IRISH WATER SIGNIFICANT URBAN WASTE WATER PRESSURES ASSESSMENT

Milford Agglomeration - Technical Report (D0342-01)

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Sole significant pressures
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Abbreviations

- AA – Appropriate Assessment
- AER – Annual Environmental Report
- BOD – Biological Oxygen Demand
- CI – Compliance Investigation
- CIWEM – Chartered Institute for Water and Environmental Management
- COD – Chemical Oxygen Demand
- CSMU – Catchment Science and Management Unit
- DAP – Drainage Area Programme
- D/S - Downstream
- DWWTS – Domestic Waste Water Treatment Systems
- DWF – Dry Weather Flow
- ELV – Emissions Limit Value
- EO – Emergency Overflow
- EPA – Environmental Protection Agency
- EQS – Environmental Quality Standard
- HA – Hydrometric Area
- ICM – Integrated Catchment Management
- NCAP – National Certificate of Authorisation
- NHA – Natural Heritage Area
- NIS – Natura Impact Statement
- OEE – Office of Environmental Enforcement
- OSPAR – Oslo & Paris Convention for Protection of the Marine Environment of the North-East Atlantic
- PAL – Priority Action List
- PE – Population Equivalent
- pNHA – Proposed Natural Heritage Area
- RBMP – River Basin Management Plan
- SAC – Special Area of Conservation
- SPA – Special Protection Area
- SSRS – Small Stream Risk Score
- SWO – Stormwater Overflow
- TSS – Total Suspended Solids
- U/S - Upstream
- UWWTD – Urban Waste Water Treatment Directive
- WFD – Water Framework Directive – Directive 2000/06/EC establishing a framework for Community action in the field of water
- WWDA – Waste Water Discharge Authorisation
- WWTP – Waste Water Treatment Plant

Glossary

- **Agglomeration** – An area where the population and / or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point.
- **Aquifer** – Water-bearing sand, gravel or rock layer yielding usable water quantities.
- **Catchment** – A catchment area is a hydrological unit. Any precipitation that falls into a catchment area will eventually end up in the same river water body if it does not evaporate. Catchments are separated from each other by watersheds.
- **Chemical status** – Chemical status is a quality index used by the Water Framework Directive. For surface waters, the default objective is 'good' chemical status, which means no concentrations of priority substances exceed the relevant EQS established.
- **Coastal water** – Surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.
- **Diffuse Pollution** – Pollution which originates from various activities, and which cannot be traced to one single source. It originates from a spatially extensive land use e.g. agriculture, industry, residential.
- **Discharge** – The release of polluting substances directly or indirectly into water bodies as defined under Article 2 (i) of Water Framework Directive 2000/06/EC.
- **Ecological status** – Ecological status is a biodiversity index developed and used by the Water Framework Directive. 'Good' ecological status is the WFD default objective in all water bodies and is defined as a slight variation form undisturbed conditions. Elements that make up ecological status included biological elements e.g. fish, macro-invertebrates, macrophytes and supporting elements e.g. physico-chemical monitoring and hydromorphology.
- **Groundwater** – All the water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
- **Investigative monitoring point** – This is required where the reason for any exceedances is unknown; where surveillance monitoring indicates that the objectives set under Article 4 for a body of water are not likely to be achieved and operational monitoring has not already been established, in order to ascertain the causes of a water body or water bodies failing to achieve the environmental objectives; or to ascertain the magnitude and impacts of accidental pollution; and shall inform the establishment of a programme of measures for the achievement of the environmental objectives and specific measures necessary to remedy the effects of accidental pollution.
- **Lake** – A body of standing inland surface water.
- **Population Equivalent** – The organic biodegradable load having a five-day biochemical oxygen (BOD-5) demand of 60g of oxygen per day.
- **Ll Aquifer** - Bedrock which is Moderately Productive only in Local Zones
- **Operational monitoring point** – Monitoring that aims to establish the status of waterbodies identified at being 'at risk' of failing to meet their environmental objectives; and assess any changes in the status of such bodies resulting from the programmes of measures.
- **Parameter** – Parameters that are indicative of the quality elements listed in Annex V of the Water Framework Directive that will be used in monitoring and classification of ecological status.
- **Pl Aquifer** - Bedrock which is Generally Unproductive except for Local Zones

- **Point Source Pollution** – Pollution arising from a discrete source e.g. the discharge from a sewage treatment works.
- **Pu Aquifer** – Bedrock which is generally unproductive
- **Q values** – Irish EPA index of water quality based on aquatic conditions.
- **River** – River means a body of inland water flowing for the most part on the surface of the land but which may flow underground for part of its course.
- **Significant pressure** – In terms of WFD, a pressure that on its own or in combination with other pressures, would be liable to cause a failure to achieve the environmental objectives set out under Article 4.
- **Sole significant pressure** – In terms of WFD, a pressure that on its own would be liable to cause a failure to achieve the environmental objectives set out under Article 4.
- **Storm Water Overflow (SWO)** – In Ireland, the majority of urban areas are drained by combined sewer systems, which convey wastewater and stormwater in a single pipe. During rainfall events the capacity of the combined sewer system may be exceeded. A stormwater overflow (SWO) is a structure designed to divert excess flows from the sewer network, either directly or via a storm sewer system, to the receiving water.
- **Subcatchment** – A subcatchment area is a fundamental hydrological unit that is used to model the runoff from a given area of land.
- **Surveillance monitoring point** – Monitoring that aims to allow assessment of long-term changes in natural conditions; the efficient and effective design of future monitoring programmes; validation of the impact assessment procedure detailed in Annex II of the Directive; and the assessment of long term changes resulting from human activity.
- **Transitional water body** – Water bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.
- **Water body** – The basic compliance and management unit for the Water Framework Directive into which all rivers, lakes, ground, transitional and coastal waters are divided

1 STEP 1 – INTRODUCTION & DATA COLLECTION

The Environmental Protection Agency (EPA) Catchment Science and Management Unit (CSMU) identified 'significant pressures' during initial characterisation activities undertaken as part of the development of the River Basin Management Plan (RBMP) 2018-2021[1].

During this initial characterisation process, significant pressures were considered to be pressures that are causing, or are likely to cause, receiving water issues. The official Water Framework Directive[2] (WFD) definition of significant pressures are '…those pressures which, either alone, or in combination with other pressures prevent or put 'at risk' the achievement of WFD Article 4(1) Environmental Objectives including the achievement of 'good' status, the non-deterioration of status, the avoidance of a significant and sustained upward trend in pollution of groundwater, and the achievement of objectives in WFD protected areas'.

The urban waste water significant pressure category encompasses both waste water treatment plants (WWTPs) and waste water networks (Storm Water Overflows (SWOs) and Emergency Overflows (EOs)). Where only one significant pressure category is affecting a water body, it is referred to as a 'sole' significant pressure.

The EPA CSMU identified 63 urban waste water agglomerations as sole significant pressures on a total of 67 river, lake, transitional and coastal water bodies. For each of the urban waste water significant pressures, the EPA CSMU identified what element has been determined to be causing issues i.e. the WWTP, Storm Water Overflows (SWOs), Emergency Overflows (EO) or a combination of these. The EPA Office of Environmental Enforcement (OEE) has raised Compliance Investigations (CIs) in relation to the urban waste water sole significant pressures. These CIs include requirements to examine the WWTPs and SWOs in terms of their potential to impact on receiving water body objectives. In addition, 57 of the sole significant urban waste water pressures have been added to the Priority Action List (PAL) by EPA OEE.

The objectives of the Significant Urban Waste Water Pressures Assessment Project are to:

- collect, collate, summarise and synthesise information in relation to the nature and magnitude of the urban waste water pressures, the pathways to receiving waters from all discharges including SWOs, and the impact on the receiving water environment;
- determine whether or not each of these pressures is significantly impacting water body status or risk, either alone or in combination with other pressure categories;
- quantify any improvements necessary to eliminate the impact of sole significant pressure Agglomerations on water body status and/or risk;
- address all of the issues highlighted in the EPA's online Water Framework Directive Application (WFD App) and in Compliances Investigations (CIs) opened for these pressures.

Outputs from the Significant Urban Waste Water Pressures Assessment Project include:

- Technical reports for each agglomeration describing in detail all of the assessment work undertaken and the conclusions and determinations made;
- Summary outcome reports for each agglomeration summarising the outcome of the assessments;

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[1] Department of Housing, Planning and Local Government, *River Basin Management Plan for Ireland 2018-2021*

[2] European Commission, *Common Implementation Strategy for the Water Framework Directive,* 2003

- An overall summary spreadsheet.

This document is the technical report in relation to the Milford agglomeration (D0342-01).

1.1 Assessment Approach

Figure 1.1 outlines the steps involved in the assessment of the sole significant pressure agglomerations.

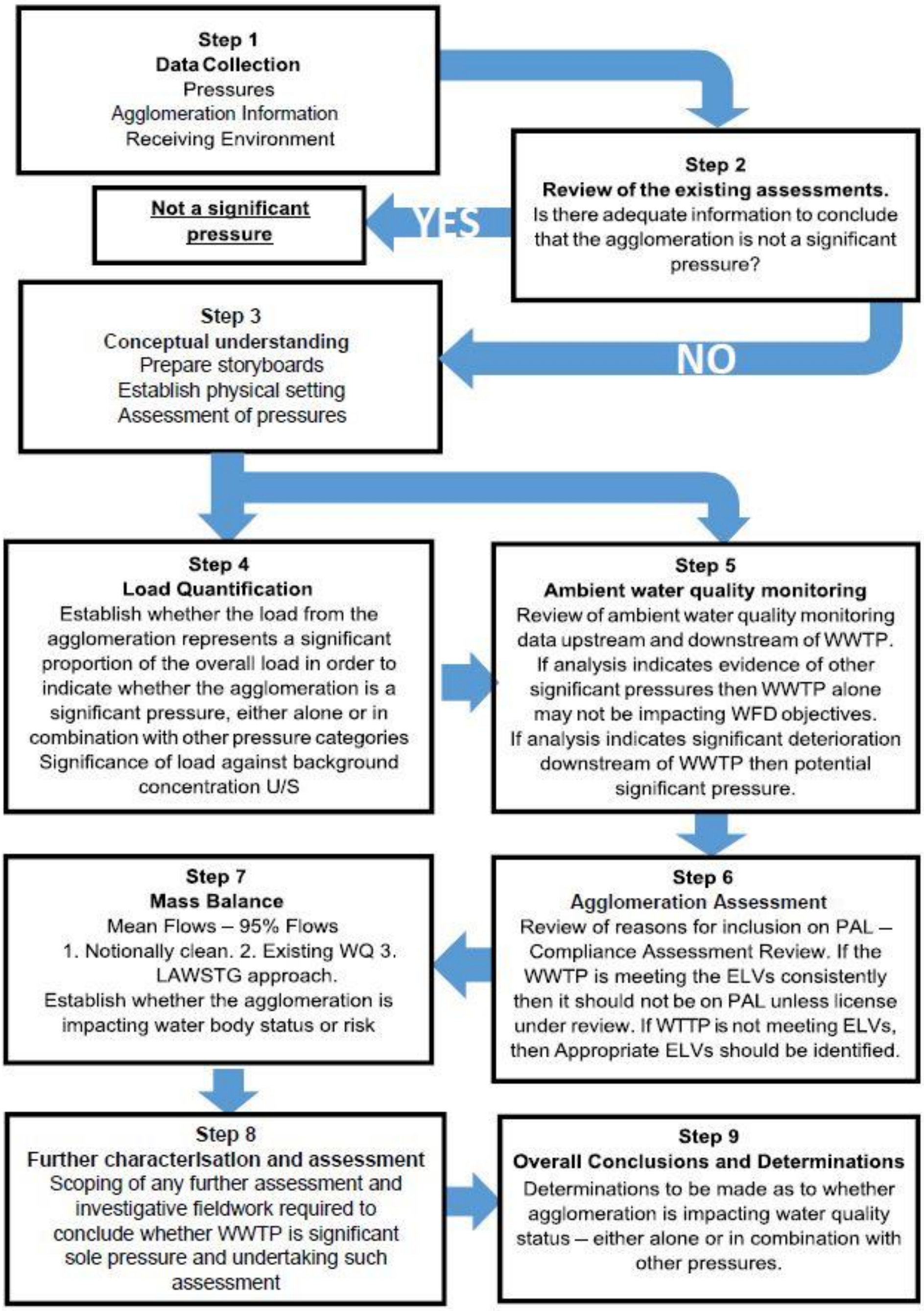

Figure 1.1: Steps included in the methodology

1.2 Milford agglomeration

Table 1.1 provides an overview of the Milford agglomeration, the receiving water environment, and the reason(s) for identification as a sole significant pressure by the EPA CSMU during initial characterisation. Figure 1.2 provides an overview map of the area surrounding the Milford agglomeration.

Table 1.1: Overview of the Milford agglomeration, Co. Donegal

Agglomeration name	Milford	**Authorisation code**	D0342-01
Design PE	920	**2019 collected PE**	1,691
Treatment level	Secondary	**2018 ELV compliant**	No
Discharges	Primary: 1 no. (TPEFF0600D0342SW001) Storm Water Overflows: 3 SWOs (SW2 and SW3 noted in the license and an additional SWO on the network that has been identified through the SWO programme)		
EPA Priority Action List (PAL)	Yes (see Section 6 for more details)	**EPA Compliance Investigation (CI)**	Yes (see Section 6 for more details)
WWTP upgrade project (completion date)	2021	**IW Programme(s)**	SWO Programme
Water bodies where agglomeration is a significant pressure			
WB Name (code): **Maggy's Burn_010 (IE_NW_39M010300)**	2010-2015 monitoring period: 'poor' ecological status ''at risk'' 2013-2018 monitoring period: 'poor' ecological status		
WB Name (code): **Lough Fern (IE_NW_39_13**	2010-2015 monitoring period: 'poor' ecological status ''at risk'' 2013-2018 monitoring period: 'poor' ecological status		
WFD App pressure and impact details:			
Pressure sub-category	**WWTP**		
Impacts	**Nutrient pollution** **Organic pollution**		

1.3 Data Collection

There were a large number of datasets available, both internally within Irish Water and from other sources, in relation to the agglomeration and the receiving water environment.

The data collected was registered in a dedicated project register and is summarised in Appendix A of this report. An indication of the relevance of the data to the Milford agglomeration assessment has been provided.

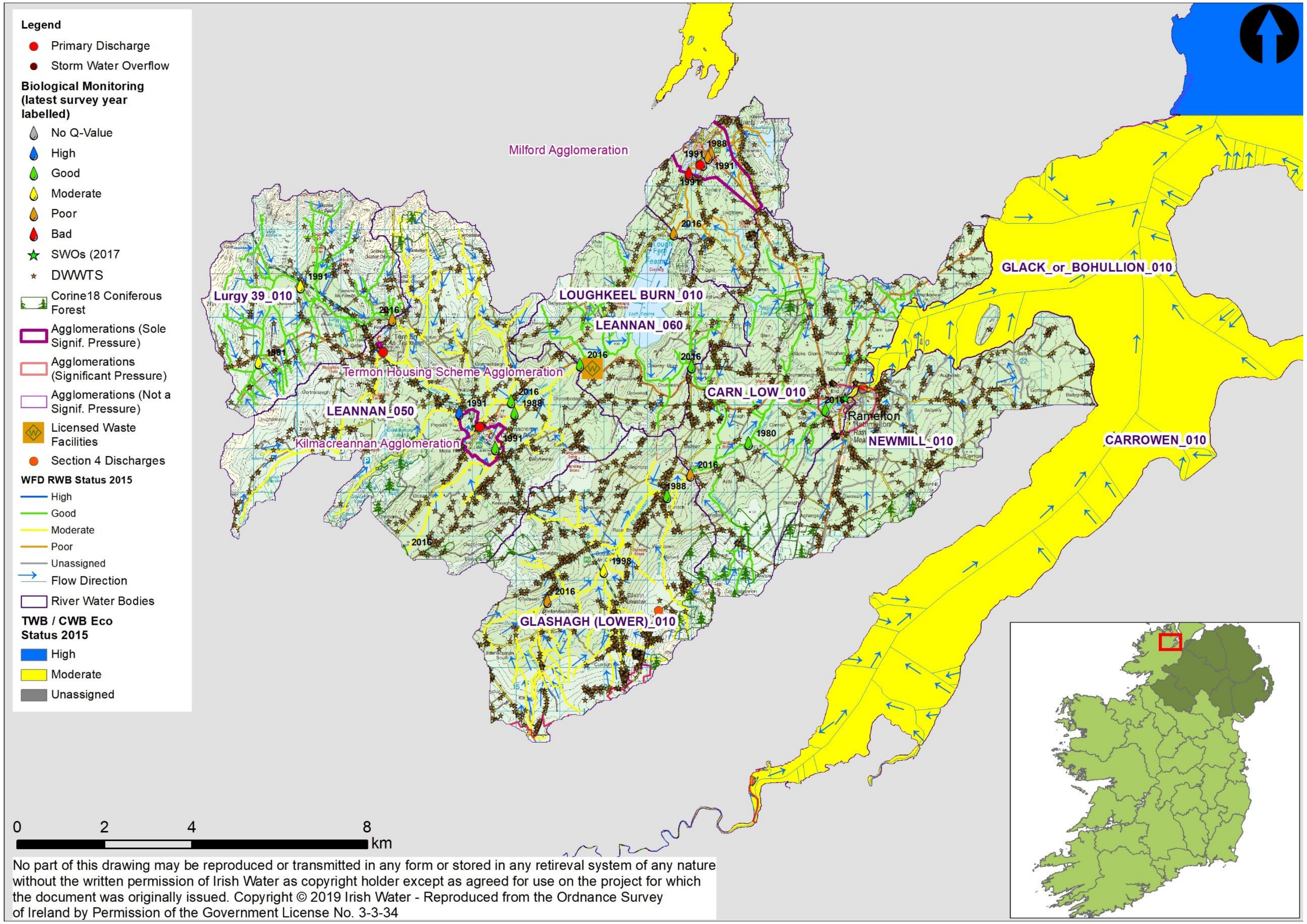

Figure 1.2: Milford agglomeration overview map

1.4 Data Quality

1.4.1 Overview

As outlined in the assessment approach (Figure 1.1), Steps 4 to 6 involve a series of calculations which use data from numerous datasets. The data is listed in Appendix A. Data availability and quality checks have therefore been carried out to ensure that data is fit for purpose and can be used in the relevant calculations.

1.4.2 Ambient Data – General

Available monitoring data from the WFD monitoring programme, compliance assessments and investigative monitoring was obtained from EPA, Local Authorities and Irish Water including:

- Ambient biological and physico-chemical monitoring results for both upstream and downstream monitoring points for all agglomerations;
- Ambient monitoring station locations;
- WFD App information on water body status, drivers, risk status, updated ambient and effluent monitoring datasets, and pressures information.

Note ambient water quality data for water bodies receiving primary discharges was downloaded from the WFD App and has already undergone review and cleansing by the EPA. Data checks typically involved are outlined in Appendix B.

1.4.3 Suitability of Ambient Monitoring Locations

Further characterisation of the stretch of water body between the upstream and downstream monitoring points allows for the identification of other potential pressures in the area, and determination of whether these may be significant pressures.

Based on the available pressure information, there are no known point source pressures between the Milford primary discharge and the downstream ambient monitoring point. Potential pressures identified include part of Milford town which would be a source of diffuse urban pressure, agricultural lands, pasture and DWWTS in an area of high pollution impact potential for surface pathways for phosphates. There are no tributaries inputting to the channel between the upstream monitoring station and primary discharge. However, there is the potential for unlicensed discharges to be present. There are numerous single dwellings with the village and environs that are outside of the agglomeration boundary and not connected to the sewer network and wastewater treatment plant. It is possible that these properties are discharging directly to the Maggy's Burn_010 via misconnections or given the susceptibility along the Water body channel could be a potential source of phosphates and nitrates from individual septic tanks systems.

EU Member States may designate mixing zones adjacent to points of discharge where concentrations of one or more substances may exceed a relevant EQS within such mixing zones if they do not affect the compliance of the rest of the body of surface water with those standards.

The distance between the Milford WWTP primary discharge point and the downstream monitoring station location was assessed to determine whether sampling may be taking place within the mixing zone which could lead to inappropriate conclusions as to the impact of the discharge.

EU Common Implementation Strategy (CIS) guidance on the identification of mixing zones[3] states that a precautionary approximation of the extent of the mixing zone (i.e. the extent of EQS exceedance in rivers that can be considered acceptable without further assessment) should be the lesser of 10* River Width or 1km, provided this does not exceed 10% of the overall water body length. The Small Stream Risk Score (SSRS) methodology[4] recommends that these assessments be carried out between 150m and 250m downstream of a discharge point on small streams.

The river width was determined from the original Local Authority WWDA licence application and is approximately 2.5 metres wide at the location of the primary discharge. On this basis, and the EU CIS guidance, the mixing zone would be within 25 metres of the primary discharge.

The distance between the Milford WWTP primary discharge point and the downstream ambient monitoring location RS39M010300 is 1.9 km. This is in line with recommended practise for undertaking SSRS downstream of a primary discharge and is outside of the estimated mixing zone based on EU CIS guidance. It is therefore assumed that this monitoring site is acceptable to assess impacts from Milford WWTP on Maggy's Burn_010.

1.4.4 Effluent Data Check

A quality check of the available effluent data was undertaken using an adopted EPA methodology[5]. The load from the WWTP as reported in the latest AER ($Load_{WWTP\ (AER)}$) was compared with estimated load based on the population equivalent ($Load_{WWTP\ (PE)}$). Where values differ considerably (i.e. by more than ten times) the possible reason for this is reviewed, i.e. it may be that the WWTP is operating at a much higher treatment efficiency rate which differs from the assumed treatment standards for the particular level of treatment when estimating the effluent load from the PE. The quality check is calculated as follows:

When;

$Load_{WWTP\ (PE)} * 0.1 < Load_{WWTP\ (AER)} < Load_{WWTP\ (PE)} * 10$

$Load_{WWTP} = Load_{WWTP\ (AER)}$

Otherwise $Load_{WWTP} = Load_{WWTP\ (PE)}$

Where;

$Load_{WWTP\ (AER)}$ = Reported AER Effluent WWTP Load

$Load_{WWTP\ (PE)}$ = PE * production rate

Table 1.2 provides a summary of the assessment for Milford. The effluent loadings calculated from measured data, as recorded in the AER, are a reasonable representation of the loads to the plant, i.e. are within the range as specified above.

