk	Overall Risk
Gley outside of 80m river buffer	309	High	High	High

Gley inside of 80m river buffer	61	High	High	High
Non-gley inside of 80m river buffer	92	High	High	High
Non-gley outside of 80m river buffer	441	Low	High	Medium

## Impact Rating

For the location of all discharges into the Faughan River (Carmoney), the WFD Ecological Status is Moderate (medium risk), with a High status for phosphorus (P) (high risk).

Information regarding the protected features and latest conditions of designated sites within the Faughan catchment are shown below in Table D-6. For the WwTW, trade discharges, septic tanks and most discharge consents, the receiving sections of the Faughan River water body are hydrologically connected to these designated sites. As such, the highest designation is the Special Area of Conservation (SAC), with identified direct impacts to named habitats/species in Annex I/II of the Habitats Directive (92/43/EEC), and the lowest condition is “unfavourable, unclassified” based on the latest data for the Special Area of Protection (SPA) and Area of Special Scientific Interest (ASSI). Furthermore, the discharge locations are upstream of Shellfish Waters. This, therefore, gives an impact score of 28 and an impact magnitude of High.

There are 15 domestic consents that discharge to an area of the water body that has no dependent site designations, and therefore no impact on relevant habitats or species, or water dependent lowest condition. They do however fall under UWWTD sensitive areas and upstream of Shellfish Waters. As a result, these discharge consents have an impact score of 14 and an impact magnitude of Low.

**Table D-6 - Designated sites within the Faughan River (Carmoney) catchment**

Designation	Site Name	Feature	Feature Type	Latest condition and sub-category	Latest monitoring year of assessment
ASSI	Bonds Glen	Oakwood	Woodlands	Unfavourable, unclassified	2022
		Purple Moor-grass and rush pastures	Grasslands	Unfavourable, unclassified	2015
		Wet woodland	Woodlands	Unfavourable, unclassified	2022
	Lough Foyle	Bar-tailed Godwit (Winter)	Bird	Favourable, Un-classified	2018
		Bewick's Swan (Winter)	Bird	Unfavourable, Un-classified	2018
		Breeding bird assemblage	Bird	Favourable, Un-classified	2008
		Coastal processes	Earth Science	Favourable, Maintained	2010
		Coastal saltmarsh	Coastal	Unfavourable, Un-classified	2016
		Curlew (Winter)	Bird	Favourable, unclassified	2018
		Dunlin (Winter)	Bird	Unfavourable, Un-classified	2018
		Eider (Winter)	Bird	Favourable, unclassified	2018
		Golden Plover (Winter)	Bird	Favourable, unclassified	2018
		Great Cormorant (Winter)	Bird	Favourable, unclassified	2018
		Great Crested Grebe (Winter)	Bird	Favourable, unclassified	2018
		Greylag Goose (Winter)	Bird	Favourable, unclassified	2018
		Invertebrate assemblage	Invertebrates	Favourable, unclassified	2007
		Knot (Winter)	Bird	Favourable, unclassified	2018
		Lapwing (Winter)	Bird	Favourable, unclassified	2018
		Light-bellied Brent Goose (Winter)	Bird	Favourable, unclassified	2018
		Mallard (Winter)	Bird	Unfavourable, Un-classified	2018
		Mute Swan (Winter)	Bird	Unfavourable, Un-classified	2018
		Oystercatcher (Winter)	Bird	Favourable, unclassified	2018
		Red-breasted Merganser (Winter)	Bird	Favourable, unclassified	2018
		Redshank (Winter)	Bird	Favourable, unclassified	2018
		Shelduck (Winter)	Bird	Favourable, unclassified	2018
		Teal (Winter)	Bird	Favourable, unclassified	2018
		Waterbird assemblage (Winter)	Bird	Favourable, unclassified	2018

		Whooper Swan (Winter)	Bird	Favourable, unclassified	2018
		Wigeon (Winter)	Bird	Unfavourable, Un-classified	2018
	River Faughan and tributaries	Atlantic Salmon - <i>Salmo salar</i>	Fish	Favourable, unclassified	2011
		Dalradian	Earth Science	Favourable, maintained	2023
		Oakwood	Woodlands	Unfavourable, unclassified	2008
		Otter - <i>Lutra lutra</i>	Terrestrial mammals	Favourable, unclassified	2015
		River	Freshwater	Unfavourable, unclassified	2011
SPA	Lough Foyle	Bar-tailed Godwit (Winter)	Bird	Favourable, unclassified	2018
		Bewick's Swan (Winter)	Bird	Unfavourable, unclassified	2018
		Golden Plover (Winter)	Bird	Favourable, unclassified	2018
		Light-bellied Brent Goose (Winter)	Bird	Favourable, unclassified	2018
		Whooper Swan (Winter)	Bird	Favourable, unclassified	2018
		Waterbird assemblage (Winter)	Bird	Favourable, unclassified	2018
SAC	River Faughan and tributaries	Atlantic salmon – <i>Salmo salar</i>	Fish	Favourable, unclassified	2013
		Otter – <i>Lutra lutra</i>	Mammal	Favourable, unclassified	2024

Note Shellfish Waters are also a designated site, however, data is only available as presence/absence.



## Combined Risk Status

### Risk Scoring Results

The overall risk score for each asset type is shown in Table D-7. Based on this, the overall discharge magnitude rank is Medium, whilst the asset impact is High . Therefore, the overall risk to the water body is considered High.

