Freshwater Pearl Mussel Assessment

Ballyclogh Wastewater Treatment Plant – D0441-01
Cecilstown Wastewater Treatment Plant – A0319-01

Version: 13th February 2018

On behalf of:
Irish Water

Tait Business Centre, Dominic Street,
Limerick City, Ireland.
t. +353 61 419477, f. +353 61 414315
e. info@ecofact.ie
w. www.ecofact.ie

TABLE OF CONTENTS

1. INTRODUCTION

Ecofact was commissioned by Irish Water to assess the impact of both the Ballyclogh Waste Water Treatment Plant (WwTP) and the Cecilstown and Environs WwTP on Freshwater Pearl Mussel (*Margaritifera margaritifera*) (FPM).

The Ballyclogh Waste Water Treatment Plant (WwTP) is located in Ballyclogh, Co. Cork (Grid Reference E149329, N101799). The Cecilstown and Environs WwTP is located in Cecilstown, Co. Cork (Grid Reference E147071, N102113). The receiving water for the Ballyclogh WwTP is the 2nd order Ballyclogh Stream. The Cecilstown and Environs WwTP receiving water is the 1st order East Lohort Stream, which is a tributary of the Ballyclough stream. Both WwTPs were assessed together as they are located in the same sub-catchment of the River Blackwater (Munster). The locations of Ballyclogh and Cecilstown and Environs WwTPs are indicated in Figure 1.

Ballyclogh WwTP has been issued with a Certificate of Authorisation (D0441-01) by the EPA. Cecilstown and Environs WwTP has also been issued with a Certificate of Authorisation (A0319-01) by the EPA. This FPM Impact Assessment is being completed in accordance with Condition 3.13 of the Certificates of Authorisation. These plants were managed by the Water Services Department of Cork County Council (CCC, 2010; CCC, 2009) prior to the current management under Irish Water.

Both WwTPs are listed among the 18 WwTPs identified as requiring further investigation "*with the aim to reduce overall nutrient, organic and sediment loads in the Munster Blackwater catchment*" in the Freshwater Pearl Mussel Munster Blackwater Sub Basin Management Plan (NS2, 2010).

A Phase 1/2 FPM survey was carried out on the Ballyclogh Stream and the East Lohort Stream. This survey was undertaken under licence from NPWS (Licence No. ClIS/2017). A chemical and biological water quality survey of the Ballyclough River and East Lohort Stream was also undertaken at five sites. The surveys were undertaken during September/October 2017.

1.1 Legislative context for conservation of Freshwater Pearl Mussel

The Freshwater Pearl Mussel *Margaritifera margaritifera* is listed on Annexes II and V of the EU Habitats Directive (1992). Annex II of the Habitats Directive requires that listed species' habitats are maintained or, where appropriate, restored to favourable conservation status. Under Annex V of the Habitats Directive this species is listed as '*a species of community interests whose taking in the wild and exploitation may be subject to management measures*'. The management of this species must be compatible with the maintenance of favourable conservation status. This species is also listed on Appendix III of the Bern Convention which requires that '*any exploitation of wild fauna specified in Appendix III must be regulated in order to keep the populations out of danger (temporary or local prohibition of exploitation, regulation of transport or sale, etc.)*'. The freshwater pearl mussel is listed as '*Critically Endangered*' in the Republic of Ireland according to the '*Ireland Red List No. 2: Non-Marine Molluscs*' (Byrne *et al*., 2009).

This species is legally protected in Ireland under Schedule 1 of the Wildlife Act (1976) (Protection of Wild Animals) (S.I. No. 112, 1990) as per the requirements of Section 23 of the Wildlife Act (1976), amended under Section 31 of the Wildlife Act (2000).

The transposition of the EU Water Framework Directive (2000) into Irish legislation, as the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) and the more recent European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272 of 2009) require

the achievement of 'good ecological status' in Irish waterbodies by 2015. Further measures for the protection of Freshwater pearl mussel are set out in the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations (S.I. 296 of 2009). This legislation sets environmental quality objectives for '*the habitats of the freshwater pearl mussel populations that are within the boundaries of a site notified in a candidate list of European sites, or designated as a Special Area of Conservation, under the European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94/1997).*'

1.2 Overview of Freshwater pearl mussel in Ireland

There are 96 populations of pearl mussels in the Republic of Ireland, some of which include two or more rivers in close enough proximity to make them one single population (NPWS, 2008). A total of 27 populations have been designated within 19 Special Areas of Conservation (SAC) which list *Margaritifera margaritifera* as a qualifying interest. Only one of the 96 populations in the country is considered to be in favourable conservation status: where reproduction and juvenile survival in the remaining populations is not matching adult mortality rates and numbers are declining annually. The conservation status of this species has been evaluated as 'Unfavourable Bad' at a national level (NPWS, 2008).

The Department of the Environment, Heritage and Local Government has prepared 27 Draft Management Plans for Freshwater Pearl Mussel populations within designated SAC sites; in accordance with Article 13 (5) of the Water Framework Directive, as transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003); and the Habitats Directive, as transposed in Ireland by the European Communities (Birds and Habitats) Regulations 2011 (S.I. No. 477 of 2011).

The gradient in freshwater pearl mussel habitats commonly lies in the interval 0.08–0.3 percent (Skinner *et al.*, 2003). The pearl mussel requires stable cobble and gravel substrate with very little fine material below pea-sized gravel (DoEHLG, 2010). Skinner *et al.* (2003) also points out that the majority of adult mussels live in dense beds in substrates of mixed cobble, stone and sand at the tail-end of pools or in the moderate flow channels of river bends. The mussel spends its larval, or glochidial, stage attached to the gills of salmonid fishes. The long-term survival of the freshwater pearl mussel depends ultimately upon host availability. The larvae attach themselves during mid- to late-summer and drop-off the following spring to settle in the riverbed gravel where they grow to adulthood i.e., five years old. This species does not reach reproductive maturity until it reaches between 7 and 15 years old, and may live for over 100 years (NRA, 2009).

The decline of pearl mussel populations in Ireland has mostly occurred from the continuous failure to produce new generations of mussels because of the loss of clean gravel beds, which have become infiltrated by fine sediment and/or over-grown by algae or macrophytes. Filamentous algae can lead to the death of juvenile mussels, through blocking oxygen exchange with the sediment (DoEHLG, 2010).

2. METHODOLOGY

2.1 Desk-study review

A desk-study was undertaken to identify existing records for the Freshwater Pearl Mussel from within the Ballyclogh catchment and the Blackwater [Munster] River catchment, and to identify the potential for this species to occur within the study area. A desk study review of the National Parks and Wildlife Service (NPWS) designations for this species relating to the Blackwater [Munster] River and the relevant legislation in place for the protection of this species was also undertaken. A GIS file of previous Freshwater Pearl Mussel records supplied by the NPWS was also used in this assessment.

2.2 Freshwater pearl mussel survey

Surveying for Freshwater Pearl Mussel (FPM) was carried out following the NPWS guidance '*Margaritifera margaritifera Stage 1 and Stage 2 survey guidelines. Irish Wildlife Manuals, No. 12'* (Anon, 2004). The survey employed a wading / bathyscope survey during September/October 2017. Surveying for FPM in shallow areas was also carried out by viewing the riverbed with the aid of polarised sunglasses. There is no suitable habitat for FPM in the East Lohort Stream and along most of the Ballyclogh Stream. Surveys were undertaken throughout the middle and lower reaches of the river using Stage 1 surveys.

2.3 Biological water quality

Biological water quality assessments were undertaken at 5 sites in the Ballyclough/Lohart stream catchment during October 2017. Figure 2 illustrates the biological sampling sites on the Ballyclogh Stream and the East Lohort Stream. The locations are also provided in Table 2.

Biological water quality sampling can be used to determine to what degree a waterbody is polluted. The macroinvertebrate ecology of a river adjusts temporally when exposed to organic pollution; this is manifested by a decline in community diversity as more tolerant taxa replace sensitive species (Toner *et al.,* 2005). The diversity and abundance of macroinvertebrate species composed in a sample therefore reflects the prevailing water quality conditions to which the community is exposed. Following the kick-sampling method defined by Toner *et al.* (2005), all taxa observed in the sample were recorded by abundance (see Appendix 1). The Quality Rating (Q) System devised by Toner *et al.* (2005) was used to obtain a water quality rating (Q-Value) and corresponding Water Framework Directive status (see Table 3) for each sample.

Table 1 Biological and chemical water quality sites assessed on the Ballyclogh Stream and East Lohort Stream during August 2017. The discharges of both WwTPs were also sampled.