[3] European Commission, *Technical Guidelines for the Identification of Mixing Zones,* 2010

[4] Environmental Protection Agency, *Guidance on Application and Use of the SSRS in Enforcement of Urban Waste Water Discharge Authorisations in Ireland*, 2015

[5] Mockler E.M, Deakin J, Archbold M, Gill L, Daly D and Bruen M, *Sources of nitrogen and phosphorus emissions to Irish rivers and coastal waters: Estimates from a nutrient load apportionment framework*, Science of the Total Environment, 2016, Volumes 601-602, pp 326-339

Table 1.2: Effluent loading check for measured parameters at Milford agglomeration

Parameter	Loading (kg/yr)		Representative
	Load WWTP (AER)	Load WWTP (PE)	
BOD	2,391	13,866	Yes
Total N	2,112	2,879	Yes
Total P	243	617	Yes

1.4.5 Step Change Detection

Effluent data for Milford WWTP is available for the period 2015-2019, and it is recognised that there may have been operational improvements, operational issues or process changes during this time. A step change analysis was therefore undertaken to highlight any step changes.

The step change analysis was undertaken by calculating the rolling mean of the 7 previous data points and plotting the results as illustrated in graphs in Appendix B for effluent parameters BOD, ammonia, and orthophosphate.

On review of the graphs, there are no identifiable trends. The full period of available data (2015-2019) for all parameters should therefore be used in calculations, such as mass-balance and load quantification.

1.4.6 Primary Discharge Data – Outlier Detection

RPS developed a custom application to enable a consistent approach to analysis and visualisation of WFD water quality data. The application was developed in Python with a user interface in Jupyter Notebook for interactive table querying, statistical analyses including Theil-Sens Slope, outlier detection, resampling and rolling means. Additional functionalities allow the analyst to:

- Select more than one location for compare ambient and effluent monitoring data;
- Adjust outlier detection sensitivity;
- Remove outliers if appropriate;
- Select time period for trend analysis.

Plots are dynamic such that the axis labels, title and legends update automatically. Figure 1.3 presents the custom tool user interface.

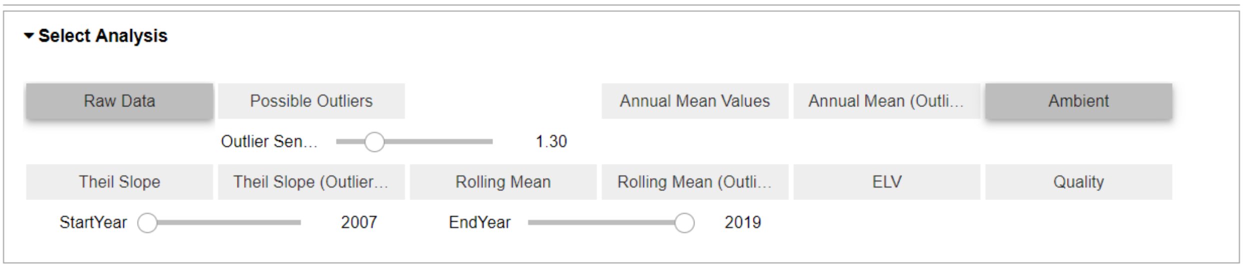

Figure 1.3: Python user interface

A sensitivity value of 1 was set for all parameters. The number of outliers detected are listed in Table 1.3 and illustrated graphs in Appendix B.

Orthophosphate has an outlier identified in June 2018, which is an elevated concentration. This correlates to elevated levels of other parameters, including BOD and Ammonia. This therefore indicates that while they are statistically outliers, they are representative of the operation of the plant, and have therefore not been omitted from the analysis.

An outlier has been detected for BOD in February 2019, where the concentration is elevated, with the fluctuation not in line with other effluent parameters. As the fluctuation is not in line with other parameters, it has been identified as a potential true outlier and has therefore been omitted from the analysis.

The remaining outliers identified for BOD and Ammonia were all elevated concentrations, which fluctuated in line with other effluent parameters. This therefore indicated that they are representative of plant operations, and therefore have been included in the analysis for mass-balance and load quantification.

Table 1.3: Outlier detection summary

Sensitivity Value	Effluent Parameter	Number of Outliers Detected	Number of data points omitted
1	BOD	5	1
	Ammonia	3	0
	Orthophosphate	1	0

STEP 1 – SUMMARY

- Milford agglomeration currently provides secondary treatment. It is currently overloaded and collecting 1,690 PE, while the plant only has a design capacity of 920 PE.
- The WFD App identifies the Milford WWTP as a significant pressure impacting the Maggy's Burn_010 water body and the Lough Fern lake water body, causing nutrient pollution and organic pollution.
- Milford WWTP has one primary discharge and three SWOs, which discharge directly into the Maggy's Burn_010 river water body. This water body is considered ''at risk'' of not meeting its environmental objectives and is at 'poor' ecological status (2010-2015 and 2013-2018). Maggy's Burn flows int the Leannan_060 river water body and then Lough Fern. The agglomeration is also considered to be the sole significant pressure on Lough Fern which is also at 'poor' ecological status (2010-2015 and 2013-2018).
- Data quality checks were undertaken on the ambient monitoring and primary discharge data, and it was determined that the full effluent dataset (2015-2019) would be appropriate for use in the calculations for Steps 4 to 7, with a BOD outlier from February 2019 omitted from the dataset.

2 STEP 2 - EXISTING ASSESSMENTS

The purpose of this step is to determine if adequate information is already available from existing assessments to achieve the aims of the project as set out in Section 1. Sources of existing assessments include WWDA licence documents, environmental assessments, and Irish Water's ongoing programmes as well as once-off studies.

Table 2.1 lists the key relevant existing assessments and indicates if any have been undertaken for this Agglomeration, with a complete list of data sources included in Appendix A. Relevant information or conclusions from these assessments are also summarised.

Table 2.1: Existing Assessments for the Milford agglomeration

Existing Information	Available for this agglomeration	Comments/Conclusions Report Reference
Irish Water Registers, Programmes and Studies		
Waste Water Capacity Register	✓	Section 6.2
Drinking Water Risk Assessment	×	-
National Certificate of Authorisation Programme (NCAP)	n/a	-
Disinfection Programme	n/a	-
Drainage Area Programme (DAP) reports	×	-
Modelling Studies	×	-
SWO Assessments	✓	Section 2.1
Environmental Assessments		
i. Ecological Impact Assessment (including Small Streams Risk Score)	✓	Section 2.2.3
ii. Habitats Directive Assessment	✓	Section 2.2.1
iii. Freshwater Pearl Mussel Assessment	×	-
iv. Other environmental assessments	×	-
Discharge authorisation-related reports		
AER Report	✓	2018 latest report available (Section 6.2.3.1)
EPA OEE Inspector Reports	✓	May 2018 most recent reporting (Section 6.2.3.2)

2.1 SWO Assessments

The assessment of SWOs undertaken for the AERs is subjective in nature and is often not undertaken consistently across local authorities.

Irish Water's SWO Programme is a national programme for assessing the impact of SWOs based on repeated outfall site surveys and consideration of impact components and receiving water use. The methodology is robust, objective and consistent.The outputs from the SWO Assessment Programme, when available, will supersede the assessments included in the AERs.

2.1.1 SWO Assessments in Discharge Authorisation Reports

2.1.1.1 2018 AER

The SWO identification and inspection report included in the 2018 AER states the significant of the one listed SWO (SW002) to be 'unknown'. It also states that the SWO is not meeting the criteria outlined in the DoE's (1995) 'Procedures and Criteria in relation to Storm Water Overflows'[6]. The volume of sewage discharged via the SWO in 2018 is unknown.

2.1.2 SWO Programme

The SWOs in the Milford agglomeration are being assessed in the Irish Water SWO Programme. Information available to date is included in Table 2.2

Table 2.2: Information from the SWO Programme

Overflow Type	Name	Asset	Emission Code	Assessed Against DoEHLG Criteria	Monitored/ Not Monitored	Significance	Included in Schedule A4 of the WWDL
SWO	TBC	Network	TBC	Not Yet Assessed	Not Monitored	Not yet assessed	No
SWO	SW2	WwTP	TPEFF0600D0342SW002	Meeting	Not Monitored	Low	Yes
SWO	SW3	WwTP	TPEFF0600D0342SW003	Not Meeting	Not Monitored	Not yet assessed	Yes

2.2 Environmental Assessment

2.2.1 Appropriate Assessment Screening Report

An appropriate assessment is required under Artcile 6 of Habitats Directive to assess, in view of best scientific knowledge and conservations objectives, if an activity (either individually or in combination with other plans or projects) is likely to have a significant effect on a European Site. The first stage of the

[6]Department of the Environment, *Procedures and Criteria in relation to Storm Water Overflows,* 1995

appropriate assessment process is a screening assessment to determine if a project can be screened out of any further assessment where there is no potential for the conservation objectives of the European site to be affected. The output from the stage 1 screening is the Appropriate Assessment Screening report.

Table 2.3: Appropriate Assessment Screening Report Summary

Appropriate Assessment Screening		**Author**	**Date**
		Donegal Councty Council	October 2008
Protected Area/ Species	**Linked to Agglomeration**	**Report Findings/ Conclusion**	**Further Action**
Leannan SAC and Lough Fern SPA.	Yes	The aggloeration discharges into Maggy's Burn which is a tributary of the River Leannan that flows into Loughy Fern. Therefore, it is directily linked to the SAC and SPA.	Appropriate Assessment required

2.2.2 Appropriate Assessment - Natura Impact Statement

Donegal County Council prepared a Natura Impact Statement to outline the findings of the Stage 2 appropriate assessment undertaken in support of the application for a discharge license for the Milford agglomeration. The summary of the conclusions of the NIS are provided below. The EPA, as the compotent authority reviewed the assessment and undertook an appropriate assessment under Article 6 of the Habitats Directive prior to issuing a license for this agglomeration.

"The water quality was recorded to be at less than good status in Maggy's Burn and thus significantly impacting fish species, including Atlantic Salmon. This water quality in Maggie's Burn is unsuitable for Atlantic Salmon and Freshwater Pearl Mussel. However, the downstream Lough Fern, has salmonids present, but it is mainly trout species. Should fish life be impacted this will in turn impact the otter community which predominantly prey on salmonids, eels and sticklebacks. An NPWS survey in 2004/2005 recorded a decline in otter population, but the Leannan SAC was not included in the survey at the time."

"The information suggests that the Milford WWTP is having an impact on the ability of qualifying interests reaching favourable conservation status within Maggie's Burn. Cumulative impact is unknown, unless the impact on Otter and Freshwater Pearl Mussel as a result of the loss of salmon population can be considered cumulative impact."

Donegal County Council determined that upgrade works were intended and necessary to improve and mitigate the site from future deterioration. In conclusion, no other feasible mitigation measures other than upgrade works to the WWTW were identified to improve the conservation objectives of the three qualifying interests identified as 'at risk'.

Table 2.4: Natura Impact Statement Summary

Natura Impact Statement		**Author**	**Date**
		Donegal County Council (Environmental Assessment Unit)	October 2008
Protected Area/ Species		**Report Findings/ Conclusion in relation to agglomeration**	
		Overall	**Justification**
Leannan SAC and Lough Fern SPA	Lowland oligotrophic lakes	Not likely to have a significant impact on conservation status.	None given.
	Otter	Potential impact from WWTW discharge.	Chemical vulnerability and possible PCB contamination affecting fish stocks likely to indirectly affect otter populations.
	Freshwater Pearl Mussel	Likely to have a significant impact on conservation status.	Species requires high quality water environment. Both Lough Fern and Maggy's Burn are unsuitable habitats for the species due to water quality issues, and muddy substrate in relation to the lough.
	Atlantic Salmon	Likely to have a significant impact on conservation status.	Due to its size, Maggy's Burn is unable to assimilate the discharge from the WWTW and as a result the warer quality is not at an acceptable stnadard for the species to thrive.
	Slender Naiad	Not likely to have a significant impact on conservation status.	Present upstream in the SAC, at the Lough Akibbon and therefore, no impact from WWTW.
	Whooper Swan	Not likely to have a significant impact on conservation status.	Distance from the discharge.

The NIS therefore concluded that the Agglomeration is likely to result in adverse impacts on the ecological integrity of Natura 2000 sites, either by itself or in combination with other plans or projects.

2.2.3 Small Stream Risk Score Assessment

A small stream risk score (SSRS) assessment was completed for Milford WWTP and included with the 2016 AER.

The assessment found that the SSRS for the upstream station was 2.40 and therefore this reach of Maggy's Burn is considered to be ‘‘at risk’’. The downstream SSRS was also classified as ‘‘at risk’’ however the score was much lower 0.80 and indicates impact from the agglomeration.

The assessment concluded that the results of the SSRS indicated that the WWTP discharge are posing a pollution risk to receiving waters (Maggy's Burn).

STEP 2 SUMMARY

- Information available in relation to the SWOs suggests potential impact on receiving water quality.
- The stage 2 Appropriate Assessment undertaken in 2010 when Donegal County Council were applying for a discharge authorisation for the Milford agglomeration. The assessment concluded that the discharges from the agglomeration are likely to result in adverse impacts on the ecological integrity of Natura 2000 sites, either by itself or in combination with other plans or projects. The assessment identified three qualifying interests that may potentially be negatively impacted and made recommendations in terms of the mitigation required to ensure the protected area objectives of Maggy's Burn could be achieved.
- The SSRS was undertaken in 2016 and reported in the AER, the results of the SSRS indicate the plant is having an impact. However there scores indicate that there are also pressures on water quality upstream of the discharge.

3 STEP 3 - CONCEPTUALISATION OF THE CATCHMENT

This section details the conceptualisation of the catchment that the Milford agglomeration is located within. A high level description of the catchment is provided as well as a more detailed description of the subcatchment within which the Milford agglomeration is located.

3.1 Catchment Description

The Milford agglomeration is situated within the Lough Swilly catchment. This catchment includes the area drained by all streams entering tidal water in Lough Swilly between Fanad Head and Dunaff Head, Co. Donegal, draining a total area of 965km². The largest urban centre in the catchment is Letterkenny. The other main urban centre in this catchment is Buncrana. The catchment is largely mountainous and is underlain by metamorphic rocks with the exception of the Glendowan Mountains in the west, which are composed of granite. These rocks generally provide relatively poor groundwater resources. This catchment comprises the catchments of the Leannan and Swilly Rivers as well as the south western part of the Malin Peninsula and the eastern side of the Fanad Peninsula.

The catchment is divided into 7 subcatchments and the Milford Agglomeration is within subcatchment Leannan_SC_020 (see Figure 3.1). Catchment conceptualisation is focused at this subcatchment level.

3.2 Subcatchment Hydrology

As seen in Figure 3.1, there are 7 river water bodies within the Leannan_SC_020 which drains the lower reaches of the Leannan River, the main channel of which flows from west to east, before it discharges into the Swilly Estuary. The section of the Leannan River in the subcatchment is composed of 2 river water bodies; Leannan_050 (into which flows the Lurgy_010 tributary from the northeast of the subcatchment; and Leannan_060. Lough Fern is located on Leannan_060. Maggy's Burn_010 tributary enters the lake from the northwest. Leannan_060 flows into Carn Low_010 then discharges to the Swilly Estuary to the west.

Hydrogeology and dominant pathways are included in the subcatchment conceptualisation in Section 3.5.

3.3 Subcatchment Land Use

The land use within the Leannan_SC_020 subcatchment is predominantly pastures and agricultural land through this low-lying catchment, with arable land, complex cultivation patterns and rough grazing all common. There are also forested areas and regions of peat bog in the upper reaches of the Leannan_050. There are areas designated for works under the County Donegal Development Plan 2012-2018 in Milford and Ramelton to conserve and enhance land for open space and amenity purposes, and to make provision for new recreation, leisure and community facilities.

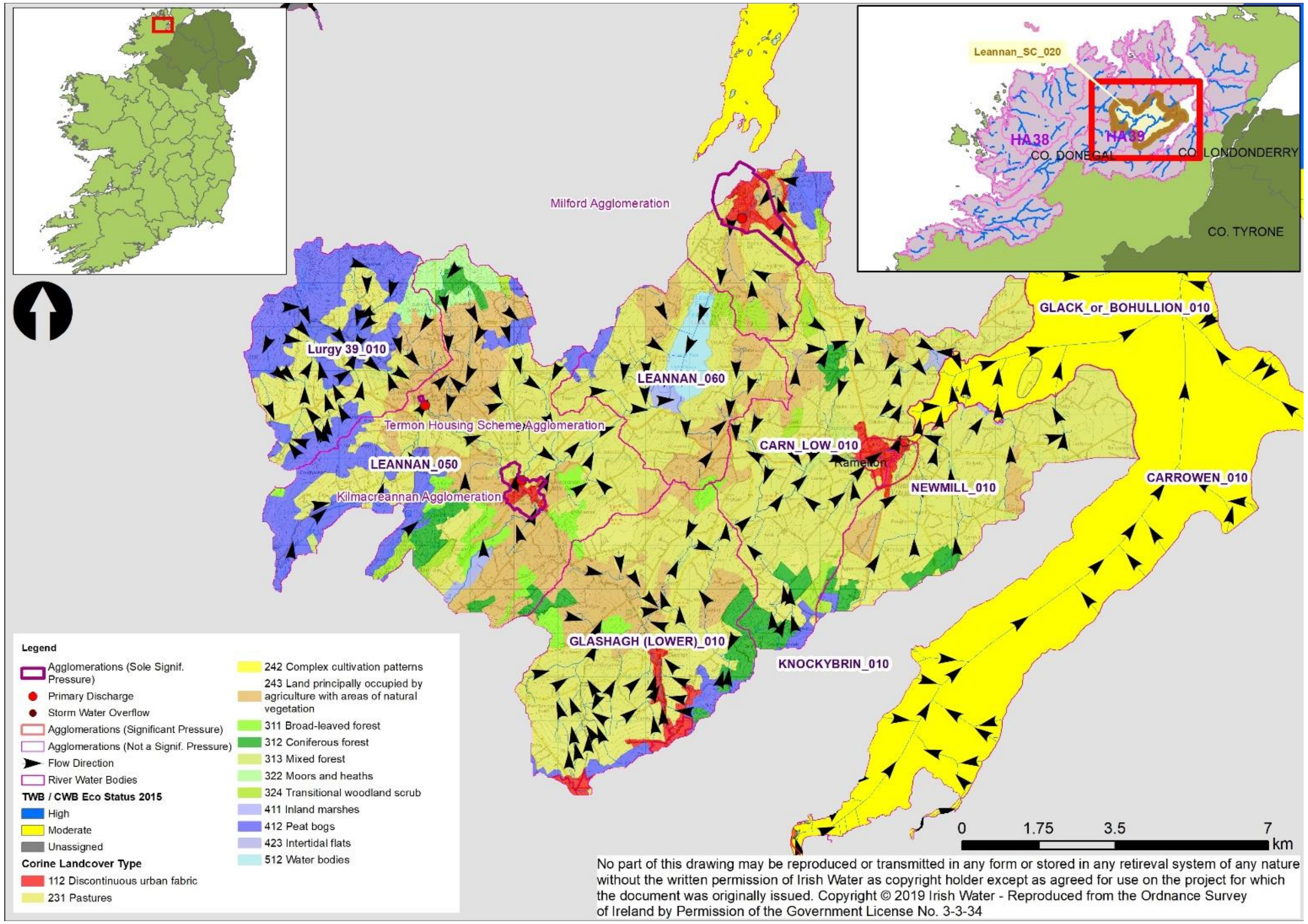

Figure 3.1: Map of subcatchments within Leannan_SC_020 and Milford agglomeration

3.4 Subcatchment WFD Protected Areas

Protected Areas within a 15km radius of the agglomeration, which encompassed the Leannan_SC_020 subcatchment and beyond, were identified using the WFD App and EPA datasets, and include:

- Drinking water abstractions:
  - WFD Registered Protected Area for Drinking Water: Lough Fern, which located on Leannan_060. Lough Swilly is also a designated drinking groundwater body underlying the subcatchment.
- Special Areas of Conservations (SACs): Cloghernagore Bog and Glenveagh National Park, Leannan River, Ballyvar Wood and Lough Swilly. There are also a number of SACs located within 15km of the Agglomeration: Lough Akibbon and Gartan Lough, Muckish Mountain, Sheephaven and Glenveagh National Park, Mulroy Bay.
- Special Protection Areas (SPAs): Derryveagh and Gelndowan Mountains, Lough Fern and Lough Swilly.
- Proposed Natural Heritage Area (pNHA): There are a number of pNHAs within the subcatchment including; Lough Swilly, which is to include Big Isle, Blanket Nook and Inch Lake, Cloghernagore Bog and Glenveagh National Park, Derriscligh Bog, Leannan Valley Woods, Lough Fern and Ballyvar Wood.
- There are shellfish designated waters at Lough Swilly, located in the west of the subcatchment.

3.5 Subcatchment Conceptualisation

The topography throughout the subcatchment is relatively low-lying, with the exception of the small hills of Lough Fern which flank the Leannan Valley. The subcatchment is underlain by poorly productive aquifers comprised of Precambrian quartizes, gneisses and schists. The main Donegal granite rock unit is also underlying the western boundary of the subcatchment.

The soils consist of predominantly poorly-drained wet soils and peat (including gleys and additional wet soils types such as peaty podzols). Large alluvium deposits exists within the lower reaches of the Leannan sub-basin. Sub-soil permeability is low to moderate around the main river channels, becoming shallower with depth to bedrock generally less than 3m across much of the remaining parts of the subcatchment.

In terms of groundwater vulnerability, the majority of the subcatchment is rated as high to extreme, reflecting the distribution of shallow soil and sub-soil depths. It is moderate in the areas of alluvium along the Leannan River main channel. Groundwater recharge is extremely low throughout implying that there is limited surface water / groundwater interactions.