**Table D-7 – Overall risk status for Faughan River (Carmoney)**

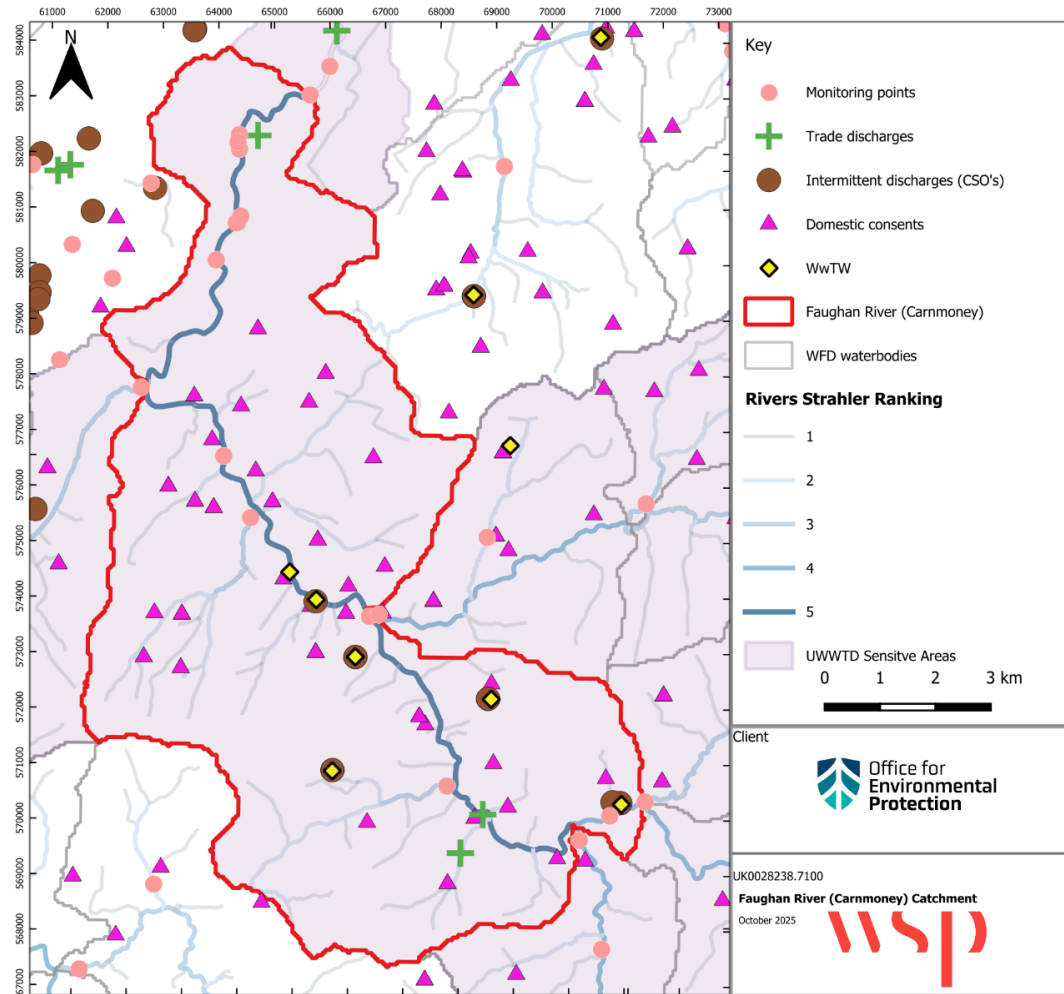
	Risk
<b>WwTW</b>	<b>High</b>
<b>Trade discharge</b>	<b>High</b>
<b>Domestic consent</b>	<b>Medium</b>
<b>Septic tanks</b>	<b>High</b>
<b>Asset Impact</b>	<b>High</b>
<b>OVERALL RISK</b>	<b>HIGH</b>

### Other Influential factors

Local knowledge of the area has identified a potential influential factor present within the catchment that may impact the overall risk of the discharges in the catchment. The Carmoney water pumping station (WPS) abstracts water from Faughan River for treatment and potable supply to the wider Derry, Londonderry and Strabane areas.<sup>4</sup> The abstraction of water from the Faughan River will reduce the dilution of discharges into that stretch of the water body, meaning there is a potential for greater impacts on downstream water bodies and protected sites than scored in the model here.

However, as the impact of river abstractions on dilution has not been considered overall in the model this impact is not reflected in the overall risk status identified for the catchment.

**Figure D-2 - Faughan River (Carmoney) example catchment**





## River Lagan (Stranmillis)

The River Lagan (Stranmillis) (UKGBNI1NE050503108) is to the southwest of Belfast, encompassing over half of NI's 3rd largest city, Lisburn. The River Lagan catchment has records of six WwTW, no trade discharges, 83 domestic consents and 977 septic tanks (Figure D-4).

### Asset Groupings

#### WwTW

Of the six WwTW, three are within the "<2000 PE and >5m<sup>3</sup>" category (Ballycairn, Drumbeg and Edenderry Belfast), whilst the other three are within the ">20,000 PE" category. The assets in the larger asset group have numerical consents for N and P and an asset age of 11-50 years old, whilst the others have no permits for N or P and an asset age of 51-100 years old. All assets have no fails or non-assessment in 6 years, and most assets discharge within main river stem, apart from Ballycairn WwTW which discharges into a headwater stream and Lisburn WwTW which discharges into a second order tributary. Four assets have no known intermittent discharges within 10 km upstream, whilst Lisburn WwTW has 3-5 and Dunmurry WwTW has 8-10. Finally, four WwTW have a population of >15,000 whilst the remaining two have a population of <2,000 (Drumbeg WwTW and Edenderry Belfast WwTW).

The above groupings, along with treatment type and N and P loading categories, result in the discharge magnitude ranks of Medium for all WwTW apart from Newtownbreda WwTW and Edenderry Belfast WwTW which have discharge magnitude ranks of Low. Based on the discharge magnitude score and impact rating, a risk rating has been assigned to all WwTW (Table D-8). The outcomes highlight that all WwTW have an overall risk rating of Medium, with the exception of Newtownbreda WwTW and Edenderry Belfast WwTW which have risk ratings of Low.

**Table D-8 - WwTW risk ratings for River Lagan (Stranmillis)**

CARID	Asset Name	Discharge Magnitude		Asset Impact		Overall Risk Rating	
		Score	Rank	Score	Rank	Score	Rank
WW002064166	Ballycairn WwTW	3	Medium	3	Medium	9	Medium

WW002064165	Drumbeg WwTW	3	Medium	3	Medium	9	Medium
WW002063958	Dunmurry WwTW	3	Medium	3	Medium	9	Medium
WW002064169	Edenderry Belfast WwTW	2	Low	3	Medium	6	Low
WW002063959	Lisburn WwTW	3	Medium	3	Medium	9	Medium
WW002063956	Newtownbreda WwTW	2	Low	3	Medium	6	Low

Table D-9 identifies 12 WwPs and 19 CSO spills in 2024 (based on NIW spill spreadsheet), although 3 assets are yet to be determined with an update to the data likely as further modelling is completed. As stated in the Faughan River (Carmony) case study, as this spill dataset is incomplete and only available for 2024, it has not been included within the assessment model reported here.