Site	Location	Irish Grid co-ordinates	
		X	Y
Site 1	Upstream of Ballyclogh Stream - Blackwater River Confluence	150672	098161
Site 2	Downstream of Ballyclogh WwTP Discharge	149309	101706
Site 3	Upstream of Ballyclogh WwTP Discharge	149409	101883
Site 4	Upstream of East Lohort Stream - Ballyclogh Stream Confluence	149085	101704
Site 5	Upstream of Cecilstown WwTP Discharge	147163	102042

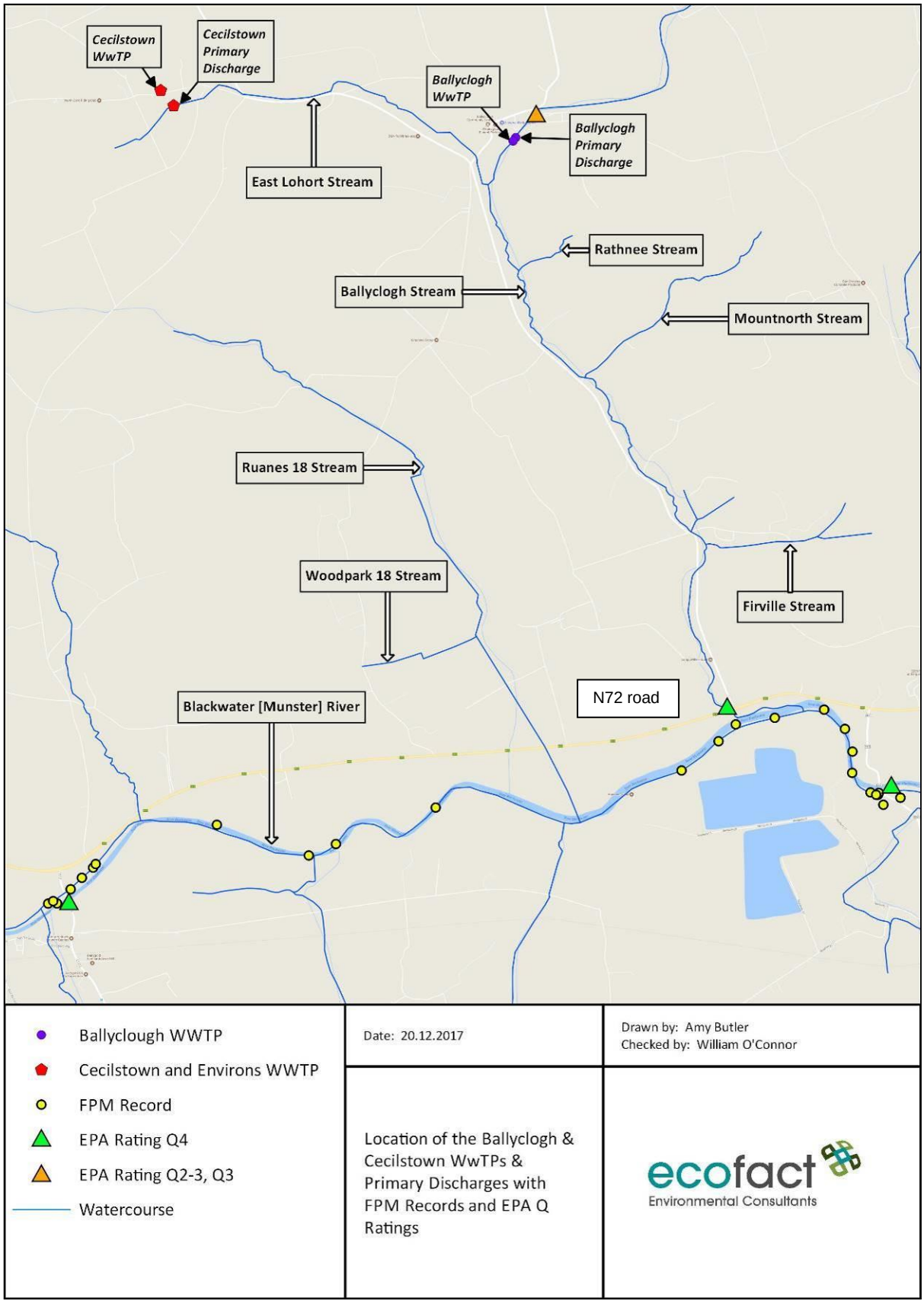

Figure 1 Location of the Ballyclogh and Cecilstown and Environs WwTPs discharges, with closest FPM records and EPA Q Ratings. The Blackwater (Munster) River SAC boundary is at the N72 road bridge.

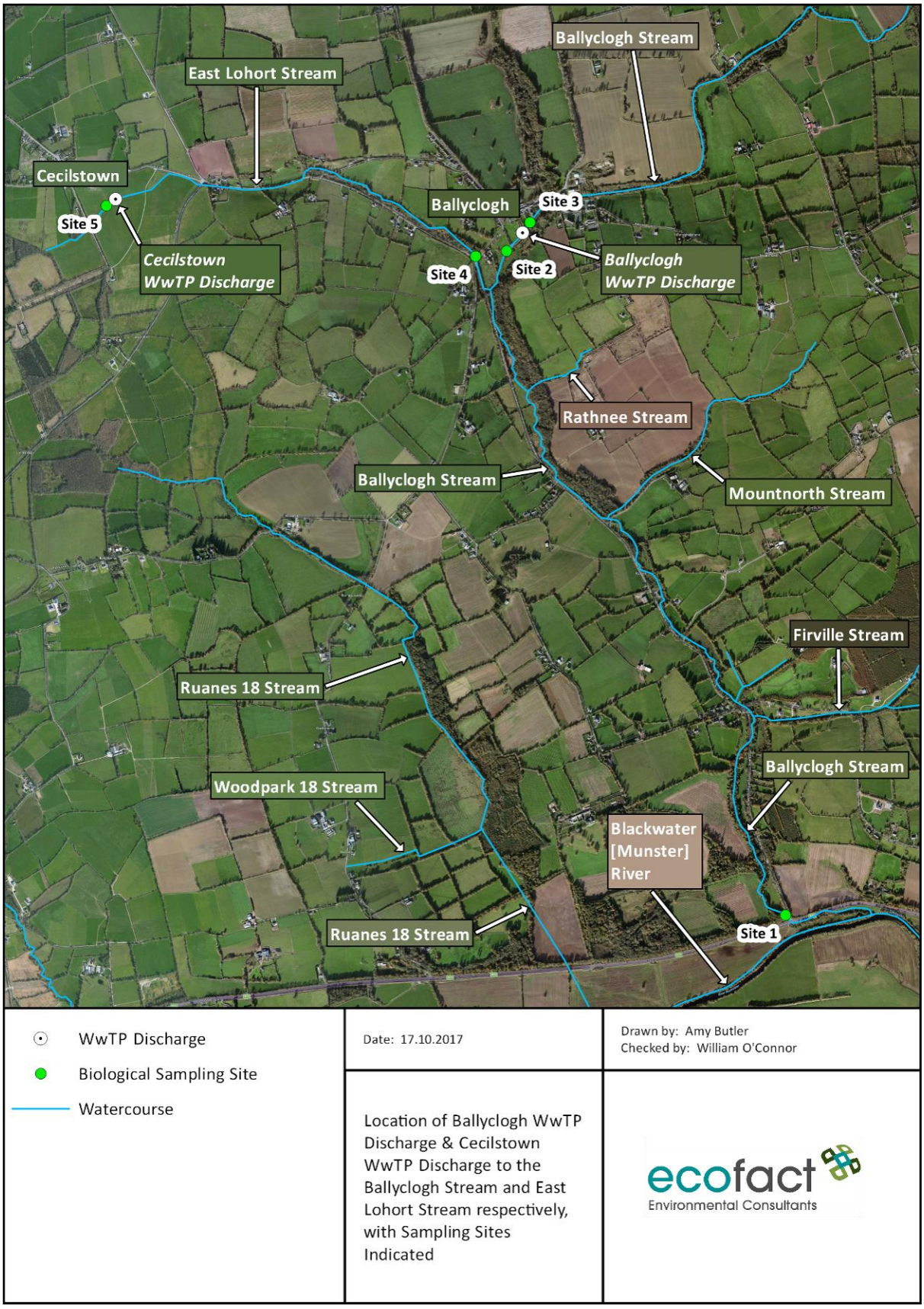

Figure 2 Location of Ballyclogh WwTP Discharge & Cecilstown WwTP Discharge to the Ballyclogh Stream and East Lohort Stream respectively, with Sampling Sites Indicated.

Table 2 Relationship between Q-Value and Ecological Status for macroinvertebrates.

Q Value*	WFD Status	Pollution Status	Condition**
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

** These values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.*
*** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses*

2.4 Chemical water quality

Water samples were taken from seven locations on the Ballyclogh Stream and the East Lohort Stream on the 9th October 2017. These locations were at Site 1-5 (see Table 1). At these locations, river water was taken by wading into the river and immersing bottles supplied by ALS Life Sciences in flowing water of sufficient depth. Care was taken not to contaminate water sampled by entering the river downstream of the sample point and working in the upstream direction. Samples were collected by courier and promptly delivered to the appointed laboratory.