Flow paths are likely to be dominated by overland and near surface flows. The susceptibility mapping (Figure 3.2) support this, with near-surface pathways for phosphate rated as high throughout much of the subcatchment where there are wet soils and alluvium. Susceptibility to sub-surface pathways for phosphate are low.

3.6 Catchment Storyboard

A schematic showing the relevant water bodies within the catchment is provided in Figure 3.3.

The Milford agglomeration discharges directly into the Maggy's Burn_010 tributary of the Leannan main channel. The river water body is classified as ''at risk'' of not meeting its environmental objective with a 'poor' ecological and biological status over the recent monitoring programmes (2010-2015, 2013-2018). Physico-chemical monitoring data indicates that there are nutrient with the indicative quality for ammonia and ortho-P consistent with 'less than good' conditions for ecological status. Milford WWTP is indicated as the sole significant pressure impacting the water body and is affecting the nutrient and organic chemistry. There are no upstream water bodies.

Maggy's burn_010 discharges into Lough Fern water body which is considered 'at risk' of not meeting its environmental objectives with a 'poor' ecological and biological status over the two most recent monitoring programmes from 2010-2015 and 2013-2018, respectively. Physico-chemical monitoring data indicates that there are no apparent nutrient issues within the Lough, however, Milford WWTP is indicated as a significant pressure impacting the water body in terms of nutrient and organic chemistry..

The most downstream water body of the Leannan_060 is considered 'not 'at risk'' under WFD characterisation, achieving 'good' ecological and biological status across the monitoring programmes from 2007-2009 to 2013-2018. The water body has no physico-chemical issues, with nutrients conditions consistent with 'high' ecological. There also no significant pressures identified on the water body.

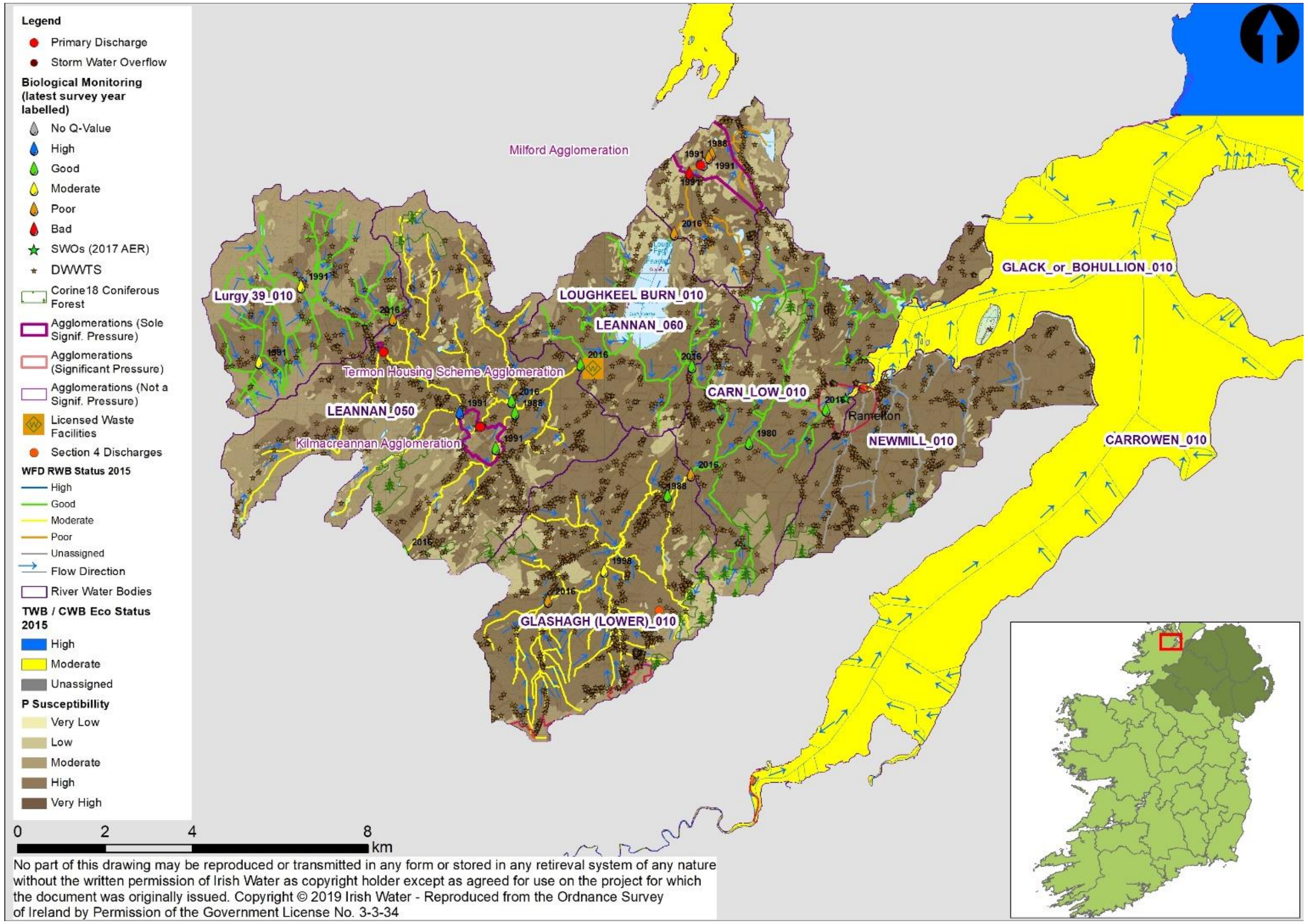

Figure 3.2: Near surface pathway susceptibility (phosphates) in Leannan_SC_020 subcatchment

Receiving Water Body

IE_NW_39M010300 MAGGY'S BURN_010	(10-15)	(13-18)	WFD Risk	Latest Q Data (Year)
Bio	Poor	Poor	At Risk	Poor (2016)
Eco	Poor	Poor		
Chem	Status	Trend	Baseline (2017) from WFD App	
Ortho-P (P) RS39M010300	Moderate	No Data	No Data	
TON (N) RS39M010300	Good	No Data	No Data	
Tot Am (N) RS39M010300	Moderate	Moderate	0.794	
WWTP treatment Level	Secondary		Overloaded?	Yes
Compliant?	Non-compliant - Failed on last inspection visit in 2016. Reoccurring ELV exceedances for BOD, TSS and Ammonia due to inadequate treatment and capacity.			
Comments	AER (2018) - Discharge may be giving rise to breaches of EQS in receiving WB. EPA Inspector's Site Visit Report (2018) – Works to combine with Ramelton and Rathmullan agglomerations and be served by one secondary WWTP with one discharge point. Limnos (2017) - plans to implement process monitoring and control measures to address screening issues and plant washout. Irish Water Update (2019) - WWTP is on Capital Investment Programme and resources are allocated for plant upgrade and combing with Ramelton and Rathmullan.			
Other Pressures	WFD App - This indicates that the WWTP is acting as a significant pressure on the receiving waters impacting nutrient and organic chemistry. No inputting WB - therefore indicates that any nutrient issues will be from a pressure acting directly on WB e.g. WWTP.			
Upstream Agglomerations	No upstream agglomerations			

Downstream Water Body

IE_NW_39_13 Lough Fern	(10-15)	(13-18)	WFD Risk	Latest Q Data (Year)
Bio	Poor	Poor	At Risk	Poor (2016)
Eco	Poor	Poor		
Chem	Status	Trend	Baseline (2017) from WFD App	
Total Phosphorus (P) RS39L010600	Good	Downwards	0.023	
Chlorophyll RS39L010600	Good	Downwards	6.674	
Tot Am (N) RS39L010600	High	Upwards	0.031	
Comments	No comments.			
Other Pressures	WFD App – WWTP at Milford is acting as a significant pressure, noted as impacting nutrient and organic chemistry.			
Upstream Agglomerations	Milford WWTP			

Downstream Water Body

IE_NW_39L010600 LEANNAN_060	(10-15)	(13-18)	WFD Risk	Latest Q Data (Year)
Bio	Good	Good	Not at Risk	Good (2016)
Eco	Good	Good		
Chem	Status	Trend	Baseline (2017) from WFD App	
Ortho-P (P) RS39L010600	High	Downwards	0.009	
TON (N) RS39L010600	Good	Upwards	0.173	
Tot Am (N) RS39L010600	High	Downwards	0.032	
Comments	No comments.			
Other Pressures	WFD App – No pressures identified.			
Upstream Agglomerations	Milford WWTP			

Key

← - Indicates direction of flow between water bodies

☐ - Receiving water body of primary discharge

Figure 3.3: Subcatchment storyboard

STEP 3 SUMMARY

- The Milford agglomeration is located within the Leannan_SC_020 subcatchment. Based on available soils and subsoils information, it is likely to have diffuse nutrients transported to the Leannan River by overland flow pathways. This is also reflected in the high phosphate susceptibility by near-surface pathways.

- A number of protected areas intersect the Leannan_SC_020 subcatchment within which the Milford agglomeration is located. A number of additional SACs and SPAs are located within a 15km radius of Milford agglomeration. There are also drinking water bodies located within the subcatchment, as well as, a number of pNHA's and a protected shellfish area.

- There is no upstream water body. The receiving water body of the Maggy's Burn_010 is classified as ''at risk'' of not meeting its environmental objectives, with 'poor' ecological and biological status across two most recent monitoring programmes (2010-2015 and 2013-2018). The only significant pressure identified in the WFD App is the Milford WWTP impacting nutrient and organic chemistry.

- The downstream river water body of the Leannan_060 is considered 'not at risk'' in terms of meeting its objectives, and has no physico-chemical issues identified. There are no significant pressures identified in the WFD App on the water body.

- Lough Fern is nested within the Leannan_060 river sub basin and is also considered "at risk" of not meeting its environmental objectives, with 'poor' ecological and biological status across two most recent monitoring programmes (2010-2015 and 2013-2018). The Milford agglomeration identified as the sole significant pressure on this lake water body.

4 STEP 4 - LOAD QUANTIFICATION

Step 4 quantifies urban waste water loads and assesses their significance on the water bodies affected. This quantification of load contribution provides an effective and useful metric to establish the relative significance of pressures; and therefore provides context to other pressures within an overall integrated catchment management (ICM) approach.

4.1 Methodology

Existing up-to-date monitoring and reporting data has been analysed and, where appropriate, calculations have been carried out to generate pollutant loads from the Milford WWTP, and to derive flow-weighted loads in the receiving waters upstream and downstream of the WWTP.

It should be noted that in order to undertake a direct comparison between the effluent discharge and ambient monitoring, total P was used as ortho-P is not reported in WWTP effluent.

All load quantification calculations are presented in Appendix C.

4.1.1 Effluent Load Estimation

Where possible, effluent loads were based on annual averages for 2015, 2016 and 2017 presented in the AERs. Where there was no measured data available, export coefficient estimation methodologies were utilised. Loads were estimated using British Water Code of Practice[7] (BOD & ammonia) and an adopted EPA methodology[5] (total P) production per capita figures. The effluent loadings were calculated as the product of **per capita production figures** (estimated mass of each parameter produced per person per day), **population equivalents** (from the Irish Water Waste Water Capacity Register) and **treatment reduction factors** (factor that the treatment level at the WWTP reduces concentrations of the key parameters).

4.1.1.1 Estimated Influent Loads (product of PE and production figures)

Influent loads were estimated as the product of per capita production rates and WWTP population equivalents. Population equivalents were available from Irish Water's Waste Water Capacity Register. Residential production per capita figures (production rates) were taken from the British Water Code of Practice[7] for BOD and ammonia, and from a nutrient load apportionment framework used by the EPA[5] for total P (Table 4.2).

[7] British Water, *Code of Practice - Flows and Loads 4 - Sizing Criteria, Treatment Capacity for Sewage Treatment Systems*, 2013, BW COP: 18.11/13

Table 4.1: Production per capita figures for BOD, ammonia & total P

Parameter	Typical Loading (g/person/day)	Source
BOD	60	British Water
Ammonia as N	8	British Water
Total P	2	Mockler

4.1.1.2 Treatment Reduction Factors

Treatment reduction factors indicate the WWTP's efficiency in reducing the concentration of a certain parameter between influent and effluent by means of treatment processes.

Total N and Total P reduction factors are taken from OSPAR**Error! Bookmark not defined.**. BOD reduction factors are taken from CIWEM[8].

Error! Reference source not found. summarises the reduction factors used to compute the estimated effluent loads from WWTPs where effluent monitoring is not available.

Table 4.2: Treatment Reduction Factors

	Treatment Reduction Factor				
Parameter	No treatment/ preliminary treatment	Primary Treatment	Secondary Treatment	Nutrient Removal	Source
Total P	1	0.667	0.467	0.1	OSPAR
Total N	1	0.727	0.545	0.3	OSPAR
BOD	1	0.7	0.35	-	CIWEM

4.1.2 Ambient Load Estimation

Upstream and downstream average ambient loads were calculated from monitoring results available from the WFD monitoring programme for the period 2015 to 2018, data is taken from the nearest WFD monitoring stations which have chemistry data available. Flow estimates were taken from the EPA's Hydrotool where there is insufficient flow data in the subcatchment

The load for each parameter is derived from the product of mean flow in the river (as per EPA Hydrotool in the case of Milford) at the monitoring location and the average monitored concentration for that

[8] CIWEM Training Module - Municipal Wastewater Treatment

particular parameter. The following hierarchy of sources/methods was used in the estimation of mean flows:

1. Gauged data used where available;
2. Gauged data scaled pro-rata on areal basis where appropriate (hydrologically similar);
3. Hydrotool value (where appropriate);
4. Hydrotool values scaled pro-rate on areal basis (where appropriate).

For hydrotool flow estimates the flow that is equalled or exceeded for 30 percent of the time in the long term (30 percentile), was used in the assessment of ambient loads, as being representative of mean flows (EPA, 1995)[9].

4.2 Ambient Data

Ambient data was available from the WFD App for monitoring station RS39M010150 (upstream) and RS39M010300 (downstream). A total of 21 BOD samples, 19 Total N samples and 1 Ortho P sample was available from the upstream monitoring station for the 2014 to 2019 period. A total of 37 BOD samples, 17 Total N samples and 21 Ortho P samples were available from the downstream monitoring station for the 2009 to 2019 period. This data was used to calculate loads for BOD, total N and total P at these sites.

4.3 Results and Findings

The difference between upstream and downstream loads were calculated and compared with the effluent load for each parameter. If the difference between the upstream and downstream loads is similar to the load within the WWTP effluent, it can be considered that the WWTP is contributing the majority of the pollutant load between the monitoring stations. If the difference in loads between the stations is much larger than the load being contributed by the WWTP, it can be concluded that the WWTP is not the sole contributor along that stretch of watercourse.

Error! Reference source not found. shows BOD, total N and total P loadings calculated for the upstream and downstream ambient monitoring locations, as well as for the WWTP primary discharge. The difference between upstream and downstream loads has been calculated, and the contribution of the WWTP to this load difference has been presented as a percentage for each parameter. Note, as discussed in Section 1.4.6, all available data has been used for WWTP load calculations. The analysis showed that:

- The WWTP accounts for an estimated 23% of the additional BOD load to the river between the upstream and downstream monitoring points. Therefore there is additional BOD load coming from other sources, possibly including SWOs which are not accounted for in the load calculations.
- The WWTP contributes an estimated 18% of the additional load of Total N between the upstream and downstream monitoring points. Again, this suggests that there are other sources of load.
- The WWTP contributes an estimated 26% of the additional load of Total P between the upstream and downstream monitoring points. Load from the WWTP accounts for more Total P increase than is

[9] Environmental Protection Agency, *Hydrological Data, A list of water level recorders and summary statistics at selected gauging stations*, 1995

measured at the downstream monitoring station, allowing for sampling error and in-stream processes, the WWTP can be identified as being the main contributing factor to Total P along the stretch of watercourse. However there are elevated levels of Total P measured at the upstream monitoring station and there is a relatively small increase in Total P between the monitoring stations.

Table 4.3: Pollutant loads (kg/yr)

	BOD	Total N	Total P
Upstream Load	8,747	15,242	467
WWTP Load	2,391	2,112	120
Downstream Load	19,138	26,891	924
Difference (Between Upstream and Downstream)	+10,391	+11,649	+457
WWTP Load as % of Downstream Load	13%	8%	13%
WWTP Load as % of Difference (Upstream and Downstream)	23%	18%	26%

STEP 4 SUMMARY

- Load quantification analysis has been carried out in relation to the Milford WWTP primary discharge.
- The load quantification analysis indicates that the Milford WWTP is not the sole significant pressure in relation to BOD, Total P and Total N in the Maggy's Burn_010 water body. However there is a SWO located upstream of the upstream ambient monitoring point which could be influencing the annual loadings in the upstream station resulting in an impact to the water body.

5 STEP 5 - AMBIENT MONITORING

5.1 Overview

The purpose of the ambient monitoring assessment was to analyse water quality data upstream and downstream of the agglomeration in order to determine the significance of the impact and associated response in the receiving waters; identifying patterns and trends that may suggest the presence of certain pressure categories. For example, a seasonal trend would explain elevated pollutant levels at certain times of year which may be linked to weather conditions. It involves a comparison of ambient monitoring data at selected monitoring stations to determine changes in water quality that could be attributed to specific pressures or issues identified along the waterbodies.

A map of the Maggy's Burn_010 water body with the monitoring stations relevant to the assessment for the Milford Agglomeration is shown in Figure 5.1.

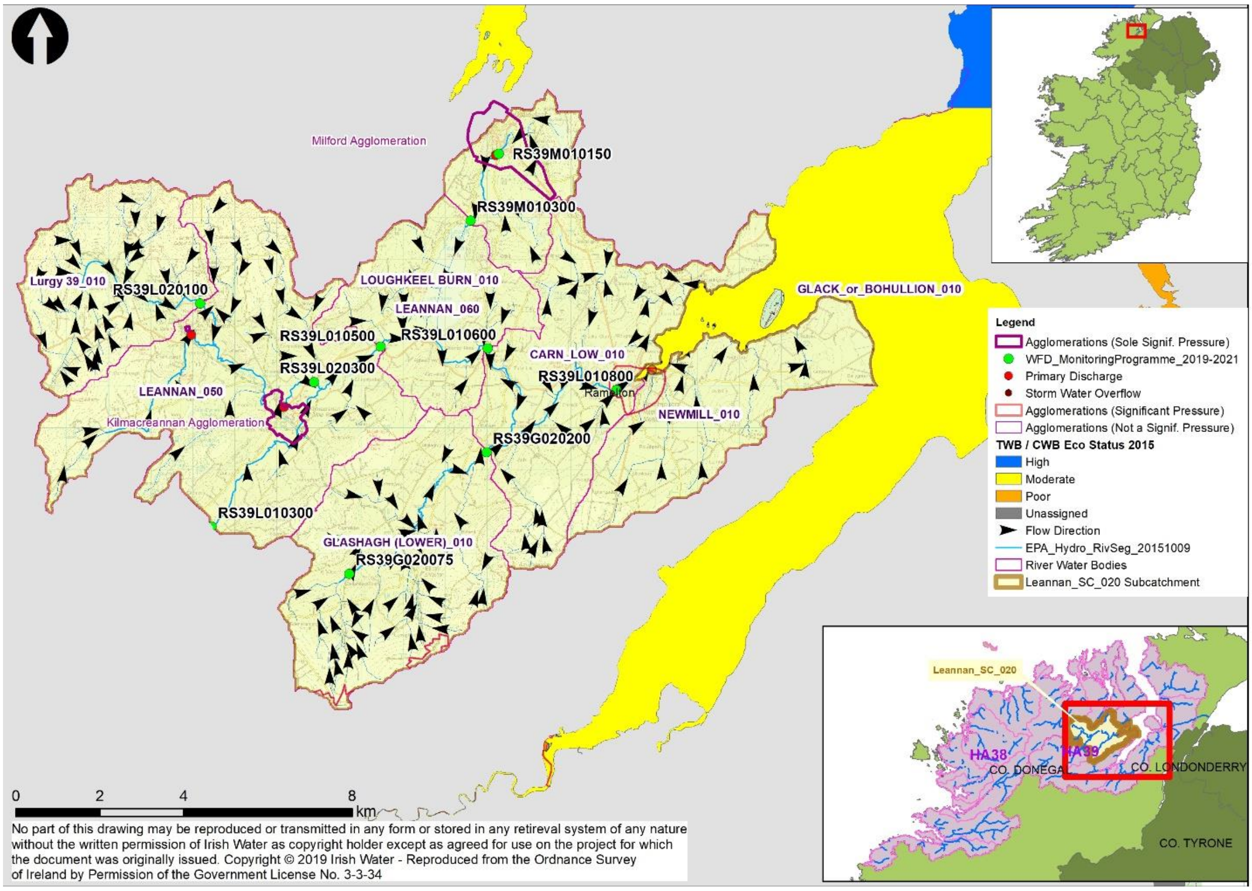

Figure 5.1: Monitoring station location map for Milford agglomeration

5.2 Methodology

The ambient monitoring assessment provides an insight into the impacts and responses in the receiving water environment upstream and downstream of the Milford agglomeration, informing and supporting the determination as to whether the glomeration is a significant pressure. The assessment also aids identification of other pollution sources.

5.2.1 Data Analysis

The following approach has been taken to the data analysis:

1. Summarise key ambient monitoring data (both biology and physico-chemical), including environmental objectives, status and drivers. This provides a high level overview of the water body and identifies potential issues.

   Additional factors taken into account include: comments from EPA biologists; historic data; and any other information available in relation to the waterbodies and pressures.

2. Conduct a time-series analysis of ammonia, orthophosphate (ortho-P) and BOD. This is to further characterise the water body and understand water quality in the receiving environment. This is completed through consideration and identification of key trends upstream and downstream of the receiving water body (i.e. seasonal or cyclical trends) that may be attributable to pressures within the water body or environmental conditions. The analysis supports the determination of whether an Agglomeration is a significant pressure.

5.3 Summary of Ambient and WFD Monitoring Data

Appendix D provides a summary of the ambient monitoring data for the Maggy's Burn_010 river water body which receives the discharges from the Milford agglomeration. It also includes the Leannan_060 which is the downstream water body.