**Table D-9 - Spills from storm overflows discharging into River Lagan (Stranmillis) in 2024**

CARID	Name	Predicted Spill Frequency / Year	Predicted Spill Volume / Year (m <sup>3</sup> )	Storm Overflow Classification
SP003067664	Huguenot Drive 2 WwPS	85	156911	Unsatisfactory

CO000984523	Lambeg Road CSO	150	60031	Unsatisfactory
CO000984366	Belvoir Park CSO	88	52890	Satisfactory
CO000984365	Hampton Park CSO	171	19472	Unsatisfactory
CO000984355	Church Road Knockbreda CSO	171	16930	Unsatisfactory
SP002022151	Huguenot Drive 1 WwPS	18	12197	Unsatisfactory
CO000984524	Sackville Street East CSO	60	6322	Unsatisfactory
CO004072052	Antrim Street CSO	8	5697	Unsatisfactory
SP002022150	Green Hill WwPS	55	5441	Unsatisfactory
CO002974781	River Road Dunmurry CSO	115	4650	Unsatisfactory
CO003042584	Antrim Street McKeown CSO	13	2034	Unsatisfactory
SP002022135	Ramada WwPS	36	924	Unsatisfactory
CO000984409	Ballynahinch Road Waterloo CSO	44	873	Unsatisfactory
SP002022759	Ballylesson Giants Ring WwPS	22	745	Unsatisfactory
CO003042476	Hill Street Waterside CSO	29	479	Satisfactory



CO000984525	Hoggs Weir Lisburn CSO	7	164	Satisfactory
CO003042519	Bow Street CSO	6	147	Unsatisfactory
CO002852833	Linenhall Street CSO	1	56	Unsatisfactory
CO002852836	Orrs Lane CSO	3	47	Unsatisfactory
CO004055273	Antrim Road Tonagh CSO	1	16	Unsatisfactory
CO000984528	Laganbank Road Lisburn CSO	1	14	Satisfactory
CO000984206	Newforge Lane CSO	1	7	Satisfactory
SP003333146	River Road West WwPS	1	3	Satisfactory
CO002853082	Hilden CSO	1	3	Unsatisfactory
CO003042485	Grand Street CSO	0	0	Satisfactory
SP002022152	Edgewater WwPS	0	0	Satisfactory
SP002022133	Long Acre WwPS	0	0	Satisfactory
SP004007668	Ballantine Garden Village WwPS	0	0	Satisfactory
SP002022147	Glenmore WwPS	0	0	Unsatisfactory
SP003396579	Gowan Meadows Ballygowan WwPS			To be determined

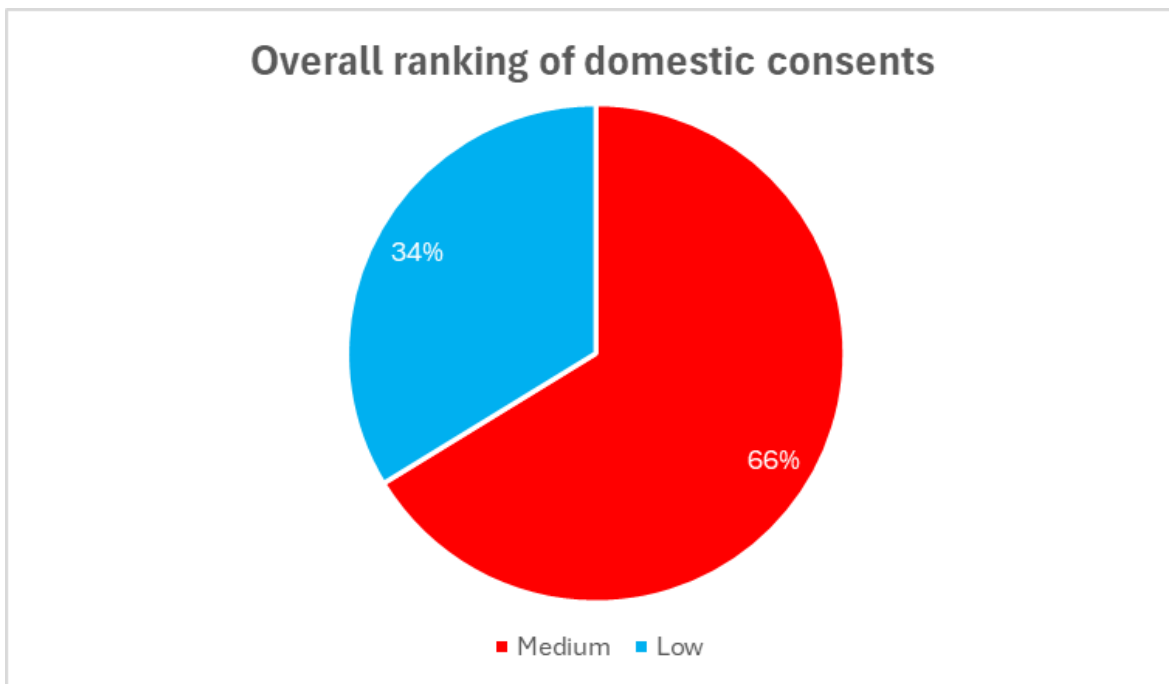
SP002919666	Linen Mill Grove WwPS			To be determined
SP002022131	Ballyskeagh WwPS			To be determined

## Domestic Consents

There are eighty-three domestic consents within River Lagan (Stranmillis), with most discharge locations located in headwater streams (fifty-five of eighty-three), eighteen located in the main river stem, eight located in second order tributaries and two in third order tributaries. Based on this information, as well as N and P loading calculations, fifty-five domestic consents have a discharge magnitude of Medium, whilst the remaining twenty-eight have a discharge magnitude rank of Low.