The following physico-chemical parameters were assessed: Toxic Metals, Alkalinity (Total as $CaCO_3$), BOD, Ammoniacal Nitrogen as N, Ammoniacal Nitrogen as NH_3, Nitrate as NO_3, Phosphate (ortho) as P, Sulphate, Nitrite as NO_2, Phosphorus, Iron, Aluminium, Phosphorus, Metals Prep, pH, Total Suspended Solids.

3. RESULTS

3.1 Desk study

3.1.1 Details of subject WwTPs

3.1.1.1 Ballyclogh WwTP

The Ballyclogh WwTP provides secondary treatment. The treatment works consist of inlet works including macerator and grit trap, a forward feeding pump sump and sequencing batch reactor. The Ballyclogh WwTP has a design population equivalent (p.e.) of 800, with an existing p.e. of 635 served by this waste water treatment plant; therefore, this WwTP is currently operating within its design capacity. The normal discharge flow from the WwTP is 176m^3/day, while the maximum discharge from the WwTP is 530m^3/day. The final treated effluent quality from the WwTP in 2011 was within the limits set out in the Urban Wastewater Treatment Regulations (2001, as amended) (CCC, 2009). The EPA Act 1992 (Urban Waste Water Treatment Regulations, 1994) define one population equivalent as 60g BOD per day. Using 60g per person per day, the organic loading to the WwTP has been estimated to be 38.1 kg/day.

The primary discharge is located on the 2nd order Ballyclogh Stream, which flows into the Blackwater [Munster] River 4.9rkm downstream of the discharge point. According to the Wastewater Discharge Certificate of Authorisation Application, there are two sampling points, one upstream of the discharge and one downstream. The upstream point is located at a bridge in Ballyclogh (E149490, N101985) approximately 220rm upstream of the discharge point. The downstream point is located at a 'small bridge' (E149490, N100608) approximately 1.4rkm downstream of the discharge point.

Ballyclogh was previously highlighted in the Urban Waste Water Treatment in 2015 report by the EPA (EPA, 2016a) as an urban area where improvements were required to resolve environmental impacts. In order to protect FPM, Ballyclogh was mentioned as a WwTP were improvements to the waste water discharge were required by the end of 2015. Ballyclogh discharge failed to meet the effluent quality standard for suspended solids in 2015. However, in the 2016 report (EPA, 2017) it was no longer listed in the report as a WwTP that requires improvements to solve environmental impacts.

According to the Ballyclogh Annual Environmental Report 2016, the effluent discharged from Ballyclogh WwTP was non-compliant with the Emission Limit Values set in the wastewater discharge licence (EPA, 2016). Ortho P (mg/l) and Ammonia NH3 (mg/l) were both in excess of these limit values. The installation of a chemical dosing plant in 2016 was to aid the process of treating phosphorous and led to Ortho P (mg/l) compliance. It is noted in the report that most of the Ammonia NH3 samples taken were compliant. The report also states that the hydraulic loading and organic loading (both the mean and maximum) were less than the peak Treatment Plant Capacity. Reference was made in this report to the guidelines for discharges noted in the Freshwater Pearl Mussel Munster Blackwater Sub-basin Management Plan (NS2, 2010). The plant was however fully compliant for phosphate in 2017.

3.1.1.2 Cecilstown and Environs WwTP

The Cecilstown and Environs WwTP provides secondary treatment. The treatment works consist of screening, aeration and clarification. The Cecilstown and Environs WwTP has a design population equivalent (p.e.) of 600, and the agglomeration currently has a p.e. of 103 (CCC, 2010). However, it was noted in the EPA Inspector's report that this WwTP did not have nutrient removal as part of the

treatment process, and therefore is likely to be contributing to elevated levels of organic and inorganic eutrophying nutrients which enter the Blackwater River upstream of a large number of Freshwater Pearl Mussel colonies. The EPA Act 1992 (Urban Waste Water Treatment Regulations, 1994) define one population equivalent as 60g BOD per day. Using 60g per person per day, the organic loading to the WwTP has been estimated to be 6.18 kg/day.

The primary discharge is located on the 1st order East Lohort Stream, which flows into the 2nd order Ballyclogh Stream 2.4rkm downstream of the discharge point, which then flows into the Blackwater [Munster] River approximately 4.6rkm downstream of the East Lohort Stream and Ballyclogh Stream confluence. According to the Wastewater Discharge Certificate of Authorisation Application, there are two sampling points, both downstream of the discharge. The closest downstream point is located at Lombardstown Road (E147579, N102075) approximately 535rm upstream of the discharge point. The next downstream point is located at Lybaun Cross (E148163, N102106) approximately 1.1rkm downstream of the discharge point.

The EPA's Urban Waste Water Treatment in 2016 Report mentions Cecilstown as a priority area where improvements are required to resolve environmental impacts. It also notes that improvements to waste water discharges are required in this urban area to protect freshwater pearl mussels (EPA, 2017); as did the Urban Waste Water Treatment in 2015 report (EPA, 2016a).

3.1.2 Ballyclogh Stream Catchment

The EPA carry out biological monitoring upstream and downstream of the Ballyclough WwTP discharge. Approximately 225rm upstream of the discharge point, the EPA have a biological monitoring station (Station Code: 18B08 0100) which was rated as Q3 in 2015, corresponding to Water Framework Directive (WFD) status 'poor'. Located approximately 4.5rkm downstream of the discharge point, the EPA have another monitoring station (Station Code: 18B08 0500) which was rated as Q4 in 2015, corresponding to WFD status 'Good'. The EPAs most recent assessment of the Ballyclogh stream is as follows: *'While Poor ecological quality was again recorded at Ballyclogh village, the lower reaches have improved to Good quality for the first time since recording began here. Further evidence of this improvement was seen in the presence of two salmon parr in the kick sample at the lower site'.* The Ballyclogh Stream flows into the Blackwater [Munster] River approximately 4.9rkm downstream of the discharge point. The EPA do not carry out monitoring on the receiving watercourse of the Cecilstown and Environs WwTP (1st order East Lohort Stream). The aforementioned 18B08 0500 monitoring station is located approximately 6.6rkm downstream (Q4 in 2015). The East Lohort Stream flows into the Ballyclogh Stream approximately 2.4rkm downstream of the Cecilstown and Environs WwTP discharge. From here, the Ballyclogh Stream flows for a further c. 4.5rkm until it flows into the Blackwater [Munster] River.

The Ballyclogh WwTP Discharges into the Ballyclogh Stream (EPA Code: 18B08). The Ballyclogh Stream rises approximately 5.5km east of the Ballyclogh WwTP, in the Baltydaniel East townland. From here it flows in a northly direction for c. 760river metres before turning west and flowing for c. 6rkm until it reaches the Ballyclogh WwTP. Approximately 370rm downstream of this point the East Lohort Stream flows into the Ballyclogh Stream. The Cecilstown and Environs WwTP discharges into the East Lohort Stream (EPA Code: 18E15). The East Lohort Stream has a channel length of approximately 2.8rkm and the Cecilstown WwTP Discharge is located c. 470rm from the source. After the confluence of the Ballyclogh Stream and the East Lohort Stream, the Ballyclogh Stream flows in a southerly direction for ca. 4.9rkm until it flows into the Blackwater [Munster] River.

The Ballyclogh catchment is located in the Blackwater [Munster] Hydrometric Area (18) in the South Western River Basin District (SWRBD). The main tributaries of the Ballyclogh Stream are the East Lohort Stream, the Mountnorth Stream and the Firville Stream. The Ballyclogh WwTP Discharge is located approximately 4.9rkm upstream of the Ballyclogh Stream confluence with the River Blackwater. The Cecilstown WwTP Discharge to the East Lohort Stream is situated approximately 7.1rkm upstream of the Ballyclogh Stream confluence with the River Blackwater.

The first ca. 6.7rkm of the Ballyclogh stream, from source to the Ballyclogh WwTP Discharge, has been assinged 'Poor' Water Framework Directive Status in the period 2010-2015. The remainder of the Ballyclogh Stream, from the WwTP Discharge to where it flows into the Blackwater [Munster] River, has been assigned 'Good' Status for the same period. The East Lohort Stream has also been assigned 'Good' Status for the same period. The WFD status of the first ca. 6.7rkm of the Ballyclogh Stream is designated as 'At Risk'. The WFD status of the rest of the catchment, including the East Lohort Stream, is currently unassigned.

The EPA carry out biological monitoring at 2 different stations within the Ballyclogh catchment. The first is located in Ballyclogh village (Station Code: 18B08 0100) and was rated as Q3 in 2015, corresponding to WFD Status 'Poor'. The second is located just upstream of the Ballyclogh Stream and Blackwater River confluence (also site 5 in the current report), which was rated as Q4 in 2015, corresponding to WFD Status 'Good' (Station Code: 18B08 0500).

Table 3 Historical EPA Biological Water Quality Ratings (Q-Values) for monitoring stations in the Ballyclogh Stream Catchment.