5.3.1 Review of WFD App Risk Assessment Information

5.3.1.1 Upstream Water Body

There is no water body upstream of Maggy's Burn_010.

5.3.1.2 Receiving Water Body

Maggy's Burn_010 is at 'poor' status and therefore is 'at risk' of not meeting its environmental objectives. The key driving factor is the biological elements at the downstream extent of the water body. Supporting nutrient conditions are also 'less than good' at the operational monitoring station.

5.3.1.3 Downstream Water Body

The Leannan_060 water body is 'not 'at risk' in terms of meeting environmental objectives due to the biological and ecological status remaining at 'good'.

5.4 Physico-chemical Data - Time Series Analysis

The time-series analysis was completed for BOD, ammonia and ortho-P, to identify and compares trends in receiving waters to effluent data and mean EQS values for BOD, ammonia and ortho-P.

The monitoring stations and available monitoring data are listed in Table. 5.2. The locations of the monitoring stations with physico-chemical data are shown in Figure 5.1. It was noted that the downstream monitoring station on the Leannan_060 was located downstream of Lough Fern, and therefore this monitoring station was unlikely to give an indication of the impact of Milford WWTP on the downstream watercourse.

Table 5.1: Ambient monitoring stations and available data

Monitoring Station		Water Body	BOD Data Available	Ammonia Data Available	Ortho-P Data Available
U/S	**RS39M010150**	Maggy's Burn_010	2014 – 2019(Apr)	2014 – 2019(Apr)	2014 – 2019(Apr)
D/S	**RS39M010300**	Maggy's Burn_010	2009 – 2019(Apr)	2009 – 2019(Apr)	2009 – 2019(Apr)
D/S	**RS39L010600**	Leannan_060	2009 – 2019(Mar)	2009-2019(Mar)	2009-2019(Mar)
Effluent					
Eff	**TPEFF0600D0342SW001**		2015-2019(Mar)	2015-2019(Mar)	2015-2019(Mar)

5.4.1 BOD

Figure 5.2 plots BOD concentrations at the ambient monitoring locations upstream and downstream of the Milford WWTP, with effluent BOD concentrations also included on the graph for comparison.

The upstream concentrations of BOD are lower than the downstream concentrations; with upstream concentrations experiencing little fluctuations around 1mg/l, despite this ambient monitoring station being located downstream of the SWO on the agglomeration network. There does not appear to be a significant seasonal factor within the dataset.

At the downstream monitoring point, a greater degree of fluctuations in BOD levels is indicative of a pressure or pressures impacting the downstream monitoring point. Potential pressures that could lead to these effects include the Milford WWTP, the SWO has no known issues and does not appear to be affecting the upstream ambient BOD concentrations. Urban diffuse pressures or point source discharges that may be present within the town or diffuse pollution pressures such as domestic wastewater treatment systems (DWWTS) may also be affecting water quality in the downstream monitoring point.

There is a greater range of variation in absolute concentrations at the downstream monitoring point compared to the upstream monitoring point, with BOD levels exceeding 10mg/l in over 32% of the data points. This is indicative of a pressure or pressures impacting the downstream monitoring point. Potential pressure that could lead to these effects include the WWTP, urban diffuse pressures or point source discharges that may be present within the town.

There is some correlation between BOD in the effluent and at the downstream monitoring point which suggests that on these occasions the Milford WWTP is impacting downstream BOD concentrations.

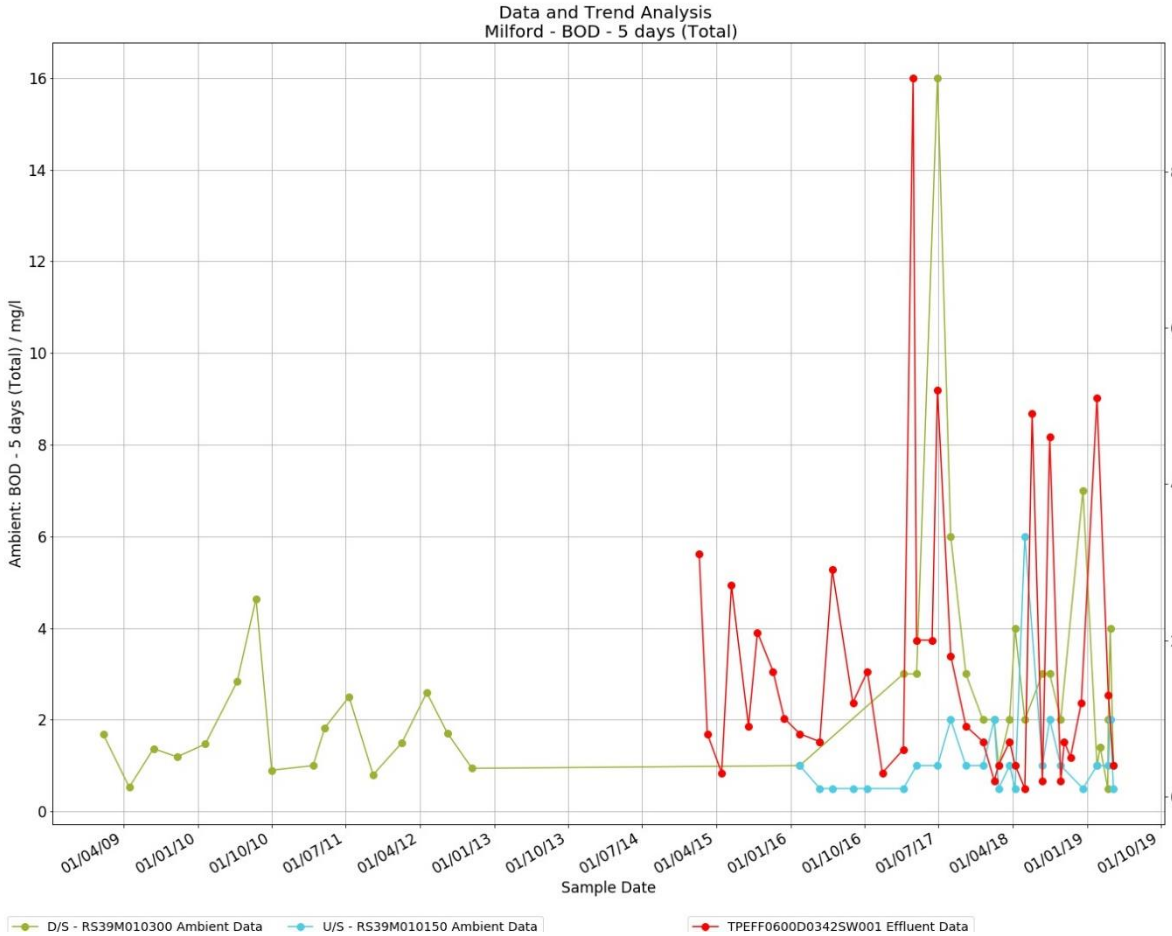

Figure 5.2: BOD concentrations for Maggy's Burn_010 ambient monitoring stations and effluent data

5.4.2 Ammonia

Figure 5.3 plots ammonia concentrations at the ambient monitoring locations upstream and downstream of the Milford WWTP, with effluent ammonia concentrations also included on the graph for comparison.

Upstream ammonia concentrations lie close to or exceed the mean EQS value of 0.065mg/l, which indicates a potential ammonia issue upstream, which could result in future annual means exceeding the EQS. Potential pressures identified upstream include the SWO, agricultural pressures, domestic wastewater treatment systems (DWWTS) or urban pressures.

In comparison, downstream data shows significantly elevated ammonia concentrations, with approximately 86% of samples exceeding the EQS. Due to the identified potential significant pressures of the WWTP discharge point and the urban area of Milford Town, it is anticipated that ammonia concentrations would be higher at this monitoring point when compared to upstream. Due to the correlation between upstream and downstream monitoring peaks in concentrations, it is likely that these peaks are influenced by storm events and the SWO could be a further urban wastewater pressure.

There is some correlation between downstream ammonia concentrations and effluent quality. However there are also occasions when the effluent quality is good but downstream ambient concentrations are high. This would suggest that there may be additional pressures other that the Milford WWTP impacting downstream ammonia concentrations, including the SWO.

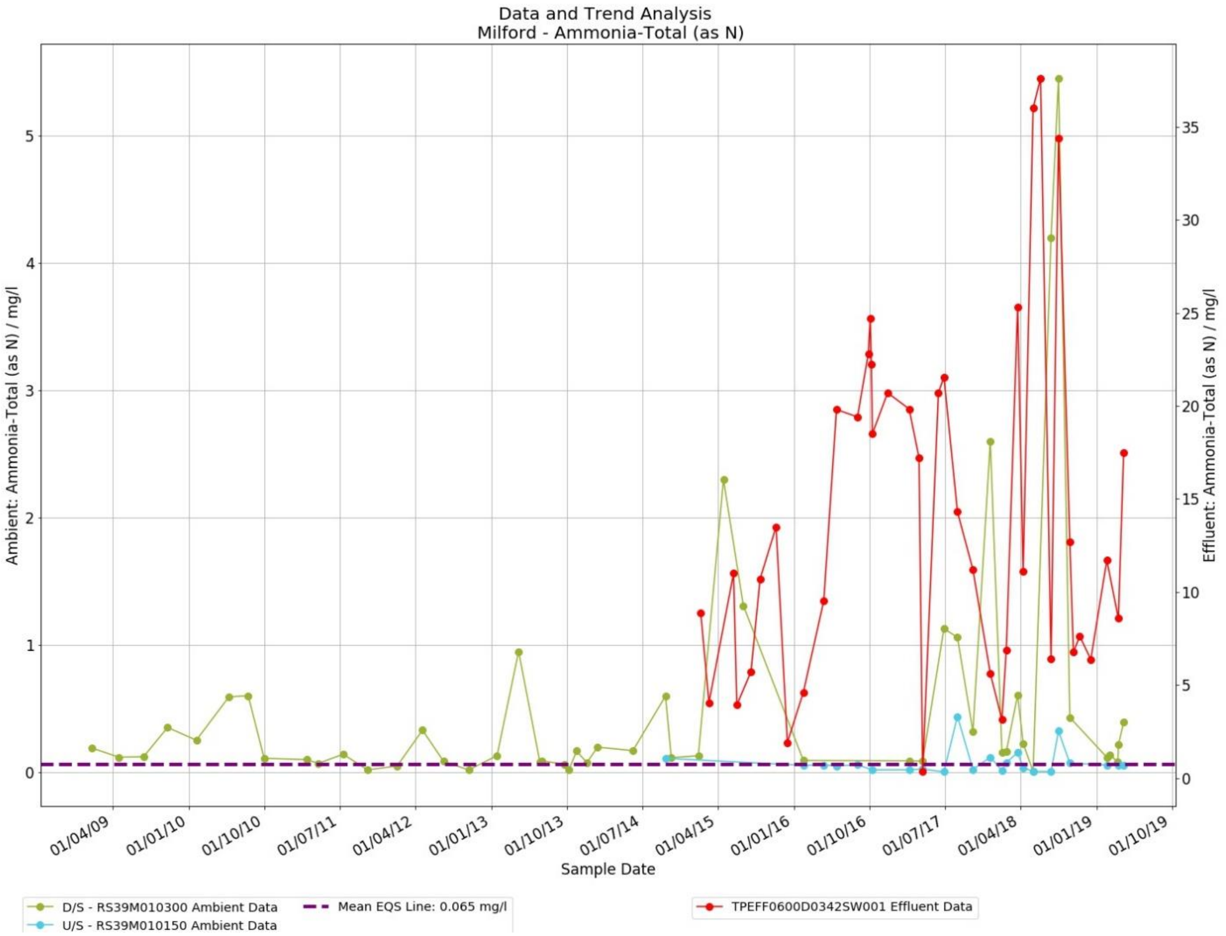

Figure 5.3: Ammonia concentrations for Maggy's Burn_010 ambient monitoring stations and effluent data

5.4.3 Ortho-P

Figure 5.8 plots ortho-P concentrations at the ambient monitoring locations upstream and downstream of the Milford WWTP, with effluent ortho-P concentrations also included on the graph for comparison.

Ortho-P concentrations are higher downstream when compared with upstream concentrations which are generally achieving the EQS, indicating that ortho-P issues are not as a result of upstream pressures. The scale of fluctuations in downstream concentrations indicate that the WWTP is acting as a pressure on the Maggy's Burn water body.

There is appears to be some correlation between downstream water quality and effluent quality. This would suggest that the Milford agglomeration is impacting downstream ortho-P concentrations.

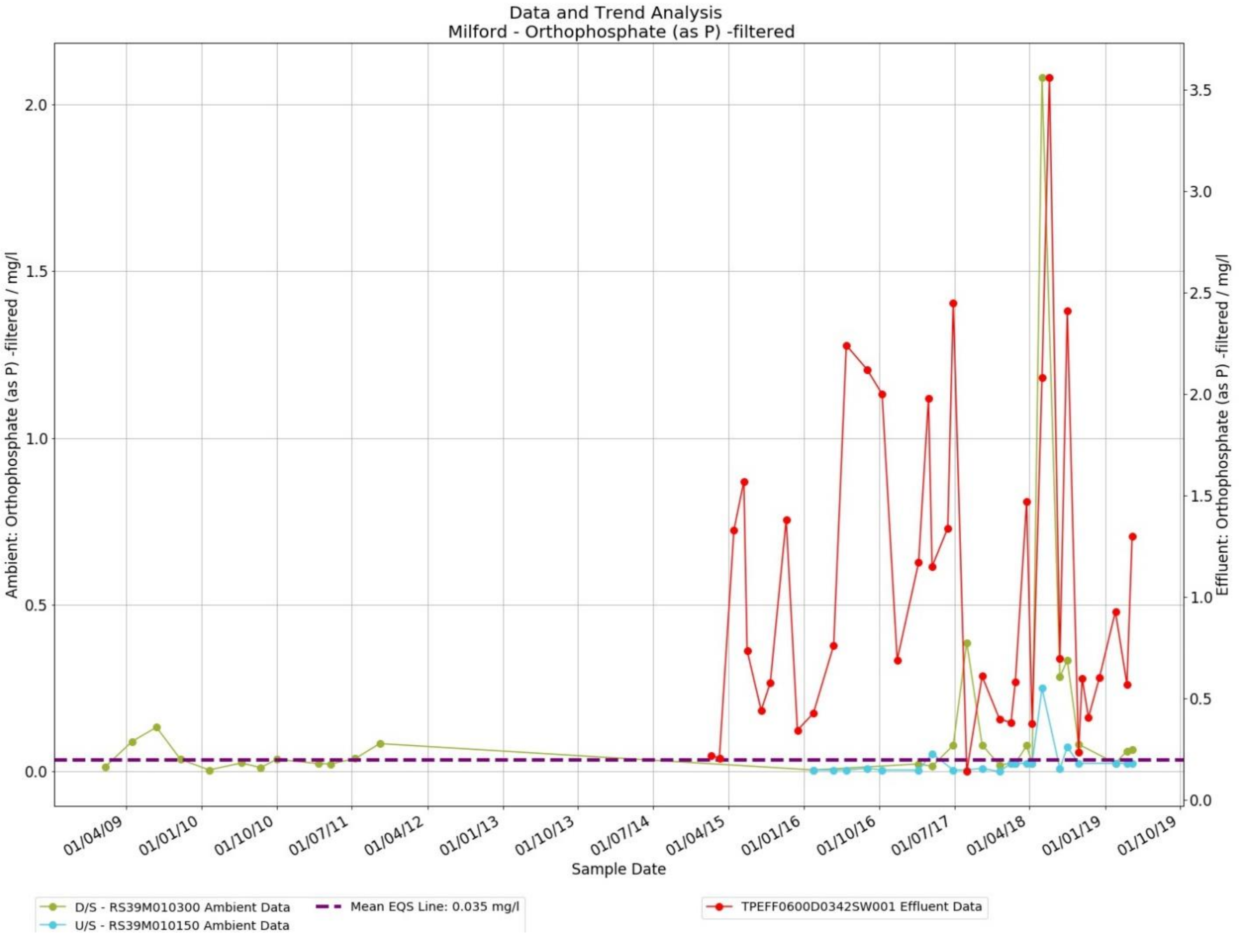

Figure 5.4: Ortho-P concentrations for Maggy's Burn_010 ambient monitoring stations and effluent data

5.4.4 Comparison of BOD, Ammonia and Ortho-P trends

When comparing BOD, ammonia and ortho-P at the downstream monitoring station, Figure 5.5, there does not appear to be a correlation between parameters, indicating that there may be different sources of pressure contributing to these fluctuations. This would therefore indicate that the Milford WWTP is not acting as a sole significant pressure on Maggy's Burn_010, however the impact of the SWO cannot be discounted.

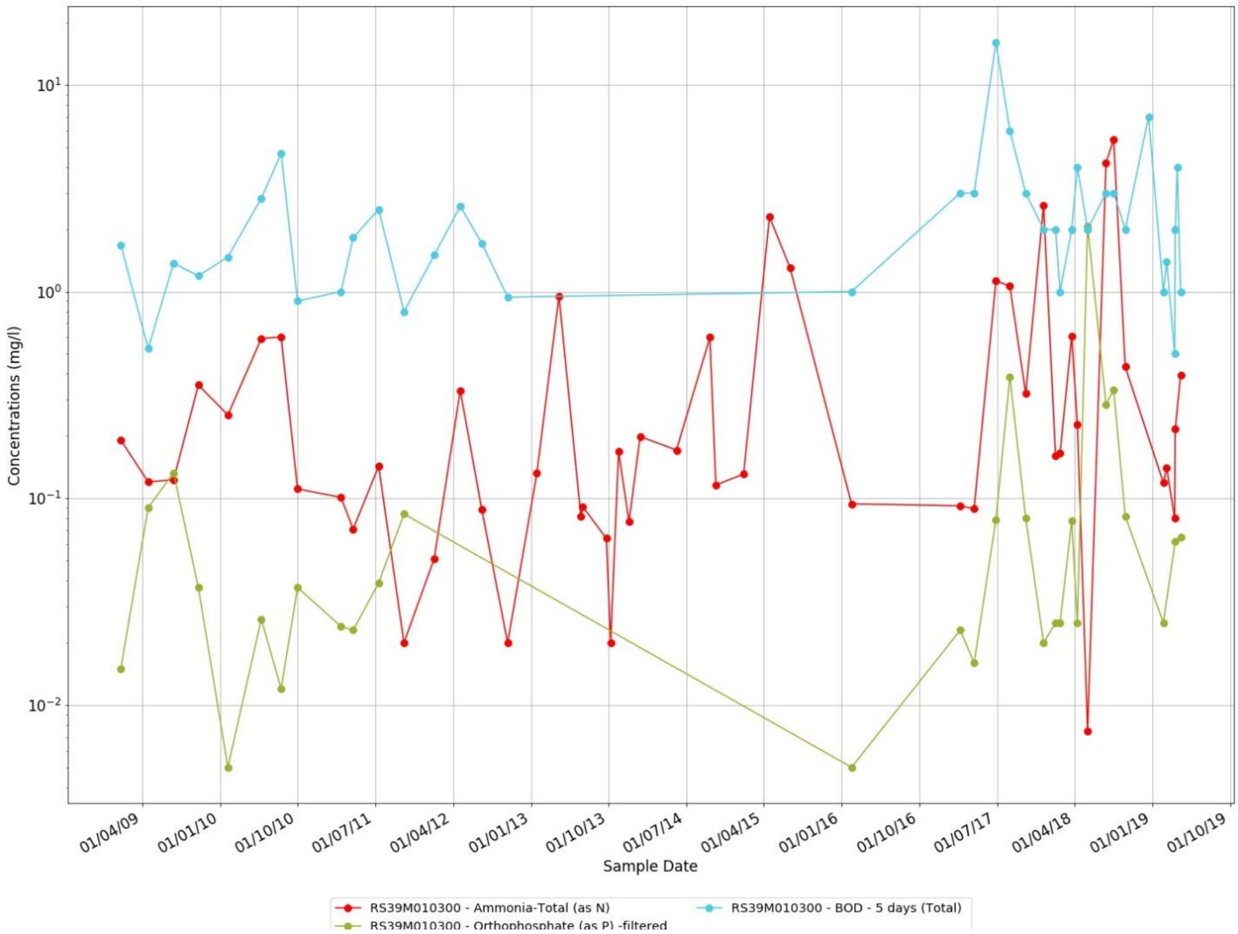

Figure 5.5: BOD, Ammonia and ortho-P comparison at ambient monitoring location downstream of Milford WWTP

It is noted the WFD Application recommends investigative action for the Milford WWTP to further characterise this water body.

5.5 Biological Monitoring

Within the Maggy's Burn_010 river water body there are two monitoring stations where biological monitoring has been undertaken, with the station locations are illustrated in Figure 5.1.

Table 5.2: Biological monitoring summary

Water body	Monitoring station	Conclusions drawn from available information
Maggy's Burn_010	RS39M010100	Pre WFD monitoring station, however showed consistently 'poor' status between 1989 and 1991 (latest data available).
	RS39M010300	Historically, this monitoring station was consistently at less than 'good' status, with Q-values representative of 'poor' status between 1998 and 2016.
Lough Fern	LS390003100800010 (Site 1 lower lake open Water) LS390003100800020 (Site 2 upper lake open Water) LS390003100800030 (Site 1a lower lake shoreline) LS390003100800040 (Site 2a upper lake shoreliner)	Macrophyte (moderate) and fish (poor) status are less than good and are the driving elements for the classification of the lake at 'poor' ecological status

As the upstream pre-WFD monitoring station consistently achieved a Q-value representative of 'poor' status historically at the Bridge in Milford, there may be pressures upstream of the WWTP and SWO that require further investigation.

Lough Fern is currently at 'poor' ecological status with fish and macrophytes the driving elements for this status classification. Nutrient levels in Lough Fern are indicative of conditions consistent with at least 'good' status. The indicative quality for nutrient conditions (Total P in particular) has improved in Lough Fern in the latest water quality monitoring programme from 'moderate' to 'good' suggesting that other pressures affecting the fish and macrophyte quality elements may be resulting in a less than good status classification.