Considering the discharge magnitude rank and receptor sensitivity, an overall risk rating has been assigned to each discharge consent. Fifty-five of the discharge consents (66%) have been assigned a Medium rating, whilst twenty-eight (34%) have been assigned a Low risk rating (Figure D-3).

**Figure D-3 – Overall ranking of domestic consents for River Lagan (Stranmillis).**



## Septic Tanks

For River Lagan (Stranmillis), the asset risk for septic tanks is High and the receptor sensitivity risk is Medium. Therefore, the overall risk rating for septic tanks is Medium (Table D-10).

**Table D-10 - Septic tank risk rating for River Lagan (Stranmillis)**

	No. of septic tanks in this category	Discharge Magnitude Risk	Receptor sensitivity risk	Overall Risk
Gley outside of 80m river buffer	101	Low	Medium	Low
Gley inside of 80m river buffer	17	Low	Medium	Low
Non-gley inside of 80m river buffer	89	MediumHigh	Medium	Medium
Non-gley outside of 80m river buffer	770	Medium	Medium	Medium

## Impact Rating

For the location of all wastewater asset, the WFD ecological status is poor potential, with a poor status for P (N/A for N in river water bodies). The discharge location from all assets is within UWWTD sensitive areas and upstream of shellfish waters. For all asset types, apart from septic tanks, the discharge locations are not hydrologically connected to a designated site. However, as septic tanks are assessed at the water body scale they are assessed as being hydrologically connected to a designated site with the highest water dependent site being an ASSI, with indirect impacts to ecological communities only and no assessment available for the lowest site condition. Information regarding the protected features and latest conditions of designated sites within the River Lagan (Stranmillis) catchment are shown below in Table D-11.

Therefore, the above gives an impact score of 18 for all WwTW and domestic consents and a score of 22 for septic tanks. Both scores result in an impact magnitude of Medium.

**Table D-11 - Designated sites within River Lagan (Stranmillis)**

Designation	Site Name	Feature	Feature Type	Latest condition and sub-category	Latest monitoring year of assessment
ASSI	Belvoir	Invertebrate assemblage	Invertebrate	Not assessed	Results not yet published as of 2023/24 assessment.
		Wood pasture and parkland	Woodland	Unfavourable, unclassified	2023

## Combined Risk Status

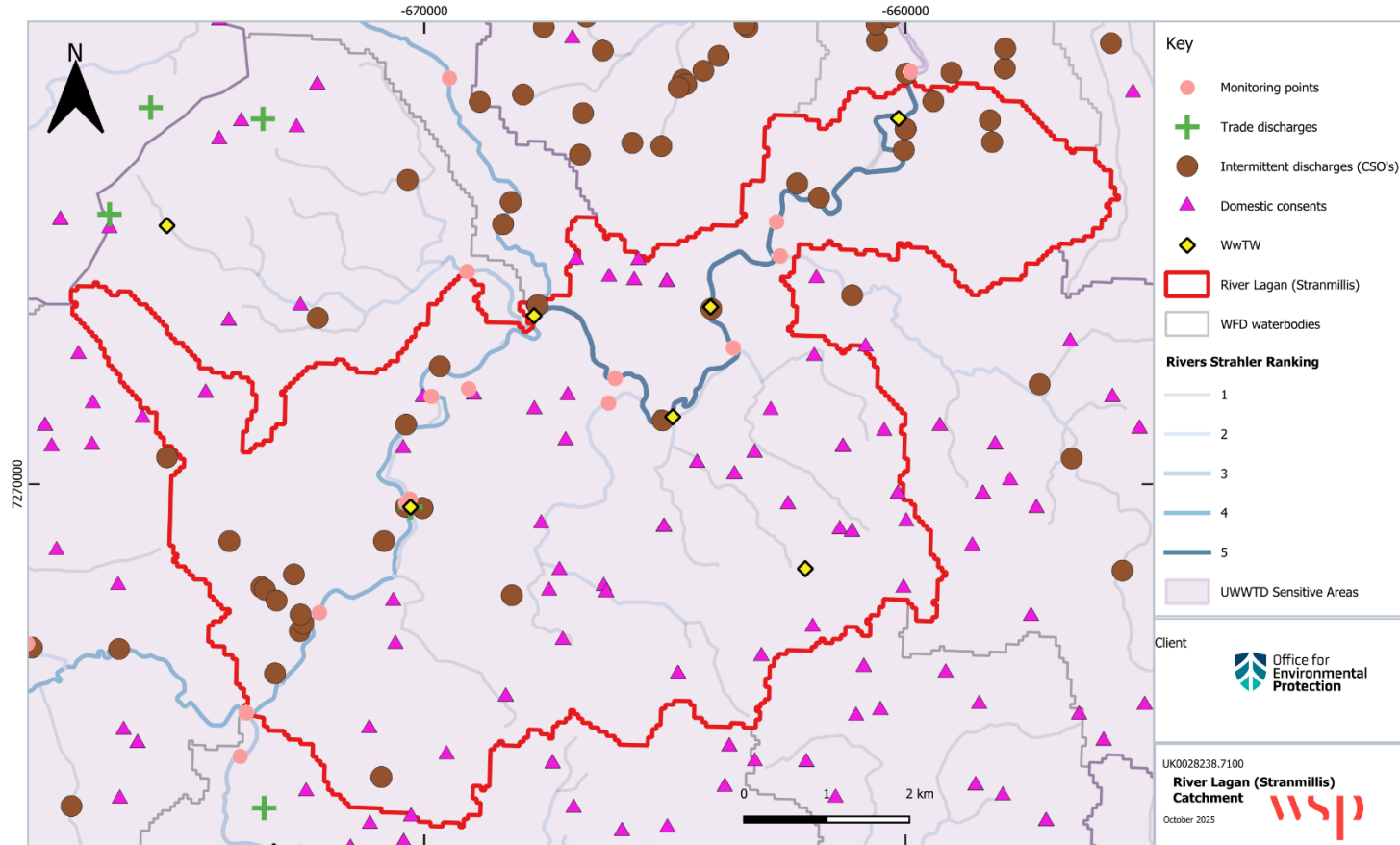
### Overall Risk Rating

The overall risk score for each asset type is shown in (Table D-12). Based on this, the overall discharge magnitude rank and asset impact is Medium. Therefore, the overall risk to the water body is considered Medium.