Station Location	Station No.	Water Feature	EPA Code	2000	2003	2006	2009	2012	2015
East Br, Ballyclogh	RS18B080100	Ballyclogh Stream	18B08	3	3	3	3	3	3
Br u/s Blackwater R confl	RS18B080500	Ballyclogh Stream	18B08	3	3-4	3-4	3-4	3-4	4

According to the EPA Envision Maps, there are no licensed IPPC facilities in the Ballyclogh Stream catchment. It is also noted in the EPA Inspectors Report for the Ballyclogh WwTP Application that there are no drinking water abstractions downstream of the WwTP Discharge (EPA, 2013). There is no indication in the Cecilstown and Environs WwTP Certificate of Authorisation Application that there are any drinking water abstraction points on the East Lohort Stream (CCC, 2010).

The Blackwater Water Management Unit Action Plan lists Ballyclogh WwTP and Cecilstown WwTP as point pressures. The pressures / risks include WwTPs and Industrial Discharges, nutrient sources, point pressures, Quarries, Mines & Landfills, Agriculture, On-site systems, Abstractions and Forestry. The main nutrient sources with particular reference to Total Phosphorus (TP) Sources are Agriculture (69%), Forestry (7%) and 9% comes from WwTPs. It is noted in the WMU Action Plan that there are 13045 septic tanks in the WMU, 8586 of which are located in areas of very high or extreme risk.

3.1.2 Freshwater Pearl Mussel records

The Article 17 report (NPWS, 2013) on the conservation status of all habitats and species listed on the annexes of the Habitats Directive included a map showing the current distribution of Freshwater Pearl Mussel *Margaritifera margaritifera*.

The subject WwTPs are located in the 10km grid square R40. The East Lohort Stream, which the Cecilstown WwTP discharges into, flows into the Ballyclogh Stream within the grid square R40. From here, the Ballyclogh Stream flows into the Blackwater [Munster] River in the grid square W59. Following this, the Blackwater [Munster] River flows through the grid squares W69, W79, W89, R80, W99, X09 and X08. The grid squares W59, W79 and W99 after the Ballyclogh Stream and Blackwater [Munster] River confluence are indicated within the known distribution of FPM in Ireland. The Blackwater River (Cork / Waterford) is a Special Area of Conservation (SAC), and the catchment is defined as a 'Margaritifera Sensitive Area'.

Figure 1 gives the locations of the Ballyclogh WwTP and Cecilstown and Environs WwTP respectively, previous FPM records and EPA Q-ratings in the wider study area. Ballyclogh WwTP primary discharge is located approximately 5.2rkm from the nearest FPM population. This FPM is located on the MBW channel and not in the Ballyclogh stream. The MBW record was recorded in 2008 and the FPM observed was a live specimen. Cecilstown and Environs WwTP Primary Discharge is located approximately 7.3rkm from the nearest FPM population. This FPM was recorded in 2008 and the FPM observed was a live specimen. Other records exist further downstream in the Blackwater, being the largest pearl mussel catchment in the country, and the main population is located just upstream of Mallow.

The Munster Blackwater Sub-basin Management Plan for Freshwater Pearl Mussel (Second draft) details the distribution of and pressures on freshwater pearl mussel in the Blackwater [Munster] catchment. In 2007, the Munster Blackwater population of freshwater pearl mussel was reported to be in unfavourable conservation status with urgent measures required to be taken to improve this status. Eighteen WwTPs within the Munster Blackwater catchment were deemed to have a significant adverse effect on the freshwater pearl mussel or its habitat (NS2, 2010). Both the Ballyclogh WwTP and the Cecilstown WwTP are listed as one of these 18 WwTPs and the following comment is noted for both WwTPs: *'The Pearl Mussel population is located downstream of this plant. It requires investigation with the aim to reduce overall nutrient, organic and sediment loads in the Munster Blackwater catchment'.*

The East Lohort Stream is considered to be too small to contain FPMs. The Ballyclough Stream is also a relatively small watercourse and also considered to be too small for FPMs to occur. The substrate at survey sites on the Ballyclogh Stream also showed evidence of water quality issues involving siltation and suspended solids, providing unsuitable habitat for Freshwater Pearl Mussels.

3.2 Field survey results

3.2.1 FPM survey

No Freshwater Pearl Mussels were recorded in the East Lohort Stream or in the Ballyclogh Stream during the current assessment. The upper reaches of the Ballyclough stream and the East Lohort Stream are relatively small and do not have suitable Freshwater Pearl Mussel habitat. The lower reaches of the Ballyclough Stream were checked, and no mussels were found despite extensive searching. Overall it is considered that this stream is below the size necessary to sustain this species. The current survey was undertaken following a very wet summer and although the water was clear during the survey the flows were likely to be higher than those which would be expected to occur after a drier period. Overall, it is concluded that this species is absent from the Ballclough stream catchment due to the relatively small size of the watercourse. There is some potential habitat in the lower reaches, but mussels were absent. FPMs are present in the River Blackwater at the Ballclough

stream confluence, and one of the key populations in this river occurs downstream of the confluence (near Mallow).

3.2.2 Biological water quality

The results of the biological water quality sampling at each biological assessment site are discussed below and Q-ratings assigned to each are shown in Table 4. A species list of the macroinvertebrate communities recorded is provided in Appendix 1.

Table 4 Biological water quality ratings and WFD status at the sites examined on the Ballyclogh Stream and East Lohort Stream.

	Site 1	Site 2	Site 3	Site 4	Site 5
Watercourse	Ballyclogh Stream	Ballyclogh Stream	Ballyclogh Stream	East Lohort Stream	East Lohort Stream
Q Value	Q3-4	Q3-4	Q3	Q3	Q2-3
Corresponding WFD Status	Moderate	Moderate	Poor	Poor	Poor

3.2.2.1 Site 1

Biological sampling was undertaken at Site 1 located approximately 4.5km downstream of the Ballyclogh WwTP discharge point. The section of this river was very enclosed by trees and the banks were heavily vegetated. The majority of individual species supported at this site were pollution tolerant (Group C) species with *Baetis rhodani* (Numerous)*, Gammarus duebeni* (Numerous) *and Potamopyrgus jenkinsi* (Common) which were well represented. Class A mayfly and stonefly larve were 'present' only. There was no filamentous algae growth on the date of sampling, but the river was silted. This site was assigned (borderline) a Q4 'Slightly polluted' rating which is equivalent to a WFD status score of 'Good'.

3.2.2.2 Site 2

Biological sampling was undertaken at Site 2 located approximately 129m downstream of the Ballyclogh WwTP discharge point. This section of the stream had a shallow embankment at one side. The majority of individual species supported at this site were pollution tolerant (Group C) species. The most common occurring macroinvertebrate species were *Baetis rhodani* (Numerous) and *Gammarus duebeni* (Dominant). The site was heavily silted and sediment plumes were very apparent during sampling. However, Group A Perlid stonefly larvae were 'present'. This site was assigned a Q3-4 'Slightly polluted' rating which is equivalent to a WFD status of 'Moderate'.

3.2.2.3 Site 3

Biological sampling was undertaken at Site 3 located approximately 66m upstream of the Ballyclogh WwTP discharge point. A total of 6 families consisting of 45 individuals were recorded at this site. There was one Group B species recorded at this site. Group C species *Gammarus duebeni* was the most commonly occurring species (Dominant). Blackfly larvae and occurred in 'Fair numbers' relative to the other species recorded. This site was rated as Q3 'Moderately polluted' which is equivalent to a WFD status score of 'Poor'.

3.2.2.4 Site 4

Biological sampling was undertaken at Site 4 located approximately 2.1km downstream of the Cecilstown WwTP discharge point. A total of 6 families were recorded from Site 4. Pollution sensitivity groups at this site include Groups B, C and D. There were no most pollution tolerant (Group E) taxa recorded at this site. The majority of individual species supported at this site were pollution tolerant (Group C) species with *Gammarus duebeni* recorded as Excessive. Two leeches from family Glossiphoniidae were present at this site. *Leptocerus sp.* were noted as 'Common' relative to the remaining species occurring in the sample. This site was rated as Q3 'Moderately polluted' which is equivalent to a WFD status score of 'Poor'.

3.2.2.5 Site 5

Biological sampling was undertaken at Site 5 located approximately 65m upstream of the Cecilstown WwTP discharge point. A total of 4 families consisting of 68 individuals were recorded at this site. Pollutant sensitivity groups include those from Group C and D only. Family Lumbriculidae and Glossiphoniidae were both noted as 'Present'. There two Group C taxon recorded at this site *Gammarus duebeni and Potamopyrgus jenkinsi,* which were 'Numerous' and 'Dominant' respectively. Plecopterans or Trichopterans were not found at this site. Family diversity at this location was lower than that recorded at Site 1 downstream of the discharge, but the stream is very small here also. This site was rated as Q2-3.