STEP 5 SUMMARY

- Ambient monitoring data was available for the period 2014 to 2019, and included biological and physico-chemical data.
- Water quality information available for Leannan_060 lies downstream of Lough Fern, and therefore it is not possible to determine the impact of the Milford agglomeration on this water body, if any. However Lough Fern is currently at 'poor' ecological status with fish and macrophytes the driving elements for this status classification. Nutrient levels in Lough Fern are indicative of conditions consistent with at least 'good' status.
- The ambient data analysis indicates that the Milford WWTP may not be the sole significant pressure on the water quality in Maggy's Burn, as the downstream effluent concentrations do not always correlate well with the effluent concentration suggesting a possible additional pressure or pressures, which could include the SWO.
- There do not appear to be any ortho-P issues upstream of Milford WWTP, with few samples exceeding the EQS value. Peaks downstream correlate with upstream peaks, however these are elevated, suggesting that pressures are amplified downstream of Milford WWTP and may be event driven.
- Ammonia concentrations at the upstream monitoring station are above the EQS value in a number of instances, indicating a potential pressure contributing to concentrations upstream. However, levels are elevated at the downstream monitoring location, suggesting that pressures between the ambient monitoring locations, including the WWTP, are impacting in this area.
- The analysis indicates that the Milford agglomeration is a significant pressure on the Maggy's Burn water body, but that it may not be a sole significant pressure. Other pressures identified include: agricultural pressures, DWWTS and urban pressures. It should be noted that there is one SWO upstream of both ambient monitoring points, which is a potential source of impact. It is possible that the agglomeration is not the sole significant pressure however this requires further investigation.
- Indicative quality for nutrient conditions (Total P in particular) has improved in Lough Fern in the latest water quality monitoring programme from 'moderate' to 'good' suggesting that other pressures affecting the fish and macrophyte quality elements may be resulting in a less than good status classification.

6 STEP 6 - AGGLOMERATION ASSESSMENT

This step identifies the reasons for the inclusion of agglomeration on the EPA's Priority Action for Waste Water Improvements List (the PAL), it also details the WWTP's compliance from historic data and reporting.

6.1 Reason for Inclusion in the Priority Action List (PAL)

A total of 57 no. of the sole significant urban waste water pressures have been added to the Priority Action List (PAL) by the EPA OEE. Table 6.1 lists the reasons for Milford's inclusion on the PAL.

Table 6.1: Reasons for inclusion of Milford on PAL

Reason for Inclusion on the PAL	Applicable to Milford agglomeration?
Larger agglomeration which is non-compliant with the UWWTD: – An agglomeration requiring secondary treatment under Article 4 of the Directive – An agglomeration requiring more stringent treatment under Article 5 of the Directive	✗ ✗
Agglomeration is contributing to 'poor' quality bathing waters	✗
Sole significant pressure on water body 'at risk' of not achieving WFD environmental objectives	✓
Agglomeration requires improvement to protect or improve habitat of the Freshwater Pearl Mussels	✗
Improvement needed to protect shellfish waters	✗
Network Improvements are needed	✗

6.2 Compliance

6.2.1 Capacity

A Waste Water Capacity Register has been developed by Irish Water to provide an indication of the available headroom (in terms of organic loads expressed as population equivalent (PE)) at WWTPs. The purpose is to support growth and development, in line with the national spatial planning policy, national housing policy and national rural development policy; without having a significant impact on the environment, specifically receiving water bodies and European sites.

The Milford agglomeration is currently overloaded, both hydraulically and organically. The plant is hydraulically overloaded by -539 m^3/day, with a design peak hydraulic capacity of 621 m^3/day and a 2018 maximum collected hydraulic loading of 1,161 m^3/day. Organically, the plant is overloaded by -771 PE, with a design capacity of 920 PE and a 2019 collected load of 1,691 PE.

6.2.2 ELV Compliance Assessment

The purpose of the ELV compliance check is to understand the performance of the WWTP, establishing whether it is operating as designed.

The ELVs outlined in the WWDA licence are summarised in Table 6.2.

Table 6.2: 2018 ELVs for Milford WWDA licence

	BOD	COD	TSS	Ortho-P	Ammonia
WWDA Licence ELV (Schedule A)	10	125	25	0	0.65

The compliance of the WWTP for 2016, 2017 and 2018 is summarised in Table 6.3 based on compliance reporting provided by Irish Water. The effluent is largely not achieving the ELVs specified in the WWDA license.

Table 6.3: Summary of compliance for Milford agglomeration 2016-2018

Parameter	2016			2017			2018		
	No. of Samples	No. ELV Breach	Compliance N (Number) Q (Quality)	No. of Samples	No. ELV Breach	Compliance N (Number) Q (Quality)	No. of Samples	No. ELV Breach	Compliance N (Number) Q (Quality)
pH	6	0	PASS	8	0	PASS	12	0	PASS
SS	6	3	FAIL Q	8	4	FAIL Q	12	3	FAIL Q
COD	6	0	PASS	8	1	PASS	12	2	FAIL Q
BOD	6	0	PASS	8	2	FAIL Q	12	3	FAIL Q
Ammonia	6	5	FAIL Q	7	7	FAIL Q	12	12	FAIL Q
Ortho-P	6	3	FAIL Q	7	1	PASS	0	n/a	FAIL N

ELV breaches can be due to changes to WWTP processes or operations, rather than to enduring issues with plant performance.

Based on the analysis of the data, the concentrations of all key effluent parameters consistently breach the ELVs. The exceedance of ELVs may be attributable to the overloading of Milford WWTP, which has a design PE of 920 and collected PE of 1961.

Milford WWTP has therefore been consistently non-compliant with its WWDA ELVs for several parameters.

6.2.2.1 Annual Environmental Report

The latest AER (2018) notes that the WWTP is non-compliant with the ELVs set in the WWDA discharge licence. A total of 4 parameters were non-compliant and in breach of the ELVs, i.e. COD, SS, BOD and Ammonia. The main cause of the non-compliance issues was noted to be due to the plant being overloaded, which is attributed to the influence of storm water infiltration.

The AER states that the discharge may be giving rise to a breach of the EQS in the receiving water regardless of WFD status, in relation to ammonia and BOD. It is noted that storm water infiltration is influencing the results.

The plant was is found to be organically and hydraulically overloaded, and the reporting states that the plant will continue to exceed capacity in the next 3 years. There are 14 incidents reported during 2018 which were due to non-compliances with the ELVs due to the plant operating above its noted design criteria. These incidents were recurring, reported to the EPA and are still ongoing issues.

In terms of the Schedule C of the WWDA, there were no specified improvement made to the agglomeration during the reporting period (2018).

6.2.2.2 EPA Inspector's Report

The latest EPA Inspector's Site Visit Report from October 2018 was undertaken to assess the compliance of Milford WWTP with the WWDA discharge licence. The report states there have been recurring breaches in ammonia ELV throughout 2018 and the plant is not designed for peak flows through the treatment process or the removal of nitrate.

However the report states that the plant is part of an Irish Water capital works project to combine with Ramelton and Rathmullan agglomerations and be served by one secondary WWTP with one new discharge point to Lough Swilly, which is noted at the assessment and planning stage.

In terms of infrastructure, the report notes that the screening system was deemed inadequate as the fine screen was not in place. There was also no noted visual evidence of surcharging on the day of visit but Irish Water advised that surcharging is evident during storm conditions.

The report concludes it was clear that the pant has ongoing operational issues due to inadequate infrastructure with respect to solids screening and storm water control in particular. The EPA has an open compliance investigation (Ref: CI000343) in relation to the need for upgrade and improvement works at Milford which Irish Water is required to respond to.

6.2.3 Proposed improvement measures for agglomeration

Capital works are planned for the Milford agglomeration as part of the Rathmullan, Milford and Ramelton Sewerage Scheme. The scheme will include:

- Construction of a wastewater treatment plant that will serve a population equivalent of approximately 5,500p.e.
- Decommissioning of the current underperforming plant in Milford, construction of a new pumping station at Milford and rising main to bring wastewater to the new plant
- Construction of two pumping stations at Ramelton and Rathmullan along with rising mains from each agglomeration that will transfer wastewater to the new plant
- Construction of a new outfall pipe that will safely discharge treated wastewater into Leannan Estuary/ Lough Swilly
- Decommissioning of two holding tanks in Rathmullan

The works are expected to be completed in 2022, however advanced works are proposed at the existing WWTP to improve screening and provide storm water storage at the WWTP.

6.3 Mass Balance Inputs

The step change analysis showed that there was no notable step changes in the data therefore the entire available effluent data was used in the mass balance assessment with the exception of the outlier identified in Section 1.

STEP 6 SUMMARY

- Milford WWTP is organically and hydraulically overloaded.
- There have been noted recurring ELV breaches at plant in particular for BOD, COD, SS and ammonia.
- The EPA Inspector's Site Visit Report indicates the plant is part of a capital works programme to combine with Rathmullan and Ramelton and be served by one new secondary WWTP and one new primary discharge.
- Capital works will be undertaken under the Rathmullan, Milford and Ramelton Sewerage Scheme which involves the construction of a new WWTP and the relocation of the primary discharges from each agglomeration to a new outfall discharging to the Leannan Estuary. These capital works will resolve the significant pressure on Maggy's Burn.

7 STEP 7 - MASS BALANCE

Mixing of a discharge with a river is described by the mass balance equation. It calculates the resultant concentration in the receiving water following the addition of a discharge and is the preferred method of determining the impact on the receiving water as it accounts for the volume of flow in the discharge.

Mass balance calculations have been undertaken for the following parameters:

- Orthophosphate;
- Total ammonia; and
- Biological Oxygen Demand (BOD).

These parameters are some of the key nutrients and quality indicators in relation to WWTP discharges, and all have environmental quality standards (EQSs) or threshold values defined in the 2009 European Communities Environmental Objectives (Surface Water) Regulations[10] and/or the EPA's WFD App.

7.1 Methodology

The concentration of a contaminant downstream of a discharge is calculated by multiplying the discharge flow by the parameter concentration, adding the resulting load to the upstream background load, and dividing the result by the flow in the receiving water. These concentrations can be compared to EQSs to determine the impact of the discharge on the receiving water.

The mass balance formula is:

$$\text{Mass Balance} = T = \frac{FC + fc}{F}$$

Where:

T = resultant concentration of contaminant downstream of the discharge

F = flow in the receiving water upstream of the discharge (m^3/day) (*established from existing EPA flow records & hydrometric data presented via the EPA Hydrotool*)

C = concentration of contaminant in the receiving water upstream of the discharge (mg/l) *(calculated from existing ambient monitoring reported in water quality monitoring information available from existing EPA monitoring programmes)*

f = Effluent discharge rate (m^3/day)

c = concentration of the contaminant in the effluent discharge (mg/l) *(calculated from the effluent monitoring data for the discharge)*

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[10] European Communities Environmental Objectives (Surface Waters) Regulations 2009

Mass balance calculations were undertaken for a number of scenarios to include different flows and background concentrations in assessing the impact of the discharge. This approach was taken to establish the potential impact at different flow conditions when compared against the appropriate EQS, i.e. mean flows were assessed against the mean EQS for each parameters and the 95 percentile flows were assessed against the 95 percentile EQS. When setting discharge ELVs it is best practice to base the calculation of the emission limit value on the 95%ile EQS at the 95 %ile flows in a water body[11].

Alternative background concentrations were used when the upstream concentrations were not consistent with the physico-chemical supporting conditions required for good ecological status to allow the impact of the discharge to be assessed in the absence of significant pressures causing water quality issues upstream. The impact of the discharge is therefore assessed separately from impacts in the upstream catchment. This is consistent with the approach recommended in the guidance, procedures and training on the licensing of discharges to surface waters and to sewer for Local Authorities[11].

The mass balance assessment was undertaken after the data quality checks outlined in Section 1 were completed.

The scenarios include:

1. An assessment of the 95%ile flow (i.e. low flow conditions) for the receiving waters against the background concentration from the upstream monitoring point compared against the 95%ile environmental quality standards.
2. An assessment of the 95%ile flow for the receiving waters against notionally clean conditions compared against the 95%ile environmental quality standards.

   Note - the notionally clean river approach is used exclusively for municipal waste water discharges. If conditions in the river upstream of the discharge are already failing to meet the good status target then, regardless of how well treated the effluent is, the target environmental quality standard cannot be met. Therefore in such instances it is necessary to separate the effect of a discharge from impacts in the upstream catchment and to assess the impact of the discharge on the assumption that upstream is meeting the good quality status. Other measures are required to address other pollutant sources to ensure that the receiving water upstream of the WWTP achieves good status under the Water Framework Directive.

3. An assessment the 95%ile flow for the receiving waters against an adjusted background concentration where the upstream water quality conditions are not achieving the EQS (based on the mid-point within the good status band for the relevant parameter) compared against the 95%ile environmental quality standards
4. As scenario 1 but using mean flows
5. As scenario 2 but using mean flows
6. As scenario 3 but using mean flows

[11] WSNTG, *Guidance, Procedures and Training on the Licensing of Discharges to Surface Waters and to Sewer for Local Authorities*, 2011

Table 7.1: Data used for mass balance calculations

	Scenario 1	Scenario 2	Scenario 3
Flow of Receiving Waters (F)	95%ile	95%ile	95%ile;
Background concentration (C)	U/S background concentration	Notionally clean conditions	Adjusted U/S background concentration not achieving EQS
EQS	95%ile EQS	95%ile EQS	95%ile EQS
	Scenario 4	**Scenario 5**	**Scenario 6**
Flow of Receiving Waters (F)	Mean Flows	Mean Flows	Mean Flows
Background concentration (C)	U/S background concentration	Notionally clean conditions	Adjusted U/S background concentration not achieving EQS
EQS	Mean EQS	Mean EQS	Mean EQS

Note – effluent flow and quality remain consistent across all scenarios assessed

7.2 Results

The results of the mass balance calculations for the six scenarios outlined above are presented in Table 7.2 and Figures 7.1 to Figure 7.3.

Table 7.2: Results of the mass balance assessments – 95%ile flows

	Assessment 1		Assessment 2		Assessment 3		
Parameter	**Existing B/ground (mg/l)**	**Resultant Conc. (mg/l)**	**Notionally clean (mg/l)**	**Resultant Conc. (mg/l)**	**Adjusted conc. (mg/l)**	**Resultant Conc. (mg/l)**	**EQS (mg/l)**
95 %ile flows							
BOD	1.098	12.647	0.260	12.452	1.400	12.718	2.200
Ortho-P	0.026	0.826	0.005	0.821	0.030	0.827	0.075
Ammonia	0.081	10.839	0.008	10.822	0.0525	10.832	0.140

	Assessment 4		Assessment 5		Assessment 6			
Parameter	Existing Background (mg/l) (based on most recent monitoring data)	Resultant Conc. (mg/l)	Notionally clean conditions (mg/l)	Resultant Conc. (mg/l)	Adjusted conc. (mg/l)	Resultant Conc. (mg/l)	EQS (mg/l)	Existing D/S mean conc.
Mean Flows								
BOD	1.098	3.579	0.260	2.879	1.400	3.831	1.500	3.95
Orthophosphate	0.026	0.198	0.005	0.180	0.030	0.201	0.035	0.02
Ammonia	0.081	2.392	0.008	2.331	0.0525	2.368	0.065	1.17

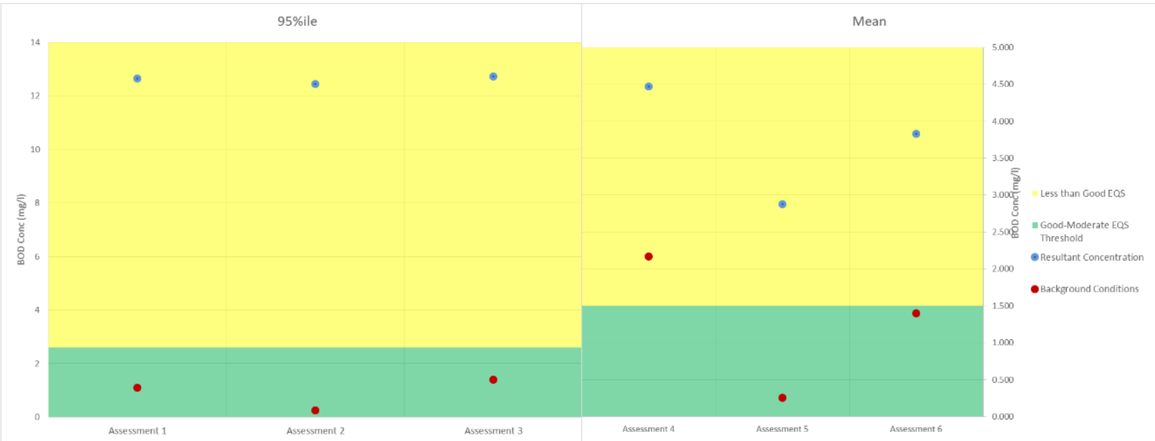

Figure 7.1: Mass balance assessments BOD (incl. background concentrations and EQS)

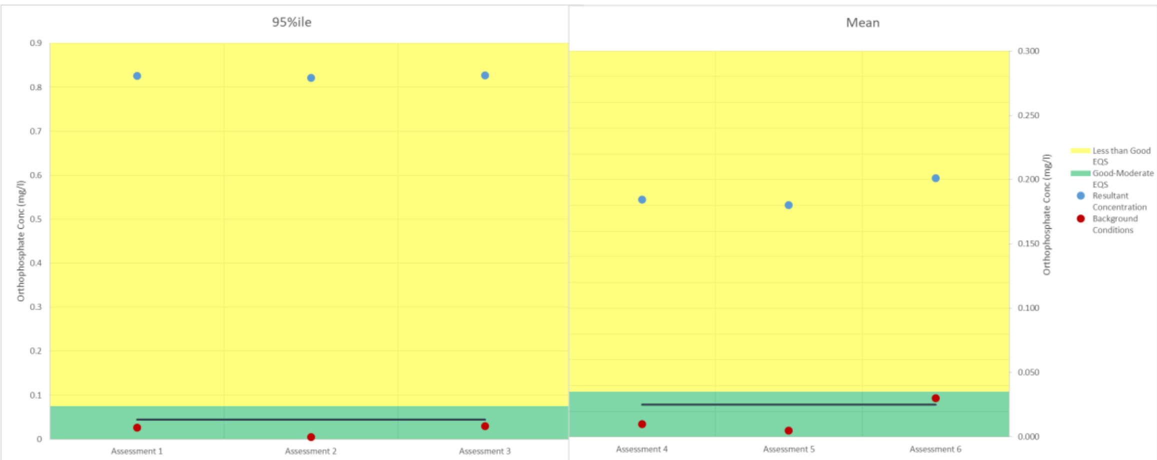

Figure 7.2: Mass balance assessments orthophosphate (incl. background concentrations and EQS)

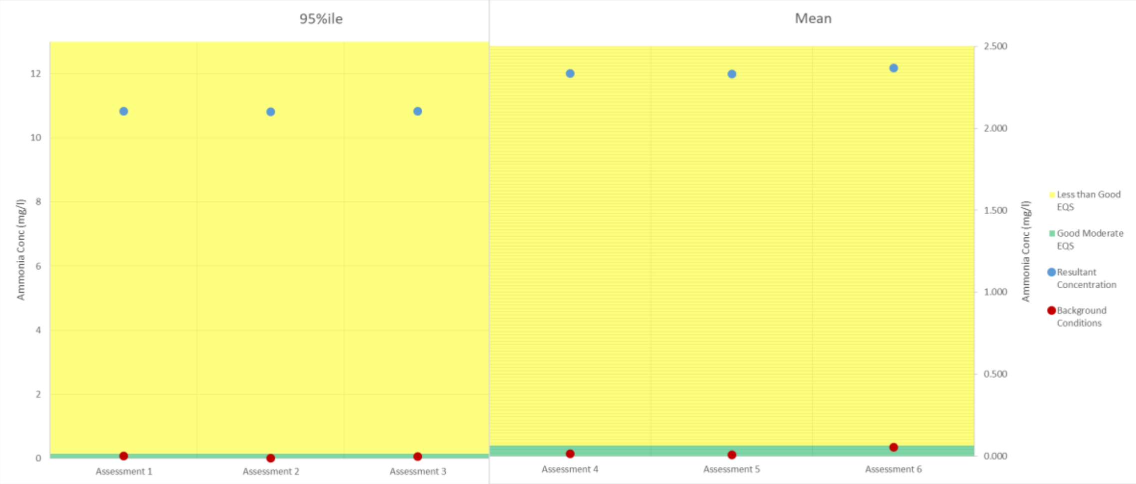

Figure 7.3: Mass balance assessments ammonia (incl. background concentrations and EQS)

The existing background concentrations for BOD are below the EQS for conditions consistent with 'high' and ortho-P concentrations are below the EQS for 'good'. The existing background concentrations for ammonia are consistent with conditions which are 'less than good' ecological status.

The mass balance assessment demonstrates a deterioration in status for all parameters as a result of the discharge even in notionally clean background conditions. This indicates that the WWTP discharge will therefore result in a failure of the environmental objectives for the Maggy's Burn_010 water body and is a significant pressure on the water body.

7.3 Assessment of Emission Limit Value

If the existing discharge were in-line with its current ELV's as presented in Table 6.2, and the mass balance assessment was undertaken for the 95%ile flows at the 95%ile environmental quality standard, the impact of the discharge would result in a failure in the 95%ile EQS for all parameters downstream of the discharge. The reason is the limited assimilative capacity in Maggy's Burn which is a key factor in the decision to relocate the discharge to a marine outfall in the Leannan Estuary subsequent to secondary treatment in the proposed WWTP.

Table 7.3: Assessment of ELV adequacy

	ELV Assessment		
Parameter	**Existing B/ground (mg/l)**	**Resultant Conc. (mg/l)**	**EQS* 95%ile (mg/l)**
BOD	1.098	19.414	2.6
Ortho-P	0.026	1.156	0.075
Ammonia	0.081	3.850	0.14

** EQS for conditions consistent with 'good' status*

STEP 7 - SUMMARY

- Measured background concentrations at the upstream ambient monitoring location indicate that there are pressures upstream of the WWTP that are affecting water quality in the Maggy's Burn_010 water body for ammonia in particular. This indicates that the WWTP is not the sole significant pressure on this water body. The SWO is upstream of the ambient monitoring location which is scheduled for monitored under the SWO Assessment & Monitoring Programme, there are no other known network issues.