**Table D-12 - Overall risk status for River Lagan (Stranmillis)**

	Risk
<b>WwTW</b>	<b>Medium</b>
<b>Trade effluent</b>	<b>N/A</b>
<b>Domestic consent</b>	<b>Medium</b>
<b>Septic tanks</b>	<b>Medium</b>
<b>Asset Impact</b>	<b>Medium</b>
<b>OVERALL RISK</b>	<b>MEDIUM</b>

Figure D-4 - River Lagan (Stranmillis) case study



# Arney River

The Arney River (UKGBNI1NW363604059) is located near the southeastern border with Ireland, and flows to the east before joining the River Erne, which flows north-west and through Lough Erne to the sea (Figure D-6). The Arney River catchment has records for four wastewater treatment works (WwTW), no trade discharges, fifty-four domestic consents and 845 septic tanks within it.

## Asset Groupings

### WwTW

Of the four WwTW, all assets fall under the “<2000 PE and >5m<sup>3</sup>” asset group and have no permits for N or P. All assets fall under “no fails or non-assessment in 6 years” and have populations of either >15,000 and <2,000 people. Two WwTW (Arney St Marys and Derryaghna) fall into the age category of “>100 years old or unknown”, whilst the other two WwTW fall into the age category of “11-50 years old”. Two WwTW (Arney St Marys and Derryaghna) discharge to a second order tributary, whilst Florencecourt discharges to a main river stem and Letterbreen West discharges to a headwater stream. Furthermore, three WwTW have no known intermittent discharges within 10 km upstream, with Derryaghna WwTW having 3-5 intermittent discharges within 10km upstream.

The above groupings, along with treatment type and N and P loading categories, result in the discharge magnitude ranks of High for Derryaghna WwTW, Medium for Arney St Marys and Letterbreen West WwTW, and Low for Florencecourt WwTW. Based on the discharge magnitude score and impact rating, a risk rating has been assigned to all WwTW (Table D-13). The outcomes highlight that all WwTW have a risk rating of Low, except for Florencecourt WwTW which has a risk rating of Negligible.

Unlike for the Faughan River (Carmoney) and Riven Lagan (Stranmillis) case studies, there was no spill data available for the Arney River water body based on the NIW spills spreadsheet. This may change when further modelling is completed.

**Table D-13 - WwTW risk ratings (Arney River)**

CARID	Asset Name	Discharge Magnitude		Asset Impact		Overall Risk Rating	
		Score	Rank	Score	Rank	Score	Rank
WW002063697	Arney St Marys WwTW	3	Medium	1	Negligible	3	Low

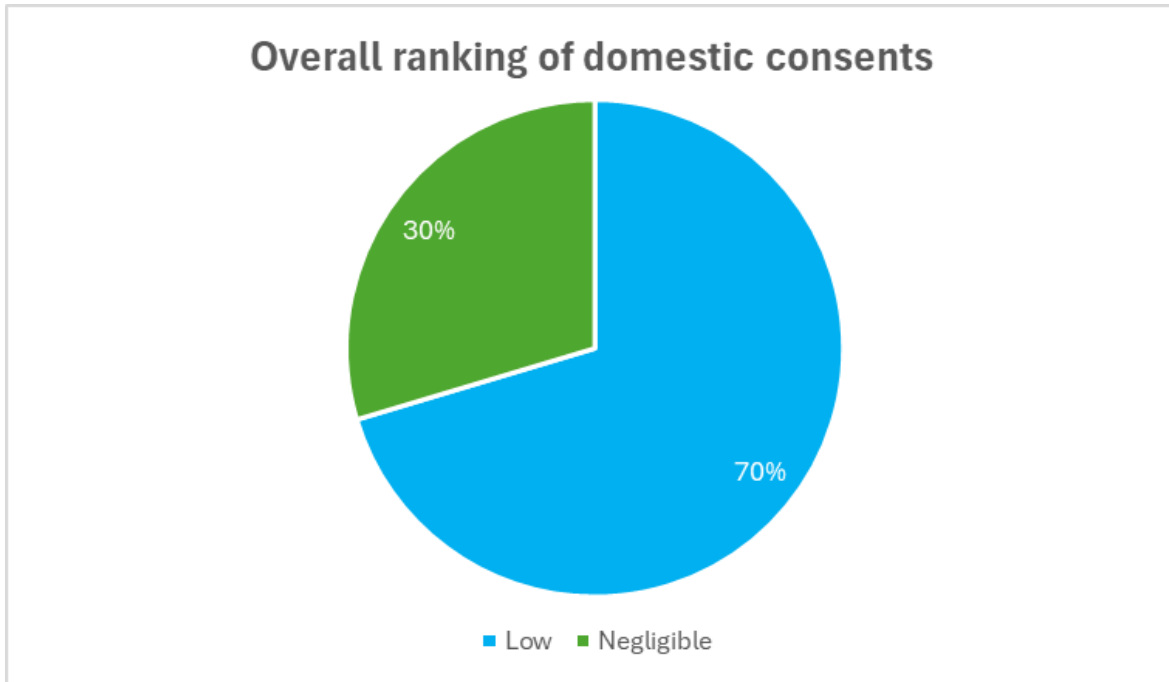
WW002063690	Derryaghna WwTW	4	High	1	Negligible	4	Low
WW002063687	Florencecourt WwTW	2	Low	1	Negligible	2	Negligible
WW002821283	Letterbreen West WwTW	3	Medium	1	Negligible	3	Low

## Domestic Consents

There are fifty-four domestic consents within the Arney River catchment, with most discharge locations located in headwater streams (thirty-eight of the fifty-four), fourteen located in second order tributaries and two in the main river stem. Based on this information as well as N and P loading calculations, thirty-eight domestic consents have a discharge magnitude rank of Medium, whilst the remaining sixteen have a discharge magnitude rank of Low.