3.2.3 Chemical water quality

The chemical water quality results of samples taken from the Ballyclogh Stream and East Lohort Stream are summarised in Table 6 to 14 below. The full suite of chemical water quality parameters tested along the results obtained are given in Appendix 2. The results are interpreted in relation to standards given in the Surface Water Quality (Objectives) Regulations (2009-2015) and also general precautionary standards for Freshwater Pearl Mussel. The site results are discussed individually below. The location of the sites are given in Table 1 and Figure 1.

3.2.3.1 Site 1

This site was located on the Ballyclogh Stream approximately 4.5km downstream of the Ballyclogh WwTP discharge. The results are summarised in Table 5 below. Many analysed parameters including Biological Oxygen Demand (BOD), Suspended Solids (SS), Phosphate (ortho; as PO4), Phosphorus (tot.unfilt), Lead, Zinc and Mercury were below the limit of detection (LOD). Nitrate (as NO3) was considered to be elevated; a value of 21.1 mg/l of Nitrate (as NO3) was detected (which is very similar to the level detected at Site 2 and 3).

3.2.3.2 Site 2

A water sample taken in Ballyclogh Stream approximately 129m downstream of the Ballyclogh WwTP discharge point (Site 2) on the 9th of October 2017 was analysed for a suite of chemical water quality parameters (see Table 6). A pH of 8.19 was recorded at this site. The Ammonical Nitrogen as N concentration of 0.06 mg/l was also considered to be slightly elevated. Heavy metals; Copper, Lead, Zinc and Mercury concentrations were all below the LOD.

Table 5 A summary of water quality results taken from Site 1 in Ballyclogh Stream on the 9th of October 2017. Suggested water quality objectives for FPM are included, as are surface water quality requirements given in European Communities Environmental Objectives (Surface Waters) Regulations 2009-2015.

Parameter	LOD/Units	Site 1 09/10/2017	Target water quality	Surface Water Regulations (2009-2015)
pH	<1 pH Units	8.33	6.5 – 7.2[b]	4.5 - 9.0
BOD	<1 mg/l	<1		1.3 (mean) 2.2(95%ile)**
Suspended Solids (total)	<2 mg/l	<2	<25*[c]	
Ammoniacal Nitrogen as N	<0.01 mg/l	0.04		0.040 (mean) 0.090 (95%ile)**
Nitrate (as NO3)	<0.3 mg/l	21.1	<0.5*[a]	
Phosphate (ortho)	<0.02 mg/l	<0.02	<0.03[a, b]	0.025 – 0.045
Phosphorus (tot.unfilt)	<20 µg/l	<20	<62[d]	
Phosphorus (diss.filt)	<10 µg/l	38.10		
Arsenic (diss.filt)	<0.5 µg/l	0.76		25[†]
Copper (diss.filt)	<0.3 µg/l	0.35		5[†]
Lead (diss.filt)	<0.2 µg/l	<0.2		1.2[#]
Nickel (diss.filt)	<0.4 µg/l	0.71		4[#]
Zinc (diss.filt)	<1 µg/l	<1		50[†]
Mercury (diss.filt)	<0.01 µg/l	<0.01		0.05[†]

**values are precautionary i.e., lowest target values from published sources are included; [a.]Bauer 1998; [b.]Oliver, 2000; [c.]Cooksley and Blake, 2014; [†]annual average. [††]Salmonid Water Regs. Non-ionised Ammonium level, **High Status.*

Table 6 A summary of water quality results taken from Site 2 in Ballyclogh Stream on the 9th of October 2017. Suggested water quality objectives for FPM are included, as are surface water quality requirements given in European Communities Environmental Objectives (Surface Waters) Regulations 2009-2015.

Parameter	LOD/Units	Site 2	Target water quality	Surface Water Regulations (2009-2015)
pH	<1 pH Units	8.19	6.5 – 7.2[b]	4.5 - 9.0
BOD	<1 mg/l	<1		1.3 (mean 2.2 (95%ile)***
Suspended Solids (total)	<2 mg/l	<4	<25*[c]	
Ammoniacal Nitrogen as N	<0.01 mg/l	0.06		0.040 (mean) – 0.090 (95%ile)**
Nitrate (as NO3)	<0.3 mg/l	24.30	<0.5*[a]	
Phosphate (ortho)	<0.02 mg/l	<0.02	<0.03[a, b]	0.025 – 0.045
Phosphorus (tot.unfilt)	<20 µg/l	<20	<62[d]	
Phosphorus (diss.filt)	<10 µg/l	34.20		
Arsenic (diss.filt)	<0.5 µg/l	0.78		25[†]
Copper (diss.filt)	<0.3 µg/l	<0.3		5[†]
Lead (diss.filt)	<0.2 µg/l	<0.2		1.2[#]
Nickel (diss.filt)	<0.4 µg/l	0.60		4[#]
Zinc (diss.filt)	<1 µg/l	<1		50[†]
Mercury (diss.filt)	<0.01 µg/l	<0.01		0.05[†]

**values are precautionary i.e., lowest target values from published sources are included; [a.]Bauer 1998; [b.]Oliver, 2000; [c.]Cooksley and Blake, 2014; [†]annual average. [††]Salmonid Water Regs. Non-ionised Ammonium level, **High Status.*

3.2.3.3 Site 3

A water sample taken in Ballyclogh Stream approximately 66m upstream of the Ballyclogh WwTP discharge point on the 9th of October 2017 (see Table 14). A pH of 8.24 was recorded. Ammoniacal Nitrogen as N levels at this site complies with the maximum limit value for High Status (mean flow) given in the Surface Water Regulations (2009-2015). Arsenic levels were found to be higher upstream compared with downstream. Suspended Solids, BOD and Phosphate (ortho; as PO4) were all below detectable limits. Heavy metal concentrations remained well within the accepted parameters as per the Surface Water Regulations (2009-2015).

Table 7 A summary of water quality results taken from Site 3 in Ballyclogh Stream on the 9th of October 2017. Suggested water quality objectives for FPM are included, as are surface water quality requirements given in European Communities Environmental Objectives (Surface Waters) Regulations 2009-2015.

Parameter	LOD/Units	Site 3 09/10/2017	Target water quality	Surface Water Regulations (2009-2015)
pH	<1 pH Units	8.24	6.5 – 7.2[b]	4.5 - 9.0
BOD	<1 mg/l	<1		1.3 (mean) 2.2 (95%ile)***
Suspended Solids (total)	<2 mg/l	<4	<25*[c]	
Ammoniacal Nitrogen as N	<0.01 mg/l	0.042		0.040 (mean) 0.090 (95%ile)**
Nitrate (as NO3)	<0.3 mg/l	23.9	<0.5*[a]	
Phosphate (ortho)	<0.02 mg/l	<0.02	<0.03[a, b]	0.025 – 0.045
Phosphorus (tot.unfilt)	<20 µg/l	<20	<62[d]	
Phosphorus (diss.filt)	<10 µg/l	12.60		
Arsenic (diss.filt)	<0.5 µg/l	1.05		25†
Copper (diss.filt)	<0.3 µg/l	<0.3		5†
Lead (diss.filt)	<0.2 µg/l	<0.2		1.2#
Nickel (diss.filt)	<0.4 µg/l	0.489		4#
Zinc (diss.filt)	<1 µg/l	<1		50†
Mercury (diss.filt)	<0.01 µg/l	<0.01		0.05†

**values are precautionary i.e., lowest target values from published sources are included; [a.]Bauer 1998; [b.]Oliver, 2000; [c.]Cooksley and Blake, 2014; †annual average. ††Salmonid Water Regs. Non-ionised Ammonium level, **High Status.*

3.2.3.4 Outfall (Ballyclogh)

A water sample taken directly from the Ballyclogh WwTP discharge point on the 9th October 2017 was analysed for a suite of chemical water quality parameters (see Table 8). This is an SBR plant but there was there a discharge flow at time of sampling. According to Irish water this plant has an ELV limit of 0.5mg/l of PO_4 as P and has this limit met throughout 2017 (See Appendix 3). Irish Water dispute the P values recorded in the current survey – there is Ferric dosing at the site and Irish Water have stated that the levels of OPO4 as P are consistently low. The results in Table 8 are from a one-off sample and were provided by ALS Life Sciences.

Table 8 A summary of water quality results taken from the Ballyclogh WwTP outfall to the Ballyclogh Stream in October 2017. The levels required under the urban Wastewater Treatment Regulations (2001-2010) are provided for comparison only.