- The mass balance calculations demonstrate that the Milford WWTP is significantly impacting water quality in the Maggy's Burn_010 water body, even in the notionally clean scenarios, and therefore the Milford agglomeration can be considered a significant pressure.

- An assessment of the adequacy of the ELVs has demonstrated that none of the current ELVs set for the key parameters are adequate due to the limited assimilative capacity in the receiving water.

8 STEP 8 - FURTHER DETAILED ASSESSMENT

The desktop-based assessment has been carried out (i.e. Steps 1 to 7). It has demonstrated that the Milford agglomeration is a significant pressure, however it may not be the sole significant pressure. The data quality checks as part of Step 1 and detailed calculations produced robust determination with high confidence that the impact of the existing WWTP is significant on the Maggy's Burn water body. However there is uncertainty as to the potential impact of the SWO that is upstream of the WWTP and upstream ambient monitoring station does have some high ammonia concentrations with a baseline based on the last three annual averages (2016-2018) of 0.081 mg/l which is consistent with conditions which are 'less than good' status. The outputs are summarised in Table 8.2.

If Steps 1 to 7 have not provided adequate evidence that an Agglomeration is a significant pressure, or a sole significant pressure, a further detailed assessment (Step 8) may be required in order to make these determinations. Further assessment categories are described in Table 8.1**Error! Reference source not found.**.

Table 8.1: Further detailed assessment categories

Further Detailed Assessment Categories	
A	Full scoping of further detailed assessment work required to achieve the aims of the overall assessment.
B	Visual assessment in relation to a discharge point in line with EPA CSMU Guidance on Further Characterisation for Local Catchment Assessments; including undertaking a stream walk, taking field notes, preparing a succinct summary and interpreting results for use in the assessments.
C	Monitoring of biological indicators upstream and downstream of a discharge point and interpreting results for use in the assessments.
D	Monitoring of physico-chemical indicators upstream and downstream of a discharge point and interpreting results for use in the assessments.
E	Taking water samples upstream and downstream of a discharge point and arranging analysis in an accredited laboratory for physicochemical parameters and interpreting results for use in the assessments.
F	Subcatchment scale modelling exercise using platforms such as SAGIS-SIMCAT or similar (to be approved by Irish Water); and interpretation of results for use in the assessments.

Table 8.2: Summary of data issues

Step	Data Confidence Issues	Data Gaps
1	No issues	No issues
2	No issues	No issues
3	No issues	No issues
4	No issues	No issues
5	No issues	No issues
6	SWO upstream of the ambient monitoring location	The other parameters are not at elevated

Step	Data Confidence Issues	Data Gaps
	may be impacting on the water quality in terms of ammonia	levels and there are no known issues with the SWO which has been confirmed with Irish Water has undertaken monitoring of this SWO.
7	No issues	No issues

STEP 8 - SUMMARY

- The Milford WWTP is a significant pressure, however there would appear to be other pressures upstream of the agglomeration causing ammonia issues which suggests that it is not the sole significant pressure in this water body.

9 STEP 9 - OVERALL CONCLUSIONS AND DETERMINATIONS

The final step draws together the findings of the preceding steps to draw overall conclusions for the Agglomeration based on a weight-of-evidence approach. These conclusions and determinations are presented on a water body basis for each water body where urban waste water was identified as a sole significant pressure. Table 9.1 presents the overall conclusions and determinations of the assessment.

Table 9.1: Overall conclusions and determinations

Water Body: Maggy's Burn_010	
Significant pressure Is the agglomeration a significant pressure i.e. is it causing water quality issues?	Yes
Sole significant pressure Is the agglomeration a sole significant pressure i.e. is urban waste water the only pressure category causing water quality issues?	No
Is the agglomeration causing water quality issues that, in the absence of other pressures, would result in the water body failing to achieve its environmental objectives?	Yes

- Milford WWTP has one primary discharge and three SWOs, which discharge directly into the Maggy's Burn_010 river water body. This water body is considered ''at risk'' of not meeting its environmental objectives and is at 'poor' ecological status (2010-2015 and 2013-2018). Maggy's Burn flows int the Leannan_060 river water body and then Lough Fern. The agglomeration is also considered to be the sole significant pressure on Lough Fern which is also at 'poor' ecological status (2010-2015 and 2013-2018).

- The stage 2 Appropriate Assessment undertaken in 2010 when Donegal County Council were applying for a discharge authorisation for the Milford agglomeration. The assessment concluded that the discharges from the agglomeration are likely to result in adverse impacts on the ecological integrity of Natura 2000 sites, either by itself or in combination with other plans or projects. The assessment identified three qualifying interests that may potentially be negatively impacted and made recommendations in terms of the mitigation required to ensure the protected area objectives of Maggy's Burn could be achieved.

- The SSRS was undertaken in 2016 and reported in the AER, the results of the SSRS indicate the plant is having an impact. However there scores indicate that there are also pressures on water quality upstream of the discharge.

- The load quantification analysis indicates that the Milford WWTP is not the sole significant pressure in relation to BOD, Total P and Total N in the Maggy's Burn_010 water body. However there is a SWO located upstream of the upstream ambient monitoring point which could be influencing the annual loadings in the upstream station resulting in an impact to the water body.

- Ambient monitoring data was available for the period 2014 to 2019, and included biological and physico-chemical data.

- Water quality information available for Leannan_060 lies downstream of Lough Fern, and therefore it is not possible to determine the impact of the Milford agglomeration on this water body, if any. However Lough Fern is currently at 'poor' ecological status with fish and macrophytes the driving elements for this status classification. Nutrient levels in Lough Fern are indicative of conditions consistent with at least 'good' status.

- The analysis indicates that the Milford WWTP may not be the sole significant pressure on the water quality in Maggy's Burn or Lough Fern, as the downstream ambient concentrations do not always correlate well with the effluent concentrations suggesting a possible additional pressure, which could include the SWO.

- There do not appear to be any ortho-P issues upstream of Milford WWTP, with few samples exceeding the EQS value. Peaks downstream water quality correlates with upstream peaks, however these are elevated, suggesting that pressures are amplified downstream of Milford WWTP and possibly event driven.

- Ammonia concentrations at the upstream monitoring station have a number of samples that are above the EQS value, indicating potential pressures contributing to concentrations upstream. However, levels are elevated at the downstream monitoring location, suggesting that pressures between the ambient monitoring locations, including the WWTP, are impacting this area.

- The analysis indicates that the Milford agglomeration is a significant pressure on the water body, but that it may not be a sole significant pressure. Other pressures identified include: agricultural pressures, DWWTS or urban pressures. It should be noted that there is one SWO upstream of both ambient monitoring points, which is a potential source of impact. The SWO is scheduled to be assessed on the SWO programme and there are no other known network issues. It is possible that the agglomeration is not the sole significant pressure however this requires further investigation as the SWO could be a potential source of upstream pressures.

- Milford WWTP is organically and hydraulically overloaded. There have been noted recurring ELV breaches at plant in particular for BOD, COD, SS and ammonia.

- Capital works will be undertaken under the Rathmullan, Milford and Ramelton Sewerage Scheme which will involve the construction of a new WWTP and the relocation of the discharge to the Leannan Estuary. These capital works will remove the pressure on Maggy's Burn and Lough Fern.

- Measured background concentrations at the upstream ambient monitoring location indicate that there are pressures upstream of the WWTP that are affecting water quality in the Maggy's Burn_010 water body for ammonia in particular. This indicates that the WWTP is not the sole significant pressure on this water body. The SWO is upstream of the ambient monitoring location and is being monitored under the SWO Assessment & Monitoring Programme.

- The mass balance calculations demonstrate that the Milford WWTP is significantly impacting water quality in the Maggy's Burn_010 water body which is possibly impacting on Lough Fern also however the indicative quality for nutrient conditions (Total P in particular) has improved in Lough Fern in the latest water quality monitoring programme from 'moderate' to 'good', even in the notionally clean scenarios, and therefore the Milford agglomeration can be considered a significant pressure.

  An assessment of the adequacy of the ELVs has demonstrated that none of the current ELVs set for the key parameters are adequate due to the limited assimilative capacity in the Maggy's Burn_010 water body.

STEP 9 - SUMMARY

- The Milford agglomeration is a significant pressure on the Maggy's Burn_010 water body causing water quality issues and would prevent the water body from aceiving its environmental objectives. However it is unlikely to be the sole significant pressure as there are other pressures affecting ammonia supporting conditions in the receiving water body which would require investigation including the SWO on hte netwrok which is currently under investigaiton ion the SWO programme.The planned upgrades for the WWTP should address the impact of the WWTP on Maggy's Burn and Lough Fern.

Appendix A

Data Collection Summary

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
24/08/2017	Irish Water	Irish Water	CoA data _22_08_2017_For Upload	Summary information for certified agglomerations	N/A
20/11/2018	Irish Water	Irish Water	IW-AM-ES-DWRA-20181116	WWDA Drinking Water Risk Assessment – methodology document and example scoresheet	N/A
20/11/2018	Irish Water	Irish Water	DWRA Official Scoresheet_20181120	WWDA Drinking Water Risk Assessment – example scoresheet	N/A
20/11/2018	Irish Water	Irish Water	IW-AM-ES-CapRegAssessment-20180831	Capacity Register assessment document – includes an assessment of impact on receiving water quality	According to the CoA (Certificate of Authorisation) (2017) Headroom Available is -3691 (2017 AER). Project underway and due completion 2021.
20/11/2018	Irish Water	EPA	National Surface Water Characterisation Spreadsheet 06122017 (full)	National Characterisation Spreadsheet	Fern considered 'at risk' (2010-2015) poor ecological status. Maggy's Burn considered 'at risk' (2010-2015) poor ecological status.

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/11/2018	Irish Water	EPA	National WRAA 11-09-17_Regions_2018priorities_20181108	Priority Areas for Action indicating where Sole significant pressures are located in PAAs (also includes RBMP Appendix 1 information) (National WRAA…)	Fern NOT identified as Area for Action. Maggy's Burn_010 identified as Area for Action.
20/11/2018	Irish Water	EPA	HES_Objectives_Feb2018	National High Ecological Status objective	N/A
20/11/2018	Irish Water	EPA	PAs_Deter_WBs_10_11_17_EDITED 8-2-2018_queried	Priority water bodies	Fern NOT identified as Area for Action. Maggy's Burn_010 identified as Area for Action. Pressure: UW for both.

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/11/2018	Irish Water	Irish Water	UWW_Final_Pressure_List_24_10_17_queried	Urban waste water significant pressures spreadsheet	WWTP discharges in upstream water body, Maggy's Burn_010 and has been identified as having a downstream impact in this water body. Operational issues noted at the WWTP. WWTP overloaded and is not designed for nitrogen removal. Persistent ELV breaches noted. CIs: The Milford Agglomeration has been identified as a single pressure on a water body 'at risk' of not meeting environmental objectives from the Water Framework Directive characterisation programme. Irish Water is required to examine the WWTP and network, and identify works required to ensure that discharges from the agglomeration do not prevent the receiving water from meeting its environmental objectives. IW should provide a corrective action plan, including timeframes, to resolve this matter.

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/11/2018	Irish Water	Irish Water	Priority Area List Q2 2018_IW Update	Priority Action List (PAL) information i.e. the reason(s) why the EPA consider the agglomerations to be priority agglomerations for action	Likely cause - WWTP. It is a candidate for the next investment. Project timelines depends on need for marine modelling/foreshore licence.

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
	Irish Water	Irish Water	Q3 2018 Update Including EDEN responses	Compliance investigation ss	The EPA SMU's initial characterisation impact assessment identified the WWTP was overloaded and not designed for nitrogen removal. Persistent ELV breaches and operational issues were noted. Milford is part of an Irish Water capital project to combine with Ramelton & Rathmullan agglomerations and be served by 1 No. Secondary WWTP with one discharge point. Currently the status is at Assessment & Planning. The existing WWTP in Milford will become a pumping station when the new combined plant is constructed. Advanced works to include a new inlet works and storm storage facilities in Milford is being advanced, this element of work is bundled with Carrigart and Kilmacrennan and Tenders for this contract will be released in Q4 2018 with construction to commence in 2019. Irish Water is undertaking comprehensive assessment of those agglomerations that have been identified as 'sole' significant pressures within ''at risk'' water bodies of which Milford is one. This assessment work will build on the initial characterisation exercise undertaken by the EPA CSMU during 2015/6. The

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/11/2018	Irish Water	Irish Water	2016_Article_17_report_for_upload	UWWTD Article 17 report	N/A
28/11/2018	Irish Water	Irish Water	Significant Pressure Monitoring Data	Significant Pressure Monitoring Data	No Influent & Effluent Data Available
21/11/2018	Irish Water	Irish Water	Limnos Assessment Tracker	Limnos Assessment Tracker	N/A
21/11/2018	Irish Water	Irish Water	2017 AER Data Collector - cleansed MH	AER Data Collector	The WWTP was non-compliant with the ELV's set in the WWDA discharge licence.
22/11/2018	Irish Water	Irish Water	211118 Surface Water Yield Assessment	Surface Water Yield Assessment	0600PUB1050 included in Assessment
21/11/2018	Irish Water	Irish Water	IW_EPA_SW Methodology 091216 for IW presentation	Irish Water National Water Resources Plan	
22/11/2018	Irish Water	Irish Water	FPM ES Report Tracker 2018	FPM Ecological Statement Report	Milford not located in FPM catchment -N/A
28/11/2018	Irish Water	Irish Water	Ambient Mon Locations 63	Monitoring locations	Milford data from monitoring stations available.
07/12/2018	RPS Galway	RPS	NCAP Reports Priority 1.zip	Site Assessment report for 7 agglomerations (CoA) on NCAP Programme	NCAP Report NOT Completed for Milford

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
07/12/2018	RPS Galway	RPS	Small Stream Risk Score for 7 WWTP and their associated discharges	Small Stream Risk Score for 7 WWTP and their associated discharges	N/A
18/12/2018	Irish Water	Irish Water	IW_Agglomerations_141218	Shapefile with boundaries of agglomerations	boundary included
17/12/2018	Irish Water	Irish Water	WFD_Chemistry_Monitoring_17122018_Donegal	WFD Monitoring Data	Milford monitoring stations included.
14/12/2018	Irish Water	Irish Water	SWO Outfall Field Inspection - Entries (Rev 6) - to SFPA.xlsx	· A spreadsheet outlining the information that will be collected in the field using the SWO Visual Assessment App (this is still draft but is unlikely to change much). I have copied some text below to put some context to this.	Information that will be collected but has not yet been captured

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
14/12/2018	Irish Water	Irish Water	Annex 1 - EPA correspondence of 8 November 2016.pdf	· A PDF document of an EPA report on a review of nutrient sensitive areas as required by the UWWTD. As mention in the workshop on Tuesday, Irish Water do not agree with all aspects of this report.	N/A
14/12/2018	Irish Water	Irish Water	Loads Template v11 20170405	Information on loads (existing and projected) issues to the EPA CSMU to assist them in their initial characterisation work.	N/A
17/12/2018	Irish Water	Irish Water	20181126-DAP Progress	List of agglomerations in our DAP programme. DAP outputs are on the SPA Alfresco Cloud site.	N/A - Milford not included in the assessment

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
17/12/2018	Irish Water	Irish Water	IW-AM-ES-SPAAggloms	63 aggloms in the SPA project with extra columns of info attached for: whether the agglomeration is included in the telemetry programme; whether the aggloms has (or will get) event duration monitors (EDMs).	Milford not scheduled for inclusion in either monitoring programme
18/12/2018	Irish Water	Irish Water	IW-AM-ES-SPAAggloms	63 agglomerations with a new column indicating which agglomerations are contained with existing/planned model domains	As Above
18/12/2018	EPA	EPA	http://www.epa.ie/QValue/webusers/	Hyperlink to Q values	Milford included
18/12/2018	Irish Water	Irish Water	Q4 2018 PAL IW Update_SPs	Q4 2018 PAL update attached for Sole significant pressure agglomerations (only 57 of the 63 Sole significant pressure agglomerations are included on the PAL).	Milford still classified as Sole significant pressure in this dataset

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/12/2018	Irish Water	Irish Water	Shellfish Tracker for 2018 AERs_SPA aggloms	Info in relation to the disinfection programme attached	N/A

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/12/2018	Irish Water	Irish Water	Shellfish_LSR_SourceMapper_SPA aggloms	Info in relation to the disinfection programme attached	N/A

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
20/12/2018	Irish Water	Irish Water	IW-AM-ES-SPAAggloms_20181220v2	Update of overall list on Project status	Planning and assessment stage.
21/12/2018	Irish Water	Irish Water	Sole significant pressure Sites - BOD Data	BOD data for the Sole significant pressure aggloms	BOD data available for Milford
21/12/2018	Irish Water	Irish Water	Ww Disinfection Shellfish Tracker_SP	information on the disinfection programme	N/A
21/12/2018	Irish Water	Irish Water	20745 - Prioritisation Matrix_SP	information on the disinfection programme	N/A
21/12/2018	Irish Water	Irish Water	20745 SAR - Conclusions	information on the disinfection programme	N/A
24/12/2018	Irish Water	Irish Water	Proposed Interim Generated Load Methodology IW 20161128 v5.2	Interim load methodology document. The methodology is currently under revision, due to be complete by end Jan 2019	Milford NOT included in the Pilot Study
24/01/2019	Irish Water	Irish Water	NCAP Report_H2_2018.xlsx	BOD data for the Sole significant pressure cert sites (CoA) aggloms (<500 PE)	N/A
30/01/2019	Irish Water	Irish Water	Regulatory_Influent_Effluent2018	2018 influent and effluent regulatory data	Data available for Milford
04/02/2019	Irish Water	Irish Water	Cert Sites 2016-2018	Available effluent monitoring for CoA sites for 2016 - 2018	N/A

Date received	Organisation Received from	Data owner	File name as received	Description	Milford
05/02/2019	Irish Water	Irish Water	IW-AM-ES-DraftReviewList-20180720_record of decisions	List of licences that we are considering for review	N/A - Removed WWDA in CR
05/02/2019	Irish Water	Irish Water	Phosphate Susceptibility	Phosphate Susceptibility map from EPA CCT	Susceptibility mapping for Milford Available
13/02/2019	Irish Water	Irish Water	Cert Sites 2014-2018	Available effluent monitoring for CoA sites for 2014 - 2018	N/A

Appendix B

Data Quality Checks

Monitoring Data General Quality Check

Numerous datasets have fed into the calculations required to assess the effluent loads, the data is listed in Appendix A.

Data availability and quality checks have been carried out to ensure that data is fit for purpose. Note that ambient data downloaded from the WFD App has already undergone review and cleansing by the EPA. Data checks typically ensured:

- that the data is within the expected range for each parameter;
- that the data has valid entries for missing data (zeros have been removed to aid statistical analysis);
- that the data has valid entries for samples below ELVs of detection or quantification;
- that the data has valid sample date and time information;
- that the measurement units are correctly recorded;
- whether flow data is available concurrently with concentrations (data taken from Hydrotool mean flow estimates at the ambient monitoring locations, if available, to calculate existing upstream and downstream loads);
- whether flows correlate with any physical constraints on the discharge arrangements (e.g. consistent pipe capacity exceedances could indicate that a sample is in a receiving watercourse rather than the actual discharge);
- that the analysis quality assurance metadata is also available (samples would have been taken and analysed in line with EPA methodologies);
- that sampling point locations are known, ideally are georeferenced, and correctly identified (analysed in ArcGIS to avoid any inter-mixing of discharge/upstream or downstream concentration datasets);
- that there is no seasonal bias within the sampling regime which might extrapolate to inaccurate annual loadings given population loading variation and other seasonal factors (the WFD monitoring programme collects samples quarterly, effluent samples are generally sampled monthly thereby ensuring averages are not heavily swayed by seasonal bias).