Considering the discharge magnitude rank and receptor sensitivity, a risk rating has been assigned to each of the discharge consents. Thirty-eight of the discharge consents (96%) have been assigned a Low-risk rating and sixteen discharge consents (4%) have been assigned a Negligible risk rating (Figure D-5).

**Figure D-5 - Overall ranking of domestic consents for Arney River**



### Septic Tanks

For Arney River the asset risk for septic tanks was High for and the receptor sensitivity risk is Medium, therefore the overall risk rating for septic tanks is High (Table D-14).

**Table D-14 - Septic tank risk rating**

	No. of septic tanks in this category	Discharge Magnitude Risk	Receptor sensitivity risk	Overall Risk
Gley outside of 80m river buffer	626	High	Medium	High
Gley inside of 80m river buffer	67	High	Medium	High
Non-gley inside of 80m river buffer	57	Medium	Medium	Medium



<b>Non-gley outside of 80m river buffer</b>	<b>95</b>	<b>Low</b>	<b>Medium</b>	<b>Low</b>
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## Impact Rating

Information regarding the protected features and latest conditions of designated sites within the Arney catchment are shown below in Table D-15. All WwTW and domestic consents discharging into Arney River have receiving water bodies at poor WFD ecological status, high status for P (N/A for N river waterbodies) and no hydrologically connected designated sites. Furthermore, the discharge locations are not within UWWTD sensitive areas or upstream of Shellfish Waters. This gives an impact score of 6 and an impact magnitude of Negligible.

However, for septic tanks the discharges impact a SAC, with direct impacts on named habitats/species in Annex I/II and the lowest condition of the water dependent site is “unfavourable, unclassified”. Furthermore, the discharge locations are within UWWTD sensitive areas. Therefore, the impact score for Arney River with respect to septic tanks is 25 and impact magnitude is Medium.

**Table D-15 - Designated sites within Arney River catchment**

	Site Name	Feature	Feature Type	Latest condition and sub-category	Latest monitoring year of assessment
ASSI	Tattenamona Bog	Lowland raised bog	Bog	Favourable, unclassified	2016
	Upper Lough Erne – Belleisle	Breeding wader assemblage	Bird	Unfavourable, unclassified	2007
		Coot (Winter)	Bird	Favourable, unclassified	2018
		Eutrophic standing waters	Freshwater	Unfavourable, unclassified	2006
		Fens	Fen, marsh and swamp	Favourable, unclassified	2007
		Goldeneye (Winter)	Bird	Unfavourable, unclassified	2018
		Great Crested Grebe (Winter)	Bird	Favourable, unclassified	2018
		Heronry	Bird	Unfavourable, unclassified	2018
		Higher plant assemblage	Vascular plant	Unfavourable, unclassified	2007
		Little Grebe (Winter)	Bird	Favourable, unclassified	2018
		Mute Swan (Winter)	Bird	Favourable, unclassified	2018
		Oakwood	Woodland	Unfavourable, unclassified	2007
		Otter - Lutra lutra	Terrestrial Mammal	Favourable, unclassified	2012
		Pochard (Winter)	Bird	Unfavourable, unclassified	2018
		Purple Moor-grass and rush pastures	Grassland	Unfavourable, unclassified	2007
		Reedbeds and swamps	Fen, marsh and swamp	Unfavourable, unclassified	2007
		Tufted Duck (Winter)	Bird	Favourable, unclassified	2018
		Wet woodland	Woodlands	Unfavourable, unclassified	2007
	Whooper Swan (Winter)	Bird	Unfavourable, unclassified	2018	
	Cuilcagh Mountain	Blanket bog	Bog	Unfavourable, recovering	2022
		Carboniferous stratigraphy	Earth Science	Favourable, maintained	2011
		Dry heath	Heathland	Unfavourable, unclassified	2022
		Dystrophic lakes	Freshwater	Favourable, unclassified	2015
		Golden Plover (Breeding)	Bird	Unfavourable, unclassified	2011
		Higher plant assemblage	Vascular plants	Unfavourable, unclassified	2006
		Inland rock - Siliceous rocky slopes with chasmophytic vegetation	Inland rock	Favourable, maintained	2012

		Inland rock - Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)	Inland rock	Favourable, maintained	2012
		Invertebrate assemblage	Invertebrates	Unfavourable, unclassified	2019
		Karst	Earth science	Favourable, unclassified	2006
		Montane heath	Heathland	Favourable, unclassified	2012
		Wet heath	Heathland	Unfavourable, unclassified	2022
	Marlbank	Basalt Hawkweed - Hieracium basalticola	Vascular Plants	Not assessed	
		Blanket bog	Bogs	Unfavourable, Un-classified	2018
		Bryophyte assemblage - Lowland calcareous rock (Special habitat 18)	Non-Vascular Plants	Favourable, Un-classified	2022
		Bryophyte assemblage - Riparian habitats (Special habitat 14)	Non-Vascular Plants	Favourable, Un-classified	2022
		Calcareous grassland	Grasslands	Favourable, Un-classified	2018
		Carboniferous stratigraphy	Earth Science	Favourable, Un-classified	2018
		Cave	Earth Science	Favourable, Un-classified	2018
		Fungi assemblage - Grassland fungi	Non-Vascular Plants	Not assessed	
		Higher plant assemblage	Vascular Plants	Not assessed	
		Inland rock	Inland Rock	Not assessed	
		Invertebrate assemblage	Invertebrates	Not assessed	
		Lichen assemblage	Non-Vascular Plants	Not assessed	
		Limestone Pavement	Inland Rock	Favourable, Un-classified	2018
		Lowland meadow	Grasslands	Unfavourable, Un-classified	2018
		Marsh Fritillary - Euphydryas aurinia	Invertebrates	Not assessed	
		Mixed ashwoods	Woodlands	Unfavourable, Un-classified	2018
		Purple Moor-grass and rush pastures	Grasslands	Favourable, Un-classified	2018
		River	Freshwater	Not assessed	
		Surface karst	Earth Science	Favourable, Un-classified	2018
		Upland Flushes, Fens and Swamps	Fen, marsh and swamp	Favourable, Un-classified	2018
		Wet heath	Heathlands	Unfavourable, Un-classified	2018
	Florence Court	Green-flowered Helleborine - Epipactis phyllanthes	Vascular Plants	Not assessed	
		Invertebrate assemblage	Invertebrates	Not assessed	
		Lichen assemblage	Non-Vascular Plants	Not assessed	