Parameter	LOD/Units	Outfall 09/10/2017	Urban Wastewater Treatment Regulations (2001-2010) (for guide only)
pH	<1 pH Units	7.63	
Suspended Solids (total)	<1 mg/l	4.7	<35
BOD, unfiltered	<2 mg/l	3.72	<25
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	6.13	<15
Ammoniacal Nitrogen Low as NH3	<0.2 mg/l	7.1	
Nitrate (as NO3)	<0.3 mg/l	20.6	
Phosphate (ortho)	<0.02 mg/l	2.69	
Phosphorus (tot.unfilt)	<20 µg/l	3550	2,000
Phosphorus (diss.filt)	<10 µg/l	2590	
Arsenic (diss.filt)	<0.5 µg/l*	1.09	
Copper (diss.filt)	<0.3 µg/l	<0.3	
Lead (diss.filt)	<0.2 µg/l*	<0.2	
Nickel (diss.filt)	<0.4 µg/l*	1.3	
Zinc (diss.filt)	<1 µg/l*	2.58	
Mercury (diss.filt)	<0.01 µg/l	<0.01	

**Levels provided for comparison only.*

The chemical water quality results for two sites sampled in the East Lohort Stream are summarised in Tables 11 and 12 under the relevant headings. The full suite of chemical water quality results is included in Appendix 1. The results are interpreted in relation to standards given in the Surface Water Quality (Objectives) Regulations (2009-2015) and also general precautionary standards for Freshwater Pearl Mussel indicated by source including Bauer (1998), Oliver (2000) and Cooksley & Blake (2014).

3.2.3.5 Site 4

A water sample taken in East Lohort Stream approximately 2.1km downstream of the Cecilstown WwTP discharge point (Site 4) on the 9th October 2017 was analysed for a suite of chemical water quality parameters (see Table 9). Many analysed parameters, BOD, SS, Lead, Zinc and Mercury were below the LOD. Nitrate (as NO3) is much higher than the target water quality requirement for FPM of <0.5mg/l. Nitrate (as NO3) was elevated downstream of the discharge. Phosphate (ortho; as PO4) and Phosphorous (tot.unfilt) also exceeds the target water quality requirement for FPM. There was generally no issue in relation to heavy metals given that all remain well below the accepted parameters as per the Surface Water Regulations (2009-2015).

Table 9 A summary of water quality results taken from Site 4 in East Lohort Stream on the 9th of October 2017. Suggested water quality objectives for FPM are included, as are surface water quality requirements given in European Communities Environmental Objectives (Surface Waters) Regulations 2009-2015.

Parameter	LOD/Units	Site 4 09/10/2017	Target water quality	Surface Water Regulations (2009-2015)
pH	<1 pH Units	8.29	6.5 – 7.2[b]	4.5 - 9.0
BOD	<1 mg/l	<1		1.3 (mean) 2.2 (95%ile)**
Suspended Solids (total)	<2 mg/l	<2	<25*[c]	
Ammoniacal Nitrogen as N	<0.01 mg/l	0.05		0.040 (mean) 0.090 (95%ile)**
Nitrate (as NO3)	<0.3 mg/l	7.20	<0.5*[a]	
Phosphate (ortho)	<0.02 mg/l	0.05	<0.03[a, b]	0.025 – 0.045
Phosphorus (tot.unfilt)	<20 µg/l	29.70	<62[d]	
Phosphorus (diss.filt)	<10 µg/l	83.9		
Arsenic (diss.filt)	<0.5 µg/l	1.06		25†
Copper (diss.filt)	<0.3 µg/l	0.57		5†
Lead (diss.filt)	<0.2 µg/l	<0.2		1.2#
Nickel (diss.filt)	<0.4 µg/l	0.84		4#
Zinc (diss.filt)	<1 µg/l	<1		50†
Mercury (diss.filt)	<0.01 µg/l	<0.01		0.05††

**values are precautionary i.e., lowest target values from published sources are included; [a.]Bauer 1998; [b.]Oliver, 2000; [c.]Cooksley and Blake, 2014; †annual average. ††Salmonid Water Regs. Non-ionised Ammonium level, **High Status.*

3.2.3.6 Site 5

A water sample taken in East Lohort Stream approximately 65m upstream of the Cecilstown and Environs WwTP discharge point (Site 5) on the 9th of October 2017 was analysed for a suite of chemical water quality parameters (see Table 10). A pH of 7.82 was recorded at this site. Ammoniacal Nitrogen as N is a pollutant that is often present in sewage. Levels at this site exceed the maximum limit value for both High and Good Status (mean flow) given in the Surface Water Regulations (2009-2015). On the day of sampling in October water levels were very low in the East Lohort Stream. Nitrate (as NO3), Phosphate (ortho; as PO4) and pH all exceed the target water

quality low. Nitrate (as NO3) was much lower upstream (Site 5) in comparison to the downstream (Site 4) concentration. However, Ammoniacal Nitrogen as N was found to be higher upstream.

The areas immediately surrounding the Cecilstown WwTP are intensively farmed and the stretch of this stream between this site and the WwTP discharge is likely to receive numerous diffuse inputs.

3.2.3.7 Outfall (Cecilstown)

A water sample taken directly from the Ballyclogh WwTP discharge point on the 9th of October 2017 was analysed for a suite of chemical water quality parameters (see Table 20). The discharge point was above the water level and heavily covered with vegetation. Phosphorus (tot.unfilt), Total Suspended Solids, BOD and Ammoniacal Nitrogen as N (low level) concentrations were all below the prescribed limits under the Urban Wastewater Treatment Regulations (2001-2010).

Table 10 A summary of water quality results taken from Site 5 in East Lohort Stream on the 9th of October 2017. Suggested water quality objectives for FPM are included, as are surface water quality requirements given in European Communities Environmental Objectives (Surface Waters) Regulations 2009-2015.

Parameter	LOD/Units	Site 5 09/10/2017	Target water quality	Surface Water Regulations (2009-2015)
pH	<1 pH Units	7.82	6.5 – 7.2[b]	4.5 - 9.0
BOD	<1 mg/l	<1		1.3 (mean) 2.2 (95%ile)**
Suspended Solids (total)	<2 mg/l	7.72	<25*[c]	
Ammoniacal Nitrogen as N	<0.01 mg/l	0.0663		0.040 (mean) 0.090 (95%ile)**
Nitrate (as NO3)	<0.3 mg/l	0.829	<0.5*[a]	
Phosphate (ortho)	<0.02 mg/l	<0.02	<0.03[a, b]	0.025 – 0.045
Phosphorus (tot.unfilt)	<20 µg/l	<20	<62[d]	
Phosphorus (tot.unfilt)	<10 µg/l	44.2		
Arsenic (diss.filt)	<0.5 µg/	1.1		25[†]
Copper (diss.filt)	<0.3 µg/l	0.865		5[†]
Lead (diss.filt)	<0.2 µg/l	<0.2		1.2[#]
Nickel (diss.filt)	<0.4 µg/l	1.41		4[#]
Zinc (diss.filt)	<1 µg/l	3.52		50[†]
Mercury (diss.filt)	<0.01 µg/l	<0.01		0.05[†]

**values are precautionary i.e., lowest target values from published sources are included; [a.]Bauer 1998; [b.]Oliver, 2000; [c.]Cooksley and Blake, 2014; [†]annual average. [††]Salmonid Water Regs. Non-ionised Ammonium level, **High Status.*

Table 11 A summary of water quality results taken from Cecilstown WwTP outfall in the East Lohort Stream in October 2017. The levels required under the urban Wastewater Treatment Regulations (2001) are provided for comparison only.

Parameter	LOD/Units	Outfall 09/10/2017	Urban Wastewater Treatment Regulations (2001)**
pH	<1 pH Units	7.99	
Suspended Solids (total)	<1 mg/l	6	<35
BOD, unfiltered	<2 mg/l	2.16	<25
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	0.311	<15
Ammoniacal Nitrogen Low as NH3	<0.2 mg/l	0.352	
Nitrate (as NO3)	<0.3 mg/l	89.9	
Phosphate (ortho)	<0.02 mg/l	1.28	
Phosphorous (tot.unfilt)	<20 µg/l	1660	2,000
Arsenic (diss.filt)	<0.5 µg/l*	1.35	
Copper (diss.filt)	<0.3 µg/l	1.05	
Lead (diss.filt)	<0.2 µg/l*	<0.2	
Nickel (diss.filt)	<0.4 µg/l*	0.698	
Zinc (diss.filt)	<1 µg/l*	5.91	
Mercury (diss.filt)	<0.01 µg/l	<0.01	

**Levels provided for comparison only.*

4. IMPACT

From analysis of the chemical water quality results it is appears that both the Ballyclogh WwTP and the Cecilstown WwTP are having an effect on water quality in the receiving waters. By comparison of the results from the upstream and downstream sites it is noted that there is an increase in nutrients in the receiving waters following the discharges from both plants. However, this is based on one sampling round only and there are many other pressures on the Ballyclough catchment – most notably from agriculture.

The Ballyclough stream is a relatively small watercourse and does not contain Freshwater Pearl Mussels. This stream is also not part of the Blackwater River (Cork/Waterford) SAC. The Blackwater [Munster] River is c. 4.9 rkm downstream from the confluence of the East Lohort Stream and the Ballyclogh Stream. The Ballyclough stream increases substantially in size along this stretch and significant dilution is provided by the Blackwater River at this point. FPMs do occur in the main channel of the MBW downstream of the confluence with the Ballyclough stream. The Ballyclough stream is affect along its length by agricultural activities.