Step Change Detection

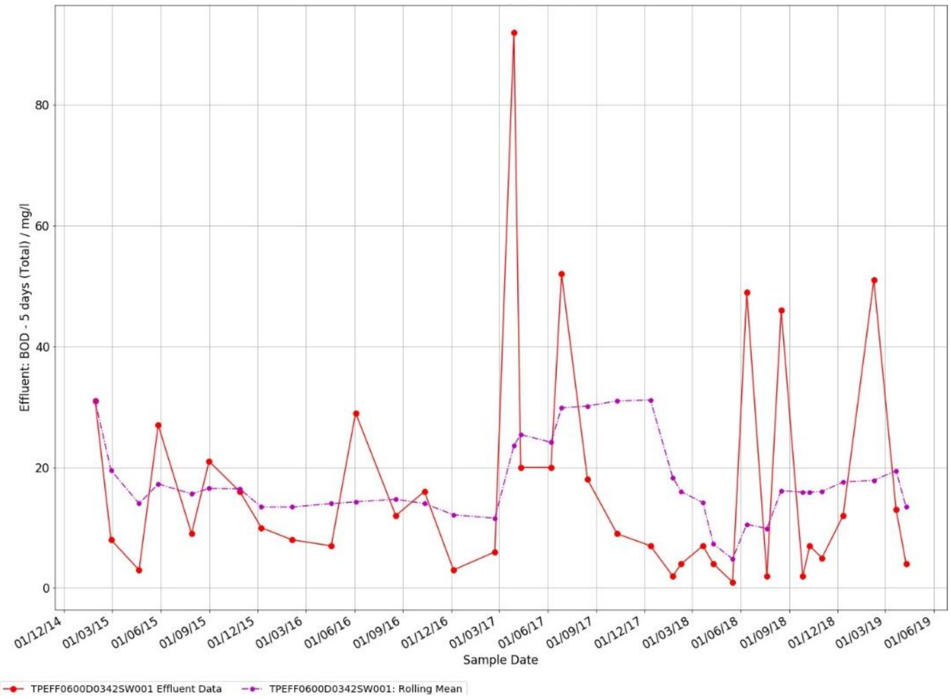

Figure 1: Milford effluent BOD concentrations step change detection

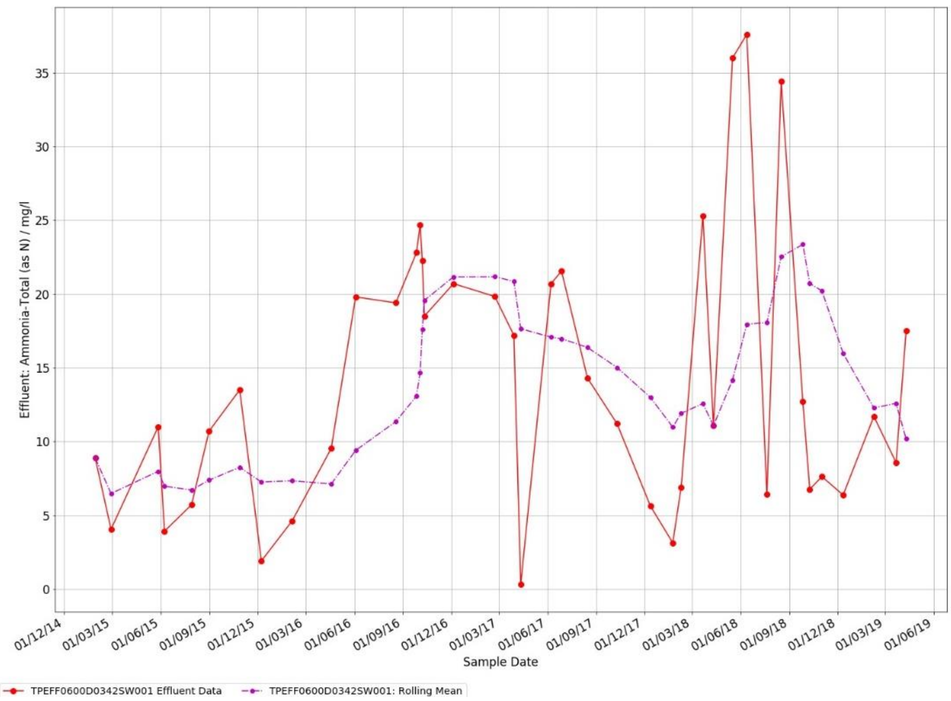

Figure 2: Milford effluent Ammonia concentrations step change detection

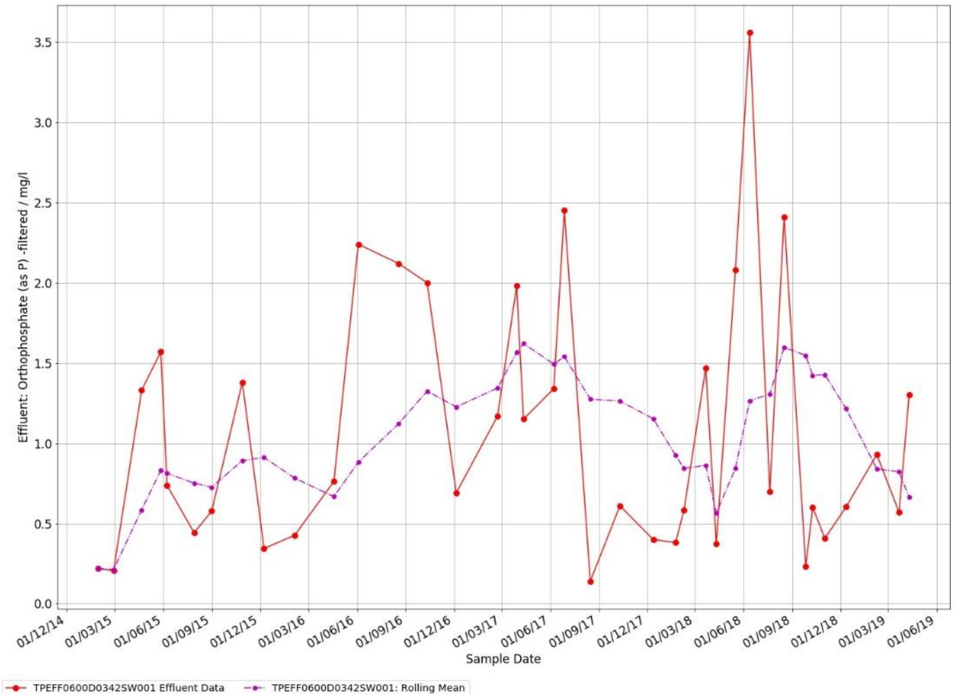

Figure 3: Milford effluent orthophosphate concentrations step change detection

Outlier Detection

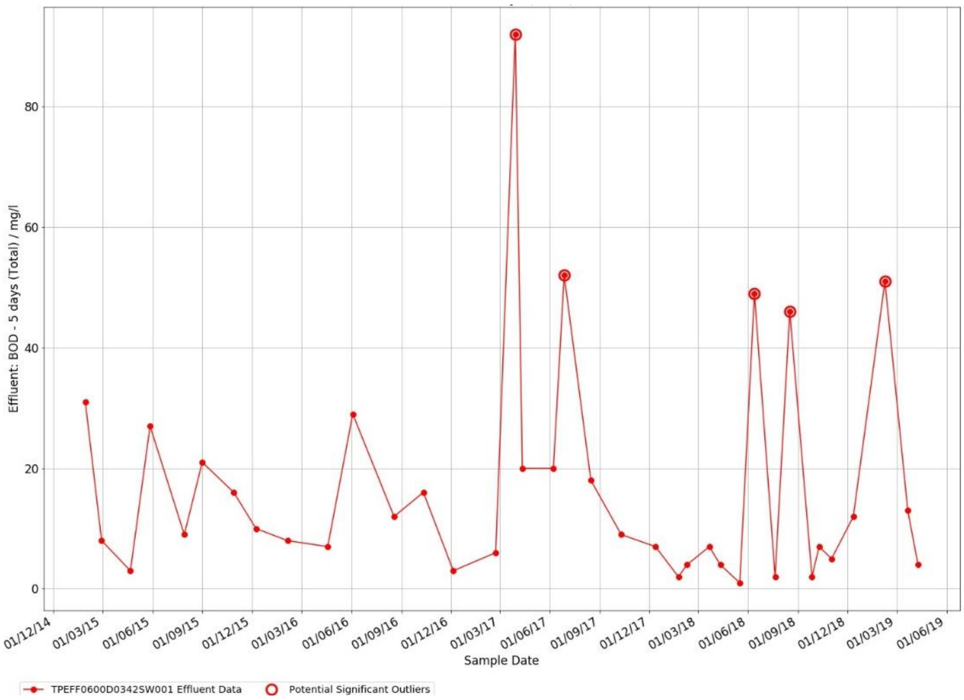

Figure 4: Milford Effluent Outlier Detection for BOD concentrations

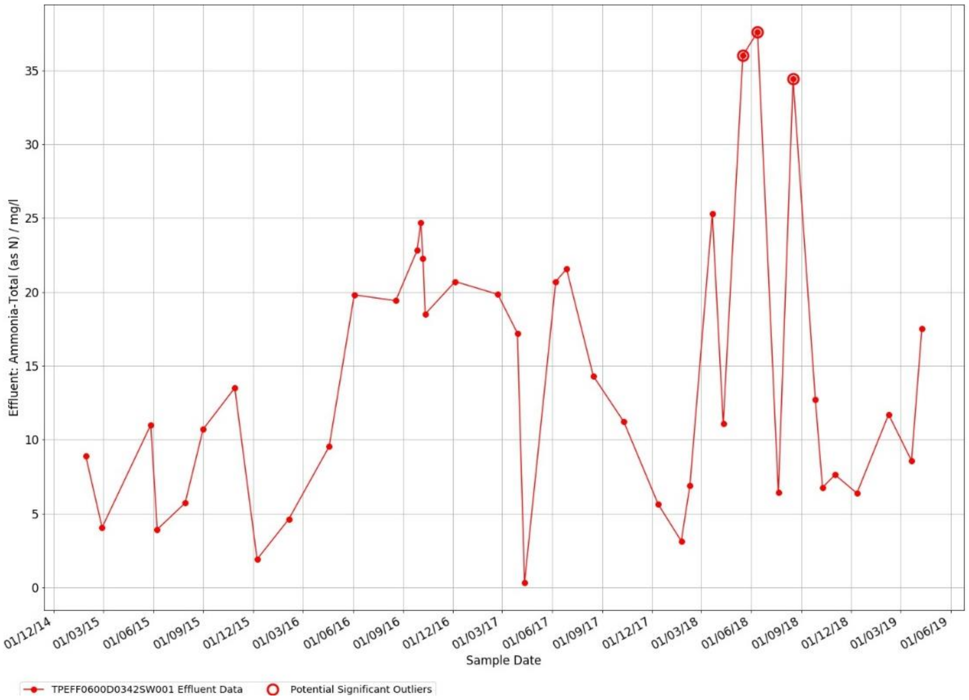

Figure 5: Milford Effluent Outlier Detection for Ammonia concentrations

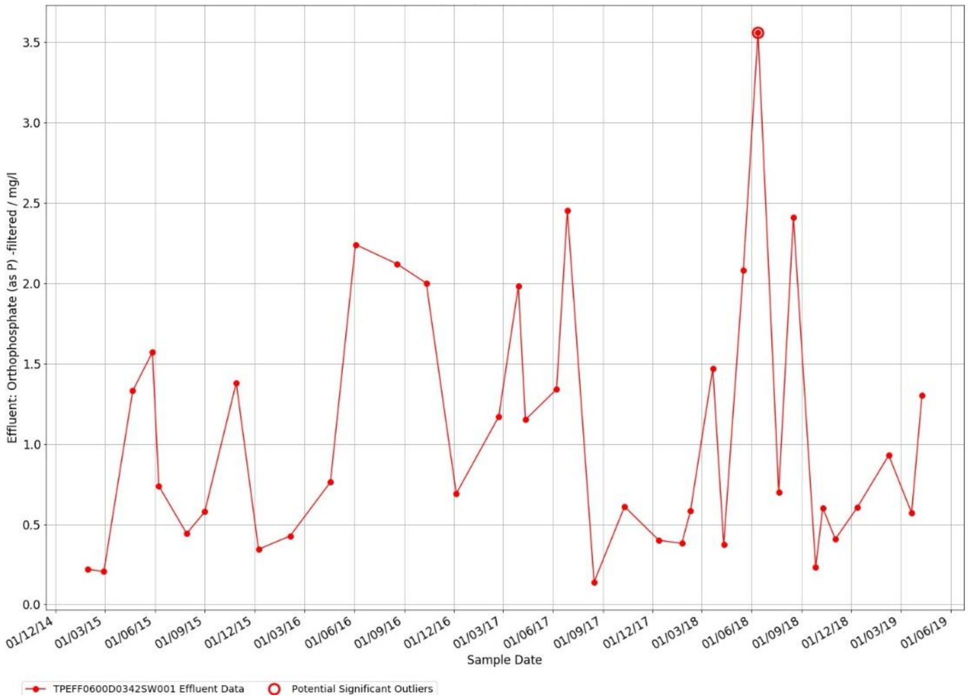

Figure 6: Milford Effluent Outlier Detection for Orthophosphate concentrations

Appendix C

Load Quantification Calculations

1 LOAD QUANTIFICATION METHODOLOGY

In order to quantify the annual load (kg/year) of a particular substance at any given location within a water body it is necessary to establish the concentration of the particular substance at that location (mg/l) and the flow at that particular location in (m^3/s).

Annual Load (kg/year) = Conc. (mg/l) * (Flow (m^3/s) * 3600 * 24 * 365) / 1000000

Where * 3600 * 24 * 365 converts m^3/s into m^3/year

And / 1000000 converts mg/l in kg/l

BOD, Ammonia and Ortho P loads discharged from the WWTPs, as well as loads upstream and downstream of the point of discharge in the channel were calculated in attempt to quantify the load from other sources entering the water body between the two monitoring points.

1.1 WWTP Loads Calculation

For licenced WWTPs, i.e. WWTPs >500 PE, the loads were extracted from the AERs for BOD, Ammonia and Ortho P, where available. For WWTP with <500 PE or where loads for these specific parameters were not reported the loads were calculated / estimated based on PEs and export coefficients. Estimated loads were also used to sense-check the load data reported in the AER.

1.1.1 AER Effluent Loads

For each specific parameter AER loads were calculated using an average of the Effluent mass emission values reported in table 3.1 of the 2015, 2016 and 2017 AERs. Where values were not reported for a specific year the average was based on the years where data was available.

AER data for 2015, 2016 & 2017, respectively, were obtained from the following sources provided by Irish Water included in the incoming data register;

- 2017 AER Data Collector
- 2016 AER Data Collector rev 4a
- 2015 AER Data Collector

For Milford agglomeration BOD, Total P and Total N effluent mass emissions were reported in the AER. The tables below illustrates how the AER loads were derived initially.

2015 BOD Effluent Mass Emission (kg/year)	2016 BOD Effluent Mass Emission (kg/year)	2017 BOD Effluent Mass Emission (kg/year)	WWTP AER Load (average of 3 annual means)
5,194	640	1,339	2,391

2015 Total P Effluent Mass Emission (kg/year)	2016 Total P Effluent Mass Emission (kg/year)	2017 Total P Effluent Mass Emission (kg/year)	WWTP AER Load (average of 3 annual means)
514	150	65	243

2015 Total N Effluent Mass Emission (kg/year)	2016 Total N Effluent Mass Emission (kg/year)	2017 Total N Effluent Mass Emission (kg/year)	WWTP AER Load (average of 3 annual means)
3,590	1,420	1,327	2,112

The step change analysis, undertaken as part of the data quality checks (see Section 1 of the main document) did not highlight any identifiable change in trend between 2015 and 2017. Therefore 2015, 2016 and 2017 AER data was used to calculate the load from the WWTP where available.

1.1.2 Estimated Effluent Loads

An estimate of loads generated by the WWTP where AER data is not available can be calculated by applying a treatment reduction factor (see **Error! Reference source not found.**) available at the plant to the estimated influent load (see **Error! Reference source not found.**).

1.1.2.1 Treatment Reduction Factor

For the purpose of estimating effluent pollutant loadings, treatment reduction factors are based on pre-determined values for each level of treatment (i.e., no-treatment, primary treatment, secondary treatment and nutrient removal) as opposed to influent mass loading values reported in the AERs, where available. For Agglomerations with no treatment of wastewater a reduction factor of “0” is applied. The tables below breakdown the reduction factors applied for the levels of treatment for Total N, Total P and BOD respectively.

Total Nitrogen

Typical Total N reduction factors as reported by OSPAR (2004) were used for the purpose of load estimation in this assessment.

Treatment Reduction Factor (Total N)

Primary Treatment	Secondary Treatment	Tertiary Treatment	Source
0.727	0.545	0.3	OSPAR

Total Phosphorous

Typical Total P reduction factors as reported by OSPAR (2004) were used for the purpose of load estimation in this assessment.

Treatment Reduction Factor (Total P)

Primary Treatment	Secondary Treatment	Tertiary Treatment	Source
0.667	0.467	0.1	OSPAR

BOD

BOD reduction factors are based on typical (conservative) values for each level of treatment as reported in the CIWEM (2015) Municipal Wastewater Treatment training manuals.

CIWEM have assumed that anywhere between a 30-50% reduction of BOD can be achieved through Primary treatment. As a conservative approach, for the purpose of this assessment 30% reduction of BOD is assumed after primary treatment (reduction factor of 0.7).

CIWEM have assumed that anywhere between a 65-85% reductions of BOD can be achieved through Secondary treatment. As a conservative approach, for the purpose of this assessment 65% reduction is assumed after secondary treatment (reduction factor of 0.35).

None of the Agglomerations within this assessment receive tertiary treatment for BOD. Primary and secondary treatment reduction factors for BOD illustrated in the table below:

Primary Treatment	Secondary Treatment	Source
0.7	0.35	CIWEM (2015)

Wastewater at Milford (D0342) receives secondary treatment and therefore the following reduction factors were applied to the estimation of effluent load calculations:

Parameter	Reduction Factor
Total N	0.545
Total P	0.467
BOD	0.35

1.1.2.2 Estimated Influent Load

The influent load is the product of the population equivalent (obtained from The Irish Water Waste Water Capacity Register) and production rates.

The typical values for standard residential production per capita figures (production rates) obtained from British Water code of Practice (no. 4) were used as an estimate of the BOD and Ammonia mass produced (grams) per person per day.

Guidelines from an adopted EPA methodology (Mockler et al., 2017[12]) were used as an estimate of the Total P mass produced per person per day. The table below summarises the typical Loadings by parameter:

Parameter	Typical Loading (g/person/day)	Source
Ammonia as N	8	British Water
Total P	2	Mockler et al, 2017
BOD	60	British Water

The collected load PE figures from the 2017 Irish Water Waste Water Capacity Register were used to calculate influent loads as follows:

[12] Sources of nitrogen and phosphorus emissions to Irish rivers and coastal waters: Estimates from a nutrient load apportionment framework, Science of the Total Environment, Volumes 601-602, pp 326-339

Parameter	Typical Loading (g/person/day)		Population Equivalent		Influent Load (g/day)
Ammonia as N	8	×	1,809	=	14,472
Total P	2	×	1,809	=	3,618
BOD	60	×	1,809	=	108,540

*Estimated Influent load = PE * Production per capita*

1.1.2.3 Estimated Effluent Load Results

Applying the recommended treatment reduction factor, based on the level of treatment at the WWTP, to the estimated influent load calculated above provided an estimate of the effluent pollutant loads as demonstrated in the table below. In the absence of a typical reduction factor for ammonia the Total N reduction factor was assumed and applied to the estimate effluent load calculations.

Parameter	Influent Load (g/day)		Reduction Factor		Effluent Load Estimate (g/day)
Ammonia as N	14,472	×	0.545	=	7,887
Total P	3,618	×	0.467	=	1,690
BOD	108,540	×	0.35	=	37,989

*Estimated Effluent load = Influent Load * Reduction Factor*

Effluent loads generated above indicate the loads generated in grams per day which were subsequently converted to annual loads in kilograms (kg/yr).

Parameter	Effluent Load Estimate (g/day)		Converts Grams to kilograms		Converts Days to year		Effluent Load Estimate (kg/yr)
Ammonia as N	7,887	÷	1000	×	365	=	2,879
Total P	1,690	÷	1000	×	365	=	617
BOD	37,989	÷	1000	×	365	=	13,866

1.2 Upstream and Downstream Loads

Loads upstream and downstream of the point of discharge from the agglomeration to the main channel were estimated based on monitoring data from the nearest WFD monitoring stations. The estimated upstream and downstream loads for each parameter were derived from the product of mean flow in the river at the respective monitoring points and the average monitored concentration for that particular parameter.

*Annual Load (kg/year) = Conc. (mg/l) * (Flow (m^3/s) * 3600 * 24 * 365) / 1000000*

This provides an average load for the monitoring locations to allow a determination of the potential additional sources of load between the two monitoring locations.

1.2.1 Quality data

To establish concentrations for each parameter, firstly, all EPA Chemistry monitoring was downloaded from the MDS module on the EDEN system for monitoring Stations upstream and downstream of each Agglomeration's Primary Discharge point and compiled in a single excel worksheet (*'Compiled Chem_Monitoring'*). Monitoring stations were chosen based on proximity to the discharge point and sufficient chemistry data.

Data was checked to ensure the column illustrating the reported concentrations (column Q) contained only numeric values. Where a value was not included in the column but a limit of detection was stated, the limit of detection was halved to derive an absolute value. Where non-numeric and zero values were identified the rows were removed.

1.2.2 Flow data

Mean flow data was required at the same point on the river as the selected EPA monitoring locations to calculate the loads at that location. Mean flows were obtained using a hierarchical approach as summarised in the different methods below.

Gauged flow data is preferred to the EPA's hydrotool data as it provides a measured record of the flows at that point rather than an estimation and therefore where gauged data was available an average of the daily means were used. Where gauged data is available on the same river the gauged flows are factored on drainage area on a pro rata basis. If gauged data is not available at the point of interest or on the same river where typology is similar, then the 30 percentile flow from the EPA hydrotool, was used. If flows are needed at a location beyond the extent of hydrotool outputs, the most upstream hydrotool value is calculated and factored up based on additional drainage area.

Method 1: Gauged data

If the WFD monitoring location coincides with a hydrometric station with sufficient flow data available, all available data from that station is downloaded and an average of the daily mean flow data is used as the mean flow at that location.

Method 2: Gauged data scaled pro-rata on an area basis where appropriate (hydrologically similar)

If the WFD monitoring location does not coincide with a hydrometric station but there is a reliable station within the same river (as long as typology is similar) with sufficient flow data available, all available data from that station is downloaded. An average of the daily mean flow data is used to derive a long term mean flow at that location, then factored up or down on a pro rata basis, based on catchment area of the hydrometric station when compared to the catchment area of the WFD monitoring station. Flood Studies Update (FSU) nodes are used to determine drainage area of the WFD monitoring station location.

Method 3: Hydrotool value (where appropriate)

Where it is deemed there is no suitable recorded flow data available a shapefile containing river segments illustrating the outputs of EPA Hydrotool flow estimates is used to estimate the mean (30%ile) flows at the location of the WFD monitoring points upstream and downstream.

30%ile flows (the flow that is equalled or exceeded for 30 per cent of the time in the long term) has been used for flow calculations, as this flow statistic is considered a reasonable representation of mean flows (EPA, 1995).