		Mixed ashwoods	Woodlands	Unfavourable, Un-classified	2021
		Wood pasture and parkland	Woodlands	Not assessed	
	Belmore Mountain	Blanket bog	Bogs	Unfavourable, Un-classified	2023
		Calcareous grassland	Grasslands	Favourable, Un-classified	2018
		Dry heath	Heathlands	Unfavourable, Un-classified	2023
		Higher plant assemblage	Vascular Plants	Not assessed	
		Inland rock	Inland Rock	Not assessed	
		Lichen assemblage	Non-Vascular Plants	Not assessed	
		Mixed ashwoods	Woodlands	Unfavourable, Un-classified	2023
		Purple Moor-grass and rush pastures	Grasslands	Favourable, Un-classified	2023
		Upland Flushes, Fens and Swamps	Fen, marsh and swamp	Favourable, Un-classified	2023
Wet heath		Heathlands	Unfavourable, Un-classified	2023	
SPA	Upper Lough Erne – Belleisle, Crom, Finn Floods, Galloon & Trannish	Whooper Swan (Winter)	Bird	Unfavourable, Un-classified	2018
SAC	Upper Lough Erne – Belleisle	Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation	Freshwater	Unfavourable, Un-classified	2008
		Otter - Lutra lutra	Mammal	Favourable, Un-classified	2024
	Cuilcagh Mountain	Natural dystrophic lakes and ponds	Freshwater	Favourable, Un-classified	2015
		Northern Atlantic wet heaths with Erica tetralix	Terrestrial	Unfavourable, Un-classified	2022
		Blanket bog	Terrestrial	Unfavourable, recovering	2022



## Combined Risk Status

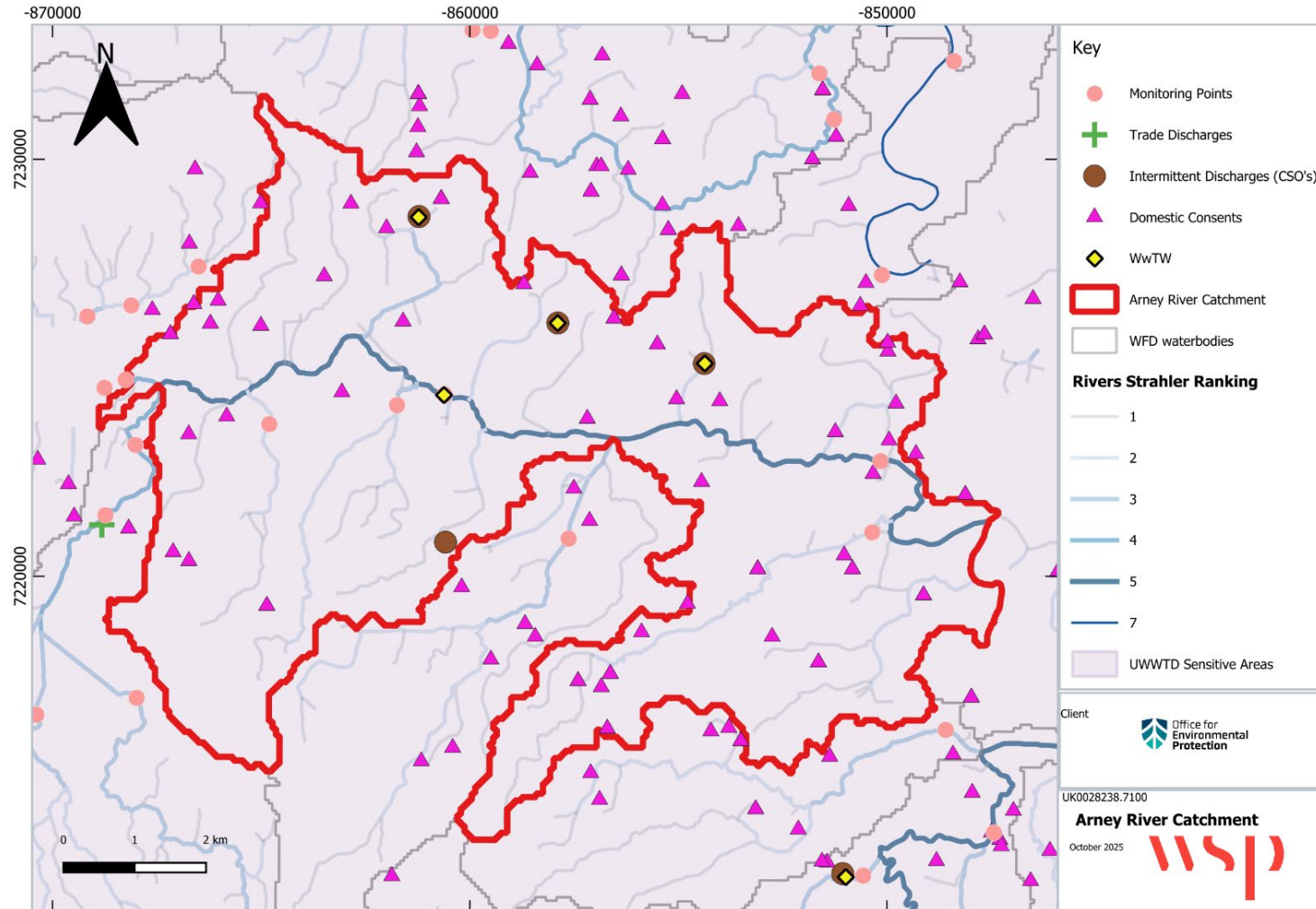
### Overall Risk Rating

The overall risk score for each asset type is shown in Table D-16. Based on this, the overall discharge magnitude rank is **Medium**, whilst the asset impact is **Negligible**. Therefore, the overall risk to the water body is considered **Low**.