The current water quality monitoring was based on one round of sampling only. It did show an increase in Ammoniacal Nitrogen as N, Phosphorus (diss.filt), Nickel and Nitrate downstream of the Ballyclough WwTP discharge. Ammoniacal Nitrogen showed a significant increase of 44% between the upstream and downstream sites. Phosphorus (diss.filt) also showed a significant increase, of 171.43% between the upstream and downstream sites. Nickel increased by 22.3% and Nitrate increased by 1.7%. With the exception of Nickel, the remaining parameters that showed significant increases could be attributed to waste / sewage discharges. This indicates that Ballyclogh WwTP could be adversely impacting on water quality in the Ballyclogh Stream. However, it is noted that Ferric dosing is in place at the Ballyclough plant and all parameters monitored by Irish Water were well within licence in 2017 (apart from one ammonia exceedance only – see Appendix 3). It is apparent that the main pressure on this waterbody is the surrounding agriculture.

The chemical water quality results for Cecilstown WwTP showed that there was an increase in pH, Nitrate, Phosphate (Ortho as PO4), Phosphorus (tot.unfilt) and Phosphorus (diss.filt). Nitrate showed the most significant increase, with a percentage change of 768.52% from upstream to downstream. Following this, Phosphate (Ortho, as PO4) showed an increase of 144.5% from upstream to downstream. Phosphorus (tot.unfilt), Phosphorus (diss.filt) and pH showed increases of 48.5%, 89.82% and 6.01% respectively from upstream to downstream. Elevated nitrate levels can be attributed to artificial fertilisers or waste discharges. Phosphates and phosphorus levels can also be linked to sewage discharges. These results indicate that Cecilstown WwTP may be having an adverse impact on water quality in the East Lohort Stream. However, again it is noted that this is based on one sampling round only and this stream is not in the SAC and does not contain FPMs. It is again apparent that the main pressure on this waterbody is the surrounding agriculture.

The biological water quality ratings for 4 out of the 5 sites in this survey received a Q rating of Q3, corresponding to WFD status 'poor'. Site 2 was rated as Q3-4, corresponding to WFD status 'moderate'. It was clear during this survey that there are background water quality issues in the Ballyclogh Stream and the East Lohort Stream. The water quality status of the Ballclough stream recovers somewhat before it enters the River Blackwater where it is significantly diluted.

Although no mussels are present in either the East Lohort Stream or the Ballyclogh Stream, the Blackwater [Munster] River, into which the Ballyclogh Stream flows, is the largest pearl mussel catchment in Ireland (NS2, 2010). The Freshwater Pearl Mussel requires very high-quality rivers with clean river beds and waters with very low levels of nutrients (NS2, 2010). Siltation and / or nutrient enrichment can be detrimental to both juvenile and adult mussels. This species is extremely sensitive

to changes in water quality, notably siltation and nutrient enrichment. Therefore, any change to water quality can be considered a significant impact to the species. The increases in Ammoniacal Nitrogen as N, Phosphorus, Nitrate and Phosphate are potentially contributing to nutrient enrichment in these watercourses. However, the main issue in these catchment is undoubtedly background water quality issues, with agricultural activities in particular contributing to deterioration in water quality.

The population of FPM in the Blackwater [Munster] River is at unfavourable conservation status and the prospects of the long-term survival of this species in the main river channel are not good. This species requires high-quality rivers with clean river beds and waters with very low levels of nutrients and it will be difficult to restore these conditions in a large river catchment with extensive agricultural and forestry activities, and many other point and diffuse sources of silt and nutrients.

The results of the current chemical water quality sampling suggest that these WwTPs may be having an impact on the receiving water. However, this is based on one sampling event only. Any impact on water quality in the Ballyclough stream does pose a risk to the FPM populations located downstream. However, this impact will be a cumulative impact in a catchment with many other impacts and pressures on downstream FPMs.

5. RECOMMENDATIONS

It is recommended that further monitoring of the Ballyclogh Stream and the East Lohort Stream be undertaken. This is already being undertaking as part of the discharge licence.

REFERENCES

Bauer, G., (1988) Threats to the fresh water pearl mussel *Margaritifera margaritfera* L. in central Europe. Biological Conservation, 45, 239–253.

Cork County Council (CCC), (2009). Discharge Certificate of Authorisation Application – Ballyclogh. Cork County Council, Ireland. http://www.epa.ie/licences/lic_eDMS/090151b2802c9fcb.pdf

CC, (2010) Water Discharge Certificate of Authorisation Application – Cecilstown. [pdf]. Cork County Council, Ireland. http://www.epa.ie/licences/lic_eDMS/090151b2803b74e3.pdf

CCC, (2010) Applications for Waste Water Discharge Certificates of Authorisation. [pdf]. Cork County Council, Ireland.http://www.epa.ie/licences/lic_eDMS/090151b2803b7e87.pdf

CCC, (2011) River Blackwater WwTP Discharges – Certificates of Authorisation Natura Impact Statement. Ryan-Hanley, Ireland.http://www.epa.ie/licences/lic_eDMS/090151b2803ddf13.pdf

DoEHLG (2001) Urban Waste Water Treatment Regulations 2001. S.I. 254 of 2001. http://www.irishstatutebook.ie/eli/2001/si/254/made/en/print

DoEHLG (2010) Urban Waste Water Treatment (Amendment) Regulations 2010. S.I. 48 of 2010. http://www.irishstatutebook.ie/eli/2010/si/48/made/en/print

DoEHLG (2009a) European Communities Environmental Objectives (Surface Waters) Regulations 2009. S.I. 272 of 2009. http://www.irishstatutebook.ie/eli/2009/si/272/made/en/pdf

DoEHLG (2009b) European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. S.I. No. 296 of 2009. http://www.irishstatutebook.ie/eli/2009/si/296/made/en/pdf

DoEHLG (2012) European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012. S.I. No. 327 of 2012. http://www.irishstatutebook.ie/eli/2012/si/327/made/en/print

DoEHLG (2015) European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2015. S.I. No. 386 of 2015. http://www.irishstatutebook.ie/eli/2015/si/386/made/en/pdf

EPA, (2017a) Urban Waste Water Treatment in 2016. Environmental Protection Agency, Ireland. http://www.epa.ie/pubs/reports/water/wastewater/Urban%20waste%20water%20report%20for%202016%20Final%20Version.pdf

EPA, (2017b) Drinking Water Report Audit Kilgarvan. Environmental Protection Agency, Ireland. http://www.epa.ie/pubs/advice/drinkingwater/epadrinkingwaterauditreports/Kilgarvan.pdf

EPA, (2017) EPA River Quality Surveys: Biological Hydrometric Area 21 - Dunmanus-Bantry-Kenmare. Environmental Protection Agency, Ireland. http://www.epa.ie/QValue/webusers/PDFS/HA21.pdf?Submit=Get+Results

EPA, (2016) Urban Waste Water Treatment in 2015. Environmental Protection Agency, Ireland. https://www.epa.ie/pubs/reports/water/wastewater/2015%20urban%20waste%20water%20report_Web%20Version.pdf

Lucey, J. (2006) The pearl mussel, *Margaritifera margaritifera* (L.), in hard water in Ireland. Biology and Environment: Proceedings of the Royal Irish Academy 106 B: 143-153

Moorkens, E.A., (1999) Conservation Management of the Freshwater Pearl Mussel *Margaritifera margaritifera*. Part 1: Biology of the species and its present situation in Ireland. *Irish Wildlife Manuals*, No.8.

Mott MacDonald Ireland, (2010) Programme of measures discharges from urban waste water treatment plants background document. Mott MacDonald Ireland, Ireland.
http://www.wfdireland.ie/docs/28_MunicipalAndIndustrialRegulations/Programme%20of%20Measures,%20Discharges%20from%20urban%20waste%20water%20treatment%20plants%20-%20background%20document.pdf

NS 2, (2010) Munster Blackwater Sub-Basin Management Plan - Second Draft. [pdf]. NS 2.
http://www.wfdireland.ie/docs/5_FreshwaterPearlMusselPlans/Freshwater%20Pearl%20Mussel%20Plans%20March%202010/Second%20Draft%20of%20Munster%20Blackwater%20Sub-Plan%20March.2010.pdf

Oliver, G. (2000) Conservation objectives for the freshwater pearl mussel (*Margaritifera margaritifera*). Report to English Nature, Peterborough.

PLATES

Plate 1 The River Blackwater upstream of the Ballyclogh Stream confluence.

Plate 2 Kick sample at Site 1 on the Ballyclogh Stream.

Plate 3 Significant sediment plume observed at Site 1.

Plate 4 Site 1 on the Ballyclogh Stream, upstream of the confluence with the Blackwater [Munster] River.

Plate 5 The Ballyclogh Stream, downstream of the Ballyclogh WwTP discharge, in between Site 1 and Site 2.

Plate 6 Kick sampling at Site 2 on the Ballyclogh Stream.

Plate 7 The Ballyclogh WwTP.