Method 4: Hydrotool values scaled pro-rate on areal basis (where appropriate)

In the event where there is no suitable recorded flow data available and beyond the extent of the EPA's hydrotool, a similar approach to step 2, using the most upstream flows available from the EPA's hydrotool is employed. Whereby, the most upstream hydrotool 30%ile flows are factored on a pro rata basis, based on catchment area at the downstream extent of the EPA hydrotool river segment in relation to the catchment area of the WFD monitoring station. Flood Studies Update Nodes are used to determine drainage area at specific locations

1.2.3 Calculation of loads

For Milford the following information was used to calculate **upstream** pollutant concentrations:

Parameter	Upstream Monitoring Station (station code)	No. of samples used to calculate average conc.	Sample Date Range	Upstream Conc. mg/l
Ammonia as N	d/s Br in Milford (u/s STW) (RS39M010150)	21		0.083
Total P	d/s Br in Milford (u/s STW) (RS39M010150)	1		0.032
BOD	d/s Br in Milford (u/s STW) (RS39M010150)	21		1.190

Note figures have been rounded to two decimal places for the purpose of reporting

For Milford the following information was used to calculate **downstream** pollutant concentrations:

Parameter	Downstream Monitoring Station (station code)	No. of samples used to calculate average conc.	Sample Date Range	Downstream Conc. mg/l
Ammonia as N	d/s Br in Milford (u/s STW) (RS39M010150)	50		0.535
Total P	d/s Br in Milford (u/s STW) (RS39M010150)	21		0.036
BOD	d/s Br in Milford (u/s STW) (RS39M010150)	37		2.605

For Milford the following mean flows were recorded and used for upstream and downstream loading calculations:

Position in relation to primary discharge to main channel	Mean Flow (l/s)	Step Used to obtain flow information	Comment
Upstream	233	Step 3	Both upstream and downstream monitoring locations used for this assessment exist on the same Hydrotool river segment (hence why the flows values are the same upstream and downstream.
Downstream	233	Step 3	

The product of the pollutant concentration and flows above generated the following pollutant loadings in mg/s.

Parameter	Position	Flow (l/s)		Conc. mg/l	Converts mg/s to kg/year	=	Load kg/yr
Ammonia as N	Upstream	233	×	0.083	x 31.536	=	612
	Downstream	233	×	0.535	x 31.536	=	3,935
Total P	Upstream	233	×	0.032	x 31.536	=	467
	Downstream	233	×	0.036	x 31.536	=	924
BOD	Upstream	233	×	1.190	x 31.536	=	8,747
	Downstream	233	×	2.605	x 31.536	=	19,138

The difference between upstream and downstream loads were then calculated, and the contribution of the WWTP to this load difference has been presented as a percentage for each parameter.

	BOD kg/yr	Total N kg/yr	Total P kg/yr
Upstream Load	8,747	15,242	467
WWTP Load	2,391	2,112	120
Downstream Load	19,138	26,891	924
Difference (Between Upstream and Downstream)	+10,391	+11,649	+457
WWTP Load as % of Downstream Load	13%	8%	13%
WWTP Load as % of Difference (Upstream and Downstream)	23%	18%	26%

Data from AER Deemed unreliable, Estimated Loads used

Appendix D

Ambient Monitoring Summary

Ambient and WFD monitoring data for the Maggy's Burn_010 and Leannan_060 water bodies

	Primary Discharge Water body				Upstream Water body		Downstream Water body	
Factor	IE_NW_39M010300 MAGGY'S BURN_010				0		IE_NW_39L010600 LEANNAN_060	
Risk Category	'at risk'				0		NAR	
Biological Status Variations/trends in Q values. 2016-2018 Q value data were available	Latest	Poor (20016)- Just u/s Lough Fern			Latest		Latest	Good (2016) Drumman Br (d/s L Fern)
	1998	3			1998	-	1998	4/5
	2001	4			2001	-	2001	4
	2004	2/3			2004	-	2004	4
	2007	2/3			2007	-	2007	4
	2010	2/3			2010	-	2010	4
	2013	2/3			2013	-	2013	4
	2016	-			2016	-	2016	4
						-		
	Latest				Latest	-	Latest	-
	1999	-			1999	-	1999	-
	2002	-			2003	-	2003	-
	2005	-			2006	-	2006	-
	2008	-			2008	-	2008	-
	2011	-			2012	-	2012	-
	2015	-			2014	-	2014	-
	2018	-			2017	-	2017	-
Chemistry								
Ammonia-Total (as N)	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	Just u/s Lough Fern						Drumman Br (d/s L Fern)	
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	0.197	2009	-	2009	0.062
	2010	-	-	0.390	2010	-	2010	0.04
	2011	-	-	0.084	2011	-	2011	0.04
	2012	0.128	-	0.123	2012	-	2012	0.04
	2013	0.201	-	0.198	2013	-	2013	0.045
	2014	0.272	0.111	0.272	2014	-	2014	0.037
	2015	1.247	-	1.247	2015	-	2015	0.027
	2016	0.094	0.049	0.094	2016	-	2016	0.033
	2017	0.882	0.106	0.882	2017	-	2017	0.03
	2018	1.406	0.087	1.406	2018	-	2018	0.034
			-	-				
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	-	2009	-	2009	-
	2010	-	-	-	2010	-	2010	-
	2011	-	-	-	2011	-	2011	-
	2012	-	-	-	2012	-	2012	-
	2013	-	-	-	2013	-	2013	-
	2014	-	-	-	2014	-	2014	-
	2015	-	-	-	2015	-	2015	-
	2016	-	-	-	2016	-	2016	-
	2017	-	-	-	2017	-	2017	-
	2018	-	-	-	2018	-	2018	-
Orthophosphate (as P) - unspecified	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	Just u/s Lough Fern						Drumman Br (d/s L Fern)	
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	-	2009	-	2009	0.011
	2010	-	-	-	2010	-	2010	0.01
	2011	-	-	-	2011	-	2011	0.01
	2012	0.01	-	0.005	2012	-	2012	0.01
	2013	0.038	-	0.038	2013	-	2013	0.011
	2014	0.08	0.032	0.080	2014	-	2014	0.009
	2015	0.02	-	0.020	2015	-	2015	0.005
	2016	-	-	-	2016	-	2016	0.009
	2017	-	-	-	2017	-	2017	0.012
	2018	-	-	-	2018	-	2018	0.007
			-	-				
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	-	2009	-	2009	-

	Primary Discharge Water body				Upstream Water body		Downstream Water body	
	2010	-	-	-	2010	-	2010	-
	2011	-	-	-	2011	-	2011	-
	2012	-	-	-	2012	-	2012	-
	2013	-	-	-	2013	-	2013	-
	2014	-	-	-	2014	-	2014	-
	2015	-	-	-	2015	-	2015	-
	2016	-	-	-	2016	-	2016	-
	2017	-	-	-	2017	-	2017	-
	2018	-	-	-	2018	-	2018	-
BOD - 5 days (Total)	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	1.193	2009	-	2009	-
	2010	-	-	2.460	2010	-	2010	-
	2011	-	-	1.530	2011	-	2011	-
	2012	-	-	1.685	2012	-	2012	-
	2013	-	-	-	2013	-	2013	-
	2014	-	-	-	2014	-	2014	-
	2015	-	-	-	2015	-	2015	-
	2016		0.600	1.000	2016	-	2016	-
	2017		1.083	5.500	2017	-	2017	-
	2018		1.611	2.889	2018	-	2018	-
Total Oxidised Nitrogen (as N)	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	Just u/s Lough Fern						Drumman Br (d/s L Fern)	
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	-	2009	-	2009	0.133
	2010	-	-	-	2010	-	2010	0.154
	2011	-	-	-	2011	-	2011	0.188
	2012	0.433	-	-	2012	-	2012	0.116
	2013	0.808	-	-	2013	-	2013	0.156
	2014	0.803	-	-	2014	-	2014	0.127
	2015	0.416	-	-	2015	-	2015	0.111
	2016	-	-	-	2016	-	2016	0.121
	2017	-	-	-	2017	-	2017	0.271
	2018	-	-	-	2018	-	2018	0.128
	2007	-	-	-	2007	-	2007	-
	2008	-	-	-	2008	-	2008	-
	2009	-	-	-	2009	-	2009	-
	2010	-	-	-	2010	-	2010	-
	2011	-	-	-	2011	-	2011	-
	2012	-	-	-	2012	-	2012	-
	2013	-	-	-	2013	-	2013	-
	2014	-	-	-	2014	-	2014	-
	2015	-	-	-	2015	-	2015	-
	2016	-	-	-	2016	-	2016	-
	2017	-	-	-	2017	-	2017	-
	2018	-	-	-	2018	-	2018	-
Additional Information								
Ecological status	Poor (2013-2018)				-		Good (2013-2018)	
WFD objective	Good				-		Good	
Protected areas	River Maggisburn- Salmonid				-		River Maggisburn- Salmonid, River Leannan- Salmonid	
Relevant info. from notes of EPA biologist	The Maggy's Burn was unsatisfactory and showed little change on recent years							
Significant issue/impact for receptor (e.g. PO4) (from Initial Characterisation in WFD App)	WFD App - This indicates that the WWTP is acting as a significant pressure on the receiving waters impacting nutrient and organic chemistry. No inputting WB - therefore indicates that any nutrient issues will be from a pressure acting directly on WB e.g. WWTP.							
NOTES	Discharge may be giving rise to breaches of EQS in receiving WB. WWTP is on Capital Investment Programme, last updated to be at the planning stage in Limnos 2017 - plans to implement process monitoring and control measures to address screening issues and plant washout.]							

Appendix E

Mass Balance Calculations

Scenario 1 - 95%ile Flows, Existing Upstream Background Concentration

AGGLOMERATION	**Milford**		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.467	*Secondary treatment*
	Treatment reduction factor based on AER Data where available	0.1407	*AER 2018*
	TP to PO4-P ratio	0.5	
	Agglomeration PE NCAP	1089	
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590	*AER 2018*
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	49,686	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	795	
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)		
	95%ile Flow (l/s)	14	
	Background concentration (C) (mg/L)	0.026	*From 3 yr av excel doc-RS39M010150 (ambient)*
	Agglomeration PE	1089	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	795	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	112	
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	56	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.1	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.04	
	Measured Effluent Concentration (mg/l)	1.07	*no outliers*
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.04	
	Measured Orthophosphate Concentration @ half TP (mg/l)	1.07	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	0.0357	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	0.8260	

AGGLOMERATION	**Milford**		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	0.0318	
	Agglomeration PE NCAP	1089	
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	49,686	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	23,849	
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)		
rECEIVING WATERS	95%ile Flow (l/s)	14	
	Backgroud concentration (C) (mg/L)	1.098	*From 3 yr av excel doc-RS39M010150 (ambient)*
	Agglomeration PE	1089	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	23849	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	758	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	0.5	
	Measured Effleunt Concentration	16.17	*Feb.2019 outlier removed*
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9	
	Existing effluent BOD Concentration (mg/l)	0.52	
	Existing measured effluent BOD Concentration (mg/l)	16.17	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	0.658	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	12.647	

AGGLOMERATION	**Milford**		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	0.248	
	Agglomeration PE NCAP	1089	
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	49,686	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	3,180	
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)		
	95%ile Flow (l/s)	14	
	Backgroud concentration (C) (mg/L)	0.081	*From 3 yr av excel doc-RS39M010150 (ambient)*
	Agglomeration PE	1089	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	3180	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	789	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.5	
	Measured Effleunt Concentration	14.12	*no outliers*
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9	
	Existing effluent Ammonia Concentration (mg/l)	0.54	
	Existing measured effluent Ammonia Concentration (mg/l)	14.12	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	0.436	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	10.839	

Scenario 2 - 95%ile Flows, Notionally Clean Background Concentration

AGGLOMERATION	**Milford**	
	PO4-P = 50% TP	
INPUT DATA		
	P production (g/person/day)	2
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.467
	Treatment reduction factor based on AER Data where available	0.1407
	TP to PO4-P ratio	0.5
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing annual TP load from AER where available (Kg/yr)	-
	Existing annual TP load from PE (Kg/yr)	1,321
RECEIVING WATERS	**Maggy's Burn_010 (IE_NW_39M010300)**	
	95%ile Flow (l/s)	14
	Background concentration (C) (mg/L)	0.005
	Agglomeration PE	1809
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	1321
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	186
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	93
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.1
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.06
	Measured Effluent Concetration (mg/l)	1.07
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.06
	Measured Orthophosphate Concentration @ half TP (mg/l)	1.07
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	0.0503
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	0.8211

AGGLOMERATION	**Milford**	
	BOD	
INPUT DATA		
	P production (g/person/day)	60
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35
	Treatment reduction factor based on AER Data where available	0.0318
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual BOD load from AER where available (Kg/yr)	-
	Existing anual BOD load from PE (Kg/yr)	39,617
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	95%ile Flow (l/s)	14
	Background concentration (C) (mg/L)	0.26
	Agglomeration PE	1809
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	39617
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	1260
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	0.9
	Measured Effleunt Concentration	16.17
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9
	Existing effluent BOD Concentration (mg/l)	0.87
	Existing measured effluent BOD Concentration (mg/l)	16.17
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	0.728
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	12.452

AGGLOMERATION	**Milford**	
	Ammonia	
INPUT DATA		
	P production (g/person/day)	8
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545
	Treatment reduction factor based on AER Data where available	0.248
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual Ammonia load from AER where available (Kg/yr)	-
	Existing anual TP load from PE (Kg/yr)	5,282
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	95%ile Flow (l/s)	14
	Background concentration (C) (mg/L)	0.008
	Agglomeration PE	1809
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	5282
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	1310
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.9
	Measured Effleunt Concentration	14.12
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9
	Existing effluent Ammonia Concentration (mg/l)	0.90
	Existing measured effluent Ammonia Concentration (mg/l)	14.12
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	0.695
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	10.822

Scenario 3 - 95%ile Flows, Adjusted Background Concentration

AGGLOMERATION	**Milford**	
	PO4-P = 50% TP	
INPUT DATA		
	P production (g/person/day)	2
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.467
	Treatment reduction factor based on AER Data where available	0.1407
	TP to PO4-P ratio	0.5
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing annual TP load from AER where available (Kg/yr)	-
	Existing annual TP load from PE (Kg/yr)	1,321
RECEIVING WATERS	**Maggy's Burn_010 (IE_NW_39M010300)**	
	95%ile Flow (l/s)	14
	Background concentration (C) (mg/L)	0.03
	Agglomeration PE	**1809**
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	**1321**
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	**186**
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	**93**
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**0.1**
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.06**
	Measured Effluent Concetration (mg/l)	1.07
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.06**
	Measured Orthophosphate Concentration @ half TP (mg/l)	**1.07**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.0562**
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.8269**

AGGLOMERATION	**Milford**	
	BOD	
INPUT DATA		
	P production (g/person/day)	60
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35
	Treatment reduction factor based on AER Data where available	0.0318
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual BOD load from AER where available (Kg/yr)	-
	Existing anual BOD load from PE (Kg/yr)	39,617
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	95%ile Flow (l/s)	14
	Background concentration (C) (mg/L)	1.4
	Agglomeration PE	**1809**
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	**39617**
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	**1260**
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	**0.9**
	Measured Effleunt Concentration	16.17
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent BOD Concentration (mg/l)	**0.87**
	Existing measured effluent BOD Concentration (mg/l)	**16.17**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**0.994**
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**12.718**

AGGLOMERATION	**Milford**	
	Ammonia	
INPUT DATA		
	P production (g/person/day)	8
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545
	Treatment reduction factor based on AER Data where available	0.248
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual Ammonia load from AER where available (Kg/yr)	-
	Existing anual TP load from PE (Kg/yr)	5,282
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	95%ile Flow (l/s)	14
	Background concentration (C) (mg/L)	0.0525
	Agglomeration PE	**1809**
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	**5282**
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	**1310**
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**0.9**
	Measured Effleunt Concentration	14.12
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent Ammonia Concentration (mg/l)	**0.90**
	Existing measured effluent Ammonia Concentration (mg/l)	**14.12**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**0.706**
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**10.832**

Scenario 4 – Mean Flows, Existing Upstream Background Concentration

Milford	
PO4-P = 50% TP	
P production (g/person/day)	2
Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.467
Treatment reduction factor based on AER Data where available	0.1407
TP to PO4-P ratio	0.5
Agglomeration PE NCAP	1089
Average Annual Hydraulic Load (Q) from AER where available	1,447,590
Average Annual Hydraulic Load (Q) from PE (m3/yr)	49,686
Existing annual TP load from AER where available (Kg/yr)	-
Existing annual TP load from PE (Kg/yr)	795
Maggy's Burn_010 (IE_NW_39M010300)	
Mean Flow (l/s)	233
Background concentration (C) (mg/L)	0.026
Agglomeration PE	**1089**
Existing annual TP load from PE (Kg/yr)	**795**
Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	**112**
Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	**56**
Existing effluent TP Concentration mg/l (= g/m3)	**0.1**
Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.04**
Measured Effluent Concetration (mg/l)	1.07
Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.04**
Measured Orthophosphate Concentration @ half TP (mg/l)	**1.07**
Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.0281**
Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.1978**

AGGLOMERATION	**Milford**	
	BOD	
INPUT DATA		
	P production (g/person/day)	60
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.7
	Treatment reduction factor based on AER Data where available	-
	Agglomeration PE NCAP	1089
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	49,686
	Existing anual BOD load from AER where available (Kg/yr)	-
	Existing anual BOD load from PE (Kg/yr)	23,849
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Backgroud concentration (C) (mg/L)	1.098
	Agglomeration PE	**1089**
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	**23849**
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	**16694**
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	**11.5**
	Measured Effleunt Concentration	16.17
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent BOD Concentration (mg/l)	**11.53**
	Existing measured effluent BOD Concentration (mg/l)	**16.17**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**2.815**
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**3.579**

AGGLOMERATION	**Milford**	
	Ammonia	
INPUT DATA		
	P production (g/person/day)	8
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.727
	Treatment reduction factor based on AER Data where available	-
	Agglomeration PE NCAP	1089
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	49,686
	Existing anual Ammonia load from AER where available (Kg/yr)	-
	Existing anual TP load from PE (Kg/yr)	3,180
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Backgroud concentration (C) (mg/L)	0.081
	Agglomeration PE	**1089**
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	**3180**
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	**2312**
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**1.6**
	Measured Effleunt Concentration	14.12
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent Ammonia Concentration (mg/l)	**1.60**
	Existing measured effluent Ammonia Concentration (mg/l)	**14.12**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**0.331**
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**2.392**

Scenario 5 – Mean Flows, Notionally Clean Background Concentration

AGGLOMERATION	Milford	
	PO4-P = 50% TP	
INPUT DATA		
	P production (g/person/day)	2
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.467
	Treatment reduction factor based on AER Data where available	0.1407
	TP to PO4-P ratio	0.5
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing annual TP load from AER where available (Kg/yr)	-
	Existing annual TP load from PE (Kg/yr)	1,321
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Background concentration (C) (mg/L)	0.005
	Agglomeration PE	1809
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	1321
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	186
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	93
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.1
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.06
	Measured Effluent Concetration (mg/l)	1.07
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.06
	Measured Orthophosphate Concentration @ half TP (mg/l)	1.07
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	0.0147
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	0.1803

AGGLOMERATION	Milford	
	BOD	
INPUT DATA		
	P production (g/person/day)	60
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.7
	Treatment reduction factor based on AER Data where available	-
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual BOD load from AER where available (Kg/yr)	-
	Existing anual BOD load from PE (Kg/yr)	39,617
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Background concentration (C) (mg/L)	0.26
	Agglomeration PE	1809
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	39617
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	27732
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	19.2
	Measured Effleunt Concentration	16.17
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9
	Existing effluent BOD Concentration (mg/l)	19.16
	Existing measured effluent BOD Concentration (mg/l)	16.17
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	3.370
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	2.879

AGGLOMERATION	Milford	
	Ammonia	
INPUT DATA		
	P production (g/person/day)	8
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.727
	Treatment reduction factor based on AER Data where available	-
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual Ammonia load from AER where available (Kg/yr)	-
	Existing anual TP load from PE (Kg/yr)	5,282
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Background concentration (C) (mg/L)	0.008
	Agglomeration PE	1809
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	5282
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	3840
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	2.7
	Measured Effleunt Concentration	14.12
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	45.9
	Existing effluent Ammonia Concentration (mg/l)	2.65
	Existing measured effluent Ammonia Concentration (mg/l)	14.12
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	0.443
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	2.331

Scenario 6 – Mean Flows, Adjusted Background Concentration

AGGLOMERATION	**Milford**	
	PO4-P = 50% TP	
INPUT DATA		
	P production (g/person/day)	2
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.467
	Treatment reduction factor based on AER Data where available	0.1407
	TP to PO4-P ratio	0.5
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing annual TP load from AER where available (Kg/yr)	-
	Existing annual TP load from PE (Kg/yr)	1,321
RECEIVING WATERS	**Maggy's Burn_010 (IE_NW_39M010300)**	
	Mean Flow (l/s)	233
	Background concentration (C) (mg/L)	0.03
	Agglomeration PE	**1809**
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	**1321**
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	**186**
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	**93**
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**0.1**
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.06**
	Measured Effluent Concetration (mg/l)	1.07
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.06**
	Measured Orthophosphate Concentration @ half TP (mg/l)	**1.07**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.0356**
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.2012**

AGGLOMERATION	**Milford**	
	BOD	
INPUT DATA		
	P production (g/person/day)	60
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.7
	Treatment reduction factor based on AER Data where available	-
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual BOD load from AER where available (Kg/yr)	-
	Existing anual BOD load from PE (Kg/yr)	39,617
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Background concentration (C) (mg/L)	1.4
	Agglomeration PE	**1809**
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	**39617**
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	**27732**
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	**19.2**
	Measured Effleunt Concentration	16.17
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent BOD Concentration (mg/l)	**19.16**
	Existing measured effluent BOD Concentration (mg/l)	**16.17**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**4.323**
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**3.831**

AGGLOMERATION	**Milford**	
	Ammonia	
INPUT DATA		
	P production (g/person/day)	8
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.727
	Treatment reduction factor based on AER Data where available	-
	Agglomeration PE NCAP	1809
	Average Annual Hydraulic Load (Q) from AER where available	1,447,590
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	82,536
	Existing anual Ammonia load from AER where available (Kg/yr)	-
	Existing anual TP load from PE (Kg/yr)	5,282
RECEIVING WATERS	Maggy's Burn_010 (IE_NW_39M010300)	
	Mean Flow (l/s)	233
	Background concentration (C) (mg/L)	0.0525
	Agglomeration PE	**1809**
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	**5282**
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	**3840**
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**2.7**
	Measured Effleunt Concentration	14.12
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**45.9**
	Existing effluent Ammonia Concentration (mg/l)	**2.65**
	Existing measured effluent Ammonia Concentration (mg/l)	**14.12**
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**0.480**
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**2.368**