**Table D-16 - Overall risk status for the catchment**

	Risk
WwTW	Low
Trade effluent	N/A
Domestic consent	Negligible
Septic tanks	High
Impact rating	Negligible
<b>OVERALL RISK</b>	<b>LOW</b>

Figure D-6 - Arney River case study



# Appendix E

## Further details of consent application requirement



## Appendix E – Further details of consent application requirement

### Domestic consents

The domestic consent process in Northern Ireland requires the completion of an online application form. The information required to be provided on the discharge details are:

- Whether there is an NI Water Ltd foul sewer/private sewer within 30 metres available
- Whether there is more than one house on the development
- Whether the property has planning information
- Whether the discharge is proposed or existing
- If the consent type for a waterway or soakaway/underground stratum. Depending on whether 'waterway' or 'soakaway/underground stratum' is selected, the following further information is required:
  - Waterway: Information on the tertiary treatment / treatment system, whether the system is certified, and the treatment efficiency (% BOD removal).
  - Soakaway/underground stratum: information on the type of system, certification of system, whether the subsurface irrigation system is at least 7m away from habitable dwellings, at least 10m away from any waterway, and at least 50m away from any drinking water supply. Information on length and width of the drainage ditch is also required. Results of percolation tests for are also required.
- Documents covering location map, site plan and CE certification are required to be uploaded.

### Non-domestic consents

Non-domestic consent require the completion of a main application form (WO1 form) accompanied by a separate application form depending on the type of discharge.

#### ***Private sewage infrastructure and wastewater utility discharges***

For sewage effluent discharges, the WO1 form must be accompanied by the Annex 5 application form. This requires the following information to be provided:

- Maximum daily discharge quantity and maximum discharge rate
- Location of discharge
- Location of sampling
- Flow measurement facilities
- Type of treatment plant (septic tank, STWs or other)
- Whether the treatment process will use chemicals
- Details of when the discharge will occur
- Receiving medium (category or waterbody and name of waterway if known)
- Details on sub-surface irrigation systems including distance from the boundary of the premises, distance to a watercourse and distance to any borehole or spring.
- Details of percolation tests

### ***Trade effluent and site drainage***

For trade effluent and site drainage discharges, the WO1 form must be accompanied by the Annex 2 application form. This requires the following information to be provided:

- Full details of the trade effluent and the processes which from which it arises
- Type and number of treatment units
- Maximum daily discharge quantity and maximum discharge rate
- Means of discharge (pipe, channel, culvert or other)
- Location of discharge
- Location of sampling
- Flow measurement facilities
- Type of treatment plants and details of treatment processes
- Details of when the discharge will occur
- Receiving medium (category or waterbody and name of waterway if known)
- Details on sub-surface irrigation systems including distance from the boundary of the premises, distance to a watercourse and distance to any borehole or spring.
- Details of percolation tests.
- Whether the discharge is rainfall dependent or independent
- Details of monitoring and sampling
- Dangerous substances present in the effluent

### ***Aquaculture***

For discharges from aquaculture, the WO1 form must be accompanied by the Annex 4 application form. This requires the following information to be provided:

- Details of the activities
- Species, age range and annual production
- Details of food used on site
- Chemicals stored or used on site
- When the discharge will occur and when it will be continuous
- Water abstraction sources and volume
- Name of receiving waterway
- Composition of effluent (BOD, suspended solids, NH<sub>4</sub>)
- Volume and flow of discharge
- Effluent Treatment processes

### ***Emergency sewage discharge***

For emergency sewage discharges, the WO1 form must be accompanied by the Annex 1 application form. This requires the following information to be provided:

- Location of discharge
- Name of receiving waterway
- Name of wastewater treatment works

- Whether the drainage system served by the pumping station is separated (separated i.e. whether all surface water flows excluded)
- Whether the pumping station is to be adopted by NI Water
- Evidence of Rivers Agency approval
- Evidence of Pre Development Enquiry (PDE) from Northern Ireland Water<sup>64</sup>
- Details of pumps: number and capacity
- Details of design features: daily flow, storage capacity, retention time, facilities for solids separation, minimum particle size to be retained by solids separation equipment, whether facilities will be provided for installation of a mobile stand-by generator, whether there will be access for a tanker to remove sewage when necessary, alarm details.

### **Industrial processes and activities regulated under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013**

For Part A activities (releases to air, water and land), a Part A permit, variation, transfer or surrender application form is required. This contains the following required details:

- Sites and emissions:
  - Sites maps and reports
  - Whether the activity will release hazardous substances that could lead to soil or groundwater contamination
  - Proposed installation activities and processes to reduce waste and emissions
  - Management techniques
  - Raw and auxiliary materials and other substances used
  - Characterisation and quantity of each waste stream
  - Recovery and disposal of waste streams
  - Energy consumption and measures for efficient energy consumption
  - Monitoring details
  - Techniques and measures for joint operations
  - Measures following cessation of activities
  - Nature, quantities and sources of foreseeable emissions
  - Whether emissions will exceed best available techniques associated emission levels (BAT-AELs)
- Receiving environment:
  - Assessment of the potential significant environmental effects (including trans-boundary effects)

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<sup>64</sup> Further information on the pre-development enquiry can be found at: <https://www.niwater.com/services-for-developers/multi-unit-developments/pre-planning/pre-development-enquiry/>



- Links with objectives of Waste Regulations (Northern Ireland) 2011
- Whether the installation is likely to have a significant effect on a European Site, and whether there are any European Sites within 7.5 km of the installation which may be affected by the emissions.
- Details of Environmental Statement (as per Council Directive 2011/927/EU)
- District council area in which the installation is located
- Whether the installation involves the release of any substance into a sewer
- Whether there are any Areas of Special Scientific Interest (ASSI) which are within 7.5 kilometres of the installation or any other ASSIs that will be affected by the emissions
- Whether the installation involves release of any substance to any water, to inland fisheries water, to a harbour managed by a harbour authority and / or to coastal waters.
- Whether the installation is for a site which a major accident prevention policy document or a safety report are required the Control of Major Accident Hazards Regulations (NI) 2015.
- Whether the installation involves the carrying out of a specified waste management activity.
- Whether the installation involves the release of any substance directly into waters under the control of the Loughs Agency or Waterways Ireland.



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