Plate 8 Ballyclogh WwTP discharge point to the Ballyclogh Stream.

Plate 9 Upstream view at Site 3, upstream of the Ballyclogh WwTP Discharge.

Plate 10 Downstream of Site 4 on the East Lohort Stream.

Plate 11 Kick Sampling at Site 4 on the East Lohort Stream.

Plate 12 Heavy siltation also noted at Site 5 on the East Lohort Stream.

APPENDIX 1 MACROINVERTEBRATE SAMPLING RESULTS

Table A1.1 Macroinvertebrates recorded during biological sampling carried out in the Ballyclogh Stream catchment during October 2017.

Group / organism	Pollution sensitivity group	Site 1	Site 2	Site 3	Site 4	Site 5
MAYFLIES Epemoptera						
Ephemerellidae						
Serratella ignita	C	Present	Present			
Baetidae						
Baetis rhodani	C	Numerous	Numerous	Common		
Heptageniidae						
Ecdynurus sp.	A	Present				
STONEFLIES Plecoptera						
Leuctridae						
Leuctra sp.	B			Present	Present	
Perlodidae						
Isoperla grammatica	A		Present			
DAMSELFLIES Odonata						
Aeshnidae						
Aeshna sp.	B		Present			
TURE BUGS Hemiptera						
Veliidae	C		Small numbers			
BEETLES Coleoptera						
Elmidae						
Elmis sp.	C	Present	Small numbers		Present	
Gyrinidae						
Gyrinus substriatus	C	Present				
CASED CADDISFLIES						
Leptoceridae						
Leptocerus sp.	B		Present		Common	
Sericostomatidae						
Silo pallipes	B		Present			
CASELESS CADDISFLIES						
Rhyacophilidae						
Rhyacophila dorsalis	C	Small numbers	Present			
TRUE FLIES Diptera						
Simuliidae	C	Small numbers	Present	Fair numbers		
Chironomidae	C			Present		
LEECHES Hirudinea						
Glossiphoniidae	D		Present		Present	Present
Erpobdellidae	D		Present			
CRUSTACEANS						
Amphipoda						
Gammaridae						
Gammarus duebeni	C	Numerous	Dominant	Dominant	Excessive	Numerous
Isopoda						
Asellidae						
Asellus aquaticus	D	Present				Dominant
SNAILS						
Neritidae						
Theodoxus fluviatilis	C	Present				
Hydrobiidae						
Potamopyrgus jenkinsi	C	Common	Present		Present	
Physidae			Present			
SPIDERS						
Hydracarina	D	Present	Present			
Argyroneta aquatica			Present	Present		
WORMS						Present
Lumbriculidae						
Total no. of individuals		77	86	45	26	68
Family diversity		12	18	6	6	4
Q rating		**Q3-4**	**Q3-4**	**Q3**	**Q3**	**Q2-3**
Status		Moderate	Moderate	Poor	Poor	Poor

APPENDIX 2 CHEMICAL WATER QUALITY SAMPLING RESULTS

Table A2.1 Water quality results were derived from in-situ probe readings from the Ballyclogh Stream and East Lohort Stream and ex-situ chemical analyses performed by Alcontrol Laboratories (UK). Samples of water were collected from the sites surveyed at Ballyclogh and Cecilstown on 9th of October 2017.

Parameter	LOD / Unit	Ballyclogh Stream				East Lohort Stream		
		Outfall	Site 1	Site 2	Site 3	Outfall	Site 4	Site 5
Suspended solids	<2 mg/l	4.70	<2	<4	<4	6	<2	7.72
Alkalinity, Total as CaCO3	<2 mg/l	295.00	225.00	270.00	270.00	250	265	235
BOD, unfiltered	<1 mg/l	3.72	<1	<1	<1	2.16	<1	<1
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	6.13	0.04	0.06	0.04	0.311	0.0503	0.0663
Ammoniacal Nitrogen as NH3	<0.2 mg/l	7.10	<0.2	<0.2	<0.2	0.352	<0.2	<0.2
Conductivity @ 20 deg.C	<0.005 mS/cm	0.89	0.47	0.56	0.52	0.8	0.511	0.413
Arsenic (diss.filt)	<0.5 µg/l	1.09	0.76	0.78	1.05	1.35	1.06	1.1
Cadmium (diss.filt)	<0.08 µg/l	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (diss.filt)	<1 µg/l	<1	<1	<1	<1	<1	<1	<1
Copper (diss.filt)	<0.3 µg/l	<0.3	0.35	<0.3	<0.3	1.05	0.565	0.865
Lead (diss.filt)	<0.2 µg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel (diss.filt)	<0.4 µg/l	1.30	0.71	0.60	0.49	0.698	0.836	1.41
Phosphorus (diss.filt)	<10 µg/l	2590.00	38.10	34.20	12.60	1320	83.9	44.2
Selenium (diss.filt)	<0.5 µg/l	<0.5	<0.5	<0.5	0.57	<0.5	<0.5	<0.5
Zinc (diss.filt)	<1 µg/l	2.58	<1	<1	<1	5.91	<1	3.52
Mercury (diss.filt)	<0.01 µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite as NO2	<0.05 mg/l	0.62	<0.05	<0.05	<0.05	0.498	<0.05	<0.05
Sulphate	<2 mg/l	44.20	12.60	15.10	13.40	32	11	2.7
Nitrate as NO3	<0.3 mg/l	20.60	21.10	24.30	23.90	89.9	7.2	0.829
Phosphate (ortho) as P	<0.02 mg/l	2.69	<0.02	<0.02	<0.02	1.28	0.0489	<0.02
Aluminium (tot.unfilt)	<50 µg/l	<50	<50	<50	<50	<50	<50	82.5
Phosphorus (tot.unfilt)	<20 µg/l	3550.00	<20	<20	<20	1660	29.7	<20
Iron (tot.unfilt)	<0.024 µg/l	0.61	0.08	0.17	0.07	0.0511	0.103	0.393
Hardness, Total as CaCO3 unfiltered	<0.35 mg/l	275.00	256.00	286.00	309.00	310	266	254
pH	<1 pH Units	7.63	8.33	8.19	8.24	7.99	8.29	7.82

APPENDIX 3 IRISH WATER BALLYCLOUGH MONITORING 2017

					Emission Limit Values							
	Monitoring Result Source	**Sampling Method**	**Date**	**pH**	**cBOD**	**COD**	**SS**	**Ammonia**	**Total Nitrogen**	**Orthophosphate as P**	**Total Phosphorus as P**	**Flow**
Primary Discharge SW001				6.0-9.0	25	125	25	1		0.5		
ELV Commencement Date:												
Exceedence Limits Composite					100%	100%	150%	20%		20%		
Exceedence Limits Grab					100%	100%	150%	20%		20%		
Maximum ELV SW001 (Composite)					50	250	62.5	1.2		0.6		
Maximum ELV SW001 (Grab)					50	250	62.5	1.2		0.6		
Primary Discharge Monitoring (SW001)				Daily	6	6	6	6		6		Continuous
SW001 E149559 N102005 Upstream								4		4		
SW001 E149298 N101770 Downstream								4		4		
Primary Discharge Monitoring (SW001)	LA	Grab	11/01/2017	7.9	1.3	23	1.25	0.5	38.42	0.025	0.1	
Primary Discharge Monitoring (SW001)	LA	Grab	01/02/2017	7.9	0.5	23	1.25	0.5	6.31	0.025	0.09	
Primary Discharge Monitoring (SW001)	LA	Composite	30/03/2017	8.2	3.8	21	5	2.5	1.58	0.025	0.1	
Primary Discharge Monitoring (SW001)	LA	Composite	12/04/2017	7.9	3.8	37	6	0.2	7.04	0.06	0.15	
Primary Discharge Monitoring (SW001)	LA	Grab	20/04/2017	8	1.5	40	6	0.1	17.7	0.025	0.16	55
Primary Discharge Monitoring (SW001)	LA	Grab	11/05/2017	7.9	0.5	22	1.25	0.05	12.5	0.09	0.22	
Primary Discharge Monitoring (SW001)	LA	Grab	21/06/2017	7.8	5.4	10.5	3	0.1	5.65	0.07	0.1	
Primary Discharge Monitoring (SW001)	LA	Grab	12/07/2017	8.2	1.7	10.5	1.25	0.05	15.48	0.08	0.1	
Primary Discharge Monitoring (SW001)	LA	Grab	02/08/2017	8.1	6	45	3	0.1	10.8	0.28	0.5	
Primary Discharge Monitoring (SW001)	LA	Composite	26/10/2017	7.8	7.4	58	1.25	0.05	15.7	0.15	0.26	
Primary Discharge Monitoring (SW001)	LA	Composite	15/11/2017	7.8	6.9	10.5	4	0.05	25.8	0.17	0.23	
Primary Discharge Monitoring (SW001)	LA	Composite	05/12/2017	7.9	0.5	10.5	4	0.05	33.6	0.39	0.